EACTA 2005 Abstracts

The 20th Annual Meeting of the European Association of Cardiothoracic Anaesthesiologists

Edited by

Pascal Colson (France) John Manners (UK)

CAMBRIDGE UNIVERSITY PRESS

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

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The investigators of these abstracts have stated in their submission letter that prospective studies where patients are involved have institutional or Ethics Committee approval and informed patient consent, and that the studies using experimental animals have institutional approval.

Typeset by Charon Tec Pvt. Ltd, Chennai, India
Printed and bound by Bell & Bain Ltd, Glasgow, Scotland

Cambridge University Press
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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Coagulation

O-1

Continuation of clopidogrel in combination with aspirin before coronary artery bypass grafting increases neither postoperative bleeding nor transfusion requirement

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Introduction: The combination of antiplatelet therapies has been recommended in patients undergoing percutaneous coronary interventions or suffering from acute coronary syndrome [1]. However, when given before coronary artery bypass grafting (CABG), most studies have reported an increase in early postoperative bleeding and blood product requirements [2,3]. These controversial findings could be partly explained by various anti-fibrinolytic strategies. The aim of our study was to evaluate the impact of clopidogrel associated with aspirin on postoperative bleeding and transfusion requirement in patients undergoing CABG, in which a standardized anti-fibrinolytic protocol was used.

Method: After approval by our ethical committee, 217 consecutive CABG patients were enrolled in a prospective and observational study. Exclusion criteria included off-pump procedure, combined surgery, redo-CABG and preoperative platelet IIb/IIIa receptor inhibitor exposure. Clopidogrel group (n = 60) included patients having aspirin and clopidogrel exposure five days prior to surgery. Aspirin group (n = 157) included patients only treated with aspirin. Aprotinin was intra-operatively used in all patients (2×10^6 UIK followed by a continuous infusion of 250×10^3 UIK/h). Student's *t*-test and Fisher's exact test were used.

Results: There was no significant difference between the groups regarding demographic and intra-operative data. However, patients of the clopidogrel group had a higher prevalence of unstable angina (33 versus 19% $P < 0.05$) and left main artery stenosis (27 versus 13% $P < 0.05$). In the postoperative period, chest tube output was not significantly different between groups at H12 and H24 (Figure). Additionally, transfusion requirement (40 versus 36%, *NS*) and rates of re-exploration (0 versus 2%, *NS*) were similar in both groups.

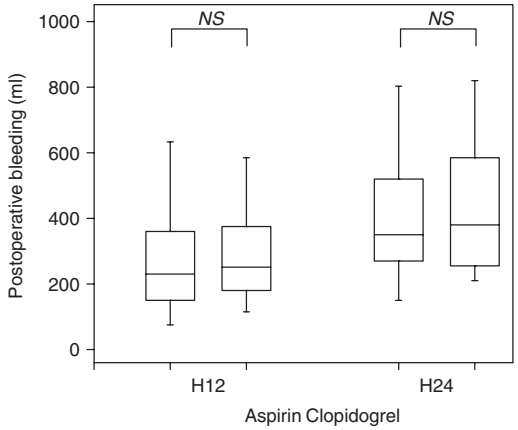

Figure. Median (25–75% and 5–95% percentiles). Mann-Whitney *U*-test was used.

Conclusion: Our results suggest that the combination of antiplatelet therapies, based on aspirin and clopidogrel, could be safety maintained until surgery without an increase in postoperative bleeding and blood transfusion requirement.

References:

1 Yusuf S, Zhao F, Mehta SR, et al. Effects of clopidogrel in addition to aspirin in patients with acute coronary syndrome without ST-segment elevation. *N Engl J Med* 2001; **345**: 494–502.

2 Englberger L, Faeh B, Berdat PA, et al. Impact of clopidogrel in coronary artery bypass grafting. *Eur J Cardiothorac Surg* 2004; **26**: 96–101.

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O-2

Clopidogrel and perioperative transfusion requirements in cardiopulmonary bypass surgery

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Introduction: Clopidogrel is a non-competitive antagonist of P2Y12, the platelet adenosine diphosphate receptor and a potent inhibitor of platelet aggregation. Recovery of platelet function post drug discontinuation takes from 7 to 14 days. The anti-platelet effect of clopidogrel is additive to that of aspirin and has shown clinical benefit in the cardiovascular disease setting [1]. Thus, the two agents are being administered together with increasing frequency [2]. Accordingly, more patients now present for cardiac surgery on combined aspirin and clopidogrel anti-platelet therapy and this may lead to increased perioperative blood loss and transfusion requirement. The aim of this study was to evaluate the effect of perioperative clopidogrel on bleeding and transfusion requirements after coronary artery bypass graft (CABG) surgery.

Method: We prospectively analysed 200 consecutive cardiac patients undergoing first time CABG surgery. Bleeding rates and blood and blood product transfusion requirements in patients taking clopidogrel and aspirin (C + A) were compared to those on aspirin alone (A). Blood loss was determined by recording maximum blood volume collected by chest drain in the 24-hour intra-operative and post-operative periods. Results are reported as percentages for discrete variables and mean and standard deviation for continuous variables. Student's *t*-test was used to compare continuous data and Fisher's exact test for discrete data. A two-tailed $P < 0.05$ was considered statistically significant. Categorical data are presented as percentages.

	A (n = 59)	C + A (n = 62)	*P*
Transfusion rate			
Blood/blood product (%)	33.9	46.8	<0.05
RBC transfusion (%)	33.9	38.7	n.s.
Units RBCs/patient	1.85 ± 0.25	2.75 ± 0.19	<0.05
Blood loss (mL)			
1st 24 hours postoperative	725 ± 328	837 ± 449	n.s.

RBC = red blood cells, mean ± SD.

Patient requirement for transfusion was significantly higher in the clopidogrel group when compared to aspirin only.

Discussions: The combination of clopidogrel with aspirin in patients presenting for cardiac surgery results in increased requirement for perioperative blood transfusion. There is also a trend towards increased blood loss in the perioperative period. These findings raise concerns about continued clopidogrel administration in the immediate preoperative period and have implications for patients undergoing non-emergent CABG.

References:

1 Kam PCA, Nethery CM. The thienopyridine derivatives (platelet adenosine diphosphate receptor antagonists), pharmacology and clinic developments. *Anaesth* 2003; **58**: 28–35.

2 Hongo RH, Ley J, Dick SE, et al. The effect of clopidogrel in combination with aspirin when given before coronary artery bypass grafting. *J Am Coll Cardiol* 2002; **40**: 231–237.

O-3

Tranexamic acid definitely reduces exposure to blood and blood products transfusion

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Introduction: Tranexamic acid (TA) is used as a fibrinolytic agent to decrease the blood loss in cardiac surgery [1]. But its impact on routine clinical practice is still unknown. This study is aimed at analysing the clinical impact of TA on transfusion in our hospital.

Method: Our hospital employs a clinical information analyst whose sole responsibility is to collect prospectively, continuously and at the bedside all data related to blood transfusion in relation to cardiac surgery. Any transfusion within our institution is administered according to strict guidelines and adherence to them is continuously monitored. From those data, we identified 4191 cardiac surgery patients who had undergone primary CABG surgery,

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

valve surgery or both combined during a period between 30/10/00 and 21/9/04. Patients who had received aprotinin were excluded. We analysed the data of patients who received tranexamic acid (TA group) with those who did not (NTA group). Our primary outcome measure was the exposure to packed red blood cells (RBC) following surgery in both groups. Our secondary outcome measures were the exposure to fresh frozen plasma (FFP) and total blood products, the proportion of patients returned to theatre because of blood loss and length of ICU stay. We performed chi-squared tests to assess differences between the groups in the proportion of patients who received RBC or FFP or total blood products and who returned to theatre. We performed Mann–Whitney tests to assess differences between the distributions of the use of RBC, FFP and total blood products and the length of ICU stay. Then we used multivariate logistic regression to adjust for the effect of other variables: age, sex, bypass time, EuroSCORE, BMI, time period, surgery type, priority, aspirin use, clopidogrel use, consultant surgeon and consultant anaesthetist.

Results: The TA group had 3359 (80.1%) patients and NTA group had 832 (19.9%) patients and exposure to blood products was 45.9% and 51.3% respectively ($P = 0.005$). There was no statistical difference between the two groups in sex, BMI, surgery type and priority.

Table.

	TA group	NTA group	*P*
Mean age (SD)	66.3 (10.3)	67.2 (10.2)	0.019
EuroSCORE (IQR)	4 (4)	4 (4)	0.014
Exposure to blood	45%	50.5%	0.005
Exposure to FFP	8.6%	11.4%	0.011
Return to theatre	4.8%	8.3%	<0.001
Days in ICU (IQR)	1 (0)	1 (0)	0.281

SD – Standard deviation, IQR – Inter quartile range.

Patients in TA group were older ($P = 0.019$) and had a higher EuroSCORE ($P = 0.014$) (Table). The number of patients who received RBC ($P = 0.005$) or FFP ($P = 0.011$) or total blood products ($P = 0.005$) and who returned to theatre ($P < 0.001$) was significantly lower in TA group. There was no difference in ICU stay between the groups ($P = 0.281$). In multivariate analysis, TA administration had a significant effect in reducing exposure to RBC (odds ratio (OR) 0.577, $P < 0.001$), FFP (OR 0.568, $P < 0.001$) and total blood product transfusion (OR 0.579, $P < 0.001$) after adjustment for other covariates. It also had a significant effect in decreasing the number of returns to theatre for re-exploration due to excessive postoperative blood loss (OR 0.483, $P < 0.001$).

Discussion: Our analysis shows that TA is an independent factor impacting on the exposure to RBC, FFP or total blood product transfusion. It also is an independent factor related to the return to theatre for re-exploration.

Reference:

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O-4

Effect of tranexamic acid on postoperative bleeding and allogeneic transfusion in on-pump cardiac surgery

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Introduction: Perioperative use of tranexamic acid (TA), a synthetic antifibrinolytic drug, decreases perioperative blood loss and the proportion of patients receiving blood transfusion in cardiac surgery, but the results may vary in different clinical settings [1]. The aim of our study was to assess the effects of two different doses of TA on postoperative bleeding and perioperative allogeneic transfusion requirements following primary, elective, on-pump cardiac surgery in patient with a low baseline risk of postoperative bleeding.

Method: In a double-blinded, prospective, placebo-controlled study, 150 patients were randomized into three groups (n = 50 each group). Among exclusion criteria were treatment with acetylsalicylic acid within 5 days or other platelet inhibitors within 10 days before surgery as well as coagulopathies and renal dysfunction. Group 1 received placebo (0.9% saline). Group 2 received TA 1 g i.v. as a bolus after anaesthetic induction, followed by a constant infusion of 400 mg/h i.v. until the end of surgery and 500 mg on bypass. Group 3 received a bolus of TA 30 mg · kg^{-1} i.v. after heparin administration. Postoperative bleeding and blood products transfused until removal of chest tubes were recorded. Blood products were transfused according to a standardized protocol. Data are presented as mean ± standard deviation and were analysed with t-test and χ^2 test.

Results: Preoperative demographics, haemostatic and surgical characteristics were comparable among groups. Blood loss was 773 ± 521 mL in Group 1, 515 ± 340 mL in Group 2 and 431 ± 192 mL in Group 3. Postoperative bleeding was significantly higher in the placebo group compared to the TA groups ($P < 0.004$). Blood loss difference between Group 2 and 3 treated with TA did not reach statistical significance. Blood products administration was not statistically different among the three groups. Re-operation due to excessive bleeding was only necessary in one patient of the placebo group. No differences in other postoperative complications were found.

Conclusions: Among our patients the use of two different doses of tranexamic acid showed a similar significant reduction in postoperative mediastinal bleeding, while transfusion needs remained unchanged compared to a placebo group.

Reference:

1 Andreasen JJ, Nielsen C. Prophylactic tranexamic acid in elective, primary coronary artery bypass surgery using cardiopulmonary bypass. *Eur J Cardiothorac Surg* 2004; **26**(2): 311–317.

O-5

An anticoagulation concept with substitution of AT III in patients with temporary assist devices

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Introduction: The main causes of mortality in patients with temporary cardiac assist devices are problems related to (anti-)coagulation. Severe bleeding in the early period after implantation of such devices initiates not only massive transfusion but also multiple re-operations, and thus, a high risk of infection. Any effort in increasing survival in these patients has to start with an adequate anticoagulation regime [1]. It was the aim of the present study to compare the outcome (bleeding and frequency of re-operations during the first days as well as survival) of a collective (group H) treated without antithrombin III (AT III) with that of another group where AT III plasma concentrations were measured daily and AT III substituted accordingly [2] (group AT III).

Method: We compared clinical data of all patients treated with a temporary assist device over a period of four years at a single centre with respect to bleeding, need for transfusion, length of stay on the assist device and survival. Data were retrospectively collected and analysed.

Results: Eleven patients were treated with a temporary assist device without considering AT III levels, whereas in 20 others AT III plasma concentrations were measured and its concentration was maintained at 80% with substitution. Seventeen patients were adults and 14 children (0–17 years). During the first five days, bleeding as well as the frequency of re-operations were significantly lower in group AT III than in group H.

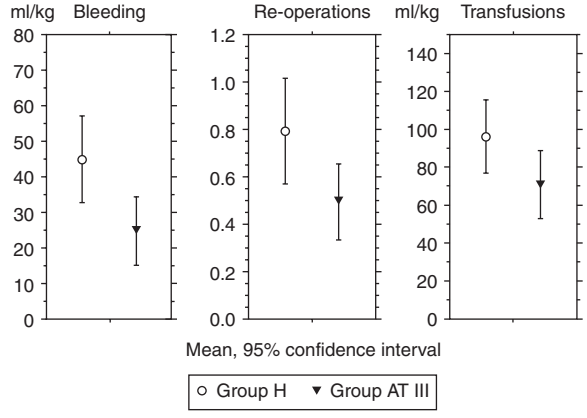

Figure.

Discussion: Inhibition of coagulation-activation with the help of AT III, together with a consistent heparin regimen is valuable to prevent severe bleeding and to diminish the number of re-operations in patients with temporary cardiac assist devices.

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2 Kanbak M. The treatment of heparin resistance with Antithrombin III in cardiac surgery. *Can J Anaesth* 1999; **46**: 581–585.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

O-6

Could modified thromboelastogram assess platelet inhibition by aspirin in off pump coronary artery bypass surgical patients and healthy volunteers?

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Introduction: Thromboelastogram (TEG) is regarded as a method by which coagulation can be measured during surgery. Off pump coronary artery bypass (OPCAB) surgical patients are routinely placed on aspirin. Conventional TEG could not detect platelet dysfunction by antiplatelet agent [1]. We used modified TEG (addition of heparin and platelet agonists) to determine whether this modified TEG could assess the platelet dysfunction by aspirin in OPCAB surgical patients and healthy volunteers [2].

Method: After institutional review board approval and consent, platelet function of 10 OPCAB patients (group 1) and 10 healthy subjects (group 2: before aspirin, group 3: after aspirin) were measured using modified TEG. The TEG method was modified from the method described by Kawasaki et al [2]. Modified TEG was performed in the presence of 10 μL of either normal saline (control), heparin (0.1 U/mL), heparin plus ADP (25 μM), or heparin plus collagen (30 μg/mL). In each group, TEG parameters (R, K time and MA) were analysed using paired t-test and one way ANOVA was used to determine the difference between groups.

Result: In group 1 (OPCAB patients) and group 2 (healthy subjects, before aspirin), the R and K time were increased significantly with the addition of heparin and then decreased subsequently with the platelet agonists (ADP or collagen) in the presence of anticoagulation (heparin). MA showed a decrease in both groups. This compares with no significant difference in all parameters in group 3 (healthy subjects, after aspirin) with the addition of heparin, ADP and collagen. There were no significant differences in each TEG parameter between groups.

		Control	Hep	Hep + Col	Hep + ADP
	R	35.1 ± 5.9	89.7 ± 7.2*	31.7 ± 2.4†	36.2 ± 2.5‡
Group 1	K	17.1 ± 2.2	32.6 ± 3.6*	22.1 ± 2.2†	26.5 ± 1.9‡
	MA	61.9 ± 5.5	50.8 ± 4.2*	23.8 ± 1.8†	27.3 ± 1.5‡
	R	44.7 ± 4.4	64.8 ± 1.6*	39.2 ± 3.3†	33.1 ± 2.8‡
Group 2	K	18.5 ± 2.1	31.1 ± 3.6*	19.2 ± 3.7†	16.9 ± 2.3‡
	MA	50.9 ± 4.1	45.6 ± 6.4*	28.0 ± 5.9†	28.9 ± 3.1‡
	R	50.5 ± 4.7	49.9 ± 3.3	45.4 ± 4.3	43.4 ± 5.2
Group 3	K	20.1 ± 2.9	23.6 ± 1.5	24.5 ± 1.7	24.6 ± 4.7
	MA	47.6 ± 6.5	45.9 ± 7.4	40.2 ± 3.6	42.4 ± 5.0

*$P < 0.05$ compared with control; †$P < 0.05$ compared with heparin; ‡$P < 0.05$ compared with heparin.
Group 1: off pump coronary artery bypass surgical patients.
Group 2: healthy volunteers before aspirin medication.
Group 3: healthy volunteers after aspirin medication.
Hep: heparin, Col: collagen.
ADP: adenosine diphosphate, R: reaction time (min), K: kinetic time (min), MA: maximal amplitude (mm).

Discussion: This study suggested that aspirin medication obliterated the effect of anticoagulation and platelet agonists in modified TEG. However modified TEG does not provide a comprehensive and sensitive reflection of platelet inhibition by aspirin. TEG should be supplemented by other methods of platelet function assessment.

References:

1 Shore-Lesserson L. Point of care coagulation monitoring for cardiovascular patients: Past and present. *J Cardiothor Vasc Anesth* 2001; **16**: 99–106.

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O-7

Blood heparin levels remains high during paediatric cardiopulmonary bypass

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Introduction: Monitoring of anticoagulation is routinely performed during cardiopulmonary bypass, commonly by activated clotting time (ACT) [1]. We additionally are measuring anticoagulation with the heparin level guided method of Hepcon HMS. Because of the significant higher heparin requirement when using the Hepcon HMS compared to conventional ACT in children we have evaluated heparin and anticoagulant haemostatic components during and after paediatric cardiopulmonary bypass (CPB) to obtain true anticoagulation levels [2].

Method: A total of 14 patients (8 <1 yr and 6 ranged 1.8–10.5 yr) were included. Informed consent was obtained from the parents. Before CPB 400 IE/kg heparin was administered. Five minutes after initiating CPB another 150 IE/kg were given. Further heparin was given if the ACT was below 400 s. Heparin was neutralized by protamine chloride (PCl) approximately 100% based on the i.v. heparin dose. Heparin levels were measured by anti-Xa assay. Antithrombin TAT complexes and prothrombin fragments F1 + 2 were also examined.

Results: CPB duration was 96 min (40–234 min). No correlation was observed with measured Heparin blood levels and Hepcon HMS data. Spearman's rank correlation coefficient was used to compare Hepcon HMS with heparin blood levels.

Table. All data are expressed as median and range.

	I	II	III	IV
Heparin	6.2	6.0	5.3	0.13
anti-Xa iu/mL	3.2–9.8	4.3–8.1	4.0–8.8	0.05–0.2
Antithrombin	84	38	51	52
% change	63–107	24–64	26–63	33–72
TAT complexes	3.5	6.0	14	39
μg/L	0.7–12	0.4–23	2–46	10–111
F1 + 2	1.2	0.9	1.2	2.3
nmol/L	0.6–3.4	0.4–2.3	0.9–4.7	0.8–5.7

I: 5 min after initial heparin; II: 5 min after 2nd dose; III: immediately before protamine; IV: 30 min after protamine.

Discussion: Heparin levels remain high during paediatric cardiopulmonary bypass with very low turnover. Antithrombin is initially diluted after starting CPB but not consumed despite mildly increased thrombin generation. Hepcon HMS gives no further information compared to ACT in paediatric cardiac patients.

References:

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Cardiac Anaesthesia

O-8

First experience with xenon anaesthesia in open heart surgery

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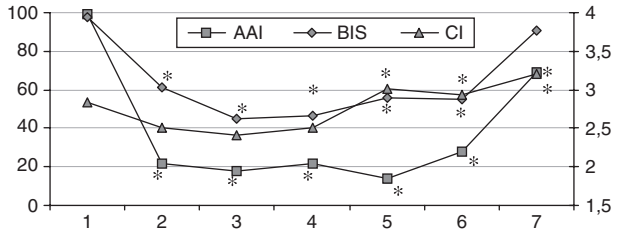
Introduction: Xenon (Xe) is a new gaseous anaesthetic that has not shown any adverse cardiovascular effects. The purpose of our study was to investigate the efficiency of Xe anaesthesia in cardiac surgery.

Method: Forty two patients (32 men and 10 women, 24–78 years of age, ASA class III–IV) included in this study, underwent cardiac surgery with CPB. Patients were premedicated with trimeperidin (0.3 mg/kg) 1 hour before surgery. After denitrogenation of the patients, anaesthesia was induced with propofol, administered by a TCI system, fentanyl 4.1 ± 0.2 μg/kg and vecuronium in standard doses, and the trachea was intubated. The anaesthetic gas mixture (Xe-O_2, 65/35) was administrated by means of a closed-circuit anaesthesia machine (Blease 8500) with a device for recycling by an original system (Russia). Fentanyl was added before skin incision (2.7 ± 0.1 μg/kg) and guided by vital signs, total fentanyl dose was 12.1 ± 0.4 μg/kg. Before CPB, Xe was stopped and the patient ventilated with O_2 (fresh gas flow 7.1 ± 0.4 L/min). During CPB anaesthesia was maintained with propofol. Xe-O_2 mixture was started again after CPB. Xe inhalation stopped at the end of surgery. The EEG bispectral index (BIS) and middle latency auditory evoked potentials A-Line© ARX Index (AAI) were both used for the hypnotic component of anesthesia monitoring. Haemodynamics, BIS, AAI, were assessed at stages: 1 – before anaesthesia, 2 – induction, 3 – skin incision, 4 – before CPB,

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

5 – after CPB, 6 – end of surgery, 7 – awakening. Data expressed as mean ± SEM. Student's *t*-test was used with $P < 0.05$ the significance level.
Results: The levels of arterial pressure and heart rate were stable. Cardiac index (CI) before CPB was 2.5 ± 0.2, and during the post-CPB period 3.0 ± 0.2 L min^{-1} m^{-2} (figure).



*$P < 0.05$ in comparsion with stage 1.

No patients needed cardiotonic support before CPB. Post-CPB average dobutamine dose was 1.9 ± 0.2 μg kg^{-1} min^{-1}. AAI was 18.3 ± 1.2 and BIS was 44 ± 3 during Xe administration. Awakening time was 4.8 ± 0.4 min after Xe was discontinued. All of the patients were extubated in the OR.
Discussion: Xe was earlier used for sedation after cardiac surgery in the ICU [1]. Our experience showed that Xe is an effective component of anaesthesia for open heart surgery.
Reference:
1 Dingley J, King R, Hughes L, et al. Exploration of xenon as a potential cardiostable sedative: a comparison with propofol after cardiac surgery. *Anaesthesia* 2001; **56**: 829–835.

O-9

The dose rate of anaesthetic drugs to maintain a constant BIS value is decreased during bypass

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Introduction: The end-tidal concentration of isoflurane required to maintain a constant Bispectral Index (BIS) value after cardiopulmonary bypass (CPB) is less than that required before CPB [1,2]. Is the same true for propofol, and does the method of fentanyl administration matter?
Method: We studied 40 adult patients undergoing cardiac surgery with CPB. Premedication of diazepam 10 mg p.o., morphine 10 mg and prochlorperazine 12.5 mg i.m. was given 90 min before induction of anaesthesia. Anaesthesia was induced with 1.0 mg kg^{-1} of propofol, then maintained with either a propofol infusion (n = 20) or with isoflurane (n = 20) throughout the procedure. Within each group, fentanyl was given either by bolus dose at induction (10 μg kg^{-1}) to 10 patients or infused using STANPUMP to maintain an effect site concentration of 3 ng mL^{-1} using Shafer's pharmacokinetic model [3] in the other 10. Allocations were randomized. The P_aCO_2 was maintained between 4.5 and 5.5 kPa and α-stat blood gas management was used on CPB. The infusion rate of propofol, or the end-tidal concentration of isoflurane, was titrated throughout the procedure to maintain the Bispectral Index (Aspect, A-2000) at 45. BIS, naso-pharyngeal temperature and anaesthetic dose rates were recorded at five consecutive one-minute intervals on five occasions (before sternotomy, after sternotomy, at normothermia before the end of CPB, after weaning from CPB, and at skin closure) and the mean value calculated. Blood pressure was maintained within acceptable values using phentolamine 0.5–1.0 mg and phenylephrine 50–100 μg. Heart rate was controlled where necessary using esmolol 0.5–1.0 mg kg^{-1} or glycopyrrolate 0.6–1.2 mg.
Results: There was no difference between the two fentanyl groups for either anaesthetic, so these data were combined. The mean infusion rate of propofol was 23.5% lower after bypass than before (Table), and the mean end-tidal concentration of isoflurane was 21.8% lower.

Table. Infusion rates of propofol in mg kg^{-1} hr^{-1} at the study times. Data are mean values (95% confidence intervals).

	Infusion rate	BIS	Temp (°C)
Pre-sternotomy	5.1 (4.7–5.5)	45.3 (37.2–53.4)	35.8
Post-sternotomy	5.2 (3.4–6.4)	44.4 (40.4–48.4)	35.6
Rewarming	3.9 (2.6–5.2)*	44.7 (42.0–47.4)	36.6
Off bypass	3.8 (2.5–5.1)*	46.3 (43.4–49.2)	36.3
Skin closure	3.9 (3.4–4.4)*	43.7 (40.6–46.8)	35.7

*$P < 0.01$ vs. baseline by Student's *t*-test.

Discussion: The dose rate of anaesthetic drugs required to maintain a constant anaesthetic "depth" is decreased following cardiopulmonary bypass, unrelated to the mode of adminstration of fentanyl. The reasons for this are unclear.
References:
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3 Online at http://pkpd.icon.palo-alto.med.va.gov (accessed 15.10.02).

O-10

Propofol in open-heart surgery: comparison between calculated and measured plasma concentrations

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Introduction: The purpose of our study was to investigate the alteration of plasma propofol concentrations in comparison with a pharmacokinetic model in open-heart surgery.
Method: The study involved 11 NYHA II–III patients (27–45 years old) undergoing mitral valve replacement. Propofol was infused by syringe pump (Graseby 3400) connected to a PC through a RS232 port prior to a calculated blood propofol concentrations (C_c). Blood C_c was calculated by Marsh's PK/PD model [1] with Kazama's age dependent BIS effect site microconstants [2] every 10 s. Propofol was infused with doses to maintain BIS close to 40. Measured plasma propofol concentrations (C_m) were determined using high-performance liquid chromatography with ultraviolet detection (Agilent 1100, column C18, Altima). Data is expressed as mean ± SEM. Values were compared by linear regression. Student's *t*-test was used with $P < 0.05$ the significance level.
Results: BIS level, C_c and C_m propofol concentrations (μg/ml) are shown in the Table. C_m was significantly higher than C_c at stages 1, 3, 4, 5, and 7. C_c and C_m closely correlated only at stages 2, 3, and 4.

Stages	BIS	C_c	C_m	rC_c–C_m
Loss of consciousness (1)	67 ± 4	3.1 ± 0.2	7.1 ± 1.4*	0.61
Intubation (2)	41 ± 3	1.9 ± 0.3	3.6 ± 1.1	0.93*
Sternotomy (3)	32 ± 3	4.6 ± 1.1	12.5 ± 3.1*	0.72*
Pre-CPB (4)	40 ± 4	2.7 ± 0.2	5.7 ± 0.5*	0.92*
During CPB (5)	40 ± 2	1.6 ± 0.1	2.9 ± 0.6*	0.53
After CPB (6)	48 ± 4	1.1 ± 0.2	1.5 ± 0.2	0.65*
Awakening (7)	83 ± 3	0.6 ± 0.1	1.2 ± 0.1*	0.4

*$P < 0.05$.

Discussion: Marsh's PK/PD model with Kazama's microconstants did not predict blood propofol concentrations at all stages of open-heart procedures. Differences between C_m and C_c may be explained by low cardiac output, haemodilution and plasma protein disturbances [3].
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O-11

Awake patient and pulmonary dysfunction: the new way?

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Introduction: The application of high thoracic epidural anaesthesia (TEA) in a conscious patient is increasingly being used for cardiac surgical procedures [1,2]. More than 170 patients underwent cardiac surgery in our department using this technique without mortality. Indication criteria and recommendations for such a method are not yet sufficiently defined [3].
Method: We have prospectively evaluated the feasibility and safety of TEA for awake patients with preoperative pulmonary dysfunction undergoing cardiac surgery. An informed consent was obtained from all of them. A thoracic epidural block was performed at the Th 2–Th 4 space. A medial approach was used and the hanging drop method was routinely employed for epidural space detection. None of those patients underwent special preoperative training to breathe spontaneously with the chest open. Sedation was provided with midazolam or dexmedetomidine.
Results: Our series consisted of eight patients with preoperative pulmonary dysfunction VC 1.12 L (0.8–1.3), FEV_1 30% (17–32). There were five cases of aortic valve replacement, two CABG cases and one combined procedure of aortic valve replacement and nephrectomy for tumour. No patient died. No

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

patient had to be intubated or mechanically ventilated. The average length stay on ICU was 49 h (16–96), the average length of hospitalization was 8.5 days. The procedure was well accepted by the patients. A prolonged ICU stay as an institutional policy was for two cases with a low EF (<25%) and for one patient who had an asthma attack on 2nd postop. day.

Discussion: The results of our small series support the hypothesis that awake TEA is safe and feasible in patients with preoperative pulmonary dysfunction [4]. A much larger study is needed for defining indication criteria for awake TEA in cardiac surgery.

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O-12

EuroSCORE reliability: is the ejection fraction as objective as presumed?

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Introduction: EuroSCORE has become an agreed standard in evaluating the results after cardiac surgery. Ejection fraction (EF) is one of the "objective" parameters. The calculated logistic mortality may in some situations be influenced very much from cardiac function (see Table).

Table. Logistic mortality with different EF

EuroSCORE	0	6	12
EF >50%	0.88	5.56	25.59
EF 30–50%	1.33	8.21	34.34
EF <30%	2.59	14.95	50.68

EuroSCORE has no definition on EF measurement [1]. The standard is based on echocardiography, but at least 3 different methods of calculating the EF are widely accepted. Another pitfall is the relative interpersonal variability in echocardiography.

Method: Twenty five echocardiography examinations, which were optimal for study of all three methods, were evaluated by one experienced echocardiography technician. The examinations were from a wide range of cardiac functions with EF from 13% to 63%. EF was calculated on the basis of M-mode echocardiography (M), Simpson's 2-D volumetric echocardiography (S) and Wall Motions Index-16 segments (W). Comparison and analysis was done primarily with Bland and Altman plots [2].

Table. Average measured EF & Cardiac function

Cardiac function	M	S	W
Poor CF	30	29	22
Moderate CF	48	42	39
Normal CF	61	51	56
All patients	48	42	40

Results: The measured average EF in the 3 groups differed considerably, especially in the group with poor cardiac function.

Average statistics	M/S	M/W	S/W
Difference (%point)	6.1	7.7	1.6
Mean error	11.7%	17.7%	6.1%
Standard deviation	24.2%	24.5%	20.5%

The average difference between methods was 1.6–7.7% point. The mean error (or bias) was 6.1–17.7% and the standard deviation of the errors 20.5–24.5%. Greatest variance was found between M-mode and WMI.

Discussion: The correlation between the methods was relatively poor although 2-D volumetric and wall motion index seemed within reasonable limits, although one could claim that an EF given without measurements methods should be given x ± 50% (95% safety limits). All measurements were done by one person and the differences would probably be even greater if handled in normal clinical situations.

From the found data one could argue that the EF parameter in the EuroSCORE calculation should be based on a fixed standard, as the 95% confidence limits for one measurement could be "covering" all three EuroSCORE groups.

References:

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Analgesia & Regional Anaesthesia

O-13

Fast track CABG surgery under general anaesthesia with remifentanil and spinal analgesia with morphine and clonidine

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Introduction: Effective postoperative analgesia is a critical part of fast track cardiac surgery [1]. In patients given fast track anaesthesia with remifentanil, we assessed the analgesic efficacy of spinal morphine and clonidine [2].

Method: After ethical committee approval and informed patient consent, 40 patients selected for coronary artery bypass graft surgery were allocated randomly into two groups in a double-blind prospective, randomized study.

General anaesthesia was performed with etomidate, isoflurane, cisatracurium, and either remifentanil (0.10 to 0.25 $\mu g\,kg^{-1}\,min^{-1}$) (fast track group) or sufentanil (up to 3.5 $\mu g\,kg^{-1}$) (control group). In the fast track group, patients received spinal morphine (4 $\mu g\,kg^{-1}$) and clonidine (1 $\mu g\,kg^{-1}$) before induction. Postoperatively, patients in both groups were connected to i.v. patient-controlled analgesia (PCA) morphine pump that delivered 1 mg bolus with a 7 min. lock-out interval. Patients were evaluated for pain on visual analogue scale (VAS), at rest and on deep breathing and for i.v. PCA morphine consumption during 24 hours. Statistic analysis used parametric or not parametric tests according to the distribution.

Results: Intravenous PCA morphine 24 hours cumulative dose was lower in the fast track than in the control group (15.8 ± 12.6 vs. 32.7 ± 22.3 mg, $P < 0.05$) (Figure). Before extubation, VAS scores were higher in the fast track group, but after, they were lower both at rest and during deep breathing. Extubation delay was shorter in the fast track group (2.6 ± 0.7 vs. 4.5 ± 1.9 h, $P < 0.05$).

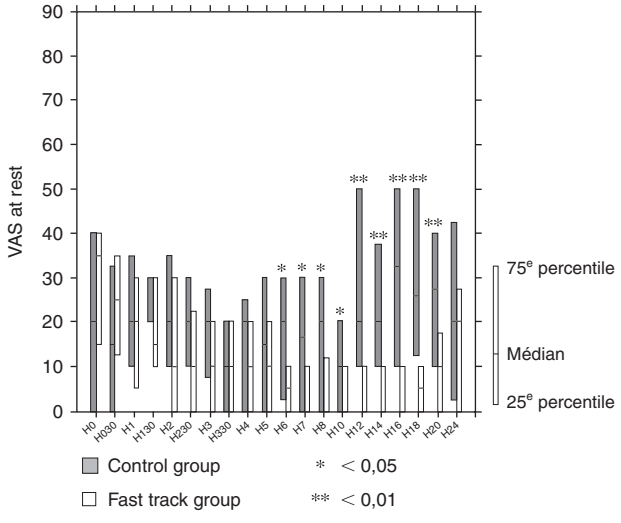

Figure.

Discussion: The combination of anaesthesia with remifentanil and spinal analgesia with morphine and clonidine produces effective analgesia after coronary artery surgery and guarantees a rapid withdrawal from respiratory support.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

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O-14

Postoperative effects of low dose intrathecal morphine in coronary artery bypass surgery

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Introduction: Effective control of pain during the immediate postoperative period after coronary artery bypass graft surgery (CABG) may decrease morbidity and mortality [1]. The aim of the study was to evaluate the effects of low dose spinal morphine administration in CABG in the early postoperative period.

Method: This study was approved by the ethical committee of Mersin University Medical Faculty and written informed consent was obtained from all patients. The patients were randomly allocated, prospectively, to receive general anaesthesia (Group K, n = 11) or general anaesthesia with the addition of intrathecal morphine (0.7 $\mu g\,kg^{-1}$) just before anaesthetic induction (Group M, n = 12). After standardized induction, anaesthesia was maintained with a remifentanil infusion 0.2–0.5 $\mu g\,kg^{-1}\,min^{-1}$ and 0.5–1% sevoflurane for all patients. After completion of surgery the remifentanil infusion was stopped and i.v. remifentanil consumption recorded. A propofol infusion, 1–2 $mg\,kg^{-1}\,h^{-1}$ was then started in both group. All patients were transferred to the intensive care unit (ICU) to receive standardized postoperative care. The propofol infusion was stopped and extubation was accomplished when extubation criteria were fulfilled. Diclofenac sodium (75 mg i.m.) was given for postoperative analgesia in both groups just when remifentanil was stopped. Pain scores, determined by visual analogue scale (VAS), were recorded directly after extubation and at 2, 4, 6 and 18 hours after admission to the ICU. Pethidine HCl (1 $mg\,kg^{-1}$ i.m.) was administered if the patient's pain score was ⩾4. Sedation scores, determined by Ramsay scale, were recorded at the same time as VAS. Postoperative complications and side-effects were recorded daily for all patients until hospital discharge.

Results: Both groups were similar with respect to demographic data, surgical characteristics and remifentanil consumption. The mean extubation time was shorter in Group M (3.58 ± 1.57 h) than Group K (4.86 ± 1.38 h) ($P = 0.045$). The mean VAS scores were less in Group M at each measured time than Group K.

Table 1. VAS scores of groups.

VAS	Group K	Group M	*P*
Extubation	4.2 ± 0.9	2.8 ± 1.6	0.016
2 h	3.9 ± 1.0	2.5 ± 1.3	0.023
4 h	3.4 ± 1.1	1.7 ± 1.2	0.004
6 h	3.7 ± 0.6	1.6 ± 1.1	0.0001
18 h	3.4 ± 0.6	1.7 ± 1.2	0.001

$P < 0.05$ was considered statistically significant.

The mean sedation scores were lower in Group M during the extubation only ($P = 0.044$). According to the VAS scores, pethidine requirement was higher in Group K ($P = 0.001$). The mean ICU stay was longer in Group K (19.30 ± 2.45 h vs. 16.25 ± 2.70 h, $P = 0.014$). No side effects such as neurological or gastrointestinal signs were noted due to intrathecal morphine used.

Discussion: Spinal morphine provided effective analgesia, earlier extubation and less ICU stay with no side effects after CABG surgery.

Reference:
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O-15

Sedation and analgesia during radio frequency treatment of atrial flutter

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Introduction: The radio frequency (RF) procedure in cardiology is an anaesthetic challenge. It can generate acute pain only during the heating process, it does not allow any in situ analgesia and it is of short duration. This study evaluates sedation, analgesia quality and secondary effects of two sedations techniques [1].

Method: After ethical committee approval and informed patient consent, two groups of 20 patients undergoing a procedure for atrial flutter were prospectively randomized to receive either sedation with TCI propofol (P group) (162.9 ± 75.8 $\mu g\,kg^{-1}\,min^{-1}$) or patient-controlled analgesia with remifentanil (R group) (0.07 ± 0.04 $\mu g\,kg^{-1}\,min^{-1}$). A sedation score, a pain score, blood pressure measurement and arterial blood gas were recorded on every patients. Patients and physicians satisfaction was noted from 0 to 10. Statistic analysis used parametric or non-parametric tests according to the distribution.

Results: Sedation scores showed a significantly higher sedation in the (P) group. Pain score analysis showed significantly more pain in the (R) group. The length of recovery was significantly longer in the (P) group (Figure). Patients and physicians satisfaction score were not different in the two groups.

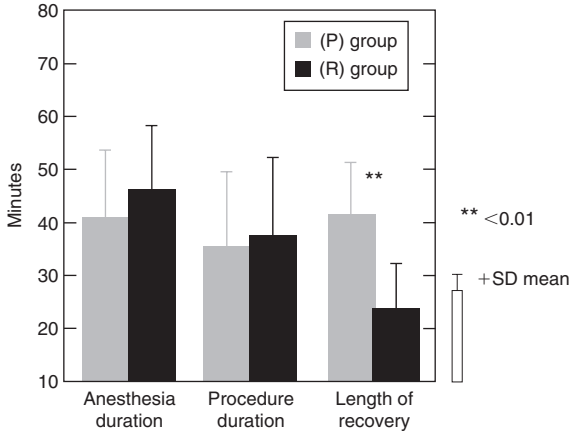

Figure.

Discussion: This study emphasizes the difficulty faced in providing adequate sedation and pain relief in flutter RF ablation. Clinicians have to deal with a potential risk of respiratory depression. Sedation for medical or surgical procedure must obey the same rules of monitoring and safety as general anaesthesia [2]. Monitoring should include a device allowing early warning of respiratory depression.

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O-16

Comparison of lornoxicam and diclofenac in the treatment of postoperative pain after cardiac surgery: a single blind, active controlled, randomized study

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Introduction: Inadequate pain control after cardiac surgery may result in increased morbidity and hospital length of stay. Non-steroidal anti-inflammatory drugs (NSAID) may be used for analgesia in postoperative pain to reduce the side effects of opioids [1]. Diclofenac is one of the most frequently used NSAID for postoperative analgesia. Lornoxicam is a new NSAID with its usage increasing with time. In this single blind study we compared these two drugs for postoperative pain control after cardiac surgery.

Method: Forty patients undergoing open heart surgery were included to the study. Patients were premedicated with oral diazepam 10 mg at midnight before the day of surgery. Anaesthesia was induced with fentanyl, midazolam, and propofol, and maintained with fentanyl and isoflurane in oxygen. After extubation, patients were divided randomly into two groups. Group I received diclofenac sodium (75 mg i.m. repeated every twelve hours) and

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Group II received lornoxicam (8 mg i.m. repeated every six hours) for 48 hours. Additional analgesia was provided with meperidine (1 mg kg^{-1} i.m.) when needed. Pain relief was evaluated with VAS (0 = no pain, 10 = worst pain) just before the first injection (baseline), and at 15 min, 30 min, 1, 2, 3, 4, 6, 12, 18, 24, and 48 h thereafter. Sedation score (0 = Awake and alert patient, 4 = Deep sedation) was noted synchronously with the VAS score, and adverse effects (gastric discomfort, nausea, vomiting, hypotension, bradycardia, renal impairment) were noted when they were observed.

Chi-squared test and Fisher's exact test were used to compare occurrences between two groups. Non-paired Student's *t*-test was used to compare measured data between the groups. $P < 0.05$ was considered significant.

Results: The two groups were similar in terms of demographic and surgical data. The base line VAS scores were similar in both groups. The VAS scores in the 15th min and 30th min were not different from baseline ($P > 0.05$), whereas VAS scores of all other measurements were significantly lower than that of baseline values in both groups ($P < 0.05$). These decreases were similar in both groups. The mean overall VAS scores were similar in both groups. We did not observe any adverse effect related to the study drugs in any patient. Laboratory measurements showed no evidence of renal damage in any group. Three patients (15%) in Group I, and two patients (10%) in Group II needed additional analgesic drug ($P > 0.05$).

Discussion: We conclude that pain after cardiac surgery may be treated with either diclofenac or lornoxicam. Further studies are required to asses the efficacy and safety of these drugs in postoperative analgesia for cardiac surgery patients.

Reference:

1 Hynninen MS, Cheng DC, Hossain I, et al. Non-steroidal anti-inflammatory drugs in treatment of postoperative pain after cardiac surgery. *Can J Anaesth* 2000; **47**: 1182–1187.

O-17

The effect of thoracic epidural anaesthesia on diastolic function

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Introduction: Thoracic epidural anaesthesia (TEA) with post-operative analgesia is known to be of benefit to many patients [1]. There is to date, no evidence of the effect of TEA on diastolic function despite growing interest in the role of diastolic dysfunction.

Method: After local ethical approval 52 patients due to undergo a coronary artery bypass graft (CABG) were recruited. TOE parameters measured were; E/A (E wave to A wave ratio), DT (mitral deceleration time), pvAvel (peak velocity of pulmonary vein A (reverse flow) wave), S/D (ratio of systolic to diastolic flow velocity in pulmonary vein), A-wave duration (mitral A wave), pvAdur-mvAdur (the difference in duration between the pulmonary reverse flow and the atrial flow) [2] and IVRT (isovolaemic relaxation time). These were performed before and after establishing a thoracic epidural blockade of T2–T10 with 10 mL of levobupivaciane 0.5%.

Results: In 42 of the 52 patients we were able to measure all TOE parameters. All the patients survived to hospital discharge.

Paired Student's *t*-test was performed for all of the relevant cardiovascular and TOE data.

Parameter	Induction mean (SD)	Epidural mean (SD)	*P* value
Cardiovascular			
Heart rate (bpm)	62.31 (11.85)	60.48 (11.34)	0.029*
MAP (mmHg)	74.17 (17.75)	68.14 (11.72)	0.014*
TOE			
E/A ratio	1.18 (0.35)	1.15 (0.26)	0.452
DT (mSec)	217.3 (73.3)	227.5 (68)	0.290
PvAvel	0.145 (0.05)	0.138 (0.05)	0.358
S/D	1.457 (0.414)	1.545 (0.417)	0.196
Adur (mSec)	183.9 (61.25)	191.36 (50.34)	0.346
PvAdur–mvAdur (mSec)	−83.19 (68.97)	−83.17 (54.34)	0.998
IVRT (mSec)	148.36 (34.62)	160.71 (38.6)	0.068

*($P < 0.05$) statistically significant

There is no statistical difference in any of the measured TOE parameters. There was a statistically significant difference in the heart rate and mean arterial pressure but this was lost when the eight patients with known left ventricular systolic dysfunction (EF <50%) were excluded.

Discussion: We have shown that thoracic epidural anaesthesia does not affect any measurable parameter of left ventricular diastolic function. This supports the use of epidurals in people with high risk of diastolic dysfunction.

An epidural block will cause statistically significant depression of cardiovascular parameters in patients with pre-existing left ventricular systolic dysfunction but not in those with an ejection fraction >50%. To look for evidence of a sympathetic block in patients with preserved systolic function we suggest using parameters other than heart rate and mean arterial pressure.

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Haemodynamics A

O-18

The effect of right coronary artery stenosis on right ventricular function in patients undergoing off pump coronary artery bypass surgery

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Introduction: Right ventricular (RV) function has important prognostic implications in off-pump coronary artery bypass surgery (OPCAB) and the degree of coronary artery stenosis affects myocardial function during distal coronary anastomosis [1,2]. This study investigated the effect of the extent of right coronary artery (RCA) stenosis on RV function and haemodynamics in patients undergoing OPCAB.

Method: Twenty four patients undergoing OPCAB were divided into two groups according to the degree of RCA stenosis. In $S_{moderate}$ group (n = 12), patients having <70% stenosis in the distal or proximal RCA were included and patients having 90% or greater stenotic lesion the in proximal RCA were included in S_{severe} group (n = 12). In all patients an intra-coronary shunt was not inserted during distal anastomosis of RCA. RV ejection fraction (RVEF) and RV volumetric parameters, measured using a thermodilution technique, and other haemodynamic variables were recorded after pericardiotomy (baseline, T1), 10 minutes after starting distal anastomosis of RCA (T2) and after sternal closure (T3). Comparisons of variables between the two groups and within each group were performed using t-test and one-way ANOVA, respectively.

Results: In S_{severe} group, RVEF significantly decreased during RCA anastomosis and did not recover to baseline value after anastomosis. In contrast, there was no significant change in RVEF during and after RCA anastomosis in $S_{moderate}$ group.

Table 1. Changes in haemodynamic variables.

		T1	T2	T3	*P* value*
CO	S_{severe}	5.3 ± 1.0	4.6 ± 1.5	5.2 ± 1.5	0.015
	$S_{moderate}$	4.6 ± 1.0	4.1 ± 0.9	5.1 ± 1.0	0.019
SvO_2	S_{severe}	80 ± 4	71 ± 8	78 ± 8	0.010
	$S_{moderate}$	78 ± 7	67 ± 6	78 ± 4	<0.001

**P*-value of one-way ANOVA for comparisons of variables within each group.
$S_{moderate}$: patients having less than a 70% stenosis in the distal or proximal RCA,
S_{severe}: patients having 90% or greater stenotic lesion in the proximal RCA,
T1: after pericardiotomy, T2: 10 minutes after starting distal anastomosis of RCA,
T3: after sternal closure, CO: cardiac output (L min^{-1}), SvO_2: mixed venous oxygen saturation (%), CVP: central venous pressure (mmHg), RVEF: right ventricular ejection fraction (%).

Mixed venous oxygen saturation decreased, and central venous pressure increased during RCA anastomosis and recovered to baseline value after

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

anastomosis in both groups. There was no significant difference in haemodynamic variables between two groups during all study period.

Discussion: RVEF significantly decreased during distal anastomosis of RCA performed without intra-coronary shunt in patients with severe proximal RCA stenosis but not in patients with moderate RCA stenosis. Although there was no significant difference in preoperative RVEF between the two groups, already depressed intrinsic RV function due to severe RCA coronary stenosis is likely to affect the result of this study.

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O-19

The influence of chest opening and closure on left ventricular stroke volume variation (SVV) and pulse pressure variation (PPV)

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Introduction: The dynamic preload indicators SVV and PPV have been shown to allow a sensitive and real-time assessment of left ventricular preload [1]. However, it is controversial whether they are still reliable parameters of cardiac preload when used in open chest conditions [2,3].

Method: Forty five patients undergoing coronary artery bypass grafting participated in the study. Anaesthesia was performed with continuous i.v. sufentanil ($2\,\mu g\,kg^{-1}\,h^{-1}$) and inhaled isoflurane (0.5 MAC) supplemented with boluses of midazolam ($0.05–0.1\,mg\,kg^{-1}$) during CPB. SVV and PPV were assessed by pulse contour analysis. The thermodilution technique was used for measurements of stroke volume index (SVI) and global end diastolic volume index (GEDI). All parameters were assessed before (T1) and after (T2) sternotomy, after weaning from cardiopulmonary bypass before (T3) and after (T4) chest closure.

Results: PPV was significantly decreased after sternotomy and increased after chest closure, similar to SVV (Table 1). Significant changes in cardiac preload were only observed after sternotomy. The changes in SVV (Δ SVV) and PPV (Δ PPV) in response to chest opening and closure were not correlated to concomitant changes in GEDI (Δ GEDI). (**Sternotomy:** Δ SVV vs. Δ GEDI: $r^2 = 0.01$, $P = 0.62$; Δ PPV vs. Δ GEDI: $r^2 = 0.02$, $P = 0.36$; **Chest closure:** Δ SVV vs. Δ GEDI: $r^2 = 0.01$, $P = 0.59$; Δ PPV vs. Δ GEDI: $r^2 = 0.04$, $P = 0.26$; linear regression analysis with Pearson's product moment correlation (r) and Spearman's rank correlation (*P*).)

Table 1: Haemodynamic changes in the perioperative time course.

	T1	T2	T3	T4
HR (min^{-1})	55 ± 13	56 ± 11	86 ± 11	87 ± 8
MAP (mmHg)	77 ± 18	81 ± 14	77 ± 10	78 ± 9
CVP (mmHg)	12 ± 3	12 ± 3	10 ± 2	12 ± 2°°
SVI ($mL\,m^{-2}$)	41 ± 11	46 ± 12**	41 ± 12	38 ± 10
SVV (%)	11 ± 5	10 ± 5	12 ± 5	14 ± 5°°
PPV (%)	15 ± 5	11 ± 5**	8 ± 4	11 ± 4°°
GEDI ($mL\,m^{-2}$)	686 ± 135	740 ± 142**	669 ± 136	660 ± 118
NE ($\mu g\,kg^{-1}\,min^{-1}$)	–	–	0.03 ± 0.03	0.04 ± 0.03
E ($\mu g\,kg^{-1}\,min^{-1}$)	–	–	0.02 ± 0.01	0.02 ± 0.02
TV ($mL\,kg^{-1}$)	7.7 ± 1.9	7.6 ± 1.8	8.2 ± 2.1	7.4 ± 1.4°

(HR = heart rate, MAP = mean arterial pressure, CVP = central venous pressure, SVI, SVV, PPV, GEDI = see text, NE = norepinephrine, E = epinephrine, TV = tidal volume; ** = $P < 0.01$ vs. T1; ° = $P < 0.05$ vs. T3; °° = $P < 0.01$ vs. T3; analysis of variance, post-hoc-testing with Fisher-LSD-test).

Discussion: The results demonstrate that the changes in SVV and PPV in response to chest opening and closure do not reflect changes in cardiac preload. Opening and closing of the chest do not only influence cardiac filling, but additionally induce significant changes in other determinants of SVV and PPV, like pulmonary and thoracic compliance, pericardial restraint and transmural pressures of the heart. Thus, SVV and PPV may not be suitable parameters of cardiac preload when used during surgical procedures with opening and closure of the chest.

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O-20

Human intestinal mucosal perfusion is well autoregulated during cardiopulmonary bypass

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Introduction: Occurrence of splanchnic ischaemia during cardiopulmonary bypass (CPB) may lead to disrupted intestinal mucosal barrier function, one causal factor for the development of systemic inflammatory response syndrome after cardiac surgery. Previous studies have suggested that autoregulation of intestinal mucosal blood flow is severely impaired during CPB in animals [1]. In this study we evaluated the intestinal mucosal autoregulation of blood perfusion during CPB in man.

Method: Ten elective cardiac surgery patients were included after informed consent and approval of the local ethics committee. Anaesthesia was performed with a combination of fentanyl, propofol and pancuronium. A custom-made two-probe laser Doppler catheter (Perimed, Sweden) was placed endoluminally in the proximal jejunum. During non-pulsatile pump flow at $2.4\,L\,min^{-1}\,m^{-2}$ at a temperature of 34°C the pump flow was altered randomly and repeatedly to either $1.8\,L\,min^{-1}\,m^{-2}$ or $3.0\,L\,min^{-1}\,m^{-2}$ in three minutes periods. Thereafter, vasodilation was induced by a bolus of prostacyclin (Flolan®, 10 μg) (n = 6), and the maximal change in mean arterial pressure (MAP) and jejunal mucosal perfusion (JMP) were recorded. Pump flow was again randomly altered to both 1.8 or $3.0\,L\,min^{-1}\,m^{-2}$. MAP and JMP were recorded at each pump flow rate (1.8, 2.4, $3.0\,L\,min^{-1}\,m^{-2}$).

ANOVA for repeated measurements followed by means comparisons and contrast analysis were used to evaluate the effects of varying pump flow rates on MAP and JMP. Wilcoxon's signed rank test was used to compare pre and post prostacyclin values of JMP and MAP. Values are expressed as mean ± sd.

Results: All patients showed a typical pattern of vasomotion (72 ± 18% of registered time during CPB). Pump flow rates of 1.8, 2.4 and $3.0\,L\,min^{-1}\,m^{-2}$ caused no significant changes in mean JMP: 204 ± 55, 214 ± 53, 197 ± 50 perfusion units, respectively, despite a significant change in MAP: 50 ± 15, 63 ± 17, 74 ± 16, respectively. Injection of prostacyclin completely abolished the vasomotion waves and JMP increased from 192 ± 53 to 277 ± 70 ($P < 0.05$) perfusion units despite a reduction in MAP from 59 ± 12 to 45 ± 10 mmHg ($P < 0.05$). During the influence of prostacyclin variations in pump flow rate revealed a pressure dependent intestinal mucosal perfusion.

Discussion: Autoregulation of intestinal mucosal perfusion is well maintained in humans during cardiopulmonary bypass within the range of the pump flow rates studied. Myogenic mechanisms at the arteriolar level are probably responsible for this pressure-independent mucosal perfusion during CPB. Prostacyclin induced a profound mucosal vasodilation and the mucosal perfusion became pressure dependent.

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O-21

Preload assessment by transpulmonary thermodilution and echocardiography in cardiac surgery patients

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Introduction: Intrathoracic blood volume index (ITBVI) assessed by the PiCCO System (Pulsion Medical System, Munich Germany) has shown to be a better preload parameter than conventional filling pressures [1]. Left ventricular end-diastolic volume indices [LVEDVI] assessed by transoesophageal echocardiography [TOE] are regarded as clinically valuable preload parameters [2]. The aim of this study was to compare ITBVI and LVEDVI as preload parameters.

Method: With local ethics committee approval and patient informed consent, 22 patients undergoing elective off-pump coronary artery bypass grafting with preserved left and right ventricular function were studied following

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

haemodynamic stabilization after induction of anaesthesia. Repeated measurements were made in each patient 10 min before and 10 min, 20 min, 40 min after a fluid bolus (hydroxyethyl starch solution 10 mL kg^{-1}). At each time point PiCCO-measurements (ITBVI, stroke volume index [SVI]) and TOE assessment (LVEDVI/SVI by modified Simpson formula: $EDVI_S/SVI_S$ and by methods of discs: $EDVI_D/SVI_D$) were performed. Linear correlation and ANOVA (Bonferroni-Dunn) was calculated; $P < 0.05$ was considered significant.

Results: The fluid bolus resulted in significant increases in cardiac filling pressures, ITBVI, $LVEDVI_S$, $LVEDVI_D$ and SVI ($P < 0.05$). Decrease of preload indices and SVI 20 min and 40 min after fluid bolus were significant for TOE parameter only. The relationship between % changes (Δ) of $LVEDVI_S$ and ΔITBVI was stronger than the relationship between $\Delta LVEDVI_D$ and ΔITBVI (Figure). For the correlations of ΔSVI-ΔITBVI r^2 was 0.58, for ΔSVI-$\Delta LVEDVI_S$ 0.62 and for ΔSVI-$\Delta LVEDVI_D$ 0.15.

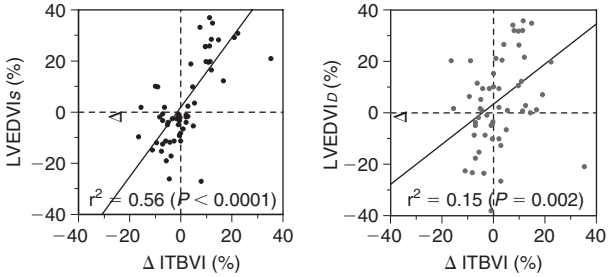

Figure.

Discussion: ITBVI and echocardiographic determination of LVEDVI using the Simpson formula showed a comparable performance as preload parameters during fluid replacement therapy. LVEDVI assessed by the methods of discs was less reliable in this series of patients.

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O-22

Trans-hepatic echocardiographic view after cardiac surgery

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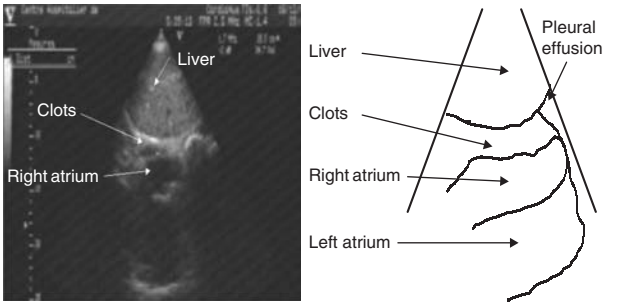
Introduction: Pericardial effusion after cardiac surgery is sometimes difficult to diagnose especially if clots are localized on the right side of the heart. We described a new echocardiography view after cardiac surgery for detect cardiac tamponade.

Method: The trans-hepatic view (THV) is obtained with the probe placed on the right side of the patient over his liver. The image's depth is enhanced to 20 centimetres, the inferior cava is found and the probe is directed to the junction between the inferior cava and the right atrium. A 4 cavities view of the heart is then obtained. THV allows inferior vena cava and hepatic venous flow measurement, clot detection and right pleural effusion. 39 patients without clinical signs after cardiac surgery were checked with this new view and a standard transthoracic echocardiography (TTE). In 11 other patients with a suspected pericardial effusion TTE and TVH were compared.

Results: In 39 patients after cardiac surgery (postoperative day 1 to 10) THV and classical TTE views were performed. THV views were obtained in 37 patients and TTE views were obtained in 30 patients. THV was not possible in only two obese patients.

In 11 others patients with suspected pericardial effusion THV found right sided clots in 11 patients while the classical TTE views detected clots or effusion in only 6 patients. 4 intubated patients had a transoesophageal echocardiography which confirmed the THV findings. Re-intervention was performed in the 11 patients. In 10 patients THV was confirmed (sensitivity 100%, specificity 90.9%). In one case a fatty heart was found without clots.



Discussion: This trans-hepatic view of the heart is easy to obtain after cardiac surgery and is better than classical TTE to detect right sided pericardial effusion. It should be integrated into a classical TTE exam after cardiac surgery.

O-23

Audit on safe placement of the central venous catheter tip

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Introduction: The placement of central venous catheters (CVC) in either of the jugular veins (RIJV, LIJV) is a routine procedure in cardiothoracic anaesthesia and intensive care. Around six million insertions occur annually in the United States and around two million per year in the United Kingdom. Despite this, there are no guidelines or recommendations for the standard position of the CVC tip. Vesely, in his recent review on the central venous catheter tip position, examined the facts relating to catheter induced perforation in detail [1]. Cadaver studies have shown that the carina always lies above the pericardial sac [2,3]. Hence in order for the CVC tip to avoid the risk of penetrating the pericardium, it should lie at or above the level of the carina. The carina can be easily identified on a plain chest radiograph. With this in mind we audited the practice in our Heart and Lung Centre looking at the position of CVC tip in relation to carina.

Method: We included all cases treated in our cardiothoracic unit between 4th October 2004 to 9th December 2004. As per the practice in our centre, all the patients had a 16 cm catheter (Quad/Quinn) inserted up to its hub. The post operative chest X ray for all cases was retrieved through our hospital PACS (Picture Archive and Communications System) and reviewed. The position of the catheter tip was noted in relation to the carina and the vertical distance between the CVC tip and carina was measured in those found to lie below the level of the carina.

Results: A total of 77 cases were included in our study (61 male and 16 female, 3.8:1). Their ages ranged between 38–79 years (median 68 years). 70 had cardiac surgery (CABG 56, valves 8, combined 4 and reopening 2), 5 had thoracic surgery and 2 were vascular surgical cases. Of all the central venous catheters, 73 were in the right internal jugular vein and 4 were in the left internal jugular vein.

Only 9 (12%) CVC tips were above the carina (all in RIJV) while 13 (17%) were at the level of the carina (12 in RIJV and 1 in LIJV). A majority (55) of CVC tips (71%) were found to lie below the carina (52 in RIJV & 3 in LIJV).

In the group in which the CVC tip lay below the carina, the vertical distance between the tip and carina was measured. 21 catheters were between 0–2 cm below, 30 were 2–5 cm below and 4 were greater than 5 cm below the carina.

Conclusions: The majority of the CVC tips in our patients lay below the carina. This could potentially be hazardous. As identification of the carina on a chest radiograph is relatively easy, more strict vigilance in placing the catheters should be recommended. We have changed the practice in our centre in view of our findings. We now recommend that the catheter be inserted up to 12 cm and not up to their hub provided blood can be freely aspirated from the proximal lumen. We are also discussing with the manufacturers the feasibility of producing a shorter length cannula.

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

O-24

Effects of modified ultrafiltration on right heart function in adult patients undergoing valvular heart surgery

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Introduction: Modified ultrafiltration (MUF) has been demonstrated to have beneficial effects in children undergoing cardiac surgery with cardiopulmonary bypass (CPB). In adults, the haemodynamic effects of MUF are little known [1,2]. The purpose of this investigation was to evaluate the effects of MUF on right ventricular function and systemic haemodynamics in adult patients undergoing valvular heart surgery.

Method: Thirty patients scheduled for elective mitral valvular surgery were randomized into either Ultrafiltration (U) or Control (C) group. In the U group only, MUF was performed just after termination of CPB for 20 minutes. Haemodynamic variables including right ventricular ejection fraction (RVEF) by thermodilution technique and haematocrit were measured before anaesthesia induction (T1), just after termination of CPB (T2), after completion of MUF in U group, and 20 minute after T2 in C group (T3) and after sternal closure (T4). In the ICU, the same measurements were performed at postoperative 6 (T5) and 12 hours (T6). Statistical evaluations were performed with Mann–Whitney *U*-test and Wilcoxon signed rank test.

Results: Total volume filtered during MUF in U group was 1033 ± 305 mL. There was no significant difference in total amount of fluid infused (2198 ± 629 vs. 2550 ± 570 mL) and urine output (1469 ± 611 vs. 1301 ± 473 mL) during operation between C and U group. After MUF (T3), RVEF ($P < 0.01$) and haematocrit ($P < 0.05$) increased in the U group, compared to the values measured at T2 but the differences disappeared at T4–T6. There was no significant difference in the haemodynamics and RV function between the two groups throughout the intra-operative period and during ICU stay.

Table. Haemodynamic variables before and after MUF.

	T2		T3	
	C	U	C	U
CI	3.2 ± 0.7	2.9 ± 1.1	3.3 ± 0.7	3.3 ± 1.3
HR	91 ± 15	84 ± 13	90 ± 8	80 ± 14*
MAP	75 ± 10	72 ± 12	80 ± 14	77 ± 9
Hct	25 ± 3	24 ± 5	26 ± 3	28 ± 5*
RVEF	30 ± 7	27 ± 8	32 ± 7	33 ± 7†

*$P < 0.01$ compared to post-CPB. †$P < 0.05$ compared to post-CPB. CI cardiac index (L min^{-1}). HR heart rate (beat min^{-1}). MAP mean systemic arterial pressure (mmHg). Hct haematocrit (%). RVEF right ventricular ejection fraction (%).

Discussion: MUF demonstrated just transient beneficial effect of improving the right heart function and haemoconcentration immediately after termination of CPB in patients undergoing valvular heart surgery. In spite of theoretical advantages of MUF including anti-inflammatory effects and beneficial fluid balance on right heart function after CPB, addition of fluid after MUF to correct postoperative hypovolaemia is likely to attenuate the positive effects of MUF on postoperative haemodynamics in those patients.

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Cardiopulmonary Bypass – Inflammation

O-25

Does early postoperative fever improve outcome?

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Introduction: Fever is a physical sign associated with inflammation and infection. During infection, fever has been demonstrated to improve host defence [1], but in patients with limited cardiac or pulmonary function fever is considered to be detrimental [2]. The aim of this study was to investigate the effect of early postoperative fever on outcome in ICU patients after cardiac or thoracic surgery.

Method: All consecutive patients (n = 1749) admitted between January 1999 and December 2003 were eligible. We restricted the analysis to patients with a length of stay in the ICU >4 days. Early postoperative fever was defined as temperature >38°C, measured with the thermistor of the urinary catheter on day 2 after surgery. Demographic data consisted of age, gender, logistic EuroSCORE, diabetes and the diagnostic categories CABG, valve surgery, combined valve and CABG, aortic aneurysm, cardiac assist device, heart and lung transplantation as well as other cardiac or pulmonary interventions. Intraoperative factors were use of extracorporeal circulation and its duration. All demographic data were prospectively entered into a database and monitoring data were recorded every 10 minutes and stored in a the patient data management system (PICIS Caresuite). Descriptive data were analysed by t-test or chi-squared test and multivariate analysis was done by logistic regression (PROC LOGISTIC, SAS 8.2). Data are given as mean with (95% CI).

Results: 567 patients stayed more than 4 days in the ICU and slightly less than half of them developed fever (n = 250). ICU mortality was 16% in febrile patients and 24% in non-febrile patients $P = 0.05$. Hospital mortality was 22% in febrile patients and 32% in non-febrile patients ($P < 0.01$). In all major cardiac diagnostic groups mortality was higher in non-febrile patients. Only after lung transplantation and aortic aneurysm surgery was ICU mortality higher in febrile patients, but this effect decreased until hospital discharge. Multivariate analysis of demographic data did not explain the occurrence of postoperative fever.

Discussion: Our data suggest a beneficial effect of early postoperative fever on ICU and hospital outcome. As no clear demographic and intra- or perioperative risk factors were related to the development of fever we think that early postoperative fever in patients with a prolonged ICU stay after surgery may indicate an improved host defence.

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O-26

Oxygen impairment and inflammatory response following cardiopulmonary bypass at 32°C versus 36°C: a randomized clinical trial

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Introduction: Cardiac surgery with use of cardiopulmonary bypass (CPB) induces an intensive activation of the inflammatory system and subsequent organ dysfunction. Postoperative oxygen impairment is prevalent and has often been evaluated using single parameter estimates [1]. More physiological complexity can be appreciated by estimation of two parameters of pulmonary gas exchange using a mathematical model of oxygen transport [2].

Normothermic and/or tepid (temperature allowed to drift towards 32–34°C) CPB has gained increasing popularity over the last decade. The aim of the present study was to elucidate the influence of temperature during CPB on the inflammatory response and the postoperative oxygen impairment.

Method: Thirty patients scheduled for elective coronary artery bypass grafting were randomized to either normothermic (36°C) or hypothermic (32°C) CPB. Oxygen impairment was evaluated preoperatively, 4 h, 44 h and 120 h postoperatively. Two parameters describing pulmonary gas exchange were calculated; i.e. shunt (%) and drop in Po_2 from the mixed alveolar compartment to the mixed lung capillary blood, ΔPo_2 (kPa). Cytokines (IL-6, IL-8 and IL-10), leukocytes and C-Reactive Protein (CRP) was analysed at the time of sternum closure, 4 h, 16 h and 44 h postoperatively. Non-parametric statistics methods were used, i.e. multivariate multi-sample rank sum test, Wilcoxon's and Spearman's rho. $P < 0.05$ was considered statistical significant.

Results: Oxygen impairment was increased within the first 120 h with peak values 44 h postoperatively (Table 1). The most significant changes in inflammatory response are shown in Table 2. There was no difference between the groups.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Table 1. Oxygen impairment, peak values. Median (range).

		Hypothermia	Normothermia
Shunt (%)	pre	1.5 (0–10.3)	1.3 (0–7.3)
	44 h	10.2 (1.5–20.8)	13.9 (5.8–21.3)
ΔPo_2 (kPa)	pre	0.33 (0–1.86)	0.65 (0–1.48)
	44 h	4.02 (1.96–12.81)	3.79 (1.36–17.40)

Table 2. Inflammatory response, peak values. Median (range).

		Hypothermia	Normothermia
IL-10 (pg/mL)	pre	3 (0–16)	3 (0–74)
	closure	133 (42–483)	120 (29–412)
IL-6 (pg/mL)	pre	1 (0–27)	2 (0–16)
	4 h/16 h	129 (33–300)	90 (29–300)
IL-8 (pg/mL)	pre	0 (0–13)	0 (0–65)
	4 h	15 (0–29)	18 (0–57)
Neutrophils	pre	58 (42–66)	57 (43–70)
	4 h	86 (74–91)	87 (79–92)
CRP (mg/L)	pre	0 (0–14)	0 (0–12)
	44 h	175 (74–330)	220 (42–330)

There was no correlation between the inflammatory response and the degree of oxygen impairment.

Discussion: Impaired oxygenation is progressively increased after cardiac surgery independent of the temperature during CPB. A well-defined inflammatory response did not correlate to the degree of postoperative impaired oxygenation.

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O-27

Characteristics and outcome of patients after cardiovascular surgery with the use of hypothermic cardiopulmonary bypass

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Introduction: It is well known that widely used severity scores like SAPS II and SOFA are not specifically designed to investigate the risk of patients (pts) undergoing cardiovascular surgical interventions. Our purpose was to compare the prognostic value of preoperative and postoperative severity scores in these patients.

Method: This retrospective comparative study was approved by the local institutional ethics committee. Exclusion criteria were an age <18 years (125 pts), incomplete data (10 pts), other than cardiovascular surgery using hypothermic cardiopulmonary bypass (17 pts). Over the period of 12 month 792 pts met the requirements for inclusion. Patient data were collected by a patient data management system (PDMS) recording all diagnostic and therapeutic procedures as well as general demographic data, ICU length of stay (LOS), and outcome. Pre- and postoperative risk scores (EuroSCORE, Higgin score, SAPS-II, SOFA) were calculated by screening the medical records. Patients were grouped as CABG, valvular surgery, valvular surgery + CABG and other cardiovascular interventions. Statistical analysis was performed using Pearson's correlation probability test. $P < 0.05$ was considered as statistically significant. Data are presented as mean ± SD.

Results: 792 pts (514 male, 278 female), age 65.7 ± 9.9 years, were included. Overall hospital length of stay was 19.6 ± 15.6 days with an ICU LOS of 3.4 ± 6 days. Higgins and EuroSCORE ($R = 0.73$, $P < 0.01$) as well as post operative severity/organ failure scores (SAPS II and SOFA) ($R = 0.69$, $P < 0.01$) showed a significant correlation. However, the predicted death rates by EuroSCORE and SAPS II showed only a weak correlation ($R = 0.45$, $P < 0.01$).

Table 1. Outcome scores, predicted death rates (PDR) and death rate (DR).

	All	CABG	Valvular surgery	Combined surgery	Other intervent
N	792	548	119	100	25
Higgins	3.5 ± 3.3	3.0 ± 3.1	4.3 ± 2.9	4.6 ± 3.9	3.7 ± 2.9
EuroSCORE	4.9 ± 3.0	4.2 ± 2.9	6.9 ± 3.0	6.7 ± 2.7	6.8 ± 2.2
EuroSCORE PDR [%]	5.9 ± 7.3	4.7 ± 6.1	8.5 ± 9.4	8.5 ± 8.8	9.4 ± 6.3
SAPS II	33 ± 16	32.7 ± 10.4	32.9 ± 10.0	36.6 ± 10.9	35.4 ± 16.2
SAPS II PDR [%]	17.4 ± 15.8	16.6 ± 15.4	169 ± 14.3	21.2 ± 17.0	21.6 ± 21.5
SOFA	6 ± 2.6	5.9 ± 2.6	6.4 ± 2.6	7.0 ± 2.6	7.2 ± 2.9
DR [%] ICU/Hosp.	4.6/5.8	4.0/4.9	3.4/4.2	6.0/10.0	16.0/16.0

Data expressed as mean ± SD.

Conclusion: Our findings on PDR using the EuroSCORE were in line with results of former studies [1]. SAPS II overestimated to a great extend the severity of illness postoperatively in all types of cardiac surgery investigated. Thus, not only the immediate consequences of the procedure but also the pre-operative state of the patients seem to be of interest when predicting the outcome in patients undergoing cardiac surgery.

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O-28

Role of systemic inflammatory response in acute renal dysfunction after cardiac surgery with cardiopulmonary bypass

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Introduction: The pathophysiology of acute renal dysfunction (ARD) after on-pump cardiac surgery still remains under discussion. However, it is known that the systemic inflammatory response increases after cardiopulmonary bypass (CPB) [1]. The aim of this study was to evaluate the role of the systemic pro-inflammatory response in ARD occurring after on-pump cardiac surgery.

Method: After informed consent, 62 patients scheduled for cardiac surgery with CPB were prospectively included. Plasma C-reactive protein (CRP), TNF and IL 6 levels were measured respectively before (T0), 30 min after the start of CPB (T1), at the end of CPB (T2), on ICU arrival (T3) and on day 1 (T4) and day 2 (T5) after surgery. ARD was defined as a 25% increase of the serum creatinine level. Data were compared with ANOVA and the Mann–Whitney test.

Results: ARD occurred in 36 patients (60%). We found no difference in the evolution of CRP, TNF or IL-6 within both groups of patients with (ARD+) or without ARD (ARD-) ($P = 0.75$, 0.86 and 0.18 respectively). There was no difference within their plasma peak levels (CRP: 254 ± 78 mg/L vs. 243 ± 86 mg/L $P = 0.44$, TNF: 17.4 ± 24.4 pg/mL vs. 22.5 ± 43.2 pg/mL $P = 0.93$, IL-6: 465 ± 471 pg/mL vs. 578 ± 566 pg/mL $P = 0.61$). Compared to other studies, our population shows a high level of ARD. This may be explained by CPB of long duration which is known to increase ARD rate, and a lower ejection fraction in the ARD population (59 ± 12 vs. 68 ± 11, $P = 0.01$).

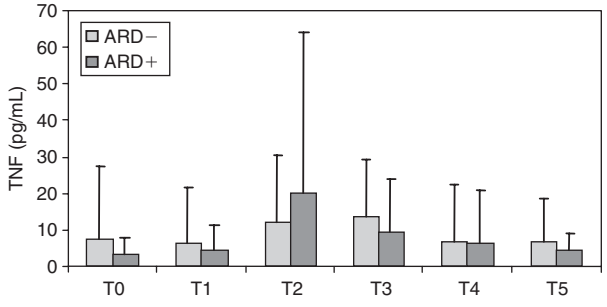

Figure. Evolution of TNF concentration between both groups

Conclusion: Postoperative ARD after on-pump cardiac surgery is not related to an increase in systemic pro-inflammatory response.

Reference:

1 McBride WT, Armstrong MA, Crockard AD, et al. Cytokine balance and immunosuppressive changes at cardiac surgery: contrasting response between patients and isolated CPB circuits. *Br J Anaesth* 1995; **75**(6): 724–733.

O-29

Plasma macrophage colony stimulating factor (MCSF) is increased at cardiac surgery

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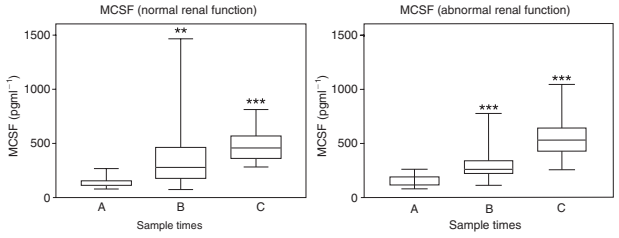
Introduction: Dendritic cell (DC) migration and maturation is thought to be an important aspect of perioperative immunity. It also constitutes a

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

pro-inflammatory mechanism. Macrophage colony stimulating factor (MCSF) is elevated during trauma, impairs DC maturation and migration and is associated with infective complications and poor outcome [1]. We wished to determine if MCSF increases at cardiac surgery and if there is associated poor clinical outcome as assessed by impaired renal function.

Method: From a large data base of 300 low risk patients, with normal pre-operative renal function, undergoing cardiac surgery at our institution, we selected 20 patients who developed renal dysfunction as defined by serum creatinine >125 μmol/L or a serum creatinine rise (delta creatinine) >35 μmol/L during a 5 day postoperative period. This group was compared with 20 patients who had normal renal function throughout. Plasma samples for cytokine analysis were obtained at pre-anaesthetic baseline (sample A) and at 2 and 24 hr post CPB (Samples B and C respectively). MCSF was measured in both groups. Within group comparison with T0 was with repeated measures ANOVA followed by paired T-Test. Between group analysis at each sampling time was with one way ANOVA and Bonferroni Multiple Comparisons Test.

Results: There was a very significant increase from baseline ($P < 0.01$) at 2 and 24 hours post CPB in both groups. No between group difference was observed.



Discussion: MCSF was significantly increased in both groups suggesting that this may constitute a new anti-inflammatory mechanism at cardiac surgery, which unlike IL-10, lasts much longer. However, impaired DC migration and maturation may be the price of this anti-inflammatory process [2]. The fact that MCSF was not significantly higher in the renal dysfunction group may reflect that the renal dysfunction arose from non-septic causes, unrelated to perioperative immunosuppression in this low risk, non-septic group of patients.

References:

1 De AK, Laudanski K, Miller-Graziano CL. Failure of monocytes of trauma patients to convert to immature dendritic cells is related to preferential macrophage-colony-stimulating factor-driven macrophage differentiation. *J Immuno* 2003; **170**(12): 6355–6362.

2 Markewitz A, Faist E, Lang S, et al. An imbalance in T-helper cell subsets alters immune response after cardiac surgery. *Eur J Cardiothorac Surg* 1996; **10**(1): 61–67.

O-30

Methylprednisolone reduces plasma macrophage colony stimulating factor (mcsf) at cardiac surgery

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Introduction: Monocyte maturation to immature dendritic cells (iDCs) is important in the response to sepsis. Macrophage colony stimulation factor (M-CSF) combined with IL-6 inhibits monocyte-to-iDC differentiation. MCSF is increased at trauma and is associated with immunosuppression and sepsis [1]. Methylprednisolone at cardiac surgery decreases IL-6 (a known inhibitor of monocyte to iDC maturation). We investigated the hypothesis that MP at low-risk coronary artery revascularization surgery involving cardiopulmonary bypass (CPB) would similarly reduce the plasma MCSF response.

Method: Twenty seven patients were randomized to receive placebo (n = 13) or methylprednisolone (15 mg kg^{-1}) (n = 14) following sternotomy. Anaesthesia and surgical techniques were standardised. Blood samples for MCSF analysis were obtained before anaesthesia induction (T0) and at one and 24 hours after end of CPB (T1 and T2 respectively). Within group comparison with T0 was with repeated measures ANOVA followed by paired T-Test. Between group analysis at each sampling time was with one way ANOVA and Bonferroni Multiple Comparisons.

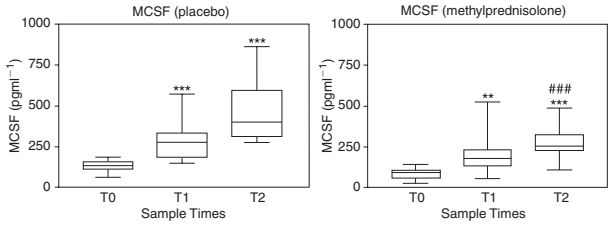

Figure 1. Plasma MCSF in placebo and methylprednisolone patients. Within group comparisons were with baseline T0 (**$P < 0.01$; ***$P < 0.001$) and between group comparisons were at individual sampling times (###$P < 0.001$).

Results: Cardiac surgery involving CPB leads to a significant increase in MCSF. This is significantly reduced by methylprednisolone administered after sternotomy.

Discussion: IL-10, MCSF and IL-6 impair monocyte to iDC maturation [1]. These cytokines are all increased at cardiac surgery. Methylprednisolone increases plasma IL-10 [2] but decreases IL-6. We now show that it also decreases MCSF. Although MP impairs monocyte to iDC maturation *in-vitro*, our study suggests that the possible *in-vivo* inhibitory effects of MP on monocyte to iDC maturation which are mediated by IL-10 may at least in part be limited by a MP mediated reduction in IL-6 and MCSF.

References:

1 De AK, Laudanski K, Miller-Graziano CL. Failure of monocytes of trauma patients to convert to immature dendritic cells is related to preferential macrophage-colony-stimulating factor-driven macrophage differentiation. *J Immunol* 2003; **170**(12): 6355–6362.

2 McBride WT, Allen S, Gormley SM, et al. Methylprednisolone favourably alters plasma and urinary cytokine homeostasis and subclinical renal injury at cardiac surgery. *Cytokine* 2004; **27**(2–3): 81–89.

O-31

The effect of methylprednisolone on percentage monocyte cellular positivity of CD14$^+$/16$^+$ at cardiac surgery

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Introduction: Fundamental to the body's protective response against infection is the ability of tissue based CD83$^+$ dendritic cells (DC) to quickly migrate to lymph nodes and functionally interact with circulating immune cells. It is thought that circulating monocytes (CD14$^+$/CD16$^-$) may differentiate to DC precursors (CD14$^+$/CD16$^+$) before migrating to tissues to help replete DCs redeployed to lymph nodes. Steroids have been used at cardiac surgery to limit the inflammatory response with reports of organ protection. However the effect of cardiac surgery on DC maturation and migration is unknown, nor if steroids modulate this effect.

Method: Twenty seven patients undergoing low risk coronary artery revascularization surgery involving cardiopulmonary bypass (CPB) were randomized to receive placebo (n = 13) or methylprednisolone (15 mg kg^{-1}) (n = 14) following sternotomy. Anaesthesia and surgical techniques were standardized. Whole blood (10 mL) was obtained at T0 (before induction of anaesthesia), T1 (after sternotomy but before administration of test drug), T2 (before institution of CPB), T3 (before sternal closure) and T4 (24 hours after CPB). Percentage cellular positivity of monocytes expressing CD14$^+$/16$^+$ was determined at flow cytometry. Within group comparison with baseline T0 was with Friedman's Test followed by Wilcoxon's Test. Between group comparison at individual sampling times was by non-parametric ANOVA followed by the Mann–Whitney test.

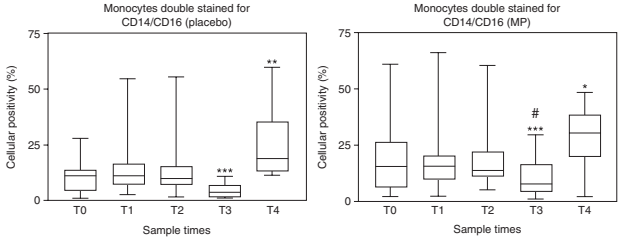

Figure: Graphs showing percentage cellular positivity of CD14$^+$/16$^+$ DC precursors in whole blood. Within group comparisons were with baseline T0 (*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$). Between group comparisons were at simultaneous sampling times; #$P < 0.05$.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Results: In both groups CD $14^+/16^+$ expression fell significantly at T3 but to a greater extent ($P < 0.05$) in the placebo group. $CD14^+/16^+$ expression increased significantly at T4 in both groups.
Discussion: The fall in whole blood CD141/CD161 expression at T3 may reflect rapid migration of DC precursors out of blood to replenish tissue DCs which have moved out of the tissues to lymph nodes. The increase at T4 may reflect a compensatory increase in blood DC precursors to replete the acute loss at T3. Although DC precursor migration is preserved in patients given MP, it is less pronounced at T3. This suggests that MP, at least temporarily (T3) significantly reduces DC precursor migration. Further study is needed to determine if this ability of MP to transiently impair DC precursor migration immediately post CPB has clinical significance.

ICU – Postoperative Care

O-32

Time to extubation after paediatric cardiac surgery in Europe

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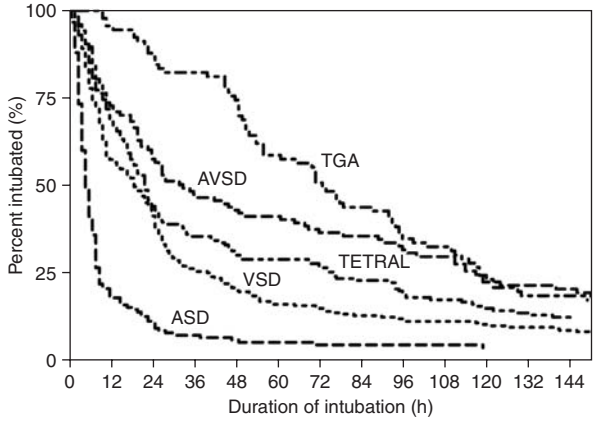
Introduction: Traditionally, children having cardiac surgery have remained intubated for prolonged periods postoperatively. The term fast track is used to describe a method for reducing costs and length of stay for surgical patients. Little is known about the current practice of respiratory support in postoperative paediatric cardiac surgical patients. In a multi-centre cohort study in adults large differences between centres in duration of ventilation [1] were identified. The aim of this multi-centre study was to gain information about the duration of respiratory support after paediatric cardiac surgery in Europe.
Method: Prospective data collection was done in 20 intensive care units admitting children after cardiac surgery. Data were transmitted on discharge to the study centre. The study is limited to 8 representative pathologies and 10 interventions to be able to detect reliable differences between groups. Centre variability in Time to Extubation TiToEx was analysed with the log rank test. Only centres that performed ⩾10 for a given intervention entered the analysis.
Results: Information on a total of 1621 children was collected from the 20 ICUs. The most frequent intervention was the closure of ASD or VSD (n = 583) followed by the correction of Fallot's tetralogy (n = 193), arterial switch (n = 161), AVSD repair (n = 128), systemic-pulmonary shunt (n = 111) and coarctation repair (n = 107). The number of children per centre was 10–358. Median TiToEx after ASD or VSD closure varied between 0–71 hours and after repair of tetralogy between 12–108 hours ($P < 0.0001$).



Conclusion: The variability in TiToEx, related to resource utilization, is large between centres. The early tracheal extubation of children following congenital heart surgery is not a new concept, but remained current practice only for ASD closure. The survival analysis of the multi-centre profiles allows the definition of predominant practice and may support centre oriented benchmarking.
Reference:

1 Lassnigg A, Hiesmayr MJ, Bauer P, et al. Effect of centre-, patient- and procedure-related factors on intensive care resource utilisation after cardiac surgery. *Intensive Care Med* 2002; **28**: 1453–1461.

O-33

Laryngeal mask airway for percutaneous dilational tracheostomy

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Introduction: Percutaneous dilational tracheostomy (PDT) has become a widespread alternative to surgery in the intensive care unit setting [1]. Concerns still exist about trauma to the tracheal wall due to insufficient visualization of anatomical structures throughout the procedure. For this reason different authors recommend the use of fibreoptic bronchoscopy (FOB), but still visualization is often impaired by the presence of the endotracheal tube in intensive care patients [2]. We investigated the use of the laryngeal mask airway (LMA) for PDT in a post cardiac surgery ICU.
Method: Thirty two patients (26M/7F, mean age 69.9 ± 11.1 years) were enrolled in the study period from 2002–2004. Informed consent was obtained from all patients (or from the next of kin). Patients were scheduled for PercuTwist-PDT [3] in the ICU, exclusion criteria being prior tracheostomy, major coagulation disorders, purulent airway secretions and active airway bleeding. Patients were randomly assigned to either a LMA group (16 patients) where the tracheal tube was substituted by LMA prior to procedure, or a non-LMA group (16 patients) where the tracheal tube was left in place. All patients were fasted for at least 6 hours prior to intervention and anaesthesia. Muscle relaxation and analgesia were provided in a standardized manner to all patients. Fibreoptic bronchoscopy was provided in all patients. Visualization difficulties, intervention times, respiratory and haemodynamic parameters, blood losses and peri- and post-interventional complications were monitored. Data were expressed as mean values ± standard deviation (SD) Variables were compared by Student's *t*-test, two-tailed $P < 0.05$ was considered statistically significant.
Results: Procedure duration was significantly different due to prior positioning of LMA in one group (18.3 ± 5.8 min vs. 12.2 ± 6.4 min, $P < 0.01$). Visualization was judged excellent in the LMA group whereas in the non-LMA group two procedures were switched to the Fantoni technique [4] and one to surgical tracheostomy because of impossible visualization of the initial puncture site. Haemodynamic and respiratory data are reported in the table. Differences between groups were not significant.

Table.

	Procedure start		Procedure end	
	LMA	Non LMA	LMA	Non LMA
Heart rate	83.6 ± 15	85.9 ± 12.7	86.4 ± 24.4	93.7 ± 13.1
MAP mmHg	87 ± 0	88 ± 11	90 ± 15	92 ± 12
PaO_2/FiO_2	194.6 ± 53.3	198.7 ± 57.1	188 ± 46.3	194.4 ± 45.5

All procedures were completed. No major complications and no procedure related deaths were observed. Late complications included 1 tracheo-oesophageal fistula and 1 tracheal stenosis in the non-LMA group (incidence of late complications 12.5%). Overall mortality was 34.3% without significant differences between groups.
Discussion: PercuTwist PDT is a safe and fast technique but in some cases limited by difficulties in fibreoptic tracheal wall visualization. LMA substitution for the endotracheal tube significantly improves quality of the procedure. The incidence of late complications in the non-LMA group was significantly higher. Further comparative studies are indispensable.
References:

1 Gysin C, Dulguerov P, Guyol JP, et al. Percutaneous versus surgical tracheostomy: a double-blind randomized trial. *Ann Surg* 1999; **230**: 708–714.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

2 Toursarkissian B, Zweng TN, Kearney PA, et al. Percutaneous dilational tracheostomy: report of 141 cases. *Ann Thor Surg* 1994; **57**: 862–867. Review.
3 Frova G, Quintel M. A new simple method for percutaneous tracheostomy: controlled rotating dilation. A preliminary report. *Intensive Care Med* 2002; **28**: 299–303.
4 Fantoni A, Ripamonti D. A non-derivative, non-surgical tracheostomy: the translaryngeal method. *Intensive Care Med* 1997; **23**: 386–392.

O-34

A predictive model for tracheostomy in a cohort of 5015 cardiac surgical patients

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Introduction: Critically ill patients (pts) on mechanical ventilation (MV) need tracheostomy (T) in 10.6–33% of cases, whereas of the 3–9.9% cardiac surgical pts undergoing prolonged (>72 h) MV, half (1.6–4.5%) are tracheostomized [1]. As no general agreement can be found in the literature, we conducted this prospective audit to assess predictive factors for T in a cardiac surgical patient cohort.
Method: On all pts admitted to our ICU from January 1997 through June 2004 we collected (i) demographics, surgical operation type and gravity score (CRS, CCS, NYHA) (ii) risk factors and underlying illnesses (iii) ICU and hospital length of stay (iv) cardiopulmonary by-pass (CPB) and aortic cross clamp times (v) ICU supportive techniques (MV, central venous catheters) (vi) T presence. SPSS was used for statistical analyses. A binary Logistic Regression Model (b-LRM) was used to estimate the effect of each considered independent variable (i.e. age, gender, operation type, gravity score, hypertension, diabetes, chronic renal failure (CRF), COPD, CPB and aortic cross clamp times, re-do, emergency operation) on a T (yes/no) outcome. *P* values less than 0.05 were considered significant.
Results: Out of 5015 pts [M:F = 2.5:1, median (IQR) age 67 (59–73) yr; 72.3% with coronary artery disease and 23.3% with valvular heart disease], 112 underwent a percutaneous T (Griggs technique) [2]. The b-LRM allowed us to identify the following independent variables as (Table) independent predictive factors of prolonged MV and T.

Table.

	O.R. (C.I.95%)	*P*
Age >65 yr	2.1 (1.4–3.2)	0.0387
Valve + CABG	2.2 (1.3–3.8)	0.0018
Re-operation	3.2 (1.6–6.4)	0.0223
CCS >2	1.9 (1.1–3.2)	0.0453
NYHA >2	4.8 (2.5–9.5)	0.0000
CRS >8	7.2 (4.8–10.7)	0.0000
Chronic Renal Failure CRF	4 (2.7–6.1)	0.0000
COPD	2.7 (1.8–4)	0.0088
Independent Variables		
Arteriopathy	2.2 (1.5–3.2)	0.0000
Cardio-pulmonary by-pass >90 min	3 (1.5–5.9)	0.0008
Aortic cross clamp >60 min	1.7 (1.1–2.6)	0.0015

Therefore a pt with CRF, NYHA > 2 and CPB time >90 min has a risk of prolonged MV and, as a consequence of T, 57.6 more risk than a pt without such risk factors.
Conclusion: This audit allowed us to define a bedside predictive model helping us to identify "a priori" pts who are more likely to need a tracheostomy. Further studies are needed to corroborate our preliminary results.
References:

1 Dunning J, Au J, Kalkat M, et al. A validated rule for predicting patients who require prolonged ventilation post cardiac surgery. *Eur J Cardiothorac Surg* 2003; **24:** 270–276.
2 Ambesh SP, Pandey CK, Srivastava S, et al. Percutaneous tracheostomy with single dilatation technique: a prospective, randomized comparison of Ciaglia blue rhino versus Griggs' guidewire dilating forceps. *Anesth Analg* 2002; **95**(6): 1739–1745.

O-35

Creatinine and N-terminal-pro-brain natriuretic peptide predict intensive care unit stay after coronary artery surgery

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Introduction: After coronary artery bypass grafting (CABG) patients usually require stabilization on the Intensive Care Unit (ICU). Early identification of those requiring a longer period of support facilitates resource management [1]. We hypothesized that prolonged ICU stay may be predicted by N-terminal pro-BNP (NT pro-BNP) and other markers of myocardial and renal dysfunction as well as preoperative morbidity.
Method: We retrospectively analysed data for all patients admitted to the ICU following CABG over a ten month period (01/12/2002–30/09/2003). We assessed preoperative chronic and acute medical conditions, operative data and postoperative complications. Creatinine, troponin T and NT pro-BNP were measured in all patients within 24 hours of CABG. The most recent preoperative creatinine was also obtained. Logistic regression analysis was considered statistically significant at $P < 0.05$. A receiver operating characteristic (ROC) curve was constructed for NT pro-BNP against ICU stay.
Results: Of 441 patients, the majority were male (355/441), had three vessel disease (380/441) and were on-pump in 274/441 cases. 287/441 cases were elective. ICU stay ⩾3 days was significantly related to preoperative creatinine level, re-sternotomy and previous myocardial infarct. However prolonged ICU stay correlated most significantly with post operative creatinine and NT pro-BNP. An NT pro-BNP threshold level of 180 pmol/L generated sensitivity, specificity and positive predictive values of 0.76, 0.52 and 0.26 respectively. The negative predictive value was 0.91. 90.9% of cases with NT pro-BNP level <180 had ICU stay <3 days, whilst 26.2% of cases with NT pro-BNP level >180 had ICU stay of ⩾3 days.

ROC analysis of NT pro-BNP versus length of ICU stay (<3 or ⩾3 days) generated an area under the curve of 0.695.

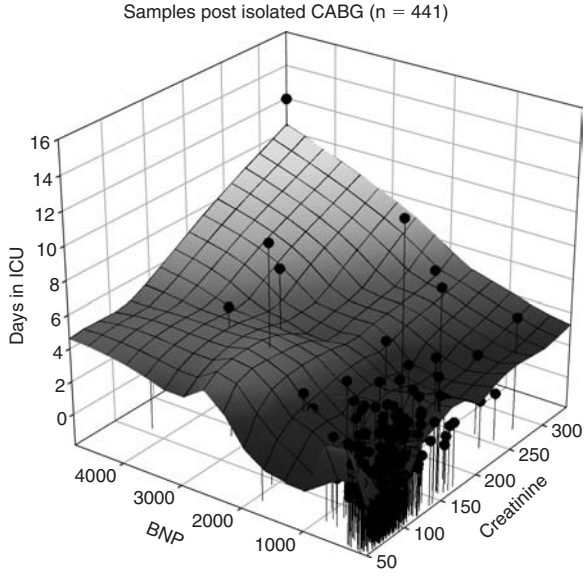

Figure 1: A three dimensional plot demonstrating day 1 postoperative NT-pro-BNP, creatinine and ICU stay

Discussion: This study shows a potential use for NT pro-BNP as a prognostic marker for ICU stay following CABG. We have shown that postoperative markers of myocardial damage and renal function are interrelated. Cardiac troponin, considered a highly specific and sensitive marker of myocardial damage, did not predict ICU stay in this study. The use of NT-pro-BNP as a predictor of ICU stay may be of use in routine clinical practice and merits further study.
Reference:

1 Lawrence DR, Valencia O, Smith EE, et al. Parsonnet score is a good predictor of the duration of intensive care unit stay following cardiac surgery. *Heart* 2000; **83**: 429–432.

O-36

Evaluation of renal function with cystatin C after on-pump cardiac surgery

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Introduction: Evaluation of renal function after cardiac surgery is difficult. Creatinine clearance is the gold standard, but is not easy to perform. Recently a new marker, cystatin C, has been proposed [1]. This marker has not yet been used for the evaluation of renal function after on-pump cardiac surgery. The aim of this study was to evaluate cystatin C in order to evaluate renal function after on-pump cardiac surgery.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Method: After informed consent, 60 patients scheduled for cardiac surgery with cardiopulmonary bypass (CPB) were prospectively included. Plasma cystatin C levels were measured and creatinine clearance was calculated as follows: C = UcrV/Pcr. Data were compared with regression analyses. $P < 0.05$ was considered as significant.

Results: The relationship between creatinine clearance and cystatin C is significant ($P < 0.01$) but non linear, and correlation is weak (Figure). The main difference of behaviour between the 2 molecules is in their fate. Cystatin C is totally excreted by glomerular filtration and catabolized in the tubule, while creatinine shows additive tubular secretion depending on urinary flow. This means that with creatinine clearance, the relationship seems more linear in the high clearance population. In the low clearance population, antidiuresis may alter creatinine secretion and modify indirectly the clearance.

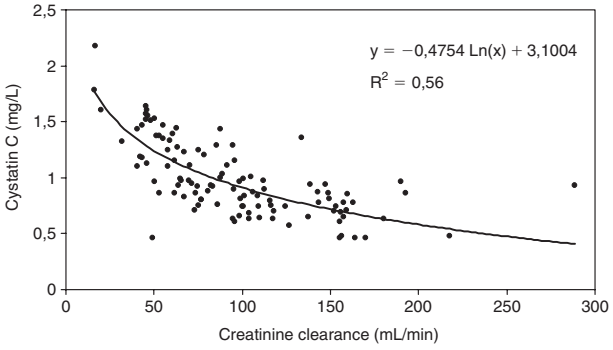

Figure. Correlation between cystatin C and creatinine clearance

Conclusion: There is too large a discrepancy between cystatin C and creatinine clearance to evaluate renal function accurately. The problem is to know where the gold standard stands.

Reference:

1 Gabutti L, Ferrari N, Mombelli G, et al. Does cystatin C improve the precision of Cockcroft and Gault's creatinine clearance estimation? *J Nephrol* 2004; **17**: 673–678.

O-37

In vivo measurement of levofloxacin penetration into lung tissue: CPB versus OPCAB

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Introduction: Nosocomial pneumonia is a feared complication following cardiac surgery. Levofloxacin, a fluoroquinolone, qualifies for the therapy of postoperative pneumonia. However, during CPB the lungs are not ventilated. Due to this fact patients develop severe changes in ventilation and perfusion of the lungs postoperatively, i.e. intrapulmonary right to left shunt caused by atelectasis [1]. Atelectasis can successfully be reduced by means of the OPCAB-technique. Hypothesizing that interstitial antibiotic concentrations in lung tissue vary substantially between patients operated on CBP and patients operated with the OPCAB-technique, we measured levofloxacin concentrations in pulmonary tissue by means of *in vivo* microdialysis [2].

Method: Twelve patients underwent elective CABG. 6 patients (group A) were operated on with CPB and 6 patients (group B) underwent CABG with the OPCAB-technique. A single intravenous dose of levofloxacin (500 mg i.v.) was administered immediately at the end of surgery.

Results: We measured the time vs. concentration profiles of levofloxacin in pulmonary tissue and in plasma in both groups during a study period of 8 hours (Fig). The Figure additionally shows the MIC_{90} (minimal inhibitory concentration of 90) values for the most relevant respiratory pathogens. Median concentration (122.84 μg/mL ± 4.3, range 42.68–203.0 μg/mL) of levofloxacin in pulmonary tissue was significantly higher ($P = 0.031$) in group B compared with group A (8.84 μg/mL ± 2.4, range 2.17–10.84 μg/mL). Median $levofloxacin_{(tissue)/(plasma)}$ concentration ratio in lung tissue was 0.625 (0.35–0.94; range) in group A vs. 6.51 (4.73–8.13; range) in group B. Median levofloxacin levels in interstitial tissue exceeded the MIC_{90} values for *Streptococcus pneumoniae* in all patients. To exceed the MIC_{90} values for *Klebsiella species* a dosage of 500 mg i.v. of levofloxacin was only sufficient in three out of six patients in group A. All patients of group B reached the MIC_{90} values for *Pseudomonas aeruginosa* vs to group A.

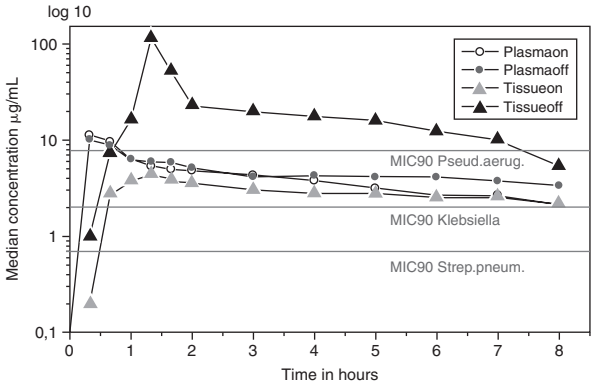

Figure.

Discussion: Data indicate that postoperative interstitial concentrations of antibiotics are influenced by the use of CPB. To exceed the MIC_{90} values for *Klebsiella species* and *Pseudomonas aeruginosa* in non-dependent parts of pulmonary tissue higher dosages of levofloxacin as the commonly used (500 mg i.v.) are required in patients undergoing CABG on CPB. Adequate tissue concentrations are reached in patients undergoing CABG with the OPCAB-technique.

References:

1 Tschernko EM, Bambazek A, Wisser W, et al. Intrapulmonary shunt after cardiopulmonary bypass: the use of vital capacity maneuvers versus off-pump coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 2002; **124**(4): 732–738.

2 Herkner H, Muller MR, Kreischitz N, et al. Closed-chest microdialysis to measure antibiotic penetration into human lung tissue. *Am J Respir Crit Care Med* 2002; **165**: 273–276.

O-38

Evaluation of the effect of preoperative medication on the incidence of mediastinitis after cardiac surgery

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Introduction: Post-sternotomy mediastinitis is a major cause of morbidity after cardiac surgery. Besides demographic risk factors, together with intra- and early postoperative adverse events, preoperative medication might increase the risk of mediastinitis. In this study we investigated the effect of demographic factors and preoperative medication on risk of mediastinitis.

Method: In a cohort study we prospectively collected pre-operative data from adult patients who consecutively underwent cardiac surgery between Jan. 2001 and Dec. 2003. Mediastinitis was defined by the surgeon based on El Oakley [1]. Stepwise logistic regression was used to determine the significant risk factors. Data are given as mean and standard deviation.

Results:

	Control Group	Mediastinitis
Number (n)	3272	171
Age (years)	64 (13)	67 (11)
EuroSCORE (logistic)	7.9 (9.7)	6.8 (6.5)
Diabetes mellitus (%)	22.1	39.2
Body mass index (kg m^{-2})	26.7 (4.2)	28.1 (4.5)
Elective (%)	88.5	89.5
Duration of surgery (min)	322 (90)	317 (76)
Aspirin (%)	28.2	45.0
Nitrates (%)	28.1	41.5
Beta blockers (%)	42.4	53.8
ACE-Inhibitors (%)	43.2	52.0
Diuretics (%)	32.1	30.4
Broncholytics (%)	8.2	8.2

Multivariate logistic regression identified three factors independently associated with the development of mediastinitis [odds ratio (95% confidence limits)]: diabetes mellitus: 1.9 (2.7-1.4). Body mass index: 1.1 (1.1-1.0). Aspirin: 2.0 (2.7-1.5). From 3443 patients analysed in our study a total of 1000 patients underwent aspirin treatment. The exact time point of last aspirin dose is not precisely known. Data about postoperative aspirin medication have not been collected but aspirin therapy is usually continued on the first postoperative day. Aspirin treatment was more frequent in the group that developed mediastinitis (28 vs. 45%).

Discussion: In addition to well-known risk factors as listed above the preoperative therapy of aspirin might increase the risk of post-sternotomy mediastinitis. The reason for this increased risk is unknown at present.

Reference:

1 El Oakley RM, Wright JE. Postoperative mediastinitis: classification and management. *Ann Thorac Surg* 1996; **61**(3): 1030–1036. Review.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Haemodynamics B

O-39

Enhancement of ventriculo-arterial coupling with levosimendan

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Introduction: Levosimendan (Levo) is a troponin calcium sensitizer that enhances myocardial contractility and induces venous, arterial, and coronary vasodilatation [1]. Levo has been shown to be effective during coronary surgery in preliminary trials [2]. We aimed to evaluate the effect of Levo on ventriculo-arterial coupling (E_a/E_{es}) in patients undergoing off-pump coronary surgery (OPCAB).

Method: We studied twenty-five patients, of whom 10 with EF $<$ 30% (group A) and 15 $<$ 30% (group B), were scheduled for elective OPCAB. Monitoring consisted of 5-lead ECG, invasive arterial pressure, Swan-Ganz catheter and 5 MHz TOE (Philips-Omniplane II) probe. The following variables were measured: HR, MAP, CVP, CO, PCWP, SVR, LVEDV, LVESV, SV and EF%. We used left ventricular elastance (E_{es} = ESP/(ESV − Vo)) to quantify cardiac contractility (we considered ESP = MAP), and arterial elastance (E_a = ESP/SV) to describe vascular systemic resistance. We used E_a/E_{es} to assess interaction between heart and vascular system. E_a and E_{es} were measured basally after induction of anaesthesia, and after levosimendan bolus administration of 12 $\mu g\,kg^{-1}$ over 20 min.

Data were analysed with Student's *t*-test for unpaired data.

Results: are shown in the table.

	I	II	*P*
Group A			
MAP mmHg	98 ± 7	94 ± 5	<0.05
SVR dyns cm^{-5}	1578 ± 13	1537 ± 14	<0.05
CO L min^{-1}	3.8 ± 1.0	4.3 ± 1.1	=0.05
EF %	29 ± 12	38 ± 14	=0.05
Ea mmHg $ml^{-1}\,m^{-2}$	5.4 ± 2.6	4.7 ± 2.6	=0.05
Ees mmHg $ml^{-1}\,m^{-2}$	3.38 ± 3.4	4.88 ± 4.7	<0.05
Ea/Ees	2.05 ± 0.50	1.11 ± 0.50	=0.05
Group B			
MAP mmHg	105 ± 13	97 ± 14	<0.01
SVR dyn s cm^{-5}	2068 ± 740	1632 ± 595	<0.001
CO L m^{-1}	3.8 ± 1	4.4 ± 1.1	<0.01
EF %	42 ± 12	48 ± 14	<0.02
Ea mmHg $mL^{-1}\,m^{-2}$	7.9 ± 2.6	5.9 ± 2.6	=0.07
Ees $mL^{-1}\,m^{-2}$	7.19 ± 3.4	8.68 ± 4.7	<0.01
Ea/Ees	1.1 ± 0.5	0.8 ± 0.5	=0.02

I: after anaesthetic induction; II: after levosimendan

Discussion: In patients with coronary artery disease Levo significantly increases myocardial elastance and reduces arterial elastance. It improves E_a/E_{es} by reducing its value from 2 to 1.1 in patients with severe LV dysfunction, and from 1.1 to 0.83 in patients with moderate LV depression, so optimizing cardiovascular efficiency.

References:

1 Figgitt DP, Gillies PS, Goa KL. Levosimendan. *Drugs* 2001; **61**(5): 613–629. Review.

2 Nijhawan N, Nicolosi AC, Montgomery MW, et al. Levosimendan enhances cardiac performance after cardiopulmonary bypass: a prospective, randomized placebo-controlled trial. *J Cardiovasc Pharmacol* 1999; **34**: 219–228.

O-40

Inhaled iloprost improves right ventricular function in patients after mitral valve repair

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Introduction: Patients undergoing mitral valve repair are at risk of developing right ventricular failure (RVF), mainly due to pre-existing pulmonary artery hypertension and an increase in pulmonary vascular resistance (PVRI) [1]. Iloprost, a stable prostacyclin analogue selectively decreases pulmonary artery pressure and may be beneficial in this selected group of patients [1,2].

Method: Twenty patients undergoing mitral valve repair participated in the study. Patients were randomized to the iloprost (I) or the control (C) group the day before surgery. Ten patients received standard treatment (β-mimetic + nitroglycerin) and 10 patients received inhalational iloprost (25 μg) + β-mimetic during the weaning phase. Systemic and pulmonary artery haemodynamics were assessed using a fast response pulmonary artery catheter and transoesophageal echocardiography. Measurements were performed after induction of anaesthesia (T1), after sternotomy (T2), 15 min after end of CPB (T3) and at the end of surgery (T4). Statistics: multiple analysis of variance for repeated measures (MANOVA, *$P < 0.05$, I vs. C).

Results: Pre and intraoperative characteristics were comparable between groups. In 3 patients of the control group CPB was re-instituted as RVF occurred.

		T1	T2	T3	T4
MAP	I	79 ± 11	68 ± 8	71 ± 8	68 ± 10
	C	82 ± 20	76 ± 18	70 ± 7	72 ± 6
PAP	I	38 ± 8	36 ± 8	27 ± 9	33 ± 7
	C	32 ± 6	31 ± 4	33 ± 2	31 ± 2
PAOP	I	26 ± 5	26 ± 7	18 ± 9	19 ± 9
	C	21 ± 7	20 ± 6	15 ± 4	22 ± 9
SVI	I	19 ± 4	21 ± 2	19 ± 6	17 ± 5
	C	16 ± 4	17 ± 7	24 ± 9	22 ± 6
SvO_2	I	69 ± 10	72 ± 11	85 ± 3	82 ± 7
	C	74 ± 16	78 ± 7	72 ± 6*	81 ± 17
PVRI	I	538 ± 286	510 ± 130	208 ± 108	290 ± 144
	C	452 ± 285	468 ± 290	410 ± 63*	318 ± 151
REF	I	18 ± 4	20 ± 7	27 ± 5*	27 ± 4*
	C	21 ± 7	20 ± 6	22 ± 5	20 ± 7

Discussion: The results of this prospective, randomized study suggest that iloprost improved right ventricular function after CPB without relevant systemic vasodilation. Development of acute RVF is less likely after treatment with iloprost.

References:

1 Rex S, Busch T, Vettelschoss M, et al. Intraoperative management of severe pulmonary hypertension during cardiac surgery with inhaled iloprost. *Anesthesiology* 2003; **99**: 745–747.

2 Theodoraki K, Rellia P, Thanopoulos A, et al. Inhaled iloprost controls pulmonary hypertension after cardiopulmonary bypass. *Can J Anaesth* 2002; **49**: 963–967.

O-41

Effects of hypertonic saline (3%) on haemodynamics in patients undergoing pulmonary resection

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Introduction: Perioperative use of hypertonic solutions has been shown to be associated with infusion of less free water, and a decrease in perioperative weight gain [1]. The aim of this study was to evaluate the effects of hypertonic saline (3%) compared with normal saline (0.9%) on haemodynamics and volume loading in patients undergoing pulmonary resection.

Method: A prospective randomized double blind study was performed in 20 patients undergoing pulmonary resection by the same surgeon. Anaesthetic management and monitoring (including insertion of an arterial line and pulmonary artery catheter) were standardized except that the patients were allocated into two groups regarding the study fluid infusion 4 $mL\,kg^{-1}\,h^{-1}$ through the central line. The study fluid in coded bags was either hypertonic saline (3%) (hypertonic group) or normal saline (0.9%) (control group). If hypotension occurred (mean arterial pressure <60 mmHg, central venous pressure <10 mmHg), addition Ringer's lactate solution boluses were administered. The haemodynamics, arterial blood gas analyses, serum electrolytes, osmolarity, and fluid balance (intra-operative and postoperative) were compared between the groups. Chi-squared test, t-test, repeated measures ANOVA were used for statistical analyses.

Results: Data is given in the table (mean ± SD)

	Control	Hypertonic	*P*
Age (yrs)	55 ± 14	56 ± 12	0.92
Weight (kg)	70 ± 13	77 ± 12	0.27
Female/male	3/7	3/7	1
Duration anaesthesia (min)	254 ± 40	215 ± 60	0.11
Intraop. Ringer solution (mL)	2660 ± 980	900 ± 435	0.001
Intraoperative urine output	880 ± 730	1030 ± 890	0.72
Initial cardiac output L min^{-1}	5.7 ± 2	6.1 ± 2	0.71
Postop. cardiac output	7.1 ± 2	9.4 ± 3	0.08
24th h cardiac output	6.7 ± 1.5	7.6 ± 1.7	0.42
Preoperative osmolarity	288 ± 5	288 ± 5	0.89
Postoperative osmolarity	292 ± 2	316 ± 10	0.001
24th h osmolarity	287 ± 13	294 ± 10	0.29
Preoperative Na mmol/L	138 ± 2	139 ± 2	0.80
Postoperative Na mmol/L	138 ± 2	150 ± 6	0.001
24th h Na mmol/L	134 ± 4	139 ± 4	0.009

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Discussion: We conclude that hypertonic saline infusion may be advantageous over normal saline in pulmonary resection surgery. With hypertonic saline, less fluid was infused intra-operatively. The associated serum electrolyte and osmolarity changes return to baseline 24 h after the operation.

Reference:

1 Järvelä K, Kaukinen S. Hypertonic saline (7.5%) decreases perioperative weight gain following cardiac surgery. *J Cardiothoracic Vasc Anesth* 2002; **16**: 43–46.

O-42

Haemodynamic effects of milrinone in patients with reduced right ventricular function during off-pump coronary artery bypass graft surgery

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Introduction: Right ventricular (RV) dysfunction is an important cause of haemodynamic derangement during off-pump coronary artery bypass grafting (OPCAB) surgery [1,2]. The purpose of this investigation was to evaluate the effect of pre-emptive milrinone infusion without a bolus dose on RV function measured by a thermodilution technique in patients with reduced RV function during OPCAB.

Method: Forty patients scheduled for OPCAB, with thermodilution RV ejection fraction (RVEF) $\leqslant$40% after anaesthesia induction, were randomly allocated to either the milrinone or control group. Milrinone (0.5 μg kg^{-1} min^{-1}) without a bolus dose [3] was infused in the milrinone group and normal saline was infused in the control group during left internal mammary artery harvesting and coronary artery anastomosis. Haemodynamic variables and RV volumetric data measured with a thermodilution pulmonary artery catheter were collected as follows: after anaesthesia induction (baseline); 10 minutes after heart displacement for each coronary artery anastomosis; and after pericardial closure. Comparisons of variables between and within groups were performed using t-test and repeated measures of ANOVA.

Results: RVEF during coronary anastomosis did not fall below the baseline value in the milrinone group. Pulmonary vascular resistance (PVR) was significantly increased only in the control group during coronary anastomoses. Cardiac index (CI) and mixed venous oxygen saturation (SvO_2) were significantly reduced during the anastomosis compared to the baseline values in the control group. On the other hand, CI and SvO_2 were maintained in the milrinone group except during anastomosis of the posterior descending artery.

Table 1. Alterations of RV Function and Volumic Parameters

		T1	T2	T3	T4	T5
RVEF	C	32 (4)	33 (5)	31 (5)	29 (6)	31 (7)
(%)	M	29 (5)	32 (7)	30 (5)	29 (6)	33 (7)
ESVI	C	93 (19)	92 (20)	81 (18)	94 (21)	93 (25)
(ml m^{-2})	M	96 (21)	85 (18)	76 (14)*	87 (19)	79 (19)*†
EDVI	C	136 (24)	136 (24)	117 (20)*	131 (23)	134 (30)
(ml m^{-2})	M	134 (24)	125 (21)	108 (15)**	121 (19)	117 (23)†

Data are mean (SD). RV: right ventricle, C: control group, M: milrinone group, T1: after induction of anaesthesia; T2: during left anterior descending artery anastomosis; T3: during left circumflex artery anastomosis; T4: during right coronary artery anastomosis; T5: after pericardial closure. RVEF: right ventricular ejection fraction; ESVI; end-systolic volume index; EDVI; end-diastolic volume index. *$P < 0.05$, compared to T1; **$P < 0.01$, compared to T1; †$P < 0.05$, compared to the control group.

Discussion: Although pre-emptive milrinone infusion without a bolus dose prevented elevation of PVR and significantly reduced the degree of reduction in CI and SvO_2 compared with the control group during OPCAB, it did not significantly improve RV function compared with the control group. It might be due to systemic vasodilatation and subsequent preload reduction from milrinone administration

References:

1 Porat E, Sharony R, Ivry S, et al. Hemodynamic changes and right heart support during vertical displacement of the beating heart. *Ann Thorac Surg* 2000; **69**: 1188–1191.

2 Kwak YL, Oh YJ, Jung SM, et al. Change in right ventricular function during off-pump coronary artery bypass graft surgery. *Eur J Cardiothorac Surg* 2004; **25**: 572–577.

3 Kwak YL, Oh YJ, Shinn HK, et al. Haemodynamic effects of a milrinone infusion without a bolus in patients undergoing off-pump coronary artery bypass graft surgery. *Anaesthesia* 2004; **59**: 324–331.

O-43

The haemodynamic effects of parenteral sildenafil after mitral valve surgery in patients with pulmonary hypertension: a pilot study

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Introduction: In the post-operative adult cardiac surgical patient, raised pulmonary vascular resistance may occur, especially following mitral valve surgery. Cyclic GMP is abundantly expressed in the vascular smooth muscle of the lungs and causes vascular smooth muscle relaxation. Phosphodiesterase-5 inhibitors (such as sildenafil) prevent the hydrolysis of cyclic GMP and have been shown to be effective pulmonary vasodilators in experimental pulmonary hypertension [1]. To date there are no clinical studies which investigate its parenteral effects in adults with pulmonary hypertension.

Method: Eight patients who underwent mitral valve replacement or repair surgery were included in the study. In the cardiothoracic surgical intensive care unit, baseline systemic and pulmonary haemodynamic values were recorded. An infusion of sildenafil citrate 1 mg/mL at a dose of 1 mg/kg over one hour was then administered to patients who were diagnosed as having pulmonary hypertension (defined as a mean pulmonary arterial pressure of $>$ 25 mmHg). Systemic and pulmonary haemodynamic values were measured every 10 minutes during the sildenafil infusion.

Results: Values were compared using standard error of the mean, $P < 0.05$ was taken to be significant. Our study showed no statistically significant change in HR, PCWP, MPAP or MAP from baseline (0). Intravenous sildenafil did produce a statistically significant reduction in PVR ($P < 0.001$) compared with baseline (0). There was a decrease in SVR and an increase in CI that did not achieve statistical significance.

	Minutes from start of infusion							
	pre	0	10	20	30	40	50	60
PVR	373	301	211	215	210	198	208	211
SVR	2499	1505	1221	1142	1157	1127	1209	1250
MPAP	41	31	28	29	29	29	29	29
PCWP	27	17	18	18	17	18	17	18
PVR/SVR	0.15	0.2	0.18	0.18	0.18	0.18	0.17	0.17
CI	1.96	2.28	2.4	2.71	2.71	2.81	2.71	2.61

PVR/SVR: dyn s cm^{-5}, CI: L min^{-1} m^{-2}.

Discussion: Although the decrease in PVR could result from increasing CI, this did not achieve significance. These early results from a small group of patients indicate that intravenous sildenafil may be an effective pulmonary vasodilator.

Reference:

1 Cohen AH, Hanson K, Morris K, et al. Inhibition of cyclic 3′–5′-guanosine monophosphate-specific phosphodiesterase selectively vasodilates the pulmonary circulation in chronically hypoxic rats. *J Clin Invest* 1996; **97**: 172–179.

Myocardial Protection

O-44

Anaesthetic protection against myocardial ischaemia in rats

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Introduction: Anaesthetic preconditioning (APC) appears to decrease ischaemia-reperfusion injury to the myocardium [1]. It is unclear whether the benefits of the anaesthetic agents are due to their effects on the ischaemic myocardium and relatively healthy myocardium surrounding the ischaemic region. We evaluated the protective effects of sevoflurane (SEV) and propofol (PRP) on the myocardial function and the inflammatory responses *in vivo*.

Method: This animal study protocol has been approved by VA animal welfare committee. The Long Evan rat was initially anaesthetized with ketamine with xylozine. Experimental design included 3 groups of rats treated with 2% sevoflurane (SEV), propofol 2 mg/kg (PRP) for 15 min before induction of ischaemia (ligation of the left coronary artery immediately distal to the first diagonal branch) and controls. The recovered rats were supplied with oxygen via a cone device and sacrificed at 6 hours or 24 hours after ischaemia.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

To evaluate ischaemic inflammatory responses, TNFα, IL-1β, IL-6, IL-10, CINC-1, MCP-1 and IFNγ proteins (ELISA) and mRNA (RT-PCR) in myocardial tissue supernatant were measured 6 and 24 hours following ischaemia. Langendorff perfusion system was used for ex-vivo assessment of the myocardial function. The global function of the left ventricle was measured using the SonoLab system. Following the functional assessment, the heart was divided into ischaemic and non-ischaemic regions. Tissue cytokines were analysed both at protein and mRNA levels using real-time polymerase chain reaction (RT-PCR). ANOVA repeated measures analysis was performed to identify the differences among the groups.

Results: Global LV function was preserved in both SEV and PRP groups compared to the control group in 6 hours. However, only SEV improved the LV function 24 hours following the induction of ischaemia. Table 1 shows the myocardial cytokine concentrations measured at 6 hours time point. TNFα, IL-1β and IL-6 genes were down-regulated in SEV and PRP groups. There is no difference in MCP-1 and IFNγ and CINC-1 among the injury groups.

Table 1.

	TNFα	IL-1β	IL-6	IL-10	CINC-1
SEV (11)	2554 ± 248	8048 ± 183	2777 ± 360	11.6 ± 2.5	881 ± 248
PRP (11)	3021 ± 248	10310 ± 183	3080 ± 360	13.9 ± 2.6	1309 ± 251
Cont (9)	4216 ± 274	13519 ± 192	4390 ± 378	22.8 ± 2.6	1553 ± 194
P value	<0.001	0.17	0.02	0.02	0.14

Value represented Mean ± SEM. Concentration of cytokines in supernatant is normalized with tissue protein and represented as pg/mg protein.

Conclusions: The study suggests that preconditioning the hearts with SEV prior to ischaemia significantly reduces ischaemic inflammatory responses and preserves cardiac function as compared to propofol and positive control. Further study including increasing sample size and in vitro study will be warranted.

Reference:

1 Nader ND, Li CM, Khadra WZ, et al. Anesthetic myocardial protection with sevoflurane. *J Cardiothorac Vasc Anesth* 2004; **18**: 269–274.

O-45

The cardioprotective properties of sevoflurane in patients undergoing coronary surgery show some ambiguity when evaluated by clinical outcome

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Introduction: Studies have shown that sevoflurane has preconditioning properties and beneficial effects during reperfusion and thus preconditioning seems a powerful mode of reducing myocardial infarction size [1,2]. However, the number of patients in most studies was low and primarily evaluation was by myocardial enzyme release. Clinical significant findings have been missing.

Method: Since 1999 all cardiac operations in Denmark have been reported to a common database for quality control and research. Patient population, anaesthesia and surgery are very much alike in the 5 surgical centres. One of the differences is the use of hypnotics (sevoflurane/propofol) and smaller differences in the approach to treatment of postoperative complications. This study holds all operations from 2 centres from 1999–2003.

Results: There were 7646 operations. Double procedures, operations on thoracic aorta, patients in a preoperative critical state, emergencies and unstable angina were excluded, leaving 5945 patients.

Patients and mortality after sevoflurane or propofol anaesthesia.

Surgery Anaesthesia	CABG No	Deaths (%)	Mitral No	Deaths (%)	Aortic No	Deaths (%)
Sevoflurane	2,075	1.40	74	4.05	299	2.01
Propofol	2,733	1.68	208	7.21	556	4.50
Total	4,808	1.56	282	6.38	855	3.63

The patients were divided into two groups based on Cardiac Centre, using sevoflurane or propofol. No difference was found between the groups in EuroSCORE and numerous other characteristics. The 30 day mortality in general was lower, but not significantly so, after sevoflurane. Combining all valves the mortality was significant lower ($P < 0.05$ chi-squared test).

Anaesthesia	CKMB
Sevoflurane	38.71
Propofol	24.38
All	33.80

CABG	EuroSCORE		
Score	0–2	3–5	6+
Propofol	0.4%	2.1%	3.3%
Sevoflurane	0.6%	1.1%	2.9%

The maximal postoperative CKMB values, as well as the postoperative use of IABP, Assist Device and high-dose inotropes were significantly higher after sevoflurane (t-test).

Discussion: Despite the high number of patients the findings were not clear. The enzyme findings particularly, differ from earlier studies evaluating troponin. However the lower mortality after valve surgery and the insignificantly lower mortality after CABG support earlier findings of the potential beneficial effects of sevoflurane. The mortality showed, as expected, greater relation to the EuroSCORE than the type of anaesthesia.

References:

1 De Hert SG, Van der Linden PJ, Cromheecke S, et al. Cardioprotective properties of sevoflurane in patients undergoing coronary surgery with cardiopulmonary bypass are related to the modalities of its administration. *Anesthesiology* 2004; **101**(2): 299–310.

2 Zaugg M, Lucchinetti E, Spahn DR, et al. Volatile anesthetics mimic cardiac preconditioning by priming the activation of mitochondrial KATP channels via multiple signalling pathways. *Anesthesiology* 2002; **97**: 4–14.

O-46

Sevoflurane preconditioning: an in vivo study of myocardial function preservation during ischaemia

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Introduction: Anaesthetics may exert a protective effect against myocardial ischaemia in animal models and humans. In the human heart, ischaemia causes myocardial velocities to be reduced both in diastole and in systole. Tissue Doppler Echocardiography (TDE) allows non-invasive measurement of such myocardial velocities. We aimed to investigate the myocardial protective effect of sevoflurane administered prior to myocardial ischaemia produced by surgical coronary occlusion in patients undergoing off-pump coronary surgery.

Method: Forty-six patients with coronary artery disease, scheduled to undergo coronary surgery, were enrolled. Inclusion criteria were severe coronary stenosis of the anterior descending coronary artery; no collateral flow to anterior descending coronary artery on preoperative angiography; at least two normokinetic segments in the myocardial region supplied by the studied vessel. In all cases a total intravenous anaesthesia was used with remifentanil and propofol. Patients were randomized to receive (group S) or not (group C) sevoflurane at inspiratory concentration of 1–2% for 15 min before coronary occlusion.

A transoesophageal TDE examination of myocardial systolic and early diastolic velocities was carried out from a mid-oesophageal long-axis view of the interventricular septum or the anterior wall of the left ventricle in both groups basally and 60 sec after coronary artery occlusion by the surgeon. Postoperatively troponin I (TpI) blood levels were measured. Data from TDE and TpI sampling were analysed with Student's *t*-test for unpaired data for statistical significance.

Results: Compared with the S group, in group C a significant reduction of systolic (Vs) and diastolic (Ev) intramyocardial velocities was found during myocardial ischaemia due to coronary occlusion (table). In the postoperative period group S showed a lower release of TpI compared to the control group: mean peak TpI 1.4 ng mL^{-1} in group S vs. 2.5 ng mL^{-1} in group C.

Table.

	Group S			Group C			
	Basal	1 min	*P*	Basal	1 min	*P*	*P* (S vs C)
Vs	7.1 ± 0.9	6.8 ± 0.4	NS	6.9 ± 1	5.9 ± 0.7	<0.05	<0.05
Ev	7.6 ± 1.5	7.1 ± 0.8	NS	7.7 ± 1.2	5.6 ± 1.2	<0.05	<0.05

Discussion: Treatment with sevoflurane before coronary occlusion seems effective in reducing functional myocardial impairment due to ischaemia. This anaesthetic preconditioning could be useful in protecting the myocardium in the case of predictable ischaemic events.

Reference:

1 Varadarajan SG, An J, Novalija E, et al. Sevoflurane before or after ischemia improves contractile and metabolic function while reducing myoplasmic Ca^{2+} loading in intact hearts. *Anesthesiology* 2002; **96**: 125–133.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

O-47

Influence of isoflurane on diastolic instantaneous pressure-flow relationship in arterial coronary artery bypass grafts

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Introduction: The effects of volatile anaesthetics on the determinants of blood flow in coronary artery bypass grafts are not completely understood. The objective of this study was to describe the influence of isoflurane on diastolic pressure-flow (P-F) relationship and on critical occlusion pressure (COP) in arterial coronary bypass grafts.

Method: After approval by the local ethics committee 16 patients undergoing CABG surgery were studied. In all patients anaesthesia was maintained with 2.0 $\mu g\,kg^{-1}\,h^{-1}$ of sufentanil and additional boluses of midazolam as clinically deemed necessary. Patients were assigned either to the isoflurane group, additionally receiving 1.0 $MAC_{Sedative}$ of isoflurane after baseline measurements (G1), or to the control group (G2). Flow measurements in the left internal mammary artery bypass graft (LIMAB) on the left anterior descending artery were intraoperatively performed twice, 15 min after discontinuation of CPB and again 15 min later (under application of isoflurane in G1). Flow measurements during five consecutive heart beats were performed by the use of ultrasound and calculations based on the transit time principle (Cardiomed 4008, Quick-Fit probes (size 2.0–3.0 mm), Medistim, Norway). Simultaneously, aortic pressure (AP), coronary sinus pressure (CSP), and left ventricular end-diastolic pressure (LVEDP) were recorded. The zero flow pressure intercept as a measure of COP was extrapolated from linear regression analysis of the instantaneous diastolic P-F relationship. In order to avoid capacitance effects of the arterial vessel on the results of this study, the analysis of P-F relationship only included data from the highest diastolic flow rate in the arterial bypass graft until the end of diastole. Linear regression analysis was performed using flow as dependent variable and AP as independent variable. Statistical analysis was performed using non-parametric tests. A P-value of <0.05 was considered statistically significant.

Results: Application of isoflurane induced a significant increase in the slope of the diastolic P-F relationship by 288%, indicating a mean reduction of coronary vascular resistance by 65%. At the same time diastolic AP and LVEDP decreased by 19% and 14%, respectively. Diastolic flow, COP, HR, and CSP did not change significantly. In G2 none of the parameters showed a significant change. In both groups COP significantly exceeded CSP and LVEDP at both points of measurement. Diastolic coronary blood flow was linearly related to the respective AP in all patients (R-values 0.85 to 0.99).

Discussion: Our data confirm the presence of a vascular waterfall phenomenon [1] in the coronary circulation after LIMAB grafting. However, isoflurane does not have an influence on the critical coronary occlusion pressure despite a reduction in coronary vascular resistance.

Reference:

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O-48

Effect of dexamethasone on postoperative cardiac troponin T production in paediatric cardiac surgery

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Introduction: The systemic inflammatory response syndrome associated with cardiopulmonary bypass (CPB) is a well known phenomenon. While steroids reduce the burst of inflammatory mediators postoperatively in adults and children alike, its benefits on clinical outcome are not totally proven. Cardiac troponin T (cTnT) is a specific marker of myocardial infarction. It is also a reliable marker of myocardial injury in the paediatric population [1]. In this study we investigated whether dexamethasone given before CPB starts provides any myocardial protection as assessed by the postoperative production of cTnT.

Method: 140 patients were enrolled in this prospective, randomized, single blinded interventional study. Patients were allocated to receive either dexamethasone (1 mg kg^{-1} during induction of anaesthesia) or act as controls (A). Our local ethics committee does not allow the use of placebo. Blood samples (0.5 mL) were taken immediately after admission to the paediatric intensive care unit and 8, 15 and 24 h later. Samples were collected in a Gel-Microtainer tube and immediately analysed by the hospital clinical chemistry department using the Elecsys Modular E170 immunochemistry analyser (Cardiac Troponin T, Roche Diagnostics, Mannheim). Ten patients admitted to the paediatric intensive care unit before surgery had cTnT levels measured as part of standard clinical practice (<0.02 ng mL^{-1}). Because cTnT concentrations were not normally distributed, the data were first subjected to a natural logarithmic transformation before analysis by repeated measures ANOVA with the Greenhouse-Geisser correction.

Results:

Table. Concentrations of cTnT in blood in ng mL^{-1} at the four different time points. Values expressed as mean (95% confidence intervals).

	T0	T8	T15	T24
Control	2(1.6–2.5)	3.1(2.5–3.7)	2.6(2.1–3.2)	2.3(1.7–2.7)
Dexam	1.8(1.5–2.1)	1.9(1.5–2.4)	1.9(1.4–2.4)	1.8(1.3–2.3)

Differences between the two groups were statistically significant ($P = 0.035$) when repeated measures ANOVA was used between the three time points (T8, T15 and T24), using dexamethasone as between subjects variable. However when looking at the parameters estimate, the differences were significant only at time point T8.

Discussion: Dexamethasone appears to limit the release of cTnT postoperatively after cardiac surgery in paediatric patients. Fifteen hours after admission to the paediatric intensive care unit, the differences are not statistically significant.

Reference:

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Transfusion/Neurologic Issues

O-49

Gender differences in postoperative neuropsychological disabilities after cardiopulmonary bypass

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Introduction: The aim of our study was to investigate the predictors for adverse neuropsychological outcome in coronary artery disease (CAD) patients following cardiac surgery with cardiopulmonary bypass.

Method: 192 patients undergoing cardiac surgery (134 coronary artery bypass grafting, 52 valve surgery and 6 atrial septum defect closure) were selected at our Institute in 2000, after informed patient consent. Records were made of preoperative concomitant diseases, EuroSCORE, delay of surgery Beck Depression Inventory (BDI) score, intraoperative extracorporeal circulation and aortic clamping times, postoperative cardiac failure, need for inotropes and intensive care unit stay. Self Rated Health, BDI score, hospital admission were assessed 6 weeks, 6, 12 and 24 months after surgery. After 36 months Illness Intrusiveness Scale, Social Support Inventory, Hostility Scale, Marital Stress Scale, Sleeping Complaints Questionnaire, Self Rated Health and BDI were recorded. Univariate analyses and multivariate logistic regressions were performed.

Results: Ten patients did not have surgery, Six died during hospital stay, 53 failed at the annual report and in the follow up 8 patients died (mortality = 7.2%). Preoperative BDI score was 8.7 ± 5.9 for males (n = 120) and 11.5 ± 5.9 (n = 62) for females ($P = 0.014$). After 24 months there were no significant difference between gender (male: 8.5 ± 6.2 vs. female: 9.9 ± 7.2). The preoperative depression was the only determinant of postoperative sleep complaints (odds ratio [OR] = 3.39; 95% confidence interval [CI] = 1.06–10.84) for men. Age, education, underlying diseases, type of surgery and anaesthesia, ICU stay, need for inotropes or postoperative cardiac failure were not associated with hostility, illness intrusiveness and hostility.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Preoperative depression was shown to be the major determinant of postoperative depression (at 6 weeks OR = 1.44, 95% CI = 1.13–1.83, $P = 0.028$) and of Self Rated Health assessed 3 years after surgery (OR = 2.07, 95% CI = 1.82–3.21, $P = 0.036$) for men, but not for women.

Discussion: Preoperative depression is related to a significantly higher neuropsychological vulnerability in men undergoing cardiac surgery.

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O-50

Cognitive impairment prior to cardiac surgery in women is related to markers of inflammation but not statin or aspirin usage

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Introduction: Therapy with HMG-coenzyme A reductase inhibitors ("statins") reduces the risk for stroke in non-surgical patients due in part to anti-inflammatory effects of the drugs [1]. Female gender and pre-existing cognitive impairment (CogImp) are important risk factors for neurologic complications after cardiac surgery [2]. The purpose of this study was to investigate for a relationship between preoperative use of anti-inflammatory drugs (statins and aspirin), C-reactive protein (CRP) levels, and CogImp in elderly women before cardiac surgery.

Method: After IRB approval and informed consent neuropsychological testing was performed in 138 women 1–2 days before cardiac surgery. CogImp was defined as $>$ 2 SD lower result on $\geqslant$ 2 cognitive tests compared with controls (58 female volunteers). Blood CRP was measured using a high sensitivity assay. Elevated CRP was defined as CRP $>$ the 95% confidence interval (19 mg/L). Data were compared with Student's *t*-test.

Results: CogImp was present in 45% of women before cardiac surgery. Age, CRP levels but not statin or aspirin use differed between women with pre-existing CogImp compared to those without (Table). The frequency of CogImp was higher for patients with elevated CRP than those without elevated CRP (50% vs. 30%, $P = 0.037$).

Table. Data for women with and without pre-existing CogImp.

	CogImp (n = 47)	No CogImp (n = 48)	*P*-Value
Age (yr)*	73.6 ± 8.6	67.8 ± 8.2	0.0009
CRP (mg/L)*	23.2 ± 37.5	10.5 ± 14.3	0.04
Statin use	63%	65%	0.847
Aspirin use	65%	71%	0.571

*mean ± SD.

Discussion: These data suggest that CogImp before cardiac surgery is associated with elevated CRP levels but its frequency is not influenced by treatment with statins or aspirin. Further investigation is needed to determine whether measurement of CRP levels might identify patients with CogImp and therefore at risk for neurologic complications of cardiac surgery.

References:

1 Gorelick PB. Stroke prevention therapy beyond antithrombotics: unifying mechanisms in ischemic stroke pathogenesis and implications for therapy. *Stroke* 2002; **33**: 862–875. Review.
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O-51

Prolongation of acoustic p300 peak latencies after ICD implantation confirms neurocognitive dysfunction

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Introduction: We have previously shown release of biochemical markers of neuronal injury after iatrogenic induced cardiac arrests during ICD placement [1]. ICD patients also scored worse in psychometric tests performed two days after the implantation as compared to patients who received a pacemaker (PM) where the same surgical and anaesthetic technique were employed [2]. Cognitive auditory P300 potentials, i.e. event-related brain potentials, correlate with the reaction time of a person after being confronted with a particular task [3]. As the latency of P300 potentials appears to be more sensitive in detecting neurocognitive deficits [4] we investigated whether P300 latencies determined after surgery would confirm our past findings.

Method: Consenting patients scheduled for ICD or PM implantation were included in this study. Cognitive evoked P300 potentials were evaluated before and two days after surgery using the Nicolet 2000 (Nicolet, Madison, WI). Ag/AgCl electrodes were placed at the vertex (Cz) and at the frontal cortex (Fz) and referenced to an earlobe A1/2 electrode. Patients had to discriminate rare tones (20%) at 2000 Hz from frequent tones (80%) at 1000 Hz both applied at 75 dB. Two sets of measurements were performed to ensure reproducibility and a low band-pass filter (0.01–30 Hz) was employed. Chi-squared and t-test as well as two-way repeated measures ANOVA were used for statistical analysis. Data are given as mean ± SD.

Results: The following table gives the number of patients evaluated (N), the age of the patients, as well as the latencies of the P300 potentials determined before and after surgery. Five vs. one patient depicted post-procedural prolongation of P300 latencies in the ICD as compared to the PM-group. Due to the small group sizes this however, did not reach statistical significance.

	ICD	PM	*P*
N	6	4	NS
Age (yrs)	55 + 14	74 + 7	<0.05
P300 baseline (ms)	369 + 61	411 + 86	<0.05
P300 postsurgery (ms)	390 + 89	356 + 42	0.07

Discussion: These results are in agreement with our previous observations, which indicate that ICD patients seem to suffer from neurocognitive alterations immediately after insertion of the ICD. In contrast, PM patients showed an improvement of neurocognitive function, which is accompanied by a decrease in P300 latencies after surgery. This may either be due to a positive learning curve or enhanced brain perfusion.

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O-52

Cognitive function after cardiopulmonary bypass: role of hyperglycaemia

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Introduction: Neuropsychological impairment is frequent after coronary artery bypass grafting (CABG) surgery [1]. Micro embolism seems to be the essential cause of these disorders [2]. The possible adverse role of hyperglycaemia has not been studied. The present study aimed to evaluate the working memory in patients after CABG, using normothermic cardiopulmonary bypass (CPB) with and without hyperglycaemia.

Method: After ethical committee approval, and patients informed consent for all the patients this prospective randomized and double blinded study included two different groups. The first (n = 10) had a CPB prime with glucose (G group), the second (n = 9) was without glucose (no-G group). Both groups had cognitive evaluation 2 days before (D-2), 8 days (D + 8) and 56 days (D + 56) after surgery. Immediate memory was assessed with the direct and indirect number spans task (DNST and INST) in order to evaluate storage and organization of the information. All patients under 75 years old with conserved left ventricular function and without diabetic mellitus were included.

Results: Both groups were equivalent in neuro-psychological performances on D-2. Glycaemia was significantly higher in the G group during CPB (25 ± 3.9 vs. 7.2 ± 1.7 mmol L^{-1} $P < 0.01$). At D + 8, INST decreased in the two groups. In the no-G group, the performances returned to the preopera-

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

tive level on D + 56. At that time, the performance was significantly lower in the G group compare to the no-G group ($P < 0.05$).

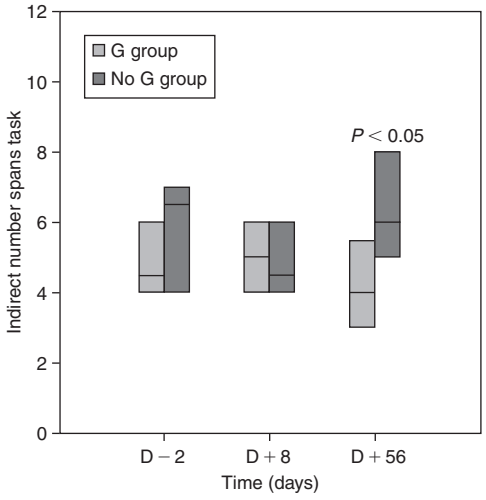

Figure.

Discussion: Hyperglycaemia persistently decreased the working memory assessed by DNST and INST. The variations were more important and prolonged with INST. During focal ischaemia, anaerobic glucose metabolism produces lactate and hydrogen ion increase, a possible explanation for the difference. This study could be one more argument in favour of maintaining a strict control of glycaemia during cardiac surgery.

References:

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O-53

Blood product requirements and mortality in coronary bypass and cardiac valve surgery in different ABO-blood-group patients

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Introduction: Negative effects of red blood cell transfusion have been identified and set in relation to the actual risk of anaemia for clinical decision-making [1–3]. Genetic differences in the reaction to transfusion may exist and allow the identification of a high risk group. We investigated the hypothesis that mortality and the need for transfusion is different in the different ABO-blood-groups.

Method: All patients undergoing coronary bypass or cardiac valve surgery in our institution during the years 1997 until 2003 were included into the survey. Data are prospectively entered into an institutional database, which is utilized for analysis. For risk stratification we used the logistic EuroSCORE. The main outcome was hospital mortality and proportion of patients transfused. Patients were grouped according to their ABO-blood group. Statistical analysis was done with the chi-squared test. A multivariate logistic regression was done to determine a risk adjusted odds ratio (OR) for each blood group in comparison with the most frequent blood group A.

Results: 5980 patients were entered into analysis.

Blood group	No	%	In-hospital-mortality all	transfused	OR	95% CI
A	2741	50	8.3	13.3	1	reference
O	2129	48	9.1	16.1	1.22	0.95/1.55
B	753	48	9.9	18.2	1.37	0.98/1.90
AB	357	52	11.2	18.6	1.40	0.91/2.15
Total	5980	50	9.6	16.6		

% = % transfused; OR = odds ratio; CI = confidence interval; reference – transfused blood-group-A-patients

There is a trend ($P = 0.1$) for a mortality difference between blood groups in the transfused patients. There was no difference in the total cohort. Mortality was increased by transfusion. The overall rate of transfusion was 50%.

Discussion: There was increased mortality in patients with blood group AB and B. This effect was only apparent in transfused patients. As the groups with a slightly increased mortality were also rarer, besides genetic reasons, a different availability or age of packed red blood cell transfusions needs further investigation.

References:

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O-54

Thromboelastography during thoracic aorta replacement with hypothermic circulatory arrest and antegrade selective cerebral perfusion

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Introduction: Surgery of the thoracic aorta is associated with a high risk of bleeding during and after interventions because of prolonged surgical and extracorporeal circulation (ECC) times. The objective of our study was to identify risk factors for excessive bleeding after ascending aorta and hemi-arch replacement during deep hypothermic circulatory arrest with antegrade selective cerebral perfusion [1] and to evaluate the usefulness of thromboelastography (TEG) in coagulation assessment of these patients (pts).

Method: Twenty four pts (15M/9F) scheduled for surgery on the ascending aorta and hemi-arch were enrolled in the study and randomly assigned to 2 groups (12 pts in a TEG monitored group, 12 patients in a non-TEG conventional monitored group). Informed consent was obtained from all patients. Exclusion criteria were liver dysfunction, chronic renal failure on haemodialysis, major coagulopathies, preoperative intravenous heparin infusion and/or inotropic therapy. Anaesthesiologists used transfusion guidelines for coagulation monitoring in pre- intra and the first 48 h post-surgery. These guidelines were based on a TEG algorithm [2] in the TEG monitored group (packed red cells [PRC] if haematocrit < 27%; fresh frozen plasma [FFP] if R values >11 minutes; platelets [Plts] if maximum angle values < 54 mm) and on local haemotransfusion guidelines in the conventional, non TEG monitored group (PRC if haematocrit <27%, FFP if prothrombin time [PT] >17 seconds and activated partial thromboplastin time [aPTT] >50 seconds). Antithrombin III (AT III) was transfused in both groups to maintain values >70%. Data were expressed as mean values ± standard deviation (SD). Variables were compared by Student's *t*-test, two-tailed. $P < 0.05$ was considered statistically significant.

Results: Results are reported in Table 1.

Table 1.

	TEG group	Non TEG group
PRC, mL/kg BW	6.7 ± 5.5	4.6 ± 4.4
FFP, mL/kg BW	8.3 ± 8.6	15.0 ± 5.0*
Plts, mL/kg BW	0.46 ± 1.6	2.7 ± 2.0***

*$P < 0.05$; ***$P < 0.01$.

In the TEG group, platelets were transfused in only 1 patient (8.3%) whereas in the non TEG group 7 patients (58.3%) received platelets ($P < 0.01$). There were less significant differences between groups in FFP transfusions ($P < 0.05$). Postoperative bleeding at 6 h, 12 h and 24 h showed a slight reduction in the TEG group but the difference did not reach statistical significance, there were no differences in PRC transfusions.

Discussion: TEG is more reliable than routine haemocoagulation assessment in predicting perioperative platelet and FFP transfusion needs in surgery for ascending aorta and hemi-arch replacement.

References:

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

O-55

Time course of postoperative platelet count after cardiac surgery

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Introduction: Platelet function and count are of importance for postoperative haemostasis. In addition platelets are involved in inflammatory processes. Several organ failure scores utilize low platelet counts as a marker of depressed bone marrow function [1]. The aim of this study was to determine the time-dependent profile of platelet count in relation to postoperative outcome.

Method: Consecutive patients (n = 4118) having operations between January 1997 and December 2001 were included. Outcome at 30 days was obtained from the national death registry (Statistik Austria). We excluded patients after heart transplantation and patients with death within 48 hours of surgery. Laboratory data were stored in a patient data management system (PICIS Caresuite). In addition we checked for missing data by comparison with a query of the hospital information system. ROC curves were obtained at day 2, 4, 8. Data as mean with (SD).

Results: 55454 individual platelet determinations were obtained in 4118 patients. 30 day mortality was 6.1%, logistic EuroSCORE 7.8 (8.8) and median length of stay in the ICU 3 days. The time-course is clearly diverging after day 4 with ROC area of 0.75 at day 4. Blood loss may partially explain the profile between day 1 and 4 (figure).

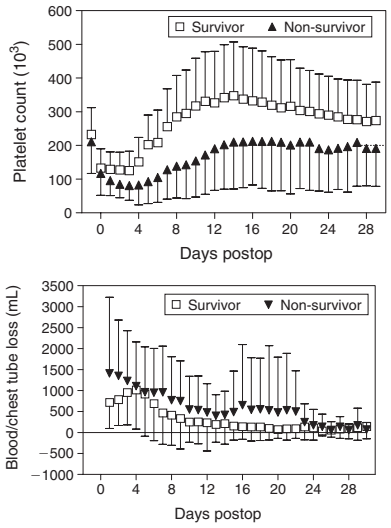

Figure.

Conclusions: This large database may serve as a reference and shows that prolonged platelet depression is related to poor outcome.

Reference:

1 Nijsten MW, ten Duis HJ, Zijlstra JG, et al. Blunted rise in platelet count in critically ill patients is associated with worse outcome. *Crit Care Med* 2000; **28**: 3843–3846.

Cardiac Surgery – Miscellaneous

O-56

Perioperative atrial fibrillation rate in patients after surgical treatment of chronic and paroxysmal atrial fibrillation: is there any difference?

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Introduction: Due to electrophysiological studies and technological progress, surgical treatment of atrial fibrillation (AF) may be performed for all types of primary indications with regard to either chronic (CAF) or paroxysmal (PAF) AF. Despite good results of surgical ablation of AF in mid and long-term follow-up, there is little data concerning perioperative AF rates in these patients. The aim of the study was to evaluate whether preoperative CAF and PAF differentiate the frequency of AF early after surgical ablation.

Method: Between January 2003 and December 2004 40 patients with CAF (Group I, age 63.1 ± 8.8 years) and 37 patients with PAF (Group II, age 60 ± 12 years) underwent concomitant surgical ablation performed by an endocardial or epicardial approach with the use of radio-frequency or cryothermia devices. Pulmonary vein isolation (PVI) was performed in patients with PAF and PVI and substrate modification procedures were performed in patients with CAF. Prospective follow-up was collected on intensive care unit (ICU) admission, during ICU stay and at ICU and hospital discharge. Chi-squared and two-tailed, unpaired Student's *t*-test were used to compare the two patient groups. Differences were considered significant at $P < 0.05$.

Results: Both groups were comparable with regard to age, gender, AF duration, cardiopulmonary bypass time, cross-clamp time, cardioversion rate, temporary external pacing, ICU and hospital stay ($P < 0.05$).

	Gp I CAF (n = 40)	Gp II PAF (n = 37)	*P*
LA diameter (mm)	50.9 ± 7	46 ± 7	=0.01
ICU admission %	15	5.4	=0.03
New onset AF in ICU %	72.5	56.7	=0.15
AF at ICU discharge %	50	18.9	=0.02
AF at hospital discharge %	55	2.7	<0.01

LA left atrium; CAF chronic atrial fibrillation; PAF paroxysmal AF.

Discussion: Despite effective sinus rhythm (SR) restoration by surgical ablation on admission to ICU, postoperative AF rate is higher than in patients without preoperative AF [1,2]. During the ICU and hospital stay there is no significant difference in AF rate between patients suffering from CAF or PAF. In ICU and hospital stay there is significantly more frequent SR restoration with amiodarone or electrical cardioversion in patients with PAF.

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2 Maisel WH, Rawn JD, Stevenson WG. Atrial fibrillation after cardiac surgery. *Ann Intern Med* 2001; **135**: 1061–1073. Review.

O-57

Influence of chronic angiotensin-converting enzyme inhibition on vasoconstrictor requirement during off-pump coronary artery bypass graft surgery

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Introduction: Angiotensin-converting enzyme inhibitors (ACEI) have been widely used in cardiac patients and conflicting results have been reported concerning the use of ACEI during anaesthesia [1,2]. This study investigated the influence of chronic ACEI on the incidence and amount of vasoconstrictors required during induction of anaesthesia and operation in patients undergoing off-pump coronary artery bypass grafting (OPCAB).

Method: Thirty six patients scheduled for OPCAB were included in this study. Patients not treated with ACEI were included in the control group (Control, n = 12). Patients treated with ACEI for more than 4 weeks were randomly divided into two groups: continuing group were patients who continued ACEI medication until the morning of surgery (ACEI-cont., n = 12) and discontinuing group were patients who discontinued ACEI 1 day before surgery (ACE-discont., n = 12). Anaesthesia was induced with sufentanil and midazolam and maintained with sufentanil and a low concentration of isoflurane. Norepinephrine (NE, 8 $\mu g\,mL^{-1}$) was used to treat hypotension according to predetermined guidelines. The amount of NE infused and haemodynamic variables were recorded as follows: during anaesthesia induction (T1), before coronary artery anastomosis (T2), and during anastomosis of the left anterior descending coronary artery (T3), left circumflex coronary artery (T4) and right coronary artery (T5). Comparisons of variables among the three groups were performed using the Kruskal-Wallis test.

Results: Ramipril (2.5–10 mg/day) was administered for a median period of 12 months in ACEI-cont. (range, 1–24 month) in both ACEI-cont. and ACEI-discont. groups. There was no significant difference in haemodynamic variables among the three groups before and during the surgery. The frequency

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

of treatment with NE was not different among groups during the study period. The amounts of NE used at T1–T4 were similar among groups. However, significantly larger amount of NE was infused in ACEI-cont. than in other two groups at T5 ($P = 0.049$). Total amount of NE infused during anastomosis of all three coronary arteries (from T3 to T5; $P = 0.015$) and during the entire study period (from T1 to T5, $P = 0.025$) were significantly larger in ACEI-cont. than in the other two groups.

Table. Amount of NE (μg) infused during OPCAB.

	T3	T4	T5	T3–T5
Control	37 (34)	82 (51)	75 (26)	175 (81)
ACEI-cont.	88 (75)	135 (119)	178 (104)*	499 (231)*
ACEI-discont.	60 (56)	59 (55)	70 (101)	201 (161)

Values are expressed as mean (S.D.). *$P < 0.05$ compared with other groups.

Discussion: Continuing ACEI treatment until the morning of surgery significantly increased the use of NE during the anastomoses. In contrast, there was no significant difference in the use of NE between control and ACEI-discont. group. Since haemodynamic instability during coronary anastomoses is an important issue in the management of patients undergoing OPCAB, discontinuing ACEIs before the surgery may help to maintain haemodynamics stable during coronary anastomosis in OPCAB.

References:

1 Licker M, Neidhart P, Lustenberger S, et al. Long-term angiotensin-converting enzyme inhibitor treatment attenuates adrenergic responsiveness without altering hemodynamic control in patients undergoing cardiac surgery. *Anesthesiology* 1996; **84**: 789–800.

2 Coriat P, Richer C, Douraki, et al. Influence of chronic angiotensin-converting enzyme inhibition on anesthetic induction. *Anesthesiology* 1994; **81**: 299–307.

O-58

Exercise testing demonstrates reduced cardiac reserves on the first morning after coronary artery bypass surgery

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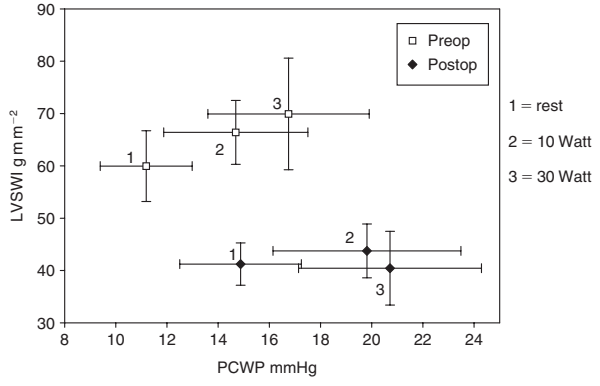
Introduction: Cardiac index (CI) and heart rate (HR) are increased and vascular tone is reduced after coronary artery bypass surgery (CABG) [1,2]. We studied the cardio-vascular response to exercise before and early after CABG.
Method: Sixteen patients with ejection fraction >50% without signs of ischaemia during 100 Watts (W) exercise were studied. Haemodynamics were measured at rest and at 10 and 30 W supine exercise before (*day 0*) and the first morning after the operation (*day 1*) using pulmonary and radial artery catheters. Oxygen consumption (VO_2) was assessed by direct calorimetry. Statistics: ANOVA for repeated measurements.
Results: Mean age: 60 ± 9 yr, EF: 69 ± 7%, no. of grafts: 3 ± 1, cross-clamp time: 27 ± 13 min. VO_2 increased from rest to 30 W by 4.3 ± 1.9 mL kg^{-1} min^{-1} on *day 0* and 5.3 ± 2.6 mL kg^{-1} min^{-1} on *day 1*, a relative increase of 113 ± 53% and 118 ± 61% respectively (NS).

Difference in the effect on CI of exercise from *day 0* to *day 1* $P = 0.03$.

		Day 0	Day 1
Cardiac index	at rest	2.9 ± 0.5	3.5 ± 0.5
(L min^{-1} m^{-2})	10W	3.6 ± 0.4	4.0 ± 0.5
	30W	4.3 ± 0.8	4.3 ± 0.7

Plot of left ventricular stroke work index (LVSWI) against pulmonary capillary wedge pressure (PCWP) with 95% confidence interval is shown in the figure.



Discussion: 30 W cycling induced a similar increase in VO_2 on *day 0* and *day 1*. However, the increase in CI during exercise was lower after the operation compared to preoperative values. LVSWI, taking HR and vascular resistance into account, increased with increasing workload before but not after the operation. The plot of LVSWI against PCWP shows a right- and downward shift consistent with myocardial dysfunction. Our data thus indicate reduced cardiac reserves in the early postoperative phase despite the increased CI at rest.

References:

1 Bauernschmitt R, Malberg H, Wessel N, et al. Impairment of cardiovascular autonomic control in patients early after cardiac surgery. *Eur J Cardiothorac Surg* 2004; **25**: 320–326.

2 Kirkeby-Garstad I, Sellevold OFM, Stenseth R, et al. Mixed venous oxygen desaturation during early mobilization after coronary artery bypass surgery. *Acta Anaesth Scand* in press.

O-59

Dexamethasone improves gut permeability in paediatric cardiac surgery

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Introduction: Cardiopulmonary bypass (CPB) can trigger a systemic inflammatory response syndrome. Little attention has been paid to the effect of CPB and the associated systemic inflammatory response on intestinal dysfunction in the postoperative period. The use of steroids in cardiac surgery remains controversial [1]. The aim of our study was to observe the effect of a single dose of dexamethasone before CPB starts on the changes in gut permeability in paediatric cardiac surgery using the dual sugar permeability test (DSPT).
Method: 34 patients were enrolled in this prospective, randomized, single blinded interventional study. Patients were allocated to receive either dexamethasone (1 mg kg^{-1} during induction of anaesthesia) or act as controls. Our local ethics committee does not allow the use of placebo. After induction of anaesthesia, 12 and 24 h thereafter, 2 mL kg^{-1} of the sugar solution was administered through a nasogastric tube. Urine was subsequently collected through a urinary catheter for 3 h. The sugar solution, prepared by the hospital pharmacy, contained 3-O-methyl-D-glucose (2 g Litre^{-1}), D-xylose (5 g Litre^{-1}), L-rhamnose (10 g Litre^{-1}) and lactulose (50 g Litre^{-1}). L/R ratios below 0.05 and recoveries of D-xylose (passive carrier-mediated transport) and 3-O-methyl-D-glucose (active carrier-mediated transport) around 10% and 30% respectively are considered normal. Repeated measures ANOVA was used to compare the two time points (T12 and T24) using dexamethasone as between subject factor.
Results:

Table. Lactulose/rhamnose ratios (L/R) and percentage recovery for xylose and 3-O-methyl-glucose (3-O MG) without (Control) and with (Dexam) dexamethasone. Values are expressed as mean (95% confidence intervals). *Denotes statistical significance between groups.

	T0	T12	T24
L/R ratios			
Control	0.57 (0.2–0.9)	0.77 (0–1.6)	0.46 (0.06–0.85)
Dexam	0.76 (0.3–1.2)	0.29 (0.2–0.4)	0.17 (0.08–0.15)*
Xylose			
Control	0.29 (0.14–0.45)	1.58 (0.4–2.7)	5.69 (2.4–8.9)
Dexam	0.34 (0.08–0.6)	2.96 (1.8–4.0)	5.47 (2.6–8.3)
3-O MG			
Control	0.38 (0.1–0.6)	3.37 (1.2–5.5)	14.4 (6.2–22.6)
Dexam	0.33 (0.09–0.6)	7.32 (3.3–11.3)	13 (6.6–19.4)*

Discussion: Our study shows that dexamethasone given before the beginning of cardiopulmonary bypass improves postoperative gut permeability as assessed by the DSPT. There were no differences in morbidity or mortality between the two groups, although those were not primary end points of the study. Dexamethasone improved the intestinal function at the morphological level (Lactulose/Rhamnose ratio) although it didn't seem to clearly affect it at the functional level (3-O-methyl-D-glucose and D-xylose absorption).

Reference:

1 Chaney MA. Corticosteroids and cardiopulmonary bypass: a review of clinical investigations. *Chest* 2002; **121**: 921–931. Review.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

O-60

Gut permeability in neonates following a stage 1 Norwood procedure

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Introduction: Intestinal mucosal ischaemia can occur in infants and children during and after cardiopulmonary bypass (CPB). Severe decreases in mucosal perfusion may contribute to postoperative mortality or complications such as necrotising enterocolitis (NEC). Neonates with congenital heart disease have a high risk of developing NEC, with a reported incidence in patients with hypoplastic left heart syndrome (HLHS) between 7.6% and 10% and mortality well above 90% [1]. We have investigated gut permeability in seven patients undergoing stage I of the Norwood procedure, applying the dual sugar permeability test (DSPT) using L-rhamnose and lactulose.

Method: Seven patients were prospectively investigated. All patients presented at term with HLHS. A standard anaesthesia was used and the same surgeon performed all the operations. Patients had been normally fed up to the day of surgery and enteral feeding was started one day after surgery. The test solution contains 3-O-methyl-D-glucose, D-xylose, L-rhamnose and lactulose. Patients received 2 mL/kg of the test solution after induction of anaesthesia (T0) and at 12 (T12) and 24 (T24) hours after the first dose. Urine was collected during 3 hours after each instillation. The sugar content in urine was analysed by capillary gas chromatography (normal values; L/R ratio <0.05). All patients were discharged from the PICU except patient 4 who died of NEC 72 hours after the operation. Repeated measures ANOVA was used for statistical analysis.

Result:

Table 1. Lactulose/Rhamnose (L/R) ratios during the three study periods. Missing values are due to the volume of urine being too small to perform the test. T0 in patient 5 is a spurious value.

	L/R ratios		
	T0	T12	T24
Patient 1	0.18	0.08	0.22
Patient 2	1.55	0.63	0.19
Patient 3	0.04	0.14	0.11
Patient 4	–	2.30	–
Patient 5	27.6	2.37	0.23
Patient 6	0.20	0.57	0.23
Patient 7	0.25	0.33	–

Gut permeability was generally increased from the outset (T0). At the time we conducted the DSPT in patient 4 there were no signs of NEC. However a L/R ratio 46 times the normal value at T12 after the first dose reflected a highly permeable small intestine. The surgical repair in patient 5 was technically difficult resulting in a long circulatory arrest time. This can explain the high L/R ratio of 2.37 at T12. Changes in L/R ratios during the study period are significant ($P < 009$).

Discussion: Gut permeability as assessed by the DSPT is abnormal in patients with HLHS from the outset and up to 24 hours after the operation. If our results are reproducible in future studies it may allow us to identify those patients at risk of developing NEC. Pre-emptive treatment of NEC before obvious clinical signs appear could have benefits in terms of morbidity and/or mortality.

Reference:

1 Hebra A, Brown MF, Hirshl RB, et al. Mesenteric ischemia in hypoplastic left heart syndrome. *J Pediatr Surg* 1993; **28**: 606–611.

O-61

Efficacy of post-operative iron therapy in iron deficient cardiac surgical patients

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Introduction: Several authors have suggested that iron supplementation after cardiac surgery is ineffective [1] possibly due to the functional iron deficiency evident after major surgery. However, their study populations had normal iron stores preoperatively. A recent audit in our own unit demonstrated that 24% of our patients have low iron stores preoperatively. It was decided to commence postoperative iron therapy to assess the effect on iron stores and haemoglobin (Hb) concentrations 6 weeks after surgery in this group.

Method: Three of our six surgeons declined to participate; their patients were used as controls. As previous work suggested that iron stores fall to 48% of their preoperative values by 6 weeks, all the other surgeons' patients whose ferritin levels were $<150\,ng\,dL^{-1}$ were discharged on 200 mg of iron sulphate three times daily. Routine demographic data was collected. In addition, admission Hb and ferritin were noted, as was discharge Hb and Hb and ferritin levels at the 6 week follow-up clinic. Statistical analyses were performed using Minitab statistical software; ANOVA where $P < 0.05$.

Results: There were no significant differences in patient demographic details nor in EuroSCORE. There was no significant difference in preoperative ferritin levels between the iron treated and non-treated group ($67\,ng\,dL^{-1}$ vs. 74) nor were there significant differences in admission ($13.8\,g\,dL^{-1}$ vs. 13.3) or discharge Hb ($9.9\,g\,dL^{-1}$ vs. 9.5). However, at 6 weeks the Hb levels were significantly higher in the iron treated group ($13.6\,g\,dL^{-1}$ vs. 12.3) and the rise in Hb concentration was also significantly higher in the treated group ($3.8\,g\,dL^{-1}$ vs. 2.8). The percentage change in ferritin levels were not significantly different (129% vs. 91).

	Iron treated n = 34	Non-treated n = 85
Initial ferritin levels ($ng\,dL^{-1}$)	67 (SD 36)	74 (42)
Initial Hb concentration ($g\,dL^{-1}$)	13.8 (1.4)	13.3 (1.6)
Discharge Hb ($g\,dL^{-1}$)	9.9 (1.3)	9.5 (1.3)
6 week Hb ($g\,dL^{-1}$)	13.6 (1.3)	12.3* (1.4) $P = 0.000$
6 week difference Hb ($g\,dL^{-1}$)	3.8 (1.5)	2.7* (1.5) $P = 0.003$

Discussion: Our results suggest that patients who have low iron stores preoperatively or who are at risk of significantly depleting their iron stores postoperatively may benefit from postoperative iron supplementation. Although the 6 week ferritin levels demonstrated no significant difference, it is felt that this is due to continued erythropoiesis and is reflected in the higher Hb concentration in the iron treated group. Such a difference leads to improved patient well-being as suggested by quality of life assessments. Despite the gastrointestinal side effects of iron, the vast majority of treated patients did not complain of GI upset, even on direct questioning.

Reference:

1 Crosby L, Palarski VA, Cottington E, et al. Iron supplementation for acute blood loss anemia after coronary artery bypass surgery: a randomized, placebo-controlled study. *Heart Lung* 1994; **23**(6): 493–499.

O-62

Haematocrit of 20% versus 25% during normothermic cardiopulmonary bypass for elective coronary artery bypass graft surgery

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Introduction: Haemodilution frequently occurs during cardiac surgery when cardiopulmonary bypass (CPB) has been instituted [1]. Much debate still exists on the minimum safe level of normovolaemic, haemodilutional anaemia to maintain oxygen delivery within the physiological range [2]. Normothermia during CPB raises the question of adequate regional and whole body oxygen delivery under conditions of haemodilutional anaemia [3]. We performed a prospective, controlled and randomized study to investigate oxygen delivery, oxygen consumption and clinical outcome of patients who were randomly allocated to a haematocrit of 20% or 25%, respectively, during normothermic cardiopulmonary bypass for isolated CABG surgery.

Method: After approval of the local ethical committee and informed written consent 50 patients were randomized to a haematocrit of 20% ± 1% versus 25% ± 1% during normothermic CPB. Inclusion criteria were: informed consent, isolated CABG surgery, age >18 and <75 years, Hct > 36% and bodyweight >70 kg. Prior to CPB all patients were subjected to isovolaemic haemodilution to obtain an haematocrit of 20% ± 1% or 25% ± 1% during CPB. HES130/0.4 (Voluven, Fresenius, Germany) was used for isovolaemic haemodilution. The pump prime was standardized for both groups and consisted of 500 mL hydroxyethyl starch 10%, 500 mL of crystalloid solution, 8000 IU heparin, 50,000 KIU aprotinin/kg and 1000 mg of methylprednisolone. Autologous blood was retransfused in each patient after weaning from CPB. Outcome measures were: blood lactate, postoperative drainage loss and transfusion requirements, incidence of organ dysfunction (neurological, cardiac, respiratory and renal), stay in ICU (h) and hospital stay (days). Postoperative intensive care therapy followed a standardized protocol. Statistical analysis was performed using the χ^2-test and Fisher's exact test for categorical and dichotomous variables, respectively. The Mann-Whitney *U*-test was applied for intergroup comparison of continuous variables.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Results: One patient had to be excluded from statistical analysis due to clot formation in the autologous blood that had to be discarded. Basic patient characteristics were not different between groups. Median time to discharge from ICU was 23 hours in both groups ($P = 0.87$). Outcome variables were not significantly different between groups (Table) and within normal range. Duration of hospital stay was not different between groups. One patient in the 20%-group died of septic multi-organ failure due to pneumonia occurring on day 3 after surgery.

Table. Oxygen delivery, consumption and outcome measurements

	Haematocrit 25%		Haematocrit 20%		
	Median	IQR	Median	IQR	*P*
Haematocrit admission to ICU (%)	25.8	24.0–26.9	23.5	20.8–25.3	0.04
DO_2 admission to ICU (mL m^{-2} min^{-1})	819	675–1089	787	665–948	0.43
VO_2 admission to ICU (mL m^{-2} min^{-1})	227	190–289	211	185–263	0.78
DO_2 at 18 h in ICU (mL m^{-2} min^{-1})	991	743–1299	910	807–1032	0.66
VO_2 at 18 h in ICU (mL m^{-2} min^{-1})	327	269–399	285	265–347	0.16
Blood lactate admission to ICU (mmol/L)	1.4	1.1–2.1	1.4	1.1–2.0	0.95
Blood lactate at 18 h in ICU (mmol/L)	1.4	1.1–2.1	1.8	1.2–2.2	0.69
Drainage loss (mL)	390	280–470	400	270–580	0.88
Transfused patients (n)	0	0%	2	9%	0.51
Agitated arousal reaction (n)	3	13%	3	14%	0.59
Myocardial infarction (n)	0	0%	0	0%	0.99
CK/CK-MB	0.05	0.04–0.07	0.05	0.04–0.08	0.99
Ventilator support (h)	10	7–13	10	9–12	0.74
Creatinine: 18 h in ICU (mg/dL)	0.86	0.80–1.08	1.02	0.82–1.13	0.65
Patients with acute renal failure (n)	1	4%	1	5%	0.73
ICU-stay (h)	23	22–25	23	21–35	0.87
Mortality (n)	0	0%	1	5%	0.47

(*continued*)

Conclusion: The results of our study in patients below the age of 75 years showed that whole body oxygen delivery was sufficiently maintained as blood lactate levels were not different between groups. Clinical outcome after elective CABG-surgery was not impaired by an haematocrit of 20% during normothermic cardiopulmonary bypass (CPB). Furthermore, lowering the safe degree of haemodilutional anaemia during CPB may prevent patients being exposed to blood products.

References:

1 Eckmann DM, Bowers S, Stecker M, et al. Hematocrit, volume expander, temperature, and shear rate effects on blood viscosity. *Anesth Analg* 2000; **91**: 539–545.

2 DeFoe GR, Ross CS, Olmstead EM, et al. Lowest hematocrit on bypass and adverse outcomes associated with coronary artery bypass grafting. *Ann Thorac Surg* 2001; **71**: 769–776.

3 The Warm Heart Investigators. Randomised trial of normothermic versus hypothermic coronary bypass surgery. *Lancet* 1994; **343**(8897): 559–563.

Poster Sessions

Haemodynamics

P-63

Wedging of the Swan-Ganz catheter: changes in left atrial and pulmonary artery pressure

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Introduction: Fernandéz-Mondéjar et al used two Swan-Ganz catheters and measured mean pulmonary artery pressure (MPAP) and cardiac output (CO) with one catheter while wedging the other [1]. They studied pigs (body weight 20–25 kg). During wedging MPAP increased and CO decreased. The effect on mean left atrial pressure (MLAP) was not reported. Our hypothesis was that MLAP could decrease during wedging in man resulting in an erroneously low wedge pressure and a too high calculated pulmonary vascular resistance (PVR

Method: Ten adult patients undergoing heart surgery with cardiopulmonary bypass were studied with ethical committee approval and informed consent. Before weaning from bypass epidural catheters were inserted into the pulmonary artery and left atrium. After weaning a 7.5 F Swan-Ganz catheter was floated to the pulmonary artery. Pressures were recorded on paper. The Swan-Ganz catheter was wedged three times with open chest and three times after chest closure. Also CO was measured in triplicate before and during wedging. MLAP at end-expiration was evaluated blindly, off-line. Analysis of variance was used for the statistical evaluation of data.

Results: MLAP decreased during wedging from 13.5 ± 2.8 (standard deviation) mmHg to 13.0 ± 3.0 (open chest) and from 15.8 ± 3.2 to 15.3 ± 3.1 (closed) $P < 0.001$ while MPAP increased from 18.8 ± 3.5 to 19.7 ± 3.5 (open) and from 21.3 ± 4.3 to 21.9 ± 4.2 (closed) $P < 0.001$. CO did not change.

Discussion: The haemodynamic effects of wedging were smaller in adult patients in the current study than in the young pigs studied by others. The observed decrease in MLAP would lead to an average overestimation of the calculated PVR by 9%, which has no clinical significance. MPAP and CO are measured before or after wedging so the increase in MPAP and a possible reduction of CO would not affect the calculation. However, it should be noted that during wedging the pressure difference across the pulmonary circulation increased by as much as 20–26%.

Reference:

1 Fernandez-Mondejar E, Hambraeus-Jonzon K, Roneus A, et al. Nitric oxide increases dramatically in air exhaled from lung regions with occluded vessels. *Acta Anaesthesiol Scand* 2003; **47**: 312–318.

P-64

Comparison of techniques for either intermittent or continuous cardiac output measurement in patients during CABG surgery

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Introduction: Continuous cardiac output (CCO) measurement may help to avoid or to adequately treat haemodynamic disturbances in patients with a high risk of cardiac failure, e.g. patients during CABG surgery. Initial studies on semi-invasive CCO measurement by Doppler flowmetry (DCO) in the descending aorta demonstrated a good agreement with data assessed by discontinuous cardiac output (CO) measurement using the pulmonary and trans-pulmonary thermodilution technique [1]. The aim of this study was to compare DCO with invasive CO- and CCO-measurement techniques during CABG surgery.

Method: The controlled, blinded study was approved by the local ethical committee. 20 patients were investigated intra-operatively during elective CABG surgery. Cardiac output was measured discontinuously by trans-pulmonary (TPCO) and pulmonary thermodilution (PCO) and continuously by DCO and pulse contour analysis (PCCO). CO measurements by thermodilution were calculated as the mean from three injections of 15 mL ice-cold isotonic saline solution and used for the calibration of PCCO. Measurements were performed after induction of anaesthesia, after sternotomy, 10 minutes after discontinuation of extracorporeal circulation, after chest closure and at the end of surgery. CCO measurements were performed from the end of the first thermodilution measurement until the start of extracorporeal circulation and from the end of the third thermodilution measurement until the beginning of the fifth thermodilution measurement period. During these periods data of CCO-measurements were assessed every minute and stored on a microcomputer. Statistical analysis was performed according to the method of Bland and Altman calculating the bias and the limits of agreement between methods (2SD).

Results: *Intermittent CO measurements*: Comparison of discontinuous CO measurements (number of paired data, n = 99; PCO: Range 3.0 to 10.0 L min^{-1}) showed a bias of −0.11 ± 0.79 L min^{-1} (2SD 1.57 L min^{-1}) for DCO vs. PCO, and a bias of 0.31 ± 0.74 L min^{-1} (2SD 1.49 L min^{-1}) for DCO vs. TPCO. *CCO measurements*: Comparison of CCO-measurements (DCO vs. PCCO, n = 2259; PCCO range 1.3 to 10.1 L min^{-1}) showed a bias of −0.16 ± 0.85 L min^{-1} (2SD 1.7 L min^{-1}).

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Discussion: Agreement of the less invasive DCO-technique with discontinuous PCO- and TPCO-measurements is acceptable for clinical routine. Similar results were found when comparing the DCO-technique with PCCO-measurements despite probable changes in intravascular volume, systemic vascular resistance, and potential alterations of the position of the Doppler probe during CABG surgery.

Reference:

1 Bein B, Worthmann F, Tonner PH, et al. Comparison of esophageal Doppler, pulse contour analysis, and real-time pulmonary artery thermodilution for the continuous measurement of cardiac output. *J Cardiothorac Vasc Anesth* 2004; **18**: 185–189.

P-65

Haemodynamic monitoring during OPCAB: comparison of thermodiluition and pulse pressure analysis derived measurements

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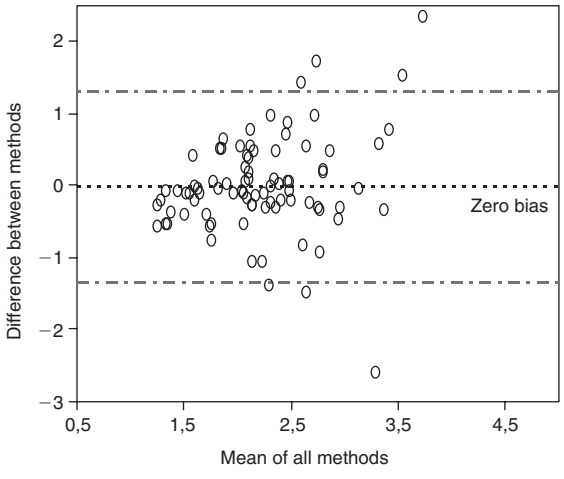
Introduction: Conventional pulmonary artery catheter (PAC) determinations of cardiac index (CI) could provide unreliable results in off pump coronary artery by-pass (OPCAB) surgery because of cardiac displacement. Recently the PulseCO system [1] has been introduced as a less invasive method for CI assessment via the analysis of pulse pressure waveform: PulseCO is easly calibrated with a single lithium dilution determination (LiDCO). The purpose of this study was to assess the agreement between PAC and PulseCO CI determinations in OPCAB patients in basal conditions and at different degrees of cardiac displacement.

Method: Nineteen consecutive patients (male/females = 18/1; age 71 ± 8 years) undergoing OPCAB surgery were recruited. All patients underwent continuous monitoring via PulseCO, calibrated after anaesthesia induction and kept during the entire procedure. Moreover PAC CI (mean of 3 consecutive CI determinations) was measured in each patient after sternotomy (basal; n = 19), after the cardiac stabilizer positioning, during the anastomoses on the anterior (ANT; n = 24), lateral (LAT; n = 14), and the posterior myocardial wall (POST; n = 9), and after heparin reversal (END BASAL, n = 19). Paired PulseCO versus PAC CIs have been compared for agreement by Bland-Altman test. A one-way paired analysis of variance (ANOVA) of PAC/PulseCO discrepancies between groups was performed.

Results: There were no complications related to Swan-Ganz and PulseCo devices. Bland-Altman analysis showed a strong agreement between overall (n = 85) CI measures (bias = −0.019 L/m^2; 95% c.i. = 0.167 L/m^2−1.30 L/m^2) (see figure). ANOVA statistics showed significant difference of PAC-PulseCO CI discrepancies in the different groups ($P < 0.0001$).



Discussion: Our analysis showed that, despite a good overall PAC/PulseCO agreement, discrepancies between techniques are significantly different for various degrees of cardiac displacement, indicating a different behaviour of PAC and PulseCO at various stages of an OPCAB procedure.

Reference:

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P-66

Comparative study of cardiac output (CO) measurement using thermodilution (TD) and electrical velocimetry (EV) techniques in patients undergoing CABG surgery

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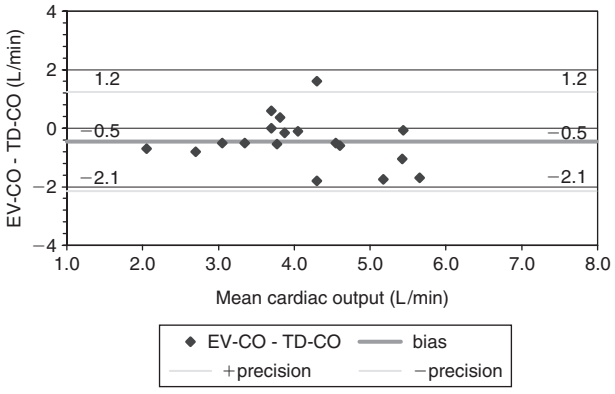
Introduction: The TD technique is still considered to be the gold standard for CO measurement. EV is a non invasive method for determining the stroke volume (SV) and CO by using the principle of rate of change in electrical conductivity of blood in the thoracic aorta [1,2]. Based on measurement of the thoracic electrical bioimpedance (TEB), EV determines the rate of change of orientation of the disc-shaped erythrocytes from random direction to alignment with their face parallel to blood flow immediately following aortic valve opening. The pulsatile alignment in the erythrocytes during the early systole and the increasing random orientation during diastole correspond to a pulsatile increase or decrease in electrical conductivity.

The objective of this study was to compare the CO measurements using EV with the clinically established invasive standards preoperatively.

Method: In 18 patients, 15 male, 3 female undergoing elective CABG procedures, 4 standard ECG electrodes (3M Red Dot™) for determining CO by EV and Swan-Ganz®-catheter (Edward Lifesciences) for CO measurement by TD were used. Measurements were taken after the introduction of anaesthesia and before surgery. A Bland-Altman Plot was calculated based on 72 pairs of CO measurements.



Results: A bias of 0.5 L/min and a precision of 1.4 L/min indicate a good correspondence of both methods, with a slight underestimation of the CO measurements using EV.

Conclusions: EV is a suitable non invasive method for CO measurements. Further investigations have to be done to calibrate this technique with a standard thermodilution method in different clinical situations.

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P-67

Central venous versus mixed venous oxygen saturation in patients undergoing cardiac surgery

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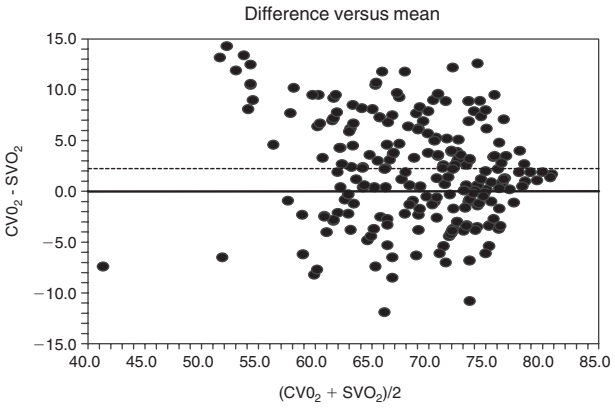
Introduction: Because of the high cost and invasiveness of pulmonary artery catheterization, monitoring by means of the central venous oxygen saturation has been proposed as a less invasive alternative [1]. The aim of the study was to assess the adequacy of the central venous oxygen saturation (ScO_2) measured on blood samples drawn from the central venous catheter as a good estimate of mixed venous oxygen saturation (SvO_2).

Method: Twenty patients scheduled for elective cardiac surgery with normal or near normal ejection fraction were admitted to the project. The protocol was approved by the Regional Ethics Committee. Written informed consent was obtained from each patient. The measurement of ScO_2 and SvO_2 were collected postoperatively after the patients were admitted to the intensive care unit. Blood samples drawn from the distal lumen of the central venous catheter were immediately analysed for oxygen saturation by ABL System

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

610, Radiometer, Denmark. Simultaneously the value of SvO_2 was read from the fibreoptic pulmonary artery catheter connected to Baxter Vigilance after in vivo calibration. The measurements were made every 10–20 min for 2–4 hours to get at least 8 measurements per person. Changes in ScO_2 and SvO_2 were compared as described by Bland and Altman [2].

Results: 257 comparative measurements were obtained.



A Bland and Altman plot of the distribution of individual differences ($ScO_2 - SvO_2$) versus mean indicates no relation between the difference and mean. The mean difference calculated to 2.23 with 95% confidence interval 0.10–4.36. This is significantly different from zero. With the SD of 5.4, the limits of agreement (mean difference ±2s) for the entire population is −8.6 and 13.0. The standard deviation within persons was 3.1 and between persons 4.4.

Discussion: We find these variation wide and unacceptable for clinical purposes and conclude that the two methods are not in agreement and are therefore not interchangeable.

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P-68

Standardized training in transoesophageal echocardiography (TOE) improves effectiveness and quality of TOE-examination and reporting

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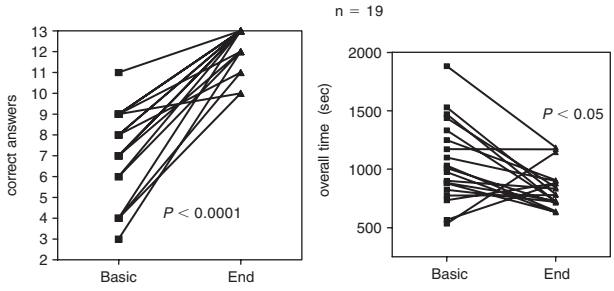
Introduction: TOE, a non-invasive monitoring and diagnostic technique with great sensitivity and specificity, needs highly qualified training [1] to be reliable in diagnosis and quantification of cardiac haemodynamics. The goal of the study was to evaluate the benefit of standardized TOE-training in terms of improvement of quality and effectiveness of examination and reporting.

Method: Sixteen cardiac anaesthetists and 3 staff-members of the Emergency Room underwent testing before and after standardized training in TOE. The following intervention included teaching of theoretical echocardiographic basics (physics, standardized cross-sectional views, nomenclature [2], measurement techniques and a newly implemented report form) for 6 hours and practical training (handling of the TOE-probe, TOE-views, comprehensive TOE-examination, and creating a report), off-line report training in 5 cases and 10 supervised TOE examinations with independent report generation with feedback. Training was performed in patients undergoing cardiac surgery after induction of anaesthesia and after cardiopulmonary bypass. Duration of the overall training was 3 months.

Pre- and post-interventional testing took place during the clinical examination of one clinical case and included 13 questions evaluating theoretical knowledge and practical skills (nomenclature of TOE-views and left ventricular walls; improvement of image quality, assessment of global cardiac functions, measurements). Number of correct answers and overall time needed were analysed.

Statistical analysis was performed using a paired t-test with $P < 0.05$ to be statistically significant.

Results: The numbers of correct answers increased significantly from basic to end ($P < 0.0001$), the overall time needed for answering decreased significantly ($P = 0.017$).



Discussion: Theoretical and practical standardized training in TOE improved quality and effectiveness of examination and reporting of TOE during cardiac anaesthesia.

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P-69

Intra-operative evaluation of coronary arteries with TOE: feasibility and preliminary results

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Introduction: Patients undergoing peripheral vascular surgery are at increased risk for coronary artery disease (CAD) [1]. This study was undertaken during general anaesthesia to identify significant coronary artery stenosis in such patients.

Method: We examined the coronary arteries of 8 patients with minor clinical predictors of perioperative cardiovascular risk and METs ⩾ 4 [2], scheduled for vascular surgery, with transoesophageal echocardiography (TOE) as follows: the origin of the coronaries arising from the sinus of Valsalva were identified with colour Doppler, whereas pulsed Doppler was used for haemodynamic significance. The peak diastolic coronary blood flow velocity ($>1\,m \cdot s^{-1}$ in the left coronary system and $>0.5\,m \cdot s^{-1}$ in the right coronary artery (RCA)), alongside the 'aliasing' phenomenon, was considered indicative of significant stenosis. Also very low velocities (<50% of normal flow velocities) were considered as a sign of severe distal stenosis in a segment not visible for TOE.

Results: The left main coronary artery (LMCA) could be visualized in all 8 patients. The circumflex and left anterior descending artery could be examined in 7 patients, whereas the RCA could be detected in 6 patients. In 5 patients TOE examination revealed abnormal flow velocities. In the first patient very low flow velocities were found in the left coronary system, suggesting severe coronary stenosis in the non-visible segments of the left coronary tree. Postoperative coronary angiography revealed severe triple vessel disease and the patient underwent successful coronary artery bypass grafting. In the second patient we found a significant stenosis in the proximal RCA, which was confirmed with angiography and treated with an intracoronary stent. The third patient had a calcified LMCA and low flow velocities in the left coronary system. He had a positive MIBI scan and is planned for further investigation. The other two patients are scheduled for further investigation.

Discussion: Although preoperative stress testing is advocated in peripheral vascular disease, there is evidence that it offers no incremental value for determining adverse cardiac outcome [3]. As an alternative approach we suggest that these patients should receive a beta blocker perioperatively and should undergo a peroperative TOE to detect CAD. Our data also support the use of perioperative TOE in emergency cases. We suggest that a peroperative TOE revealing CAD, should be followed by coronary angiography and a negative TOE by non invasive cardiac investigations, even in patients with METs ⩾ 4.

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

P-70

Focus assessed transthoracic echocardiography (FATE) in aortic valve replacement

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Introduction: Postoperative monitoring and treatment of the patient undergoing aortic valve replacement (AVR) is a complex challenge. Balancing between inotropes and volume load requires detailed information about the true determinants of the global function of the heart (preload, afterload, contractility, compliance and relaxation). In addition, significant pathology must be considered, further stressing the need for bedside imaging of the heart and pleura. Ultrasound is the only method which provides real-time bedside imaging of the heart. We have earlier proposed a rapid method for cardiopulmonary screening and monitoring (FATE) and have shown that at least one usable window for cardiac imaging was obtainable in 97% of a mixed ICU population [1]. The purpose of this study was to evaluate the feasibility of FATE in patients undergoing AVR by assessment of the image quality in the perioperative period.

Method: Following the FATE protocol (sub-costal, apical, parasternal and bilateral pleural imaging) 35 patients were studied 1. preoperative, 2. the first postoperative day and 3. before discharge from the hospital. The image quality for the cardiac windows was assessed by one experienced echocardiographer and graded I – V (I = no image, II = poor and unusable, III = usable, IV = good and V = perfect image quality). For pleura scanning the presence of pleural effusion was recorded.

Results: The apical view provided the best cardiac window in all study periods. Preoperatively all patients were judged to have at least one usable cardiac window, postoperative 29 (83%) and before discharge 33 patients (94%) had at least one usable window. Pleural effusion was found preoperatively in one patient (unilateral), postoperative in 10 (unilateral) and one (bilateral) and on discharge in 14 (unilateral) and 4 (bilateral).

Discussion: This study shows that the FATE protocol is feasible in patients undergoing AVR since more than 4/5 have at least one usable cardiac window in the immediate postoperative period with further enhancement of the image quality on discharge. The a priori preferable window is the apical view. The reason for loss of image quality is not quite clear but interpolated air is a very likely cause. FATE proved the development of pleural effusion in more than 50% of patients during the 4–5 postoperative days.

We conclude that the FATE concept is very useful for perioperative cardiopulmonary screening and monitoring in patients undergoing AVR.

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P-71

Impact of nutritional status on mortality of 34 patients supported by ventricle assist device (VAD)

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Introduction: The implantation of a VAD for end-stage heart failure is a therapeutic approach in adult cardiac surgery. The nutritional status of patients with end-stage heart disease supported by VAD while awaiting cardiac transplantation is not yet well known [1]. The aim of this study was to evaluate nutritional assessment: prior to implantation (D-1), one month after (D30), during transplantation (DTx) and/or death (DD).

Method: A retrospective clinical study including 34 ASA IV patients was performed between June 1997 and December 2002. Data: age, sex, weight, height, Body-Mass Index (BMI = weight [kg]/height^2 [m^2]), serum albumin level (Alb g/L). Statistical analysis was done with a P value <0.05 taken as significant*. Data are expressed as median and extremes [ ], Odds Ratio (OR), 95% confidence interval [95%CI].

Results: Age: 40.5 yr [10–63]; 30 men, 4 women. VAD used centrifugal pumps (3), pulsatile pneumatic (18), electrically powered (5), total artificial heart (8). BiVAD (23), left (9), right (2). Indications: ischaemia (19), dilated cardiomyopathy (12), myocarditis (2), post-partum (1). Average duration: 67 days [1–261]. Transplantations: 18 (3 patients died). Overall mortality: 19 patients.

	D-1	D30	DTx	DD	Total
n	34	24	15	19	34
BMI	21.4	19	20	17.6	19.4
	[12.4–33.8]	[14.7–30.4]	[13.7–28.1]	[9.3–26.5]	[9.3–28.1]
ALB	25.3	26.6	30.1	20.3*	24.6
	[14.2–39.9]	[19.4–36.3]	[26–37.5]	[15–30.7]	[15–37.5]

Discussion: No significant correlations were observed between BMI of the various groups of patients objectively "thin" (BMI <20). Multivariable logistic regression demonstrated that low albumin level (<21 g/L) and albumin level >33 g/L were respectively independently associated with increased mortality ($P = 0.004$; OR = 0.541; [95% CI 0.36–0.82]) and with transplantation success ($P = 0.003$; OR = 1.38; [95% CI 1.12–1.71]).

Conclusion: These results seem to demonstrate that a seriously deteriorated albuminaemia level has an impact on patient survival with VAD and after Tx [2]. Nutrition intervention is important before and after implantation of VAD [3].

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P-72

Development of an experimental porcine model for left ventricular hypertrophy

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Introduction: Severe left ventricular hypertrophy (LVH) is commonly caused by acquired valvular aortic stenosis (AS). After aortic valve replacement the left ventricle remains hypertrophic with impaired compliance and relaxation, leaving abnormal haemodynamics as a challenge in the immediate postoperative period [1,2]. In addition, many LVH patients are overly sensitive to pericardial effusion and therefore readily develop symptoms of tamponade at an earlier stage than non-LVH patients. The haemodynamic management of LVH patients is poorly understood, and many aspects remain unknown. Some features could be disclosed by means of a long term animal LVH model in which the difficulties of the haemodynamic management could be recreated and investigated systematically. The aim was to develop a long term porcine LVH model using supra-coronary aortic banding.

Method: Sixteen female 5 kg domestic piglets were divided randomly into two groups. In the first group (n = 12) we performed the actual banding procedure and in the second group (n = 4) we performed a sham-operation to obtain baseline values. The ascending aorta was exposed via a left lateral thoracotomy and a suture was passed through a silicone tube individually fitted to the circumference of aorta with no stenosis. The ends of the suture were tied together and the pericardial sack and the layers of muscle and skin were closed.

Left ventricular mid-septal and free wall thickness at papillary muscle level were assessed at follow-up examinations after four, six and eight weeks by echocardiographic measurements through a right transthoracic acoustic window using a 3.5 MHz Matrix transducer. At eight weeks follow-up examination, each animal was euthanized and the post-mortem mass of the dissected left ventricle was measured in order to calculate the LV/body weight ratio. Results are displayed as mean ± standard deviation. An unpaired t-test was used and $P < 0.05$ was considered statistically significant.

Preliminary results: Two banded piglets developed acute postoperative pulmonary oedema and were euthanized. At four weeks follow-up mid-septal thickness was 0.75 ± 0.08 cm in the banded group and 0.60 ± 0.08 cm in the sham group ($P = 0.017$), while free wall thickness was 0.77 ± 0.06 cm and 0.60 ± 0.06 cm ($P = 0.003$) in the banded and sham groups respectively.

Conclusion: A practical, feasible long-term porcine model of LVH has been established. Due to the nature of the gradual increase in LV afterload the model may mimic the pathogenic progression of LVH as seen in acquired AS.

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P-73

Amrinone prophylaxis for improved weaning from CPB in patients undergoing coronary surgery

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Introduction: Cardiosurgical procedures with CPB are accompanied by myocardial dysfunction, which can lead to heart failure in the immediate post bypass period and requires the use of catecholamine support. The aim

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

of this study was to investigate the efficacy of a single dose of amrinone [1], given before weaning from CPB, in improving cardiac function in the immediate post bypass period.

Method: The study included 38 patients, NYHA IV, mean age of 61 ± 7 years, who underwent CABG. The mean duration of aortic cross clamping time was 65 ± 11 min and the mean time of CPB 87 ± 14 min. Patients were randomly divided into the two equal groups. Patients of Gp 1 (amr.) received amrinone 1.5 mg/kg infused over 5 minutes into the bypass circuit before weaning from CPB. Patients of Gp 2 (contr.) did not receive amrinone before weaning from CPB. Base ejection fraction of left ventricle of contr. and amr. groups was 46 ± 3.5% and 45 ± 3%. For estimation of right ventricular function we used a Swan-Ganz catheter with fast thermistor [2]. TOE was used for estimation of left ventricular function. Measurements of variables which reflected systolic and diastolic function of right and left ventricles were recorded at point T-1 (prior to initiation of CPB) and T-2 (15 min after the end of CPB). The number of patients requiring inotropes/vasopressors after CPB (at T-2) was also recorded in both groups. All data are expressed as mean values and standard deviation. Statistical analysis was performed with Student's *t*-test.

Results: In patients of Gp 2 (without amrinone) end-diastolic compliance (RVEDV/RAP) of the right ventricle (C) was decreased by 24 ± 9% at T2 ($P < 0.05$). Isovolaemic relaxation time of the left ventricle (IVRT) was increased by 37 ± 11% ($P < 0.05$) in comparison with T1. At T2 there was no decrease of C and increase of IVRT in amrinone-treated patients.

		amr.gr.	control gr.
C ml/mmHg	T-1	19.2 ± 1.7	20.5 ± 2.1
	T-2	20.6 ± 1.4	15.6 ± 1.6*#
IVRT cm/sec	T-1	80 ± 6	74 ± 7
	T-2	76 ± 10	102 ± 9*#

* $P < 0.05$ inside gr. between T-1 & T-2. # $P < 0.05$ between gr. at T-2

The number of patients who required supplemental inotropes following separation from CPB in amr. group was 2.5 times less, but the frequency of vasopressors administration in amr. group was 3 times higher than in contr. group.

Conclusion: A single dose of amrinone, given before weaning from CPB prevents dysfunction of right and left ventricles and decreases requirements for supplemental catecholamines in the immediate post bypass period. Increased use of vasopressor with milrinone is just as important as reduction in inotrope requirement.

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ICU – Postoperative Complications

P-74

Hyperglycaemia and mortality after paediatric cardiac surgery

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Introduction: Hyperglycaemia was reported to be an independent predictor of mortality and morbidity in critically ill adults [1,2]. The role of high blood glucose levels after paediatric heart operations has been poorly investigated.

Method: An observational cohort study was performed between August 2001 and December 2003. Perioperative data (107 variables) of 843 patients who underwent paediatric heart surgery were investigated. Blood gas, minimum and maximum glucose values of the first 24 (D0) and 24–48 (D1) hours were also recorded. Death at the intensive care unit (ICU) was used as the clinical end-point. Mann-Whitney *U* test, univariate and multiple logistic regression were applied.

Results: 1. At the ICU 33 patients died. They spent a median of 13.9 (± 16.6) day at the ICU. 2. Maximum blood glucose levels during the first 48 hours were significantly higher among patients who died (D0: 11.4 ± 4.8 vs. 8.6 ± 2.7 mmol/L, $P < 0.0001$; D1: 11.1 ± 4.6 vs. 7.8 ± 3.3 mmol/L, $P < 0.0001$). 3. In univariate model the odds ratio for death was 1.85 (95% CI: 1.4–2.4, $P < 0.0001$) and 2.1 (95% CI: 1.6–2.8, $P < 0.0001$) for every increase of 2.8 mmol/L above 8.2 mmol/L of the maximum glucose values of D0 and D1 respectively. 4. Independent risk factors of fatal events in multiple model are in the table.

Variable	OR	95% CI	*P*
Preoperative ICU stay	5.1	1.9–13.3	0.001
Duration of cardiopulmonary bypass (min)	1.01	1.01–1.02	0.001
D0 minimum base excess (mmol/L)	0.8	0.7–0.9	0.010
D0 cumulative inotropic index	1.3	1.1–1.6	0.004
Administration of nitric oxide	4.1	1.5–11.3	0.007

Conclusions: Postoperative glucose levels were higher among patients who died after surgery. According to our results postoperative blood glucose levels in paediatric cardiac patients are not independent determinants of mortality.

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P-75

Infection and glucose levels in a postoperative paediatric cardiac unit

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Introduction: Diabetes mellitus and postoperative hyperglycaemia have been shown to predispose to serious infection after adult cardiac surgical procedures [1]. The relationship between blood glucose (BG) and serious infection has not been investigated after paediatric cardiac surgery [2].

Method: Medical records of 432 consecutive paediatric patients (median age: 15.1 months, range 0–656), admitted to our postoperative intensive care unit following cardiac surgery in a tertiary cardiac center between January 2003–December 2003 were retrospectively reviewed. Serious infection was defined as positive blood culture, catheter related or deep sternal wound infection. Early (⩽5 days) and late (>5 days) infections were analysed separately. Univariate analyses and multivariate logistic regressions were performed.

Results: There were 20 deaths (4.6%), 77 patients with cardiac failure (17.8%), 22 with renal failure requiring dialysis (5.1%) and 46 with non-vascular pulmonary dysfunction (10.6%). 39 early and 45 late infections were recorded. Multiple models for infections are shown below.

	OR	95% CI
Early infection		
Weight (kg)	1.14	1.05–1.23
Height (cm)	0.94	0.90–0.98
Previous operations (no.)	1.71	1.06–2.78
Intra-operative transfusion (mL kg^{-1})	1.01	1.00–1.02
CPB time (min)	1.01	1.00–1.01
Fever on POD1 (>39°C)	2.72	1.10–6.76
Lowest BG level on POD1 (10 mg dL^{-1})	0.85	0.72–0.99
Late infection		
Delayed chest closure	8.33	3.17–21.9
Pleural fluid on POD2	3.25	1.27–8.23
Highest BG level on POD1 (10 mg dL^{-1})	1.10	1.01–1.19

OR: odds ratio; CI: confidence interval; CPB: cardiopulmonary bypass; POD1, POD2: first and second postoperative day.
Low BG levels were associated with early infections ($P = 0.02$), whereas high levels predicted late complications ($P = 0.02$).

Discussion: Disturbances of glucose homeostasis are associated with an increased rate of infection complications in the paediatric postoperative critical care unit.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

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P-76

Risk factor analysis of infections developing after open heart surgery

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Introduction: Infection development after open heart surgery prolongs hospitalization time, increases costs and also causes a severe increase in mortality [1]. To protect from infection after open heart surgery, we must analyse correctly and eliminate preventable risk factors.
Method: 1000 consecutive patients who had open heart surgery since January 2002 in our hospital were followed. Data collection included the following factors: preoperative (age, sex, hospitalization time, emergency operation, ASA scores, DM (diabetes mellitus), hypertension, smoking, non-cardiac infections); intra-operative (operation time, bypass time, cross-clamp time, operation room laminar flow air conditioning); postoperative (intubation time, nutrition, antibiotics, complications). Hospital infections definitions were determined according to CDC (Centre of Disease Control) criteria. T test and chi-squared test were used in the univariate analysis. To determine independent risk factors multivariate logistic regression analysis was used.
Result: Sites of Infection and ratios are respectively, surgical (4.2%), nosocomial pneumonia (2.4%) catheter infections (0.6%), urinary tract (0.2%), bacteraemia (0.8%), other (1%), total (9.2%). Sex, ASA score, preoperative hospitalization time, use of antibiotics, blood transfusion, operation time, bypass time, cross-clamp time, intra-aortic balloon pump, inotropic medications, intubation time, enteral or parenteral nutrition in the postoperative period, use of steroids, re-operation, re-admission to ICU, presence of any complications, duration of ICU stay, use of blood and blood products were defined as risk factors in the univariate analysis. Independent risk factors are shown in the table.

Table 1. Independent risk factors in development of infection.

VARIANT	OR	*P* value	95% CI
Female sex	1.7	0.038	1.03–2.82
EF < 40%	3.8	0.002	1.7–8.7
Absence of laminar flow	1.8	0.002	1.1–2.9
Re-admission to ICU	3.3	0.015	1.3–8.7
Prolonged ICU stay	1.04	0.039	1.0–1.7

Discussion: Postoperative infection ratio in cardiac surgery units vary from 2–50%. Patients during the early post operative period are very dependent on hospital staff, so the probability of direct contact with hospital staff is high, increasing the infection risk. Either mechanical ventilation or i.v. catheter usage increases device associated hospital infection ratio. Female patients with EF < 40% are at higher risk for infection in the postoperative period. We must watch these patients more closely. On the other hand, the presence of laminar flow in the cardiac surgery operation room clearly decreases infection risk.
Reference:
1 Kollef MH, Sharpless L, Vlasnik J, et al. The impact of nosocomial infections on patient outcomes following cardiac surgery. *Chest* 1997; **112**: 666–675.

P-77

Risk factors for death of patients following pre-hospital cardiac arrest due to myocardial infarction

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Introduction: Survival rate after pre-hospital cardiac arrest ranges between 2 and 80% [1,2]. The aim of the study was to evaluate the prognostic value of serum lactate concentration (SLC) and cardiac index (CI) in patients following pre-hospital cardiac arrest due to myocardial infarction treated pharmacologicaly.
Method: The study group comprised 50 unconscious, consecutive patients, admitted to the Intensive Cardiological Care Unit (ICCU), following pre-hospital, sudden cardiac arrest due to myocardial infarction. The study group comprised 16 (32%) female and 34 (68%) male patients, average age 64.3 (29–92) years. SLC and CI were measured during days 1, 2, 3, 4, 5, 6, 7 and 14 of hospitalization. The results were statistically analysed (logistic regression) in order to determine the influence of particular parameters on the risk of death (receiver-operating characteristic curve, ROC).
Results:

	Cardiac Index (L min^{-1} m^{-2})					SLC (mmol/L)				
	Died		Survived			Died		Survived		
Day	n	Mean	n	Mean	*P*	*n*	*Mean*	*n*	*Mean*	*P*
1	37	2.0	13	2.5	0.00	37	6.7	13	2.7	0.00
2	24	2.0	13	2.9	0.00	24	5.9	13	1.8	0.00
3	15	2.1	13	3.0	0.00	15	3.7	13	1.5	0.00
4	12	2.2	13	2.9	0.00	12	3.7	13	1.2	0.00
5	11	2.1	11	2.9	0.00	11	3.6	11	1.3	0.00
6	11	2.1	11	2.8	0.00	11	5.6	11	1.2	0.00
7	4	2.1	11	2.9	0.06	4	3.7	11	1.1	0.09
14	2	2.5	5	2.8	0.70	2	1.3	6	1.0	0.18

The area under the ROC for SLC on the first day of hospitalization as a risk factor of death was 0.93 with cut-off value 6 mmol/L, which allows that parameter to be identified as an independent risk factor of death. CI on the first day of hospitalization was not found as an independent risk factor of death.
Discussion: CI measurements determine the dynamism of disease progression and SLC values determine prognosis considering patients following pre-hospital cardiac arrest.
References:
1 Bachman JW, McDonald GS, O'Brien PC. A study of out-of-hospital cardiac arrests in northeastern Minnesota. *JAMA* 1986; **25**; 477–483.
2 Dodek PM, Wiggs BR. Logistic regression model to predict outcome after in-hospital cardiac arrest: validation, accuracy, sensitivity and specificity. *Resuscitation* 1998; **36**: 201–208.

P-78

Analysis of renal dysfunction after cardiac surgery based on measured creatinine clearance

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Introduction: Renal injuries are frequent during cardiac surgery and renal dysfunction increases morbidity and mortality after cardiac surgery [1]. Determination of risk factors and renal function can be of value in these patients.
Method: We studied the changes of measured creatinine clearance (MCC) during the 3 postoperative days in 172 patients scheduled for cardiac surgery. Creatinine clearance was measured at T0, T1 and T3 respectively before surgery, one day and 3 days after. Renal dysfunction was determined by a MCC decrease of 25%. Perioperative data and events were noted. Patients were grouped according to a MCC decrease of 25% or not and pre-existing renal insufficiency. Cockcroft-Gault calculated clearance CGCC was compared to preoperative MCC. Statistical analysis was by multivariate analysis ($P < 0.05$) and regression analysis between CGCC and MCC.
Results: 30% of the patients (n = 51) have preoperative renal insufficiency (RI group) defined as a MCC less than 60 mL/min.

Table 1. Postoperative renal dysfunction in RI and NRI Groups.

	RI group 30% n = 51	NRI group 70% n = 121	Total 172
Renal dysfunction at T1	27% n = 14	42% n = 51	38% n = 65
Renal dysfunction at T3	19% n = 10	42% n = 51	35% n = 61

Table 2. Creatinine, MCC and MCC variation in patients with renal dysfunction.

	T0	T1	T3
Creatinine (μmol/L)	97 + 35	97 + 53	106 + 9
MCC (mL/min)	99 + 48	42 + 24	54 + 31
Delta MCC (%)		−56 + 20	−54 + 19

Multivariate analysis showed that female gender, CPB duration (>2 h), blood transfusion (>2 red packed cells), were statistically linked with renal

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

dysfunction after cardiac surgery. Hospital stay was increased in patients with a renal dysfunction (11 ± 5 vs. 15 ± 6 days $P < 0.05$).

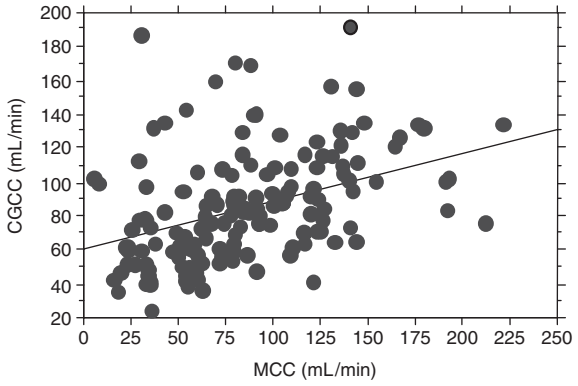

Figure. Relation between preoperative CGCC and MCC. CGCC and MCC have a weak relation ($r = 0.392$ $P < 0.01$).

Discussion: Renal dysfunction after cardiac surgery is not more frequent in patients with preoperative RI. Some RI patients improve their haemodynamic status during surgery that can explain these results. CPB duration, female gender and transfusion are risk factors of renal dysfunction. Patients with a 25% decrease of MCC have an increased hospital stay. Preoperative assessment of renal function by the Cockcroft-Gault calculated method underrates renal dysfunction before cardiac surgery.

Reference:

1 Wang F, Dupuis JY, Nathan H, et al. An analysis of the association between preoperative renal dysfunction and outcome in cardiac surgery: estimated creatinine clearance or plasma creatinine level as measures of renal function. *Chest* 2003; **124**(5): 1852–1862.

P-79

Incidence of tracheostomy in different groups of cardiac surgical operations

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Introduction: Patients (pts) undergoing major cardiac surgery need prolonged mechanical ventilation (MV) (>72 hr) in 3–9.9% of cases and half of them undergo tracheostomy (T) [1]. We conducted this study to assess whether any variability in T incidence exists between different cardiac surgical operation sub-groups.

Method: On all pts admitted to our ICU since January 1997 through to June 2004, we collected (1) demographics, surgical operation type and gravity score (CRS, CCS, NYHA), (2) risk factors and underlying illnesses, (3) ICU and hospital length of stay, (4) cardiopulmonary by-pass (CPB) and aortic cross clamp (ACC) times, (5) MV and presence of T. SPSS was used for statistical analyses. Continuous variables were compared using non parametric tests, while differences in proportions with chi-squared test. Cumulative Kaplan-Meier curves were constructed using the log-rank method to assess survival differences in different sub-groups. $P < 0.05$ was considered significant. Indication for T (Griggs technique) was a reasonably supposed or certain probability of prolonged MV [2].

Results: A total of 5015 pts [M:F = 2.5:1, median (IQR) age 67 (59–73) yr] were admitted to our ICU and stratified in four different sub-groups (Table).

	CABG	Valve	Combined	Other**	*P* value
Pts	3269 (65.2%)	809 (16.1%)	357 (7.1%)	580 (11.6)	
T (%)	57 (1.7%)	16 (2.3%)	20 (4.5%)	19 (2.3%)	<0.005
Age*	66	65	71	65	<0.005
ACC*	59	82	102	69	<0.005
CRS*	3	5	6	5	<0.005

*median. **other operations: ASD, VSD, aorta aneurysm.

112 pts underwent a percutaneous T. Stratifying pts according to surgical operation type, we found a lower T rate in pts undergoing CABG 1.7% (57 pts) than in others. Moreover pts undergoing CABG were younger, had a shorter ACC time, were less sick if compared with pts of other groups (table). Kaplan-Meier plots showed a lower survival among T pts (log-rank = 370.35, $P < 0.05$) and a lower survival in T pts undergoing combined operation (log-rank = 9.38, $P < 0.05$). Neither early nor late T complication occurred in any pts group.

Conclusion: This audit allowed us to define that patients undergoing CABG are less likely to undergo T than other cardiac surgical operation subgroups. Further prospective studies are warranted to corroborate our results.

References:

1 Bezanson JL, et al. Presurgical risk factors for late extubation in Medicare recipients after cardiac surgery. *Nurs Res* 2004; **53**(1): 46–52.

2 Ambesh SP, Pandey CK, Srivastava S, et al. Percutaneous tracheostomy with single dilatation technique: a prospective, randomized comparison of Ciaglia blue rhino versus Griggs' guidewire dilating forceps. *Anesth Analg* 2002; **95**(6): 1739–1745.

P-80

Cohort study on outcome after pre- or intra-operative IABP use in cardiac surgery

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Introduction: The use of the Intra-Aortic Balloon Pump (IABP) is a widespread technique during the perioperative period to support patients with low cardiac output or with difficulty in weaning from the extracorporeal circulation (ECC) [1]. The aim of our study was to analyse mortality in a cardiac surgery population with and without IABP.

Method: We have examined a population of 6164 patients aged more than 18 who underwent a cardiac operation. 224 patients were supported by IABP, preop (n = 65) for haemodynamic instability after cardiac catheterization or acute cardiac failure and intra/postop (n = 159) mostly for difficult weaning from ECC. We compared 2 groups, IABP and no-IABP. In both we have examined the relation between the use of IABP and the mortality at different EuroSCORE values. Univariate analysis was done by ANOVA and chi-squared test. Multivariate analysis was done by COX regression analysis. Data are presented as mean with SD (SD).

Results: Demographic characteristics are the following: of 4040 men and 2124 women respectively 3.7% and 3.4% received IABP, mean BMI was 26.6 for IABP and 26.4 for no-IABP, mean EuroSCORE was 21.8 for IABP and 7.4 for no-IABP ($P < 0.001$). Diagnostic categories were 62% isolated coronary, 14% valvular/rare conditions and 24% combined interventions. Odds for IABP were 1:4 in patients with preop ejection fraction (EF) < 30%, 1:18 with EF 30–50% and nearly 1:100 with normal EF.

Both pre- and intra/postOP IABP patients had significantly higher mortality rates than no-IABP (figure) ($P < 0.001$). At all EuroSCORE risk levels IABP use was associated with an increased risk of death.

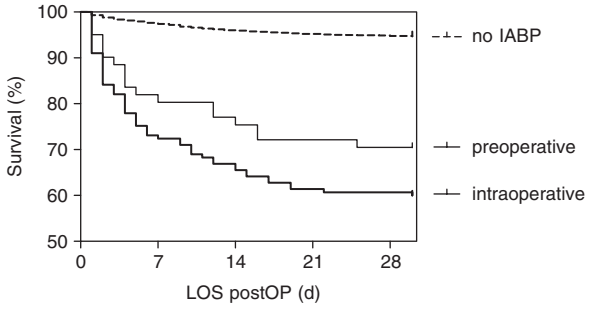

Figure.

Discussion: In this cohort study we found that there is no difference between pre- and intra/postOP IABP and that IABP use is associated with high mortality. We think that this finding may be explained by the IABP use as treatment rather than prophylaxis in this high risk population.

Reference:

1 Baskett RJ, Ghali WA, Maitland A, et al. The intraaortic balloon pump in cardiac surgery. *Ann Thorac Surg* 2002; **74**(4): 1276–1287. Review.

P-81

Prone position ventilation in acute respiratory distress syndrome after major surgery

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Introduction: Acute respiratory distress syndrome (ARDS), accompanied by severe hypoxaemia, uncommonly complicates the postoperative course [1]. Prone position ventilation (PPV) may improve oxygenation [2,3].

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Method: Between 01/01/2003 and 30/06/2004 we retrospectively studied the safety, feasibility and efficacy of PPV for severe hypoxaemia after major surgery.

One way analysis of variance with Bonferroni *post hoc* test was performed for multiple comparisons and Chi squared test was used to compare percentages.

Results: Clinical characteristics of 17 patients were: age 74.4 ± 5.5 years, 11 males, SAPS II the day of PPV 44.5 ± 8.9, number of organ failures using Organ Dysfunction and Infection model 2.9 ± 0.8. Surgical procedures were: cardiac (n = 12), vascular (n = 3) and thoracic (n = 2). PPV was performed after 4.5 ± 5.5 days of mechanical ventilation. Causes of ARDS were: cardiopulmonary bypass (n = 6), unknown (n = 5), pneumonia (n = 3), sepsis (n = 2), transfusion lung injury (n = 2) and aspiration (n = 1). Mean duration of PPV was 17 ± 4 hours. PaO_2/FiO_2 ratio variation are shown in the table.

	SP baseline	PP	SP (1 hour)	SP (Day 1)	*P* value
PaO_2/FiO_2 mmHg	103 ± 36	205 ± 93*	149 ± 63*°	187 ± 66*†	<0.0001

*$P < 0.05$ vs. SP baseline; °$P < 0.05$ vs. PP; †$P < 0.05$ vs. SP (1 hour after supine repositioning)

The ratio improved in all patients during PPV. One hour after supine repositioning, only 4 patients conserved the prone position improvement. Mean $PaCO_2$ remained stable (42 mmHg). Tidal volume in PP or SP was comparable (8 ± 1 mL/Kg) and adapted to obtain an inspiratory plateau pressure < 30 cm water. Positive end expiratory pressure was more frequently applied in PP than SP (13/17 vs. 11/17, respectively; $P = 0.1$), with a higher value (8.5 ± vs. 9.5 ±, respectively; $P = 0.1$). No complication occurred during mobilization. Three patients developed cutaneous complication on the face without aesthetic sequelae. Hospital mortality rate was 47%, with 18 ± 10 days of mechanical ventilation and an intensive care length of stay of 22 ± 11 days.

Conclusion: Severe hypoxaemia after cardiovascular and thoracic surgery may be corrected by prone position ventilation without severe complication but the effect seems transitory.

References:

1 Milot J, Perron J, Lacasse Y, et al. Incidence and predictors of ARDS after cardiac surgery. *Chest* 2001; **119**: 884–888.
2 Langer M, Mascheroni D, Marcolin R, et al. The prone position in ARDS patients. A clinical study. *Chest* 1988; **94**: 103–107.
3 Gattinoni L, Tognoni G, Pesenti A, et al. Effect of prone positioning on the survival of patients with acute respiratory failure. *N Engl J Med* 2001; **345**: 568–573.

P-82

Low oxygen delivery during cardiopulmonary bypass and postoperative acute renal failure in coronary operations

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Introduction: The lowest haematocrit (HCT) on cardiopulmonary bypass (CPB) has been recognized as a risk factor for postoperative acute renal failure (ARF) in coronary patients [1,2]. Lowest HCT and pump flow are the two determinants of oxygen delivery (DO_2) during CPB. The present study addresses the specific role of pump flow, lowest HCT and lowest DO_2 during CPB in determining postoperative ARF (need for renal replacement therapy) in adults undergoing coronary surgery with CPB.

Method: 1,048 consecutive patients scheduled for surgical coronary revascularization have been admitted to this prospective observational study conducted during six months of activity in our Institution. Exclusion criteria were chronic dialysis treatment and off-pump cardiac surgery.

Results: 28 patients (2.6%) met the criteria for ARF. At a univariate analysis patients with ARF were significantly older, had a higher preoperative serum creatinine level, a higher rate of chronic obstructive pulmonary disease (COPD) and diabetes, and received a longer CPB procedure. Lowest HCT on CPB, pump flow indexed, DO_2 indexed on CPB were significantly associated with ARF. At a multivariate analyses the lowest pump flow indexed ($P = 0.004$), the lowest HCT on CPB ($P = 0.004$) and the lowest DO_2 indexed ($P = 0.001$) were independent risk factors for ARF. To explore the predictive value of each one of the study variables, a ROC analysis with ARF as target variable to be predicted was applied. The best predictor was the DO_2 indexed, with an area under the curve (AUC) of 0.76 and a cut-off value placed at 272 $mL\,min^{-1}\,m^{-2}$ (sensitivity 68%, specificity 68%). DO_2 indexed remained an independent risk factor for ARF even considering the transfusion risk factor.

Discussion: This study confirms the association between lowest HCT on CPB and adverse renal outcomes in coronary operations, but attributes a higher predictive value to the lowest DO_2 indexed on CPB. These data support the hypothesis of "ischaemic" damage of the kidney during CPB as a possible basis for postoperative renal dysfunction or ARF.

References:

1 Ranucci M, Pavesi M, Mazza E, et al. Risk factors for renal dysfunction after coronary surgery: the role of cardiopulmonary bypass technique. *Perfusion* 1994; **9**: 319–326.
2 Swaminathan M, Phillips-Bute BG, Conlon PJ, et al. The association of lowest hematocrit during cardiopulmonary bypass with acute renal injury after coronary artery bypass surgery. *Ann Thorac Surg* 2003; **76**: 784–792.

P-83

OPCAB, CABG and cost of ICU stay after cardiac surgery

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Introduction: Postoperative complications increase the cost of ICU stay. Off-pump coronary artery surgery (OPCAB) is thought to cause less postoperative complications [1]. The aim of this study was to compare total cost and length of ICU stay in OPCAB and CABG patients with various ranges of preoperative EuroSCORE (ES).

Method: Individual costs of ICU stay (intermediate unit costs excluded) of 788 consecutive adult patients who underwent first-time coronary revascularization over a 10 months period were calculated. Individual data for each patient were extracted from hospital laboratory, X-ray department, records department, pharmacy and blood bank and then added, creating total cost of ICU stay for each individual patient. Salaries of the ICU personnel and maintenance costs were not included. Local currency (Polish zloty) was converted to Euros to enable comparisons with other European countries (exchange rate for 13.12.2004). Length of ICU stay for each patient was extracted from the database and cost of 24 hours of ICU stay was calculated. Descriptive statistics and t-test were used. $P < 0.05$ was considered significant. Data are expressed as mean ± SEM.

Results: Duration of ICU stay, mean total ICU cost and mean daily ICU cost stay was lower in all OPCAB patients. Comparing patients in the same ES ranges, OPCAB patients generated less cost only in ES range 3–5 (see table below).

	ES	n (%)	ICU (hours)	Total ICU cost (Euro)	Daily ICU cost (Euro)
CABG	all	477 (61%)	42 ± 2	280 ± 20	161 ± 3
OPCAB	all	311 (39%)	*31 ± 2	*196 ± 14	*150 ± 5
CABG	0–2	169 (64%)	30 ± 2	193 ± 15	156 ± 4
OPCAB	0–2	96 (36%)	27 ± 2	164 ± 16	146 ± 5
CABG	3–5	205 (57%)	44 ± 4	305 ± 37	161 ± 4
OPCAB	3–5	156 (43%)	*30 ± 2	*175 ± 15	*139 ± 3
CABG	⩾6	103 (64%)	56 ± 7	374 ± 48	168 ± 7
OPCAB	⩾6	59 (36%)	41 ± 6	304 ± 53	183 ± 23

*$P < 0.05$ – OPCAB vs. CABG

Conclusion: OPCAB patients with ES 3–5 have lower length of ICU stay and generate lower cost. OPCAB and CABG patients with ES 0–2 and ⩾6 are not significantly different in this regard.

Reference:

1 Cheng DC, Bainbridge D, Martin JE, et al. Evidence-Based Perioperative Clinical Outcomes Research Group. Does off pump coronary artery bypass reduce mortality, morbidity, and resource utilization when compared with conventional coronary artery bypass? A meta-analysis of randomized trials. *Anesthesiology* 2005; **102**: 188–203.

P-84

Abdominal complications associated with cardiac surgery

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Introduction: Gastrointestinal complications (GIC) after cardiac surgery are associated with a high mortality [1]. Because of the absence of early specific

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

clinical signs, diagnosis is often delayed. This retrospective study aims to describe patients with GIC after cardiac surgical procedures.
Method: Retrospective analysis of all patients who underwent cardiac operation at our institution during 3 years (2001–2003) was performed in a search for GIC in the postoperative period. Patients were divided into group A (GIC) and group B (no GIC). Data were extracted from the hospital database. Student's *t* test and χ^2 test were used for statistical analysis
Results: 4606 patients underwent cardiac surgery and 74 patients (1.6%) were identified with GIC. Patients with GIC underwent: coronary artery surgery (47 pts), combined valve replacement and coronary artery surgery (19 pts), aortic aneurysm resection (4 pts) and heart transplantation (4 pts). 26 patients needed laparotomy and 48 patients did not. Mortality was 84% for laparotomy patients and 67% for conservatively treated patients ($P = 0.12$). In 17 patients (23%) GIC was related to the patient's terminal condition and appeared only at post-mortem examination in the form of diffuse bowel ischaemia. Results are shown in a table below. Early re-thoracotomy in group A was performed mostly because of bleeding (19/74 pt) or myocardial ischaemia (11/74 pt).

	Group A (n = 74)	Group B (n = 4532)	*P*
Age (years)	64 ± 8	59 ± 11	<0.001
EuroSCORE	5.4 ± 3.2	3.9 ± 2.8	<0.001
Off-pump surgery	14.9%	34.7%	<0.01
Death	68.9%	3.4%	<0.0001
Early re-thoracotomy (<7 days)	60.5%	8.8%	<0.0001
Postoperative ischaemia	13.8%	1.5%	<0.0001
Perioperative cardiac arrest	29.1%	0.9%	<0.0001
Renal replacement therapy	60.0%	1.5%	<0.0001
IABP support	58.2%	5.4%	<0.0001

Conclusion: GIC are rare, but carry very high mortality. Patients with early re-thoracotomy, ischaemia or low cardiac output state are at risk of developing GIC in the postoperative period.
Reference:
1 Poirier B, Baillot R, Bauset R, et al. [Abdominal complications associated with cardiac surgery. Review of a contemporary surgical experience and of a series done without extracorporeal circulation.] *Can J Surg* 2003; **46**: 176–182. French.

Cardiac Surgery

O-85

The addition of sevoflurane to propofol-fentanyl anaesthesia does not decrease the elevation of cardiac enzymes after cardiac surgery

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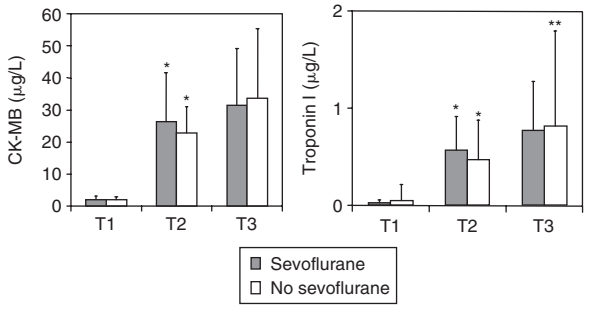
Introduction: Sevoflurane has been shown to protect the heart against ischaemia and reperfusion injury in patients undergoing coronary surgery [1]. Our study was aimed to assess whether the addition of sevoflurane to intravenous anaesthesia reduces the elevation of cardiac enzymes as markers of myocardial injury after c-ardiac surgery.
Method: Elective cardiac surgery patients were randomly divided into two groups. In both groups anaesthesia was induced with midazolam, propofol, fentanyl and pancuronium. In the P group anaesthesia was maintained with propofol and fentanyl during the whole operation. In the S group sevoflurane (1–1.5%) was added to propofol-fentanyl anaesthesia before and after cardiopulmonary bypass. Serum troponin I and CK-MB concentrations were measured before (T1) and after surgery (T2) and on the first postoperative day (T3). Statistical analysis was done using the ANOVA test for repeated measurements, Student's *t*-test and χ^2.
Results: We studied 55 patients (28 in the P group and 27 in the S group). 28 patients were operated for CABG, 15 for valve surgery and 11 for combined procedures. There were no differences between the groups in demographic data, and the duration of operation and cardiopulmonary bypass (CPB). The serum concentrations of troponin I and CK-MB increased significantly after surgery in both groups but there were no difference between the groups. A further significant increase in the troponin I concentration was measured 24 h after surgery only in the P group but there was no difference in troponin I concentration between both groups. There were no differences in the time to extubation and in the length of stay in the ICU between both groups.



Discussion: Our study showed that no additional cardiac protection was observed during cardiac surgery if sevoflurane 1–1.5% was added to intravenous propofol-fentanyl anaesthesia before and after CPB. In contrast to other studies, we included patients scheduled for CABG as well as valve surgery.
Reference:
1 De Hert SG, ten Broecke PW, Mertens E, et al. Sevoflurane but not propofol preserves myocardial function in coronary surgery patients. *Anaesthesiology* 2002; **97**: 42–49.

P-86

Impact of transfusion on time to extubation

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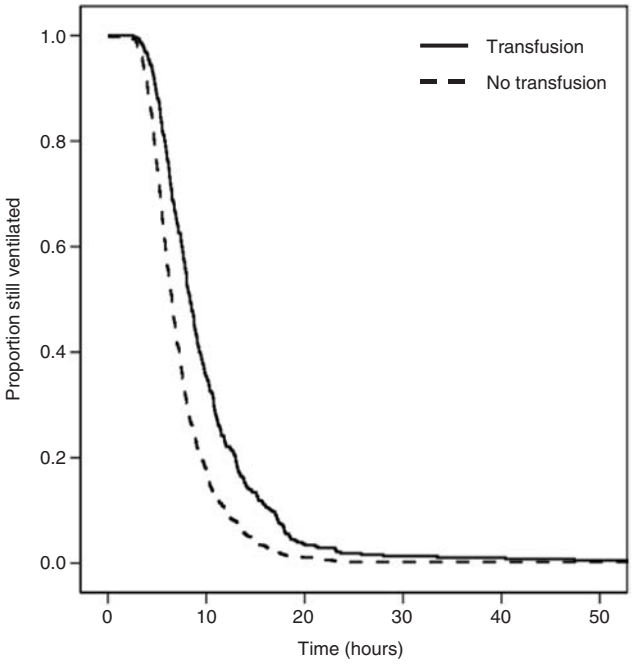
Introduction: Blood transfusion has been identified as one of the predictors of prolonged mechanical ventilation after coronary artery bypass graft surgery [1]. By analysing data from our continuous prospective audit of blood transfusion, we aimed at evaluating the impact of allogeneic transfusion on the time to extubation in our practice.
Method: With IRB approval, data obtained from 1229 patients who underwent elective cardiac surgery between January 2003 and May 2004 and bled less than 400 mL in the first four postoperative hours were included in this analysis. Transfusion was administered according to institutional strict guidelines (haemoglobin <8.5 g/dL or haematocrit <20%, compliance monitored at above 90%). Postoperative respiratory care (including decision to extubate) was led by senior nurses in accordance to our institutional guidelines. Data are described as median with inter-quartile range (IQR). Non-parametric tests were employed for statistical analysis of data. Groups were compared by Cox proportional hazard model.
Results: Three hundred and seventy nine of the study patients (31%) received a transfusion. In the transfused group, the extubation time was higher (500 min, IQR 370–690) compared to the non-transfused group (390 min, IQR 300–520; $P < 0.05$).



https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Transfused group was older, with higher EuroSCORE, lower BMI and lower haemoglobin compared to the non-transfused group. After adjusting for these covariates, transfusion was still associated with a 28% increase in median time to extubation (risk ratio 0.71; 95% confidence interval 0.62 to 0.81; $P < 0.001$).

Discussion: In this review of our audited practice, we observe that transfusion delayed extubation. It is therefore possible that transfusions may hinder the process of weaning from mechanical ventilation.

Reference:

1 Habib RH, Zacharias A, Engoren M. Determinants of prolonged mechanical ventilation after coronary artery bypass grafting. *Ann Thorac Surg* 1996; **62**: 1164–1171.

P-87

Aprotinin does not decrease allogeneic blood transfusion in patients undergoing on-pump CABG with the use of a cell saver

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Introduction: It was shown that aprotinin (A) reduces blood loss, thus decreasing the need for allogeneic blood transfusions [1]. It may not be so effective in the presence of other blood saving measures. The purpose of this study was to investigate the efficiency of intra-operative A administration on blood loss and transfusion requirements in patients undergoing on-pump CABG with the use of a cell saver.

Method: In a prospective, randomized clinical trial 73 patients (elective coronary bypass grafting with CPB) were assigned to one of three groups: group A6 (n = 25) received A intraoperatively in a total dose of 6×10^6 KIU. 1×10^6 KIU of A was infused before incision, next 2×10^6 KIU of A during surgery before CPB, and an additional dose of 3×10^6 KIU A was added to the pump prime. Group A3 (n = 24, total dose of A3 $\times 10^6$ KIU) was treated with A as for A6 before CPB, but A was not added to the pump prime. Group A0 (n = 24) did not receive A. A non-pulsatile roller pump (Cobe, USA) and hollow-fibre oxygenator (Terumo, Japan) were used in all patients ($2.5\,L\,min^{-1}\,m^{-2}$, t 34–35°C). In all patients the cell saver (Cell Saver5, Hemonetics®) was used intraoperatively. The results were statistically analysed using ANOVA, chi-squared test or Fisher's exact-test (two-tailed) for categorical variables, and expressed as M ± SD.

Results: Groups did not differ significantly with respect to preoperative premedication and surgical data, infusion therapy, Hb, Ht or erythrocyte count pre- and postoperatively. No patient needed re-exploration for bleeding and nobody receive FFP or thrombocyte transfusions. Bank blood was transfused in 2 patients in group A6 (270 ± 184 mL), and in 1 patient in group A3 (320 mL). In group A0 nobody receive allogeneic transfusions, $P > 0.05$. Results are summarized in the table.

	A6	A3	A0
Op. (mL)	282.9 ± 127.0	325.1 ± 195.2	293.2 ± 83.3
Op. (mL/kg)	3.4 ± 1.3	3.9 ± 2.0	3.6 ± 0.9
Post. (mL)	412.3 ± 147.2	525.5 ± 238.8	601.8 ± 187.6**
Post. (mL/kg)	5.2 ± 2.2	6.4 ± 2.9	7.4 ± 2.5**
C.S (mL)	1180 ± 220.5	1232 ± 395.2	1414 ± 354.9**
C.S (mL/kg)	14.8 ± 4.3	15.0 ± 4.4	17.4 ± 4.8*
Ht preop. (%)	39.7 ± 4.1	41.5 ± 3.7	41.1 ± 2.7
Ht 1 day post	34.7 ± 5.0	36.0 ± 4.4	35.2 ± 4.0
Ht 2 day post	33.0 ± 5.0	34.9 ± 3.2	33.8 ± 4.5
Ht 3 day post	33.2 ± 6.0	32.9 ± 5.7	32.0 ± 4.7
Ht discharge	36.2 ± 3.5	33.5 ± 4.4	35.7 ± 4.9

Op. – intraoperative blood loss; Post. – postoperative blood loss; C.S – intraoperative cell saver reinfused erythrocyte volume; vs. A6 *P <0.05 **P <0.01

Conclusion: In our study only 6×10^6 KIU of A clearly diminished postoperative blood loss, but neither aprotinin regimens reduced the need for allogeneic transfusions.

Reference:

1 Laupacis A, Fergusson D. Drugs to minimize perioperative blood loss in cardiac surgery: meta-analyses using perioperative blood transfusion as the outcome. The International Study of Peri-operative Transfusion (ISPOT) Investigators. *Anesth Analg* 1997; **85**: 1258–1267.

P-88

Incidence and risk factors analysis of neurologic complications after cardiac surgery

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Introduction: Cerebral complications seriously increase the mortality and morbidity rate after cardiac surgery [1]. The aim of this study was to determine the risk factors and incidence of neurologic complications in patients undergoing cardiac surgery.

Method: 1119 patients who had operations between January and July 2004 were prospectively followed to determine the neurologic complications. Neurologic complications were defined as focal neurologic deficits, confusion/coma and postoperative delirium. The statistical analysis was realised by t-test for parametric variables and chi-squared test for nonparametric variables. $P < 0.05$ was considered statistically significant. Logistic regression model was used to analyse multiple covariates.

Results: Cerebral complications were recognized in 36 of the 1119 patients after cardiac surgery (3.2%). They were hemiparesis or hemiplegia in 12 patients, post operative delirium in 15 patients, coma in 8 patients and visual defect in 1 patient. When we compared the demographic data and the associated diseases between the groups, patients with cerebral complications were significantly different in age, having diabetes mellitus (DM), hypertension and carotid artery disease from the patients without cerebral complications ($P < 0.001$). There were no differences between the groups in operation type (coronary artery bypass grafting, valve replacement or combined), off-pump or on-pump surgery. However there were significant differences between the groups in operation, bypass and cross clamping times and re-operation because of bleeding rate ($P < 0.001$). Mortality rate was significantly higher in patients with cerebral complications ($P \leqslant 0.001$).

Table. The independent risk factors of developing cerebral complications

Variables	Beta	P value	Odds ratio (%95 CI)
Age >65	1.41	0.001	4.11 (1.8–9.2)
DM	1.45	<0.001	4.3 (1.9–9.5)
Carotid arterial disease	2.71	<0.001	15.05 (6.2–36)
Re-operation due to bleeding	1.19	0.028	3.2 (1.13–9.5)

Discussion: The reasons for cerebral complications after cardiac surgery are complex and multifactorial. In our study especially, the situations that affect cerebral autoregulation were identified as independent risk factors. Therefore cerebral perfusion pressure and the factors that affect this pressure in patients over 65, with DM, hypertension or carotid arterial disease, should be followed more closely. In addition to this, re-operation after bleeding and associated hypotension can increase the cerebral complication rate.

Reference:

1 Ahlgren E, Arén C. Cerebral complications after coronary artery bypass and heart valve surgery: risk factors and onset of symptoms. *J Cardiothorac Vasc Anesth* 1998; **12**: 270–273.

P-89

Assessment of global oxygenation by cerebral oximetry following cardiac surgery

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Introduction: Cerebral oximetry ($CrSO_2$) is marketed for monitoring regional perfusion disturbances such as during carotid endarterectomy [1]. The goal of this study was to investigate $CrSO_2$ as a parameter of global oxygenation after cardiac surgery in adult patients with normal cranial Doppler examination.

Method: After obtaining ERB approval and written informed patient consent, $CrSO_2$ was measured by near infrared spectroscopy (INVOS 5100, Somanetics, USA) on the patient's forehead. Cerebral rSO_2 was recorded every 90–120 min for up to 8 hours. Correlation of rSO_2 to arterial (SaO_2), central-venous ($ScvO_2$), and mixed-venous ($SmvO_2$) oxygen saturation, cardiac index (CI), mean arterial pressure (MAP), haemoglobin concentration (Hb), time after surgery (t), and body temperature (bT) was determined by linear regression analysis ($P < 0.05$). Sensitivity and specificity of changes in rSO_2 to predict changes in $SmvO_2$ were calculated.

Results: 31 adult patients (158 measurements) were included. Mean (±SD) rSO_2 was 65% (±7%). Linear correlation coefficients of rSO_2 were: to SaO_2 ns, $ScvO_2$ 0.29, $SmvO_2$ 0.33, CI 0.28, MAP 0.23, Hb 0.51, t 0.34, bT 0.27 (ns = not significant, all others $P < 0.05$). Sensitivity and specificity of changes in rSO_2 to predict changes in $SmvO_2$ was 85% and 80%, respectively.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

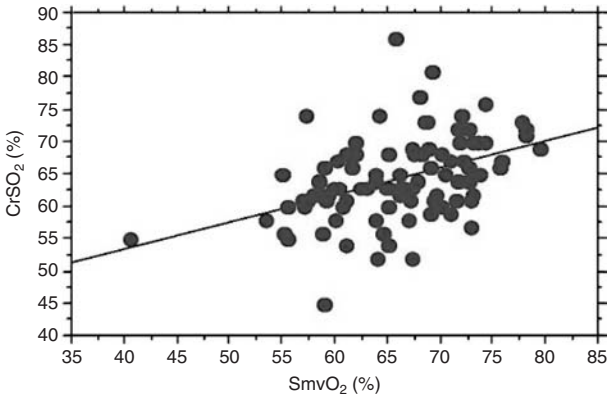

Figure. Cerebral rSO_2 against $SmvO_2$ (%).

Conclusion: $CrSO_2$ is more dependent on haemoglobin concentration and global haemodynamic function as measured by venous ($SmvO_2$) than on arterial oxygenation. The correlation of $CrSO_2$ with time after surgery and body temperature may be influenced by peripheral perfusion.

Reference:

1 Samra SK, Dy EA, Welch K, et al. Evaluation of a cerebral oximeter as a monitor of cerebral ischemia during carotid endarterectomy. *Anesthesiology* 2000; **93**: 964–970.

P-90

Paediatric patients in their first year of life undergoing corrective cardiac surgery exhibit an unusual pattern of cytokine response

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Introduction: Upon investigating children with congenital cardiac disease in their first year of life, having operations using cardiopulmonary bypass (CPB), it was found that these patients characteristically had two patterns of cytokine reactions.

Method: Eighteen children with congenital cardiac disease, undergoing surgery using CPB, were studied. There were 12 males and 6 females. The age ranged from 4 to 11.5 months. The average length of CPB was 87.6 ± 37.0 minutes. The patients included in this study had no clinical or microbiologic evidence of associated infection and were not receiving anti-inflammatory medication before surgical intervention. The presence of IL-6, IFN-γ, TNF-α, IL-10 were studied using electrochemiluminescence. The research covered the period before the operation, 24 hours after the operation, and three days after the operation. The local ethics committee approved the study.

Results: The children who were tested were then divided into two subgroups A and B. In the subgroup A (n = 9) the patients demonstrated a classic cytokine response (Fig. 2: Group A) with an increased level of almost all cytokines, tested one day after the operation. In all of these patients in the first day after the operation there appeared a systemic inflammatory response syndrome (SIRS). Among them there arose infection complications (77%; criterion χ^2; $P = 0.05$) more frequently than in subgroup B. In subgroup B the presence of all cytokines was significantly increased before the operation (IL-10 8115.7 ± 9734.9 pg/mL with a range from 246 to 23576.2 pg/mL). There was a decrease in the concentration of all cytokines on the first day after operation. Henceforth their concentration did not change, as measured on the third day (Fig. 1: Group B). These patients were noted to have a more favorable clinical outcome.

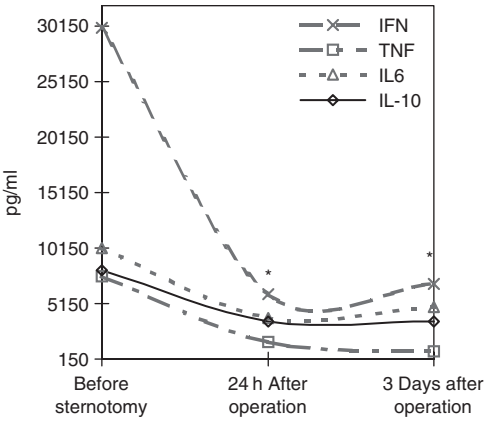

Figure 1. Group B

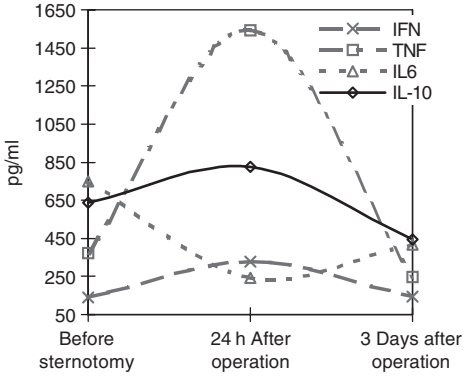

Figure 2. Group A

Discussion: No difference was found in clinical conditions preoperatively between the two groups. It is possible that the different cytokine levels are the result of genetic predisposition. In one study [1] an unusual cytokine pattern was described after CPB in newborns. The two types of cytokine reactions described above in cardiac surgical patients in their first year of life distinguish them both from newborns and from older age groups [2].

References:

1 Alcaraz AJ, Sancho L, Manzano L, et al. Newborn patients exhibit an unusual pattern of interleukin 10 and interferon gamma? serum levels in response to cardiac surgery. *J Thorac Cardiovasc Surg* 2002; **123**: 451–458.

2 Seghaye MC, Duchateau J, Bruniaux J, et al. Interleukin-10 release related to cardiopulmonary bypass in infants undergoing cardiac operations. *J Thorac Cardiovasc Surg* 1996; **111**: 545–553.

Anaesthesia – Analgesia

P-91

High thoracic epidural anaesthesia and analgesia in cardiac surgery – a retrospective study

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Introduction: According to many studies high thoracic epidural anaesthesia (TEA) offers many advantages over general anaesthesia in patients undergoing cardiac surgery [1,2]. On the contrary there is still an awareness of possible epidural haematoma formation with serious neurological consequences [3]. Studies concerning this problem are heterogeneous and refer to about 6000 patients altogether. Because of more than ten years experience with TEA we have decided to determine the risk of serious neurological complications associated with TEA.

Method: A single centre has performed a retrospective analysis of its patients who underwent cardiac surgery from 1995 to 2002. Primary end point was an incidence of spinal cord compression such as radicular back pain or progressive neurological deficit in patients who had cardiac surgery under combined general and TEA. A secondary end point was an incidence of combined unfavourable events. A comparison of outcome between the groups of patients with TEA and balanced anaesthesia was carried out.

Results: Records from 3966 patients were analysed. 1519 of them underwent cardiac surgery with TEA and 2447 patients were operated on using balanced general anaesthesia.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Table 1. Patient characteristics.

	TEA + GA group	GA group	*P*
Age	62.3 (8.9)	63.0 (9.1)	0.0150
Sex-male. %	79.2	75.6	0.0120
Weight. kg	81.2 (12.3)	80.8 (12.6)	NS
NYHA*	0 (2)	0 (2)	NS
EF < 40%. %	9.5	10.3	NS
Stroke. %	5.8	5.8	NS
COPD. %	9.9	10.2	NS
ECC. min*	72 (33)	75 (32)	<0.00001
Cross clamp. min*	35 (21)	37 (20)	NS
Valve surgery. %	7.9	12.7	<0.00001

In the TEA group no patient had developed a sign of spinal cord compression by the time of hospital dismissal. Patients in the TEA group were extubated earlier (4 hours of mechanical ventilation vs. 6 hours in GA group, $P < 0.00001$), but there was no statistically significant difference in other analysed data (mortality, ICU stay, incidence of stroke, arrhythmia, postoperative myocardial infarction, pulmonary and wound infection).

Table 2. Postoperative outcome.

	TEA + GA	GA	*P*
30 day mortality. %	1.8	2.4	NS
Mechanical ventilation. hr*	11 (7)	13 (8)	<0.00001
ICU stay. hours *	43 (29)	44 (34)	NS
Postoperative stroke. %	5.0	4.4	NS
Postoperative arrhythmia. %	31.1	31.8	NS
Postoperative MI. %	1.8	1.8	NS
Pulmonary infection. %	3.4	4.1	NS
Sternal infection. %	0.9	1.3	NS

TEA was insufficient in 81 cases (5% of all patients in TEA group). In this situation analgesia was supported with morphine i.v.

Discussion: General anaesthesia combined with TEA in cardiac surgery is safe and allows earlier extubation than general anaesthesia. Our study is compatible with others that have shown that peridural haematoma formation is an extremely remote possibility.

References:

1 Blomberg SG, Emanuelson H, Ricksten SE. Thoracic epidural anesthesia and central hemodynamics in patients with unstable angina pectoris. *Anesth Analg* 1989; **69**: 558–562.
2 Pastor MC, et al. Thoracic epidural analgesia in coronary artery bypass graft surgery: seven years' experience. *J Cardiothorac Vasc Anesth* 2003; **17**(2): 154–159.
3 Rosen DA, Hawkinberry DW 2nd, Rosen KR, et al. An epidural hematoma in an adolescent patient after cardiac surgery. *Anesth Analg* 2004; **98**(4): 966–969.

P-92

Thoracic epidural analgesia is beneficial after coronary revascularization

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Introduction: Epidural analgesia is increasingly used in cardiac anaesthesia. The goal of this study was to compare the course of inhalation anaesthesia and the early postoperative period after coronary revascularization with and without the use of thoracic epidural analgesia (TEA).

Method: Sixty stable patients were prospectively randomized to receive either TEA combined with general anaesthesia (group I, n = 30) or general anaesthesia alone (group II, n = 30) for coronary revascularization. 13 patients in group I and 14 patients in group II were revascularized off-pump. In group 1, epidural catheters were inserted at least 12 hours before the operation at the T1–T2 or T2–T3 level. Three analgesic solutions (S-1, S-2, S-3) were prepared: 0.25% bupivacaine (B) with 10 μg/mL fentanyl (F) (S-1), 0.19% B with 6.25 μg/mL F (S-2) and 0.125% B with 6.25 μg/mL F (S-3). S-1 was used before induction (9–10 mL), S-2 during anaesthesia (6–10 mL/h) and S-3 in the postoperative period (2–8 mL/h). Isoflurane-based anaesthesia was used. The observational period lasted 24 hours. Incidents of light sedation or pain were treated with repeated i.v. boluses of midazolam or morphine. Systolic blood pressure was kept in a range of 100–140 mmHg with the use of nitroglycerine infusion. Standard extubation and discharge from ICU criteria were used [1]. Haemodynamic stability (automatic recording of HR and BP), usage of interventional drugs as well as extubation and ICU times were compared with the use of ANOVA or Mann-Whitney test when appropriate and $P < 0.05$ was considered significant.

Results: Haemodynamic stability was comparable. Only the mean heart rate was significantly lower during anaesthesia. Recovery times and the usage of interventional drugs were different (see table, $^*P < 0.05$).

	Group I	Group II
Extubation (min)	*294 ± 166	589 ± 170
ICU stay (h)	*20 ± 8	29 ± 22
Hospital stay (days)	6 ± 2	7 ± 4
Morphine (mg)	*8 ± 5	18 ± 10
Nitroglycerine (mg)	*13 ± 10	35 ± 32

Conclusion: TEA combined with general anaesthesia is superior to general anaesthesia alone in our patients undergoing coronary revascularization.

Reference:

1 Woda RP, Michler RE. Postoperative care of the cardiac surgical patient. In: Hensley FA Jr, Martin DE, Gravlee GP eds. *A Practical Approach to Cardiac Anesthesia*. 3rd ed. Philadelphia: Lippincott Williams & Wilkins, 2003; 256–258.

P-93

Total spinal anaesthesia for coronary artery bypass grafting: are there any benefits over general anaesthesia?

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Introduction: Haemodynamic stability, optimization of myocardial energetics, simple technique, low costs and postoperative analgesia are target points for anaesthesia for CABG [1]. The aim of the study was to compare haemodynamics and assess safety of general anaesthesia (GA) with shallow GA combined with total spinal anaesthesia (TSA) in patients with normal left ventricular systolic performance undergoing elective CABG.

Method: This was a prospective study of two groups: Group 1 comprised 22 patients with TSA (intrathecal 0.5% bupivacaine 4 mL and 100 μg fentanyl, 30° Trendelenburg position, L2/L3/L4 puncture sites) and supplementary shallow GA; Group 2–23 patients with GA based on thiopental, fentanyl, pancuronium and O_2/sevoflurane. Intraoperative haemodynamics (arterial pressures, ventricular filling pressures, heart rhythm and rate) and body temperature (initial, 2 minutes after intubation, sternal split, aortic cannulation, 10 minutes after weaning from bypass, after sternal closure and at the end of the procedure) as well as fluid balances and anaesthetic and vasoactive drugs demands were compared. Postoperative haemodynamics, respiratory parameters and eventual complications due to TSA were evaluated. Data were demonstrated as mean values (M) and standard deviation (SD). Variation score (SD/M × 100%) was used as the index of parameter dispersion (or instability). For statistical analysis Student's *t* test and χ^2 tests were used.

Results: Arterial pressures after intubation and sternal split were significantly lower in group 1 than in group 2 (systolic 114.6 vs. 147.5 after intubation, $P < 0.001$; 103.0 vs. 128.1 after sternal split, $P < 0.001$). Heart rate after sternal split and during cannulation was lower in group 1 than in group 2 (70.9 vs. 82.2, $P < 0.05$ and 74.0 vs. 94.1, $P < 0.001$). Variation score for heart rate (10.9% vs. 13.4%) and systolic blood pressure (14.5% vs. 19.8%) from tracheal intubation to the end of the procedure showed better stability of haemodynamics in TSA patients ($P = 0.005$ for systolic blood pressure, not significant for heart rate). Body temperature drop before cardiopulmonary bypass was faster and more pronounced in group 1 (36.4®35.15 vs. 36.4®35.6°C). There were no differences in fluid balances between groups. Opioid and sevoflurane as well as vasodilation agent demands were significantly higher in group 2 than in group 1. Inotropic support was used in one case from group 2 when weaning from cardiopulmonary bypass (dobutamine 5 $\mu g\,kg^{-1}\,min^{-1}$). No statistical differences in ICU stay, time to extubation, postoperative myocardial enzymes levels and opioid demands between groups were demontrated. There were no post-puncture headaches or pruritus in any patient. Prolonged apnoea reversed by low-dose naloxone due probably to brain-stem action of intrathecal fentanyl in one group 1 patient was the only complication that could be referred to TSA

Conclusion: Total spinal anaesthesia supplemented by shallow general anaesthesia for elective CABG in patients with normal left ventricular systolic performance may be (in the absence of contraindications) an attractive alternative to various techniques of general anaesthesia as it provides safe, predictable and cheap anaesthesia and very stable haemodynamics.

Reference:

1 Lee TW, Grocott HP, Schwinn D, et al. Winnipeg High-Spinal Anesthesia Group. High spinal anesthesia for cardiac surgery: effects on beta-adrenergic receptor function, stress response, and hemodynamics. *Anesthesiology* 2003; **98**(2): 499–510.

P-94

Sufentanil reduces the stress response measured by levels of plasma cortisol in the pre-bypass phase in adult patients undergoing cardiac surgery

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Introduction: Intraoperative inadequate analgesia can lead to vegetative and humoral instability. This response has been documented by an increase of the non-specific stress marker cortisol, increase of level of endogenous norepinephrine etc. Opioids like fentanyl and sufentanil are widely used in anaesthesia during cardiac surgery and both have a correlation with a reduction of the stress response and with haemodynamic stability [1,2]. We studied the relationship of different doses of sufentanil (SUF) and intraoperative stress measured by level of plasma cortisol.

Method: A prospective observation study included patients who underwent open heart surgery in our department in a period of one month (n = 112), except those with a known history of corticoid therapy. Observations were confined to pre-bypass (PBP) because of the possibility of multifactorial influences to the metabolic response of cardiopulmonary bypass (CPB). Anaesthesia during PBP was managed according to the individual experience of each anaesthesiologist and maintained by midazolam (5–10 mg), SUF (30–200 μg), isoflurane (0.5–2%) or sevoflurane (0.5–2.5%) and relaxant drug. When a volatile agent was not sufficient to prevent hypertension, vasodilator NTG was administrated (0–4 mg). We recorded the doses of SUF and NTG during PBP. The stress response was assessed by measuring plasma cortisol levels. Two blood samples were taken from each patient: the first (CORT1) after induction of anaesthesia before skin incision, the second (CORT2) after cannulation of the heart but before CPB. Samples were cooled and analysed by radioimmunoassay. We investigated relationships: a) between dose of SUF and increase of concentration of cortisol (CORT2–CORT1), b) between dose of SUF and dose of NTG (we supposed that insufficient dose of SUF would not be able to diminish release of endogenous norepinephrine that resulted in hypertensive reaction and need of pharmacological vasodilatation) c) correlation between (CORT2–CORT1) and concentration of used volatile agent (we supposed limited effect of volatile anaesthetics due absence of analgesic property). The obtained data were statistically analysed by regression analysis and Spearman's rank correlation.

Results: We found a strong correlation between dose of SUF (μg) and increase of plasma cortisol level (CORT2–CORT1) in PBP ($r = -0.435$, $P < 0.001$). A more sensitive value in this relationship is represented by dose of SUF related to body weight (μg/kg) ($r = -0.554$, $P < 0.001$). There was also a correlation between dose of SUF and dose of NTG required for management of haemodynamic stability during periods of hypertension ($r = -0.2905$, $P < 0.01$).

No correlation was found between plasma cortisol and concentration of used volatile agent ($r = -0.0654$, non specific). Logically there was then found a positive correlation between increase of plasma cortisol (CORT2–CORT1) and dose of NTG ($r = 0.4484$, $P < 0.001$).

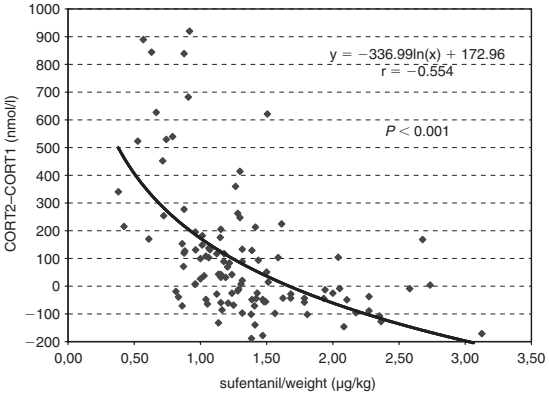

Figure shows relationship between dose of sufentanil related to body weight (μg/kg) and increase of plasma levels (nmol/L) of cortisol.

Discussion: We conclude that SUF administered pre-bypass reduces the stress response measured by plasma cortisol levels and dose of NTG required to maintain haemodynamic stability. We also deduce that the stress response was reduced specifically due to the analgesic effect of sufentanil.

References:

1 Hudson RJ, Henderson BT, Thomson IR, et al. Pharmacokinetics of sufentanil in patients undergoing coronary artery bypass graft surgery. *J Cardiothorac Vasc Anesth* 2001; **15**: 693–699.

2 Duncan HP, Cloote A, Weir PM, et al. Reducing stress responses in the pre-bypass phase of open heart surgery in infants and young children: a comparison of different fentanyl doses. *Br J Anaesth* 2000; **84**: 556–564.

P-95

The opioid-sparing effect of magnesium after cardiac surgery

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Introduction: Perioperative administration of intravenous magnesium has been associated with smaller opioid requirements without increased adverse effects [1,2]. We evaluated the opioid-sparing effect of magnesium gluconate in the context of postoperative analgesia after cardiac surgery.

Method: After having obtained informed consent thirty-eight patients were included in the controlled, double-blinded study. Immediately after induction of anaesthesia half of these patients randomly received magnesium gluconate (86.5 mg/kg bolus followed by a continuous infusion of 13.8 mg kg^{-1} min^{-1}), while the other half received placebo. Intraoperatively administered remifentanil was continued at a dose of 0.05 μg kg^{-1} min^{-1} into the postoperative period. Remifentanil was titrated to effect with pain being evaluated by a pain intensity score (PIS) in the intubated patient (range 1–6, 1 representing no and 6 unbearable pain) and later on by a colour VAS scale (range 0–100, i.e. no and worst pain, respectively). A PIS ⩾3 or a VAS ⩾30 induced step increases of remifentanil by 0.01 μg kg^{-1} min^{-1}. A respiratory rate ⩽10 caused a decrease by the same magnitude. For statistical analysis we used multivariate analysis and Student's *t*-test.

Results: To obtain adequate pain scores after extubation 20% less remifentanil was required in the magnesium group ($P < 0.05$). In addition, more frequent adjustments because of insufficient pain control had to be made in placebo group before extubation (11 vs. 5 patients). Magnesium application almost doubled serum magnesium levels. VAS score determined during the first 12 hours after extubation were not different between groups ($P > 0.05$). However, respiratory rates ⩽10 with concomitant decreases of the remifentanil dose were observed more in the magnesium group ($P < 0.05$). No serious side effects like hypotension and sedation were observed in the treatment group.

Discussion: The perioperative administration of magnesium gluconate enabled us to reduce the remifentanil dosage required for adequate postoperative analgesia after cardiac surgery by 20%.

References:

1 Tramer MR, Schneider J, Marti RA, et al. Role of magnesium sulfate in postoperative analgesia. *Anesthesiology* 1996; **84**: 340–347.

2 Koinig H, Wallner T, Marhofer P, et al. Magnesium sulfate reduces intra- and postoperative analgesic requirements. *Anesth Analg* 1998; **87**: 206–210.

P-96

Phrenic nerve infiltration with ropivacaine 0.2% in lung resection surgery to reduce ipsilateral shoulder pain

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Introduction: Ipsilateral shoulder pain after thoracotomy is very frequent and sometimes severe [1]. The aetiology of this pain remains unclear but the most coherent explanation is that the shoulder pain originates from the irritation of the pericardium and the pleura and is transmitted via the phrenic nerve. Thoracic epidural analgesia reduces very effectively post-thoracotomy pain in the dermatomes related to the incision. However it is not efficient in alleviating shoulder pain [2].

The aim of the study is to evaluate whether infiltration with ropivacaine 0.2% around the phrenic nerve fat pad relieves ipsilateral shoulder pain in lung resection surgery [3].

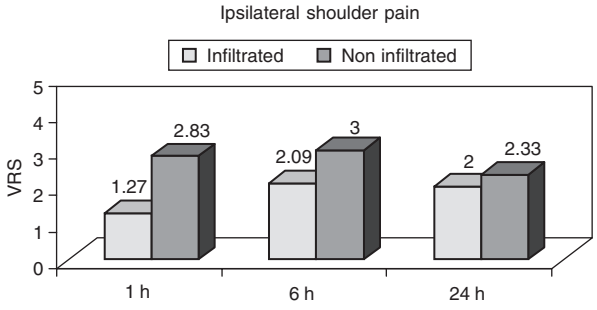
Method: Twenty five patients under lung resection surgery were included in the study. Patients were randomized to one of two groups (I – infiltrated and NI – non infiltrated) before induction of general anaesthesia. General anaesthesia was induced with fentanyl (2–3 μg kg^{-1}), propofol (2–3 mg kg^{-1}) and maintained with sevoflurane. A muscle relaxant was routinely used. A mid-thoracic epidural catheter was inserted before surgery (initial bolus 10 mL of ropivacaine 0.2% with fentanyl 25 μg at the start of surgery; continuous infusion 10 mL h^{-1} of ropivacaine 0.15% and fentanyl 1 μg/ml). At the end of surgery and before chest closure, patients in group I were infiltrated by the surgeon with 10 mL of ropivacaine 0.2% around the phrenic nerve fat pad near the pericardium and diaphragm. Post-thoracotomy analgesia was provided with epidural local anaesthetic infusion (ropivacaine 0.15% and fentanyl 1 μg ml^{-1} via a thoracic epidural catheter (8 ml hr^{-1}) and paracetamol 1 g/8 h i.v.

All the patients were extubated at the end of surgery in the operating room. Ipsilateral shoulder pain and post-thoracotomy incision pain were evaluated 1, 6 and 24 hours post-extubation using a five-point verbal ranking score (VRS).

Wilcoxon test was used to evaluate and analyse the results of our study.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Results: Ipsilateral shoulder pain scores were lower in the ropivacaine infiltrated group. No diaphragmatic paralysis was found in any of the twenty five patients.



Discussion:
The preliminary results show that phrenic nerve infiltration with ropivacaine relieves ipsilateral shoulder pain in lung resection surgery.

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3 Barak M, Ziser A, Katz Y. Thoracic epidural local anesthetics are ineffective in alleviating post thoracotomy ipsilateral shoulder pain. *J Cardiothorac Vasc Anesth* 2004; **18**(4): 458–460.

Pharmacology

P-97

Antibiotic prophylaxis and value of direct gram-stain examination of protected brush specimen for postoperative ventilator associated pneumonia

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Introduction: Antibiotic therapy alters the diagnostic value of protected brush specimens (PBS) for ventilator associated pneumonia (VAP) [1]. Using PBS alone, diagnosis of VAP needs 24 to 48 hours. Direct Gram-stain examination (DGSE) accurately shortens this delay [2,3]. After major surgery, antibiotic prophylaxis (AP) therapy is recommended [4] to limit postoperative wound infection but it may alter the value of DGSE to diagnose VAP.
Method: During a one year period (2000), we retrospectively studied all patients suspected of VAP after cardiac, vascular and thoracic surgery. In this context, fibreoptic bronchoscopy with PBS was performed and the sample was read by the same microbiologist within 30 minutes after Gram-staining. Value of DGSE for early diagnosis of postoperative VAP during or after AP was evaluated.
Results: Fifty patients, among the 640 patients treated with mechanical ventilation, were clinically suspected of VAP after cardiac (n = 42), vascular (n = 5) and thoracic (n = 3) surgery. Twenty two (44%) episodes were microbiologically proven pneumonia using the threshold of 1000 cfu/mL for quantitative PBS cultures. DGSE had a sensitivity of 95.5%, a specificity of 82.1%, a positive predictive value of 80.7% and a negative predictive value of 95.8%. Specificity and positive predictive value decreased when PBS were performed during AP, respectively, 57.1% and 42.9%. Strict concordance between DGSE identified pathogen and Gram staining cultured pathogen was 63.6% during AP vs. 94.9% after the last infusion of AP even if delay is short.
Conclusion: DGSE of PBS may be a good postoperative tool to eliminate diagnosis of VAP early even if PBS is performed during antibiotic prophylaxis.

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2 Marquette CH, Wallet F, Nevierre R, et al. Diagnostic value of direct examination of the protected specimen brush in ventilator-associated pneumonia. *Eur Respir J* 1994; **7**: 105–113.
3 Mimoz O, Karim K, Mazoit JX, et al. Gram staining of protected pulmonary specimens in the early diagnosis of ventilator-associated pneumonia. *Br J Anaesth* 2000; **85**: 735–739.
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P-98

Two boluses of tranexamic acid are as effective as a constant infusion for blood transfusion saving in cardiac surgery with CPB

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Introduction: Tranexamic acid (TA) is an indirect antifibrinolytic agent. It reduces the blood loss after cardiac surgery and blood requirements after cardiac surgery with cardiopulmonary bypass (CPB). The dosages employed are different, from 10 to 150 mg kg^{-1} body weight followed or not by a constant infusion (CI) of 1 mg kg^{-1} h^{-1} until the 10th postoperative hour [1] or by a second intravenous (IV) injection after CPB [2]. The aim of the study was to compare two modes of administration, IV or CI.
Method: After local ethic committee approval, informed consent was obtained in 50 patients undergoing coronary bypass surgery with CPB. They were randomly assigned to IV TA group (n = 25) with two TA intravenous injections of 15 mg kg^{-1}, one before surgical incision and one after the injection of protamine, or to CI TA group (n = 25) with one TA intravenous injection followed by a constant infusion of 1 mg kg^{-1} h^{-1} during 12 hours. Blood loss, blood requirements, coagulation tests (after anaesthesia induction, before injection of protamine and at the 6th post operative hour) were compared between the two groups. In 10 patients in each group, TA plasma concentrations were measured by high performance chromatography. Blood samples were taken 2 minute after the first injection (T1) after the start (T2) and at the end (T3) of CPB, at the arrival in the intensive care unit (T4) and at the 6th postoperative hour (T5). Values were expressed as mean (SD) and compared with one-way analysis of variance. A level of $P < 0.05$ (*) was considered significant.
Results: Because of surgical bleeding with re-operation, one patient was excluded in the CI TA group. The demographic and surgical data were similar in the two groups. No patient was transfused during operation. There were no differences between coagulation tests. The given amount of TA was higher in the IV TA group (30 mg kg^{-1}) than in the CI TA group (20 mg kg^{-1}). Plasminogen levels decreased slowly in the two groups, with plasmin inhibition by α_2 antiplasmin. In spite of the antifibrinolytic therapy, a D-Dimers production was observed. Blood loss and blood requirements were the same in the two groups (table 1).

	IV TA	CI TA
n	25	24
Tubes removal (h)	53 (22)	56 (18)
Total blood loss (mL)	1020 (138)	967 (208)
Transfused patients (n)	12	10

In the CI TA group, after a peak, a gentle decrease of TA plasma concentration was observed with a steady state from T4. A second concentration peak was observed in the IV TA group, at T4, 65 ± 18 minute after the second IV injection of TA (table 2).

	T1	T2	T3	T4	T5
IV TA μg mL^{-1}	155 (16)	81 (28)	51 (13)	114 (15)	23 (8)
CI TA μg mL^{-1}	144 (25)	91 (12)	76 (9)	69 (10)	54 (8)

Discussion: All the TA plasma concentrations were above 13 μg mL^{-1}, a level considered effective for inhibiting fibrinolysis [3]. Blood loss and requirements were the same. Two bolus of TA are as effective as a constant infusion for blood transfusion saving in cardiac surgery with CPB.

References:

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

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P-99

Blood product requirements and risk assessment in coronary bypass and cardiac valve surgery

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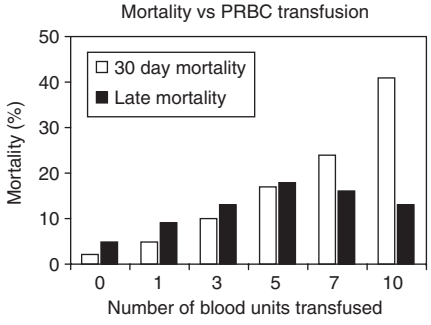
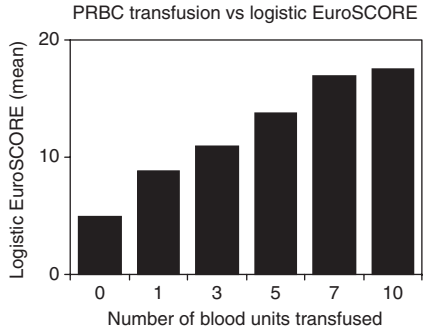
Introduction: Transfusion requirements are a focus of concern due to the risks in connection with administration of blood products and due to the costs [1,2]. The first step in improving transfusion algorithms is the evaluation of actual transfusion practice and outcome. We investigated how the risk stratification with logistic EuroSCORE and the need for transfusion are correlated with 30-day-mortality.

Method: All patients undergoing coronary bypass or cardiac valve surgery in our institution during the years 1997 until 2001 were included in the survey. Data were prospectively entered into an institutional data base. Risk-stratification with logistic EuroSCORE was set in relation to the need for transfusion. Early and late mortality were analysed in respect of intra-operative transfusion requirements. Patients were grouped into no transfusion, 1–2 PRBC (packed red blood cell transfusions), 3–4, 5–6, 7–9, 10 or more PRBC. Groups were evaluated for correlation between logistic EuroSCORE and transfusion and 30-day-mortality. Data are given as mean (95% CI).

Results: 4197 patients were entered in the analysis. Mortality-rate increased with the increasing need for transfusion. Increase of need for transfusion parallels the severity of disease, according to the increase in logistic EuroSCORE ($P < 0.01$). At each level of risk, the mortality was higher in transfused patients. The difference in mortality was 7.5% (3–12) ($P < 0.01$).





Discussion: Transfusion requirement and mortality closely correlate with logistic EuroSCORE. At any level of preoperative risk assessment, transfusion indicates a substantial additional risk. Thus probably future quality control should include process related measures in addition to preoperative risk factors. Further attention should be given to the possibility of modifying these process related factors. The role of transfusion as a risk factor needs further investigation.

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P-100

Effects of midazolam and ketamine on autonomic nervous system in patients with different type autonomic regulation

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Introduction: The autonomic nervous system (ANS) plays an important role in the maintenance of perioperative haemodynamic stability. The purpose of this study was to determine the effects midazolam and ketamine on the autonomic response in cardiac surgical patients with different types of autonomic regulation.

Method: The active tilt-test was performed the day before CABG in 63 ASA physical status III–IV patients. Preoperative treatment included β-blockers, nitrates and ACE-inhibitors. The premedication included diazepam 10 mg and trimeperidine hydrochloride 20 mg. In the operating room patients were administered midazolam 0.1–0.15 mg/kg and then ketamine 0.7 mg/kg 5 min later. Power spectral analysis of the short-term records (5 min) of heart rate variability (HRV) has been used to study ANS during the active tilt-test and injection of hypnotics. High Frequency (HF), Low Frequency (LF) in normalized unit (n.u.), LF/HF and Total Power were analysed. Statistical analysis was performed using Student's *t*-test. Data are presented as M ± SD.

Results: After the active tilt-test two groups of patients were identified. Gr. 1 (n = 15) had high activity of the sympathetic nervous system (SNS) and gr. 2 (n = 15) had high activity of the parasympathetic nervous system (PSNS). The results of analysis of HRV are presented in the table (*P* – between previous step).

Group	Step	HF normal (n.u.)	*P*	LF/HF	*P*
1	Before	11.3 ± 5.13	–	6.9 ± 3.67	–
	Midazolam	20.1 ± 12.7	<0.05	3.4 ± 1.86	<0.001
	Ketamine	7.9 ± 4.88	<0.05	10.0 ± 6.93	<0.01
2	Before	45.9 ± 9.86	–	0.9 ± 0.57	–
	Midazolam	23.8 ± 9.86	<0.001	1.7 ± 0.57	<0.001
	Ketamine	13.5 ± 9.66	<0.001	5.8 ± 3.10	<0.01

Discussion: Analysis has shown that in gr. 1 midazolam increased HF normal and decreased LF/HF that reflected decreasing SNS activity. Administration of ketamine decreased HF normal and increased LF/HF, which demonstrated increasing of SNS activity. In gr. 2 both hypnotics decreased HF normal and increased LF/HF that reflected decreasing PSNS activity. So benzodiazepines may reduce SNS activity [1] as well as PSNS.

Conclusion: Our results demonstrated that midazolam reduces dominating activity of ANS independently of the type of autonomic regulation. Ketamine increases the activity of SNS independently of type of autonomic activity against a background of midazolam administration.

Reference:

1 Ikeda T, Doi M, Morita K, et al. Effects of midazolam and diazepam as premedication on heart rate variability in surgical patients. *Br J Anaesth* 1994; **73**: 479–483.

P-101

The effects of intraoperative dexmedetomidine and midazolam infusion on haemodynamics in coronary artery bypass graft surgery

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Introduction: Dexmedetomidine, a short acting alpha2-receptor agonist, reduces myocardial oxygen demand by decreasing heart rate and provides a stable intra-operative haemodynamic profile [1]. In this study we used a continuous intravenous dexmedetomidine infusion given before and during operation to compare haemodynamic changes and evaluate troponin-I levels in coronary artery bypass graft surgery.

Method: After ethic committee's approval, thirty patients scheduled for elective CABG were randomly allocated into two equal group (n = 15). In group D, induction was with dexmedetomidine 1 $\mu g\,kg^{-1}\,h^{-1}$ i.v. (infused in 10 min) whereas in group M, induction was with midazolam 0.05 mg/kg, each with fentanyl 20 μg/kg. Tracheal intubation was facilitated with cisatracurium 0.15 mg/kg. Anaesthesia was maintained with continuous infusions of dexmedetomidine 0.4 $\mu g\,kg^{-1}\,h^{-1}$ or midazolam 0.1 $mg\,kg^{-1}\,h^{-1}$, and 0.25–0.50% sevoflurane for both groups. The haemodynamic parameters of heart rate (HR), mean arterial pressure (MBP), central venous pressure (CVP), mean pulmonary artery pressure (MPAP), pulmonary capillary wedge

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

pressure (PCWP), cardiac output (CO), pulmonary vascular resistance and systemic vascular resistance were recorded. Blood samples were taken before induction of anaesthesia, 1 hour after completion of surgery and 24 hours postoperatively for troponin-I, CK and CK-MB levels. Total analgesic and inotropic drug consumption were recorded. Mann-Whitney *U* test and Wilcoxon's signed rank test were used for comparisons of the groups.

Results: Demographic characteristics were similar in both groups ($P > 0.05$). Ages of patients (56.5 ± 11.5 & 61.8 ± 6.6; $P > 0.05$) and LVEF of patients (60.1 > 3.2 & 63.2 > 2.8; $P > 0.05$) were not different between the group D and group M. After induction of anaesthesia and intubation, MAP and HR values were significantly reduced in both groups, whereas these values were increased at the end of bypass and operation ($P < 0.05$). No significant changes in CVP, PCWP and PVR were observed following either drug. There were no significant differences between the groups for troponin-I, CK and CK-MB levels.

	Drug	I	II	III	IV	V	VI
HR	D	80.9 ± 14.8*	74.1 ± 14.4*	66.9 ± 12.7*	64.9 ± 13.8*	82.8 ± 19.1	96.7 ± 17.7*
	M	81.9 ± 12.5	82.5 ± 12.1	68.5 ± 13.4*	76.6 ± 17.7	93.0 ±* 12.5	98.8 ± 18.0*
MAP	D	102.3 ± 16.9	95.7 ± 18.1	87.7 ± 17.0*	74.1 ± 8.7*	71.4 ± 11.7*	72.8 ± 11.9*
	M	100.5 ± 15.0	93.9 ± 14.3*	81.1 ± 11.0*	77.9 ± 13.4*	70.4 ± 9.1*	65.4 ± 8.9*
MPAP	D	15.6 ± 3.4	14.3 ± 5.1	15.6 ± 3.9	10.5 ± 3.4*	13.1 ± 4.4	13.3 ± 3.9
	M	14.3 ± 4.3	13.2 ± 4.3	15.2 ± 4	10.1 ± 2.9	14.2 ± 4.3	12.6 ± 4.3
CO	D	5.9 ± 2.4	6.2 ± 2.3	5.7 ± 1.7	3.5 ± 0.6*	4.9 ± 1.8	6.2 ± 1.6
	M	5.9 ± 2	5.6 ± 1.5	5.8 ± 1.5	4 ± 1*	5.3 ± 2.1	6.3 ± 2.3

I preop; II infusion 10 min; III end of induction; IV pre-bypass; V end bypass; VI end operation.
*means to $P < 0.05$ in the intra-group comparison.

Extubation time was shorter in the dexmedetomidine group than midazolam group (11.2 ± 3.6, 14.5 ± 4.0 h) ($P < 0.05$). Follow-up in the ICU were similar in two groups (44.2 ± 4.6, 48.5 ± 5.3 h, $P > 0.05$).

Discussion: The haemodynamic results of dexmedetomidine and midazolam were similar. We conclude that dexmedetomidine can be used reliably during CABG surgery.

Reference:

1 Talke P, Li J, Jain U, et al. Effects of perioperative dexmedetomidine infusion in patients undergoing vascular surgery: The study of Perioperative Ischemia Research Group. *Anesthesiology* 1995; **82**: 620–633.

P-102

The effects of postoperative dexmedetomidine and midazolam infusion on haemodynamics and sedation in patients after coronary artery bypass grafting

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Introduction: Dexmedetomidine is a selective α-2 adrenergic receptor agonist with sedative properties [1]. Due to its stabilizing haemodynamic profile, it attenuates myocardial oxygen consumption and also facilitates early extubation. This study was designed to compare the effects of dexmedetomidine and midazolam on postoperative haemodynamic stability and sedation levels in coronary artery bypass grafting (CABG).

Method: Thirty patients scheduled for elective CABG were randomly allocated into two equal groups (n = 15). Anaesthesia maintenance was provided with 0.4 $\mu g^{-1} kg^{-1} h^{-1}$ dexmedetomidine in group D and 0.1 $mg^{-1} kg^{-1} h^{-1}$ midazolam in group M. In the intensive care unit (ICU) group D received 0.2-0.4 $\mu g\, kg^{-1} h^{-1}$ dexmedetomidine infusion and group M received 0.5–1μg kg^{-1} min^{-1} midazolam infusion and both continued for 45 hours after extubation. The level of sedation and VAS scores of both groups were recorded at postoperative 30th min, 4th and 12th h.

A thermodilution pulmonary artery catheter was inserted in all patients and heart rate (HR), mean arterial pressure (MAP), central venous pressure (CVP), mean pulmonary artery pressure (MPAP), pulmonary capillary wedge pressure (PCWP), cardiac output (CO), cardiac index (CI), pulmonary vascular resistance and systemic vascular resistance (SVR) were recorded on stabilization in ICU, pre-extubation, and post-extubation at 30 min, 4 and 12 h. Criteria for extubation: 1 Sedation discontinued and patient not in pain or agitated. 2 Cardiovascular stability (systolic pressure > 90 mmHg). 3 Core temperature >36.4°C. 4 Spontaneous ventilation with PaO_2 >12 kPa on FiO_2 <0.4 and $PaCO_2$ <7 kPa. 5 Blood loss from chest drains <60 mL h^{-1}. 6 Urine output >1 mL $kg^{-1} h^{-1}$.

Results: Demographic variables were similar between these two groups ($P > 0.05$). In group D HR was increased at postoperative 30 min and 4 h ($P < 0.05$). No difference was noted in these two groups for CVP. MPAP and PCWP did not change in group D but there was rise in group M. In group D, CO and CI increased after extubation. Stroke volume (SV), PVR and SVR measurements were not statistically different. Mann-Whitney *U* test and Wilcoxon's signed rank test were used for comparisons of the groups.

	Drug	I	II	III	IV	V
HR	D	89.4 ± 14.7	97.5 ± 17.2	103.5 ± 10*	99 ± 5.1*	95 ± 5.9
	M	92.3 ± 16.6	93 ± 11.2	99.4 ± 15.9	94.3 ± 13.8	94 ± 10.9
MAP	D	76 ± 13.5	77.9 ± 10.4	78.7 ± 13.8	79 ± 9.6	80.6 ± 6.7
	M	72.9 ± 10.8	77 ± 9.2	75.4 ± 10.9	73.3 ± 7.5	72.2 ± 13.1
MPAP	D	16.2 ± 4.7	18.4 ± 4.6	18.1 ± 4.7	18.2 ± 3.9	18.8 ± 5
	M	15.4 ± 3.5	17.3 ± 3.2	19.7 ± 4.8	19.8 ± 3.8	17.6 ± 4.8
CO	D	5.4 ± 2.1	5.9 ± 1.7	7.4 ± 2.1*	6.7 ± 1.7	6.1 ± 1.3
	M	5.7 ± 1.4	6.1 ± 1.8	6.8 ± 2.1	6.5 ± 1.7	6.1 ± 1.1

I ICU arrival; II before extubation; III after extubation 30 min; IV 4 h; V end 12 h.
*means to $P < 0.05$ in the intra-group comparison.

Extubation time was shorter in the dexmedetomidine group than midazolam group (11.2 ± 3.6, 14.5 ± 4.0 h) ($P < 0.05$). Postoperative sedation and VAS scores were similar between two groups.

Conclusion: Dexmedetomidine provides desirable sedation levels, toleration to mechanical ventilation and extubation in ICU after CABG.

Reference:

1 Herr DL, Sum-Ping STJ, England M. ICU sedation after coronary artery bypass graft surgery: dexmedetomidine-based versus propofol-based sedation regimens. *J Cardiothorac Vasc Anesth* 2003; **17**: 576–584.

P-103

Hypertonic hydroxyethyl starch solution for hypovolaemia management after coronary artery bypass grafting

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Introduction: The aim of the study was to compare the difference of haemodynamic and volume parameters in the early postoperative period when hypertonic hydroxyethyl starch solution (HyperHaes®, Fresenius) or the usual infusion therapy was used for hypovolaemia management [1].

Method: After approval of Biomedical Ethics Committee and signed informed consent form, the data of 80 patients in Kaunas Heart Centre who underwent coronary artery bypass grafting (CABG) with cardiopulmonary bypass because of coronary artery disease, were analysed. Patients were randomly divided into two groups. Patients of the control group received 500 mL Ringer's solution as the primary component for hypovolaemia management. Patients of the experimental group (HH) received 250 mL of 7.2% NaCl/6% hydroxyethyl starch solution. The measurements were made before and immediately after the infusion, and 60 and 180 min after infusion. The parameters of central haemodynamics, the temperature gradient and fluid balance were evaluated. For the remainder of the 24 hours lactated Ringer's solution was used for volaemia management in both groups. T-test for comparison of two groups was used.

Results: are shown in the table.

Parameter	Group	Before	At 60 min	At 180 min
PCWP mm/Hg	Control	7.7 (4.8)	8.4 (5.1)	7.5 (4.6)
	HH	6.7 (4.0)	8.7 (3.9)[a]	8.9 (4.6)[a]
CVP mm/Hg	Control	6.1 (3.3)	6.8 (3.4)	7.1 (4.1)
	HH	5.9 (3.7)	8.1 (5.2)[a]	7.5 (4.1)[a]
CI L $min^{-1} m^{-2}$	Control	2.6 (0.6)	2.6 (0.6)	2.7 (0.6)
	HH	2.6 (0.7)	3.1 (0.6)[a,b]	3.1 (0.6)[a,b]
SVI mL min^{-1}/m^{-2}	Control	33.4 (10.3)	33.3 (9.8)	32.7 (7.4)
	HH	33.0 (9.4)	36.54 (8.69)[a]	37.6 (9.5)[a,b]
SVRI dyn s cm^{-5} m^{-2}	Control	2278 (794)	2236 (704)	2016 (656)[a]
	HH	2254 (794)	1866 (716)[a,b]	1785 (670)[a]
PVRI dyn s cm^{-5} m^{-2}	Control	332 (142)	349 (130)	331 (151)
	HH	334 (157)	267 (133)[a,b]	245 (144)[a,b]
T gradient °C	Control	6.5 (2.4)	6.7 (2.8)	6.9 (2.8)
	HH	6.1 (2.8)	5.7 (2.6)	5.4 (2.8)[b]
Na^+ mmol/L	Control	138.7 (3.6)	138.8 (3.0)	139.1 (2.5)
	HH	137.8 (2.8)	142.4 (3.1)[a,b]	143.4 (2.82)[a,b]

[a] $P < 0.05$ inside the group; [b] $P < 0.05$ between the groups.
The data are presented as mean (SD).

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Conclusions: Hypertonic hydroxyethyl starch solution for hypovolaemia management after coronary artery bypass grafting in comparison with lactated Ringer's solution had a positive influence on haemodynamic parameters. After infusion, CI and SVI increased, afterload (SVRI and PVRI) decreased, the need for infusion therapy during 24 hours and positive fluid balance decreased.

Reference:

1 Järvelä K, Kaukinen S. Hypertonic saline (7.5%) after coronary artery bypass grafting. *Euro J Anaesthesiol* 2001; **18**: 100–107.

P-104

The myocardial protective effect of esmolol and glutamate in blood cardioplegia in open heart surgery

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Introduction: Esmolol has been found to prevent myocardial ischaemia during cardiac surgery [1]. Furthermore, adding glutamate and aspartate to blood cardioplegia were reported as myocardium-protective. In the course of open heart surgery, cardiac arrest is achieved with conventional cardioplegia to provide myocardial protection. We aimed to show a myocardial protective effect of esmolol and glutamate in blood cardioplegia in elective open heart surgery.

Method: Forty five adult patients, ASA grade 3 scheduled for open heart surgery were included. Patients were randomly allocated according to the agent added to blood cardioplegia by an anaesthetist who was blinded to the study, Group E (esmolol), Group G (glutamate), Group C (control). Anaesthesia was induced with 0.3 mg kg^{-1} etomidate, and vecuronium bromide was given for endotracheal intubation. Anaesthesia was maintained with air in oxygen and 1–1.5 μg kg^{-1} min^{-1} remifentanil infusion. A Swan-Ganz catheter was inserted into the left internal jugular vein. Cardiac output (CO), cardiac index (CI), troponin T (TT) and creatinine kinase MB (CK) were recorded after induction (t1), at the end of surgery (t2) and at 24 h postoperatively (t3). Friedman, chi-squared and ANOVA tests were used for statistical analysis. For all analyses, differences were considered to be significant at $P < 0.05$(*).

Results: Demographic data were similar in all groups. Need of inotropic agent was more in Group C than the others.

Table. TT and CO values as Means ± SD

	Group E	Group G	Group C
CO-t1	4.8 ± 1.33	4.2 ± 1.1	4.8 ± 1.1
CO-t2	4.9 ± 1.3	4.7 ± 1.2	4.1 ± 0.9
CO-t3	5.1 ± 0.9*	5.2 ± 1.3*	4.3 ± 0.6*
TT-t1	0.01 ± 0.0	0.01 ± 0.0	0.01 ± 0.0
TT-t2	0.4 ± 0.32	0.5 ± 0.33	1.12 ± 0.52*
TT-t3	0.42 ± 0.42	0.53 ± 0.45	1.13 ± 0.49*

Discussion: Increased TT in Group C during the surgery and increased CO in Group E and Group G at the end of the surgery, shows a myocardial-protective effect of glutamate and esmolol added to the blood cardioplegia (Table). In open heart surgery, glutamate and esmolol added to blood cardioplegia are an advantage in myocardial protection.

Reference:

1 Scorsin M, Mebazaa A, Al Attar N, et al. Efficacy of esmolol as a myocardial protective agent during continuous retrograde blood cardioplegia. *J Thorac Cardiovasc Surg* 2003; **125**: 1022–1029.

P-105

Cardioprotective effects of preoperative β-blockers in OPCABG surgery

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Introduction: Preoperative β-blockade therapy has recently been shown to convey a survival benefit in CABG surgery [1]. The benefit of preoperative β-blockers (β-b) therapy before off-pump coronary artery bypass graft surgery (OPCABG) has not been assessed. The aim of the present study was to assess the effect of preoperative use of β-b before OPCABG.

Method: In a retrospective study, 195 consecutive patients undergoing OPCABG between 09/2000 and 03/2003, were divided into 2 groups (β-b and without β-b). Hospital mortality, perioperative myocardial infarction (MI) and postoperative troponin values were determined in relation to preoperative risk factors (table 1). Several complications were studied and described in table 2. Troponin I [2] and CKMB values were compared at the arrival in ICU, 6, 18 hours later using t test.

Results: 137 patients received β-b before surgery. The β-b patients had less risk factors (table 1). Mortality and postoperative complications tended to be lower among treated patients (table 2). We found a reduction of postoperative CKMB (19.7 ± 35 vs. 34.7 ± 70, $P = 0.058$) and troponin I (3.6 μg/L ± 7.9 vs. 8.8 ± 26, $P = 0.054$) on day 1 with the use of β-b. The lack of preoperative β-b therapy was associated with greater troponin I values > 3.9 μg/L [2] (RR = 2.5) and higher mortality (RR = 5.2), after logistic regression.

Table 1

	β-b n = 137	Without β-b n = 58	*P*
Age (years)	65 ± 12	69 ± 9	0.03
EuroSCORE	3.8 ± 2.5	5.7 ± 3.4	<0.0001
LVEF (%)	55.7 ± 18	48.8 ± 18	0.03
MI < 6 month (%)	29.9	32.7	0.82
Hypertension (%)	56.3	69.5	0.12
Peripheral vascular disease (%)	13.1	29.3	0.012
Renal failure (%)	2.9	15.5	0.003
Cerebrovascular disease (%)	8.75	10.3	0.94
Diabetes (%)	22.9	27.2	0.65
Urgency (%)	1.46	6.8	0.12

Table 2

	β-b	Without β-b	*P*
Mortality (%)	1.46	8.6	0.041
Postoperative dialysis (%)	0.73	3.4	0.001
Arrhythmia (%)	20.4	25.8	0.68
Inotropic drugs > 5 μg kg^{-1} min^{-1} (%)	1.5	10.3	0.004
MI (%)	15.3	27.6	0.04
Blood transfusion (%)	0.51 ± 1.4	1.26 ± 2.0	0.008
Ventilation (h)	4 ± 1.8	5.1 ± 4.2	0.01
Stay in ICU (days)	1.9 ± 5.3	2.5 ± 4.0	0.46
Stay at hospital (days)	8 ± 2.3	11 ± 10	0.03
New admission in ICU (%)	0	3.5	0.15

Discussion: Preoperative β-b therapy, despite a non optimal prescription, was associated with less complications and adjusted mortality in OPCABG surgery. These benefits could be explained by cardioprotective effects of β-b proved by reduction of postoperative CKMB, troponin values and MI.

References:

1 ten Broecke PWC, De Hert SG, Mertens E, et al. Effect of preoperative β-blockade on perioperative mortality in coronary surgery. *Br J Anaesth* 2003; **90**: 27–31.

2 Carrier M, Pellerin M, Perrault LP, et al. Troponin levels in patients with myocardial infarction after coronary bypass grafting. *Ann Thor Surg* 2000; **69**(2): 435–440.

P-106

Comparison of the haemodynamic effects of esmolol and diltiazem in off-pump CABG surgery

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Introduction: Esmolol, with its very short duration of action and very fast titration, has advantages regarding regulation of the ventricular rate when haemodynamic changes are caused by myocardial ischaemia during off-pump CABG (OPCAB). In this study, the effect of esmolol, a short acting β blocker, and diltiazem, a Ca antagonist, on heart rate and haemodynamics during OPCAB [1] were compared.

Method: 24 patients scheduled for elective OPCAB were allocated to two random groups. 10 patients in group D and 8 patients in group E were taking beta-blockers in the preoperative periods. After induction of anaesthesia the first group (Gp E) was given esmolol (500 μg^{-1} kg^{-1} bolus, 100 μg^{-1} kg^{-1} h^{-1}) and the other group (Gp D) was given i.v. infusion of diltiazem (5–10 mg^{-1} h^{-1}) until the end of the operation.

Haemodynamics were measured before induction of anaesthesia, at the end of induction, after intubation, at the beginning of the operation, after sternum retraction, before bypass, during distal anastomosis, at the end of the anastomosis and at the end of the operation. Mann-Whitney *U* test and Wilcoxon's signed rank test were used for comparisons of the groups.

Results: There were no significant differences between demographic data of the two groups. Ages (55.8 ± 2.8 & 59.5 ± 3.7; $P > 0.05$), and LVEF (62.3 ± 3.1 & 65.1 ± 2.2; $P > 0.05$) were not different between the group D and group E. There were no significant differences in heart rate between the groups. Blood pressure values were lower in group E (58.16 ± 7.4) compared to group D (68.2 ± 6.2) during the distal anastomoses ($P < 0.05$). PAP

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

values decreased similarly in both groups at the end of the anastomoses and at the end of the operation. There were no differences regarding PVR values between the two groups. CI in group E was found to be lower before bypass, during distal anastomoses and at the end of the anastomoses compared to before induction. The reduction of CI in group D before bypass during distal anastomoses and at the end of anastomoses did not reach statistically significant levels. The SVR values were found similar in both groups.

	Group	I	II	III	IV	V
HR	E	76.5 ± 12	71.3 ± 19	69.1 ± 11	74.8 ± 7	88.1 ± 11
	D	75.2 ± 13	74.2 ± 19	74.8 ± 10	67.0 ± 10	75.0 ± 11
MAP	E	97 ± 9.90	71.8 ± 8.4*	58.16 ± 7.4*	60.1 ± 9.1*	72.6 ± 15*
	D	96.2 ± 11	64.7 ± 12*	68.28 ± 6.2*	64.0 ± 3.0*	79.5 ± 11*
MPAP	E	15.1 ± 3.4	11.6 ± 3.0*	10.6 ± 3.0*	9.6 ± 4.0*	11.6 ± 3.0*
	D	15.7 ± 2.7	12.1 ± 3.6	12.8 ± 1.9	11.5 ± 2.7*	11.8 ± 3.8*
PCWP	E	9.0 ± 5.6	7.0 ± 3.5	6.3 ± 2.3	3.5 ± 3.6*	5.8 ± 2.3
	D	7.8 ± 2.4	6.8 ± 2.8	6.7 ± 1.9	6.7 ± 3.9	7.1 ± 5.0
CI	E	3.1 ± 0.9	1.95 ± 0.3*	2.0 ± 0.2*	1.6 ± 0.5*	2.41 ± 0.4
	D	2.3 ± 0.8	2.42 ± 1.4	1.9 ± 10	1.84 ± 1.1	2.42 ± 1.4
CVP	E	4.50 ± 3.3	2.50 ± 1.0	2.33 ± 1.7	1.33 ± 1.7	2.33 ± 2.5
	D	8.42 ± 4.2	4.42 ± 3.4*	5.14 ± 3.5*	3.1 ± 3.2*	5.2 ± 2.6*

I preop; II pre bypass; III during anastomoses; IV end of anastomoses; V end of operation. *$P < 0.05$ group comparison.

Discussion: The haemodynamic changes in our patients were similar while the reduction in MAP and CI was significant in the esmolol group. There were no changes in heart rates when compared to preoperative values.

Reference:

1 Chassot PG, van der Linden P, Zaugg M, et al. Off-pump coronary artery bypass surgery: physiology and anaesthetic management. *Br J Anaesth* 2004; **92**: 400–413. Review.

P-107

Sotalol use in prevention of atrial fibrillation after cardiac surgery: Which limits?

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Introduction: Atrial fibrillation (AF) is frequent after cardiac surgery. Sotalol is one of the potent drugs against that complication [1].

Method: We analysed during 2 months the feasibility of an extensive use of sotalol as a prophylactic drug against AF. All patients operated from 01/06 to 01/08/2003 by our cardiac surgery team were scheduled to receive postoperatively sotalol intravenously at a rate of 40 mg to 80 mg per day the first two days and then 80 to 320 mg orally the days after. According to the sotalol prescribed, four groups emerged: Group I, patients who received sotalol throughout the hospital stay (from the 1st postoperative day to hospital discharge); Group II, patients who developed adverse effects with sotalol use (reasons for discontinuing sotalol were noted); Group III, patients with atrio-ventricular block, long QT, or with bronchial hyper-reactivity, asthma or cardiac insufficiency (pre-existing or perioperative) who were ineligible to receive sotalol; Group IV consisted in patients who did not received sotalol due to the ICU doctor's prescription although no contraindication existed. Rate of AF was noted among the different groups. Statistical analysis was performed by appropriate tests (Student or χ^2).

Results: 165 patients were enrolled. Sotalol was prescribed in 103 patients, contraindicated in 30 patients (18%) and not prescribed in 32 patients (19%) (physician choice). Among the 103 patients sotalol was fully prescribed in 93 patients (56%), stopped in 10 patients (6%). Sotalol adverse effects was 10% (10/103): sotalol was stopped in 10 patients because of bronchial reactivity in 4 and bradycardia in 6 patients.

AF occurred in 36.3% of the entire population, only in 27% of group I, 66% in group II, 40% in group III and 44% in group IV ($P < 0.005$ between group I and the others).

Table. Types of surgery among groups.

	Surgery		
	Aortic	Mitral	Coronary
Group I n = 93	31	7	55
Group II n = 30	8	8	14
Group III n = 10	2	3	5
Group IV n = 32	11	7	14

After coronary surgery patients receiving sotalol had an AF rate of 20% vs. patients without sotalol who had an AF rate of 50% ($P < 0.05$). In this study, multivariate analysis showed that risk factors for postoperative AF were preoperative AF, age, mitral valve surgery and lack of preoperative beta-blockers.

Discussion: Extensive use of sotalol is possible after coronary surgery and aortic valvular surgery except in patients with contraindications. Sotalol reduces postoperative AF after coronary bypass surgery by comparison with the non-prescribed group. Lack of preoperative beta blockade is a risk factor of postoperative AF especially in patients, undergoing coronary bypass surgery.

Reference:

1 Evrard P, Gonzalez M, Jamart J, et al. Prophylaxis of supraventricular and ventricular arrhythmias after coronary artery bypass grafting with low-dose sotalol. *Ann Thorac Surg* 2000; **70**: 151–156.

Case Reports and Miscellaneous

P-108

Non-compacted cardiomyopathy associated with acute mitral chordae rupture: case report

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Introduction: Non-compacted ventricular myocardium (NCVM) is a rare congenital cardiomyopathy characterized by a lack of myocardial fibre compaction, increased trabeculation and deep intertrabecular recesses of the left ventricle (LV) [1,2]. Clinical manifestations range from asymptomatic to thromboembolic events, ventricular arrhythmias and congestive heart failure. There are no reports in the literature of NCVM and mitral valve (MV) involvement requiring cardiac surgery.

Case report: We present a 39 years old man with a medical history of a cerebral ischaemic event 6 years ago, admitted to the hospital due to congestive heart failure. Transthoracic echocardiography showed a posterior mitral leaflet prolapse, severe MV regurgitation, mild LV dilatation, ejection fraction of 48% and increased trabeculation of the lateral and apical walls of the LV compatible with NCVM. Coronary angiography was normal. Cardiac magnetic resonance was also compatible with NCVM. The patient was scheduled for cardiac surgery. Preoperative screening was normal. General anaesthesia with propofol and remifentanil was used. Intraoperative monitoring included: cerebral oxygen saturation (SrO_2), cardiac output and transoesophageal echocardiography (TOE). The TOE four chamber view showed a prolapse of the P2 segment. Surgical exploration of the MV showed a chordal rupture between P2 and P3 segments. Resection of P2 segment was performed. After cardiopulmonary bypass disconnection a perfect coaptation of the MV was confirmed by TOE. The postoperative course was uneventful. An electrophysiological study performed after surgery was negative for induction of ventricular arrhythmias.

Discussion: We have presented the uncommon disease of NCVM with an unusual clinical manifestation of MV chordae rupture. To our knowledge, there are no reported cases of NCVM and anaesthesia. We used total intravenous anaesthesia, SrO_2 cerebral monitoring due to the history of cerebral ischaemic event and TOE, mandatory in all MV repair surgery. No perioperative arrhythmias, common in NCVM, were detected, perhaps due to normal cardiac electrophysiology, demonstrated after surgery. MV repair was successfully performed in this patient without any potential major complication, but NCVM is a disease with a poor mid-term prognosis. To spread the knowledge of NCVM by its peculiar echocardiographic picture may contribute to better detection and prevention of potential complications.

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2 Rigopoulos A, Rizos IK, Aggeli C, et al. Isolated left ventricular noncompaction: an unclassified cardiomyopathy with severe prognosis in adults. *Cardiology* 2002; **98**: 25–32.

P-109

Tracheal displacement and tracheo-innominate artery fistula: case report

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

Introduction: Tracheo-innominate artery fistula is a rare but life-threatening complication of tracheostomy. Usually it occurs when a tracheostomy is located distal to the 4th tracheal ring, caused by pressure necrosis of the tube cuff left in the same position for a long time [1].

Case report: A 57-year-old female patient underwent left pneumonectomy for destroyed lung due to tuberculosis. On the 12th postoperative day she was transferred to intensive care unit (ICU) because of respiratory insufficiency, where she was intubated for respiratory support. The culture of tracheal aspiration and thoracocentesis material resulted in growth of methicillin resistant staphylococcus aureus (MRSA). On the 5th day of intubation, a percutaneous dilatational tracheostomy (Ciagli method) was performed. On the 9th day, the tracheostomy cannula had to be withdrawn because of bronchospasm, subcutaneous emphysema and increased airway pressure. Due to subcutaneous emphysema, a new tracheostomy cannula could not be inserted and the patient was re-intubated with the cuff inflated on the site of tracheostomy.

On the 15th day, a projectile haemorrhage through the tracheostomy incision under dressing was observed. The haemorrhage was stopped by hyperinflation of the tube-cuff and the patient was taken as an emergency to the operation room. At exploration, it was found that the tracheostomy had been performed through the fifth tracheal ring at which level the innominate artery ruptured due to cuff pressure. The innominate artery was ligated and the patient transferred to ICU. The patient died on the 20th day since the first intubation.

Discussion: In a patient with deranged cervical anatomy it is proposed that tracheostomy be performed directly surgically or under ultrasonographic guidance if a percutaneous method is performed [2]. In our case the division of inferior pulmonary ligament, the pulmonary vessels and the left bronchus may all have contributed to the mobilization and upward displacement of the trachea [3] which resulted in a lower tracheostomy than the fourth tracheal ring. Additionally, it has also been reported that structural tissue damage occurring with MRSA infection in the stoma region may accelerate fistula formation.

In conclusion, we believe that in a patient after pneumonectomy, consideration of the possibility of tracheal and vascular displacement can protect against tracheo-innominate artery fistula. Additionally, when a fistula occurs, control of the haemorrhage by over-inflation of the tube cuff can provide some valuable time before surgical repair.

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P-110

Perfluorocarbon emulsion in re-do aortic valve replacement in a Jehovah's Witness: case report

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Introduction: A 65 years old female patient of the Jehovah Witness faith, 5 years after aortic valve replacement, was admitted to hospital due to congestive heart failure with mitral valve regurgitation (MR 3+), LVEF of 45% and haemolytic anaemia.

Case report: At admission to the hospital her haemoglobin level was 82 g/L. Preoperative treatment consisted of intravenous ferrlecit 250 mg every third day and folic acid 10 mg daily. Total amount of ferrlecit given to the patient was 2 g. At the end of treatment haemoglobin was 94 g/L. During the operation volume was sustained with Ringer's solution, Dextran-70 and HES 6%. Considering the complexity of the procedure, the condition of the patient and limitations of her faith for autologous blood transfusion [1] it was decided to utilize perfluorocarbonate (PFC, Perftoran). It was used as addition to the priming solution and intravenously at the end of the procedure. During the surgery, a closed circle was maintained between intra-operative blood salvage and cardiopulmonary bypass (CPB).

The priming solution for CPB consisted of PFC emulsion 10%, 2.28 g/Kg with Ringer's solution. During surgery 5100 mL were aspirated from the surgical field while 1600 mL of processed red blood cells was re-transfused. Duration of CPB was 156 min with AC time 118 min. A successful re-do aortic valve replacement, mitral valve reconstruction (Alfieri's technique) and single aorto-coronary bypass on the beating heart were performed. At the end of the operation haemoglobin level was 59 g/L with haematocrit 17. In the next two days 0.85 g/Kg of PFC was administrated daily. Additional therapy were rHuEPO (Eprex), 4000 IU in 10 doses, and 4 doses of ferrlecit, 125 mg every third day. Two weeks after surgery haemoglobin level was 86 g/L. After prolonged postoperative treatment of 3 weeks, due to anaemia, the patient was discharged in a good condition. Over two years follow up the patient's condition improved.

Discussion: Perfluorocarbon emulsions are being clinically evaluated as artificial oxygen carriers to reduce allogeneic blood transfusions or to improve tissue oxygenation [2]. The characteristics of PFC improving O_2 carrying capacity of blood, gas exchange and metabolism in tissue were successfully realized in our Jehovah's Witness patient.

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1 Smith LM. Ethical perspectives on Jehovah's Witnesses' refusal of blood. *Cleveland Clinic J Med* 1997; **64**(9): 475–481.
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P-111

Who is to blame for a spate of sternal wound infections?

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Between January and March 2004, shortly after moving into our new theatre block, there occurred 6 serious sternal wound infections. The local Infection Control Team and Health Protection Agency (HPA) were called into investigate the source of infection. The causative organism was rapidly identified as *Enterobacter Cloacae*.

All the patients belonged to one surgeon, who also operated at another hospital with a zero incidence of infection in that institution. His technique was minutely observed by successive teams from infection control and was found to be faultless. The same was true of the trainee surgeons and theatre nursing team. Theatre and air-conditioning systems were subjected to a detailed analysis in case there was contamination from the building works, which were still going on adjacent to the hospital block where the theatres are situated.

Attention then turned on the anaesthetists. Our techniques and practices were placed under close scrutiny and we were found wanting. Two main areas of concern were rapidly identified: the sterility of central line insertion and the use of propofol infusions during cardio-pulmonary bypass. Nobody was immune from the infection control teams ensconced, with clipboards, in the anaesthetic rooms. We were forced to fully scrub up and gown up for insertion of all central lines and we were forbidden to re-fill propofol syringes. Prophylactic antibiotic policy was also modified to include gentamicin at induction of all cardiac cases.

After nearly 2 months the source of infection was identified. Enterobacter was found in the refrigerator that was holding the semi frozen Hartman's solution used by this surgeon alone for slush. It had an identical phage type to that causing the wound infections. Since then the infection control team has not visited us again. However the changes instigated in our anaesthetic practice have been maintained.

The majority of the anaesthetists found the experience daunting and somewhat hostile. At one point we were, without doubt, seen as one of the possible main culprits for the infections. Surprisingly on a number of occasions when being 'tested' the infection control team nurses declined to give immediate feedback to the anaesthetist, stating it would be incorporated later into a report. After strong objections, this policy was changed, and an immediate analysis and comment was given to each anaesthetist.

The main lesson that we as a group of cardiac anaesthetists learned was that one often thinks one's techniques are carried out to a high standard. However, when formally observed, there is often surprising variability between practitioners and some aspects of our care may indeed have been substandard. Despite the experience, we feel it would be useful to invite the infection control team to review our practices on an annual basis to ensure the continuing maintenance of the highest possible standards.

P-112

Continuous renal replacement therapy and intravenous levosimendan in a case of multiple organ failure after mitral valve replacement: a case report

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Case report: Acute renal failure (ARF) remains a major complication of cardiac surgery and extracorporeal circulation (ECC) [1]. Patients with postoperative ARF demonstrated a higher incidence of complications and worse outcomes. Frequently, they need continuous renal replacement therapy (CRRT) with increasing ICU length of stay and costs. A significant number of

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

patients develop ARF in the context of multiple organ failure (MOF) [2]. Levosimendan is a new 'calcium sensitizer' drug with inotropic properties and proven efficacy in acute heart failure.

We describe the case of a 59 year old female patient (59 kg BW, 165 cm height) with diagnosis of infective endocarditis and severe aortic valve insufficiency. She underwent scheduled aortic valve replacement. Postoperative transoesophageal echocardiograhy (TOE) revealed a new perforation of the anterior leaflet of the mitral valve with severe insufficiency and she underwent emergency mitral valve replacement. After event free surgery, cardiac function deteriorated despite high inotropic support (epinephrine 0.2 $\mu g\,kg^{-1}\,min^{-1}$, norepinephrine 0.3 $\mu g\,kg^{-1}\,min^{-1}$, enoximone 8 $\mu g\,kg^{-1}\,min^{-1}$) and she rapidly developed cardiogenic shock and MOF. At this point we decided to start levosimendan at 0.1 $\mu g\,kg^{-1}\,min^{-1}$ for 24 h. Haemodynamic, respiratory and metabolic parameters are listed in the table. Values on day 0 are prior to levosimendan infusion.

Table

	day 0	day 1	day 2	day 9
C I. L min^{-1} m^{-2}	4.6	3.8	3.2	3.6
MAP. mmHg	57	58	97	67
PaO_2/FiO_2	173	216	312	240
Lactate. mmol/L	4.6	3.9	1.5	1.6
Urine. mL/24 h	460	2070	970	1640
APACHE II score	36	33	17	13
SOFA score	17	16	11	9

The patient recovered rapidly as confirmed by APACHE II and SOFA scores, urine output increased and CRRT was discontinued on day 5 post-surgery. She left the ICU on day 9 post-surgery and the hospital on day 15 post-surgery without functional impairment.

Discussion: Patients with acute heart failure and MOF syndrome are often not responsive to high conventional inotropic support [3]. Levosimendan is a new calcium sensitizing agent with unique therapeutic properties and different from other conventional inotropes. The patient we describe improved rapidly with levosimendan after only 24 hours. We were able to discontinue early CRRT and dismissed the patient from the ICU after 9 days despite a severe MOF syndrome. She was discharged from the hospital after 15 days without impairment. Levosimendan should be considered as a therapeutic option in patients with MOF and cardiac failure.

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P-113

Paraplegia after elective cardiac revascularization: case report

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Introduction: Paraplegia after coronary artery bypass grafting (CABG) is an uncommon complication. The mechanisms of the spinal cord injury in this context are not clear. The outcome is unpredictable [1]. We present the case of a patient with postoperative paraplegia after elective CABG who fully recovered.

Case report: A 50-year-old white male with previous anterior myocardial infarction was admitted for elective CABG surgery. He had a recent (two months) history of interventional angioplasty and stenting of the left anterior descending artery (LAD). The present angiography showed intra-stent occlusion, significant stenosis of the circumflex artery and normal ventricular function. Laboratory work-up was within normal limits except for the presence of factor V Leiden. Two-vessel coronary bypass grafting using the left internal thoracic artery for LAD and reversed saphenous vein graft for the first marginal artery was uneventfully performed. The postoperative course was satisfactory for the first four hours. Thereafter he developed a hypertensive crisis followed by ischaemic changes in the right coronary artery (RCA) territory on ECG and, within minutes, cardiac arrest (electro-mechanic dissociation).

Surgical re-exploration was decided as an emergency, during cardiac resuscitation. No bypass graft dysfunction was found. RCA spasm was suspected and the patient was stabilized with diltiazem and moderate inotropic support. New angiography performed by the right femoral route showed moderate left ventricular dysfunction, inferior hypokinesia, functional grafts and normal RCA. After 24 hours the patient was alert and oriented and was successfully extubated.

Neurological examination revealed paraplegia with sensory deficit below T12. The deep tendon reflexes and the plantar reflexes were absent. Sphincters tone and reflexes were abolished. The patient left the ICU after 14 days. The rehabilitation was continued in a specialized clinic. At one month after surgery he recovered sphincters control and ambulation. Mild persistent lower limb spasticity persisted. At three months after surgery he was fully recovered.

Conclusions: This is the presentation of the rare neurological complication of paraplegia after CABG, in a patient with factor V Leiden trait and postoperative acute myocardial infarction with cardiac arrest, who fully recovered. The factors which could contribute to this clinical presentation were: postoperative hypertensive crisis, spinal hypoperfusion during cardiac resuscitation and dispersion of aortic atheroma associated with spinal microembolism during control angiography. The postoperative arterial thrombo-embolic risk in patients with factor V Leiden trait needs to be evaluated.

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P-114

TOE and Swan-Ganz for haemodynamic management of patients undergoing cavo-atrial tumour thrombectomy: case reports

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From 4% to 10% of patients with renal cell cancer have transluminal tumour propagation into the inferior vena cava. Radical excision of the tumour is the only treatment modality which could guarantee long term disease-free survival [1]. The anaesthetic management of patients undergoing cavo-atrial tumour thrombectomy requires close haemodynamic monitoring and eventually a veno-venous shunt for mechanical circulatory assistance [2].

Case reports: Between June and September 2004 two women, mean age 30 yr, with malignant renal haemangio-pericytoma underwent 5/6 nephrectomy and caval thrombectomy. The distal level of the vena cava tumour thrombus was below the supra hepatic vein. Before surgery we positioned a thoracic epidural catheter, level T8–T9, for administration of morphine chlorhydrate 3 mg at the induction and infusion of naropein 0.2% at 4 mL/h for 48 hours after surgery. We used a balanced anaesthesia with midazolam, fentanyl, sevofluorane and cisatracurium with BIS-spectral index range 40–50. Fenoldopam 0.1 $\mu g\,kg^{-1}\,min^{-1}$ was started at the beginning of surgery and continued for 48 hours in the postoperative period. A Swan-Ganz catheter with end-diastolic-volume-index (EDVI) feature and a TOE probe were also positioned. In particular we have also measured the transmitral flow because normal individuals usually respond to preload reduction with a proportional decrease in both E-wave and A-wave velocities.

The preload was optimized before caval clamping using index of volume loading from TOE (left ventricular end diastolic area (EDA), four chamber mid-oesophageal view, transmitral flow) and Swan-Ganz (PCWP and EDVI). The caval clamping time was a mean 20 min. Mechanical circulatory assistance was not required. TOE did not show a floating mass in the right chambers.

	Patient 1			Patient 2		
	I	II	III	I	II	III
CO	8.7	7.9	8.8	9.9	8.7	9.6
HR	94	110	105	100	104	111
MAP	100	95	78	106	99	86
CVP	13	9	11	15	11	13
PAPM	26	16	22	30	18	24
PWCP	9	8	9	11	10	11
SVR	761	830	606	769	846	610
PVR	150	75	110	160	79	116
LVSWI	72	55	51	783	602	52.6
EDVI	185	119	110	195	125	120
EDA	26	22	24	27	23	24
E-Wave	62	50	60	64	55	62
A-Wave	59	48	56	65	54	62

I: pre-clamp; II: clamp; III: post-clamp.

The table shows the haemodynamic parameters before, during and after caval declamping. Both patients produced a diuresis $>0.5\,mL\,kg^{-1}\,min^{-1}$ a mean of 5 hours from renal artery declamping. There was an increase in serum creatinine $<44\,\mu g/L$ from baseline in the 72 postoperative hours.

Conclusion: Intraoperative haemodynamic monitoring with TOE and Swan-Ganz catheter with EDVI is of help before, during and after caval clamping. They are complementary for evaluating preload. Moreover fenoldopam in

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

these cases may provide renal protection and allow control of the arterial pressure in the postoperative period.

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P-115

Incisional administration of local anaesthetic provides satisfactory analgesia after port access heart surgery

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Introduction: The new technique of cardiac operations using the Port-Access (PA) system (Heartport, Cardiovations, Somerville, NJ) [1] avoiding sternotomy requires modification of the anaesthetic technique. The aim of our study was to evaluate the new method of postoperative pain relief after PA heart surgery.

Method: Ninety-seven patients who underwent cardiac surgery using the PA system, already extubated on the operating table, were enrolled in the study. Mitral valve, tricuspid valve, cardiac tumour removal or atrial septal defect closure procedures were performed. Before closing the surgical wound in the right inframammary grove (the length of skin incision was from 2.5 to 3 cm), a multihole epidural catheter (Portex clear G 18 epidural catheter with three lateral eyes) was placed between the muscles alongside the wound. The catheter was connected to a PCA pump. 10 mL of 0.75% ropivacaine was given as a bolus through the catheter at the end of the procedure and after the patient had been admitted to the ICU, a continuous infusion of 0.15% ropivacaine was started. The intensity of pain in the ICU was evaluated by VAS score (0 = no pain, 10 = worst pain imaginable), which was recorded every 4 hours for the first 24 hours. If the VAS pain score was greater than 3 and the pain had maximum intensity in the area of catheter, a bolus 5 mL of 0.15% ropivacaine was given, but if the pain originated somewhere else, a bolus of piritramid was given i.v. The number of boluses of ropivacaine and piritramid were recorded. The side effects of local anaesthetic and catheter in the wound were recorded as well. Descriptive statistics are reported as mean and SD.

Results: The median VAS score and median number of bolus application of LA and piritramid are reported in the table.

	Mean	±SD
VAS	2.7	1.5
Number of bolus LA	2.0	1.1
Number of bolus piritramid	1.7	1.1

VAS = visual analogue scale, LA = local anesthetic.

We did not observe any side effects that could be related to the LA or the catheter placed in the wound. No catheter tips were sent for microbiological analysis because of wound infection. Ten randomly chosen catheter tips that were sent for microbiological analysis were sterile.

Discussion: Our study showed that satisfactory pain relief could be achieved with incisional administration of the LA. Because there is no need to use a great dose of opioid analgesic the patients are awake and spontaneously breathing in the operating room right after the end of the operation and can be extubated on table. Unpleasant side effects and complications of orotracheal intubation and mechanical ventilation can therefore be avoided.

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P-116

Cervical plexus blockage for carotid endarterectomy: comparison of bupivacaine and ropivacaine

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Introduction: Carotid endarterectomy (CEA) is an important procedure to prevent stroke. There are major considerations when choosing an appropriate anaesthetic technique for patients undergoing CEA. These are ability to monitor adequacy of cerebral perfusion, prevention of stroke or reversible ischaemic neurological deficit and avoidance of a myocardial infarction during the operation. Regional anaesthesia techniques allow continuous evaluation of neurological function and therefore can help to determine the incidence, timing and causes of cerebral ischaemia [1]. The aim was to compare the effectiveness of cervical plexus block (CPB) performed with either ropivacaine 1% or bupivacaine 0.5%.

Method: After approval of the ethics committee, in a prospective, blinded, randomized trial, 40 patients received deep CPB with 0.3 mL kg^{-1} divided among C2–C4 injections using ropivacaine 1% or bupivacaine 0.5%. Then a superficial cervical block was performed with 0.15 mL kg^{-1} lidocaine 1%. During the operation, haemodynamic parameters (heart rate, blood pressure, ECG, SaO_2) and BIS were monitored before CPB, after 20 min CPB, before carotid cross-clamp, after cross-clamp, end of the operation and postoperatively 1st hour. The need for intraoperative supplemental analgesia and degree of pain were also recorded. We checked perioperatively the mental condition of the patients by talking with him and by giving him orders to move his extremities. Requirements for postoperative analgesics and pain assessment scores (VAS) were recorded for 1 hour after surgery. ANOVA was used for statistical analysis.

Results: Haemodynamic parameters and BIS were not found significant statistically between bupivacaine and ropivacaine. The need for intraoperative supplemental analgesia was observed (8 patients with ropivacaine 1%, 1 patient with bupivacaine 0.5%) and lidocaine 1% was given by the surgeon (approximately 0.15 mL kg^{-1}). VAS were lower in the bupivacaine group (1.5 ± 0.9) than the ropivacaine group (2.5 ± 0.4) during surgery ($P < 0.05$). VAS were determined in the bupivacaine group (2.1 ± 0.8) and in the ropivacaine group (3.8 ± 0.3) postoperatively ($P < 0.05$). Diclofenac sodium (IM) was used for analgesic requirements in the ropivacaine group (7 patients) after postoperative 3 hours.

Discussion: Ropivacaine 1% is an appropriate agent to perform CPB for CEA [2] but it has a shorter analgesic effect than bupivacaine 0.5% during the postoperative period. We concluded that bupivacaine has an advantage of longer postoperative pain relief than ropivacaine.

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P-117

Double-lung high frequency jet ventilation is a safe alternative to one lung ventilation for thoracic surgery

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Introduction: Double-lung high frequency jet ventilation (HFJV) applied to a conventional endotracheal tube may be an attractive alternative to the usage of double lumen endotracheal tube and one lung ventilation (OLV) for major and minor thoracic procedures [1]. However few comparative studies on this subject exist in the literature. The aim of the present study was to compare haemodynamics and oxygenation during HFJV and OLV during anaesthesia for thoracic procedures.

Method: 80 patients were randomly allocated to receive either HFJV (n = 40), with drive pressure (DP) 80–120 kPa f = 200/min) or OLV (n = 40, f = 12, TV = 8 mL/kg) during major and minor thoracic procedures. All patients were anaesthetized with a target-controlled infusion of propofol. Muscle relaxation was achieved with rocuronium and analgesia was provided with continuous epidural infusion of 0.5% ropivacaine. A transoesophageal probe for non-invasive cardiac output measurements was inserted after induction of anaesthesia. Arterial and central venous blood samples for gas analysis were taken before induction of anaesthesia (0), prior to the start of the studied mode of ventilation (I), and then every 30 min during HFJV or OLV. Haemodynamic parameters were recorded at baseline (I) and every 15 min during HFJV or OLV. Measurements were taken for 120 minutes. ANOVA or Mann-Whitney test were used when appropriate and $P < 0.05$ was considered significant.

Results and Discussion: Exclusion criteria were excessive bleeding requiring using of vasoconstrictors and blood transfusions. Patients in study groups were comparable. 16 pts in HFJV group and 15 pts in OLV group underwent major thoracic procedures (pneumonectomy, bilobectomy, lobectomy) other procedures were minor (tumourectomy, segmentectomy, pleurectomy). Blood pressure, stroke volume aortic blood flow and cardiac index tended to be higher in HFJV group. However the difference was statistically significant only in a few measurements. $PaCO_2$ values were significantly higher in HFJV group when this mode of ventilation was prolonged over 1 hour. No differences in heart rate, systemic vascular resistance, and PaO_2 values were recorded. No major complications were found and all procedures were performed safely. Surgeons satisfaction was comparable in both groups.

Conclusions: Ventilation and haemodynamic conditions provided by double-lung HFJV are comparable to OLV during thoracic surgery.

https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

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P-118

The impact of preoperative total body showering with povidone-iodine on skin flora

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Introduction: The goal of preoperative skin disinfection is to reduce the skin flora around the operative field. Different disinfectant agents can be used for total body shower in the preoperative period [1]. In this study we examined the effect of showering with povidone-iodine on skin flora, using a method that allows both qualitative and quantitative evaluation.

Method: Twenty male patients, age 56 $\pm$ 7 years, scheduled for cardiac surgery were included in the study. The first sample was obtained before the first shower, the second following it. The third sample was taken before the second shower and the fourth following it. Povidone-iodine containing 7.5 mg free iodine mL^{-1} (Betadine®, Egis, Hungary) was used as the skin disinfectant. Bacterial samples were taken with contact Rodac Petri plate (Neomed, Italy). Samples were taken from the same part of the chest. A 16 cm^2 area was examined and averaged. The plates were incubated for 24 hours at 37°C and the colony forming units (cfu) were counted. The method is described in details elsewhere [2].

Statistical method: Wilcoxon's rank-sum test.

Results: The bacterial count did not change significantly following the first shower but increased after the second (Table 1).

Table 1. The effect of povidone-iodine shower on skin flora.

	Before	After	Before	After
Sample	1st shower	1st shower	2nd shower	2nd shower
Cfu/cm^2	6.7 (2–12.9)	7.4 (5–13.8)	3.3 (2–7.5)	15.9 (11–44)*

Median of colony forming units (cfu) (min–max). *$P < 0.05$.

Discussion: Our results suggest that shower with povidone-iodine does not reduce the cfu on skin. On the contrary, the bacterial count significantly increased following the second shower. Further research is needed with more patients to achieve statistically valid conclusions.

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Acknowledgement: Bolyai scholarship of the Hungarian Academy of Sciences supported this study. Dr. N. Kovacs helped with the statistics.

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https://doi.org/10.1017/S0265021505001353 Published online by Cambridge University Press

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