Sevoflurane consumption – laryngeal mask vs. tracheal intubation

doi:10.1017/S0265021508003943

EDITOR:

The laryngeal mask (LM) is widely used in ambulatory anaesthesia. Current anaesthetic practice requires rapid recovery and overall time-optimization, particularly in the ambulatory setting [1]. The aim of the present study was to compare sevoflurane consumption in LM vs. tracheal intubation (TI) anaesthesia guided by BIS (bispectral index monitoring), during outpatient gynaecological surgery, and also to determine the difference in the recovery profile between the two anaesthetic techniques.

After institutional approval and informed consent, 50 female patients, ASA physical status I or II, scheduled for hysteroscopy on an ambulatory basis were recruited for the study. Patients were randomly assigned to one of the following two groups: the LM group ($n = 25$) and the TI group ($n = 25$). Exclusion criteria were a history of significant cardiorespiratory, renal or hepatic dysfunction, gross obesity (body mass index $>30\,kg\,m^{-2}$), alcohol intake, concurrent treatment with medication known to affect anaesthetic requirements, as well as a history of gastro-oesophageal reflux. Patients received no premedication.

On arrival in the operating room, patients were asked to perform the 'picking up matches' test [2]. Apart from standard monitoring, end-tidal carbon dioxide ($ETCO_2$) and inspired and end-tidal sevoflurane concentrations were recorded (Datex-Ohmeda S/5™ Anaesthesia Monitor, Helsinki, Finland). The sevoflurane vaporizer (Sevorane® Abbott Vapor19.3, Lubeck, Germany) was filled to the top and weighed in a scale with a precision of 0.1 g in the range up to 15 000 g (NJW-HGS Series, Scale Direct (Scotland) Ltd, Glasgow, UK). We tailored the anaesthetic concentrations using the BIS™ Monitor, Model 1A-2000™, System Rev. 3.12 Main Program 0289242B. The BIS signal and its trend line were obtained from Zipprep™ electrodes (Aspect Medical Systems Inc., Newton, MA, USA).

Before anaesthetic induction, metoclopramide 10 mg and ranitidine 50 mg were administered intravenously (i.v.). After preoxygenation, anaesthesia was induced with propofol 2–2.5 $mg\,kg^{-1}$ followed by i.v. succinylcholine 0.8 $mg\,kg^{-1}$ to facilitate direct laryngoscopy or LM insertion. Before attempting direct laryngoscopy or LM insertion, anaesthesia was supplemented with sevoflurane in oxygen under manual ventilation to ensure a BIS value between 35 and 45. When the airway was secured, ventilation was assisted with 60% nitrous oxide in oxygen plus sevoflurane using a circle breathing system with a CO_2 absorber at a fresh gas flow of 2 $L\,min^{-1}$ and setting the vaporizer to maintain intraoperatively a BIS value of 35–45 in both the groups. When succinylcholine had worn off and spontaneous ventilation resumed, patients in both groups were allowed to breathe spontaneously. All patients received analgesics upon completion of the surgical procedure, thus 1200 mg of paracetamol i.v. and 75 mg of diclofenac i.m.

Measurements were recorded: (1) just before anaesthetic induction (baseline); (2) prior to LM or tracheal tube insertion; and (3) immediately after airway instrumentation. End-tidal sevoflurane concentrations and $ETCO_2$ were recorded in patients of both groups at 5-min time intervals. Those values were averaged and the mean end-tidal sevoflurane concentration and mean $ETCO_2$ were calculated for each patient. After completion of the hysteroscopy, nitrous oxide and sevoflurane administration were discontinued and the times from sevoflurane discontinuation to: (a) spontaneous eye opening and (b) to the removal of the LM or of the tracheal tube were recorded. The quantity of sevoflurane consumed in g during the operation was measured after completion of surgery by disconnecting and reweighing the vaporizer as described previously. The inhaled anaesthetic consumption per minute ($g\,min^{-1}$) was then calculated for each patient. Patients were assessed for orientation, sedation and sitting ability at 0, 15, and 30 min after extubation or LM removal by an anaesthesiologist blinded to the study design. To assess orientation, the following questions were asked: (a) where are you? (b) what is the day today? (c) what is the date? (d) what is your date of birth? The patient was accredited 1 point for each correct answer. Sedation was assessed as sleepy (1 point), sleepy but arousable (2 points) and spontaneously awake (3 points). Sitting ability with (scored as no) and without (scored as yes) help was also assessed. The 'picking up matches' test was performed at the same time points. The time from

Correspondence to: Kassiani Theodoraki, Department of Anaesthesiology, Aretaieio Hospital, Athens, Greece. E-mail: ktheodoraki@hotmail.com; Tel: +30 210 2112672; Fax: +30 210 7211007

Accepted for publication 26 December 2007 EJA 4734
First published online 13 March 2008

Table 1. Intraoperative data, anaesthetic requirements and recovery profiles.

Parameter	LM group ($n = 25$)	TI group ($n = 25$)
Duration of anaesthesia (min)	35.1 ± 13.1	36.2 ± 10.1
Time to eye opening (min)	5.0 ± 1.3	7.2 ± 1.5*
Time to airway removal (min)	6.4 ± 1.4	8.8 ± 1.5*
BIS value at eye opening	89.2 ± 2.3	89.1 ± 2.1
BIS value at airway removal	96.9 ± 1.6	96.3 ± 1.7
Mean end-tidal CO_2 (mmHg)	42.3 ± 2.6	41.2 ± 3.5
Mean inspired sevoflurane concentration (%)	2.00 ± 0.53	2.44 ± 0.63#
Mean end-tidal sevoflurane concentration (%)	1.56 ± 0.40	2.12 ± 0.63*
Weight of consumed sevoflurane (g)	17.56 ± 8.07	26.04 ± 9.04*
Sevoflurane consumption rate (g min^{-1})	0.48 ± 0.20	0.73 ± 0.26*
Time to discharge from PACU (min)	56.4 ± 12.3	60.6 ± 12.9
Orientation score		
0 min	4 (1–4)	3 (1–4)
15 min	4 (3–4)	4 (2–4)
30 min	4 (4–4)	4 (3–4)
Sedation score		
0 min	3 (2–3)	3 (1–3)
15 min	3 (3–3)	3 (2–3)
30 min	3 (3–3)	3 (3–3)
Sitting ability		
0 min	20	16
15 min	25	23
30 min	25	25
Nausea and vomiting	2	3

Data are mean ± SD median (range) or numbers of patients.
LM: laryngeal mask; TI: tracheal intubation; BIS: bispectral index monitoring; PACU: post-anaesthesia care unit
*$P = 0.01$.
#$P = 0.012$.

arrival to discharge from the PACU and the occurrence of postoperative nausea and vomiting were recorded. Patients were discharged from PACU using the maximum score of the criteria for fast-tracking after outpatient anaesthesia proposed by White and Song [3].

The primary outcome measure of the study was sevoflurane consumption. Prior to the study, the estimated sample size was calculated to be 23 patients in each group in order to detect a 30% difference in sevoflurane consumption rate between the two groups with a power of 80% and an α level of 0.05. Sevoflurane consumption rate in patients anaesthetized with an LM had been estimated from initial pilot observations at approximately 0.50 ± 0.18 g min^{-1} at a fresh gas flow rate of 2 L min^{-1}. Patient characteristics data were analysed with the unpaired *t*-test. Orientation and sedation scores, sitting ability and nausea and vomiting were analysed with the χ^2 test or Fisher's exact test where appropriate. Intergroup comparisons of time required to complete the 'picking up matches' test was performed with repeated measures Analysis of variance. *P* values of less than 0.05 were accepted as statistically significant.

The two groups were comparable with respect to patient characteristics. Sevoflurane requirements and consumption to obtain the same BIS values were significantly smaller in the LM group than in the TI group. The time interval between sevoflurane discontinuation and eye-opening and the time to airway removal was shorter in the LM group as compared with the TI group.

No difference was detected between the two groups in orientation score, sedation score or sitting ability at the specified time points after emergence.

The incidence of nausea and vomiting during patient stay in the recovery area was similar in the two groups. Time required to perform the 'picking up matches' test was different between the two groups only immediately after awakening (16.3 ± 4.8 s in the LM group vs. 21.0 ± 7.8 s in the TI group, $P = 0.013$). No difference was detected in the scores of this test between the two groups 15 and 30 min after emergence. Finally, time to discharge from PACU did not differ between the two groups (Table 1).

Previous studies have shown that LM insertion in children can be performed at a lower sevoflurane concentration than that required for tracheal intubation [4,5]. However, those studies were confined to anaesthetic requirements during airway instrumentation and not to maintenance of anaesthesia. Cork and colleagues [6] compared the LM vs. TI in ambulatory surgery regarding haemodynamics and laryngeal reflexes protection. They did not quantify

hypnosis as we did using the BIS monitor neither did they calculate the amount of the anaesthetic consumed with each technique.

In our study, we used an objective monitor to quantify hypnosis, thus ensuring comparable levels of anaesthesia in both groups intraoperatively. We maintained BIS values between 35 and 45, which are lower than those required to prevent awareness, because in studies specifically relating BIS to sevoflurane, values lower than 50 reliably indicated an adequate depth of anaesthesia [7]. Another reason is that our patients were breathing spontaneously and lower BIS values might minimize movement or EMG interference.

Increased sevoflurane requirements to maintain predetermined BIS values might account for the longer awakening time in the TI group. Immediate co-ordination ability and subtle manual dexterity assessed by the 'picking up matches test' were affected by exposure to higher concentrations of sevoflurane in the TI group as shown by the difference in the test results immediately after arousal. No significant difference in performing the test was observed thereafter. In fact, in short-duration procedures such as half an hour or so, inhalational anaesthetic uptake is mostly limited to the vessel-rich group and recovery times for different inhalational anaesthetics or for different amounts of the same anaesthetic will be similar. Nonetheless, less amount of anaesthetic for the same procedure costs less money. This may explain the fact that the different sevoflurane consumption did not affect nausea and vomiting or duration of stay in PACU between the two groups. The lack of blinding, not feasible for technical reasons, may be considered a limitation of our study. However, the amount of anaesthetic consumed, the 'picking up matches' test and BIS values consist objective recordings, minimizing the bias in interpretation of our results.

Today, improved recovery times leading to safe reduction of turnaround times and optimization of resource utilization are becoming the target of the so-called 'fast track' anaesthesia [1]. Under the present study design, use of the LM was associated with lower sevoflurane requirements and consumption, shorter awakening time and shorter time to remove the airway device but similar duration of stay in the PACU when compared with the TI group.

K. Theodoraki, A. Fassoulaki
Department of Anaesthesiology
Aretaieio Hospital
Athens, Greece

Acknowledgements

This work was supported by a grant by the National and Kapodistrian University of Athens, code number: 70/4/8207.

References

1. Eger EI, White PF, Bogetz MS. Clinical and economic factors important to anaesthetic choice for day-case surgery. *Pharmacoeconomics* 2000; **17**: 245–262.
2. Paraskeva A, Papilas K, Fassoulaki A, Melemeni A, Papadopoulos G. Physostigmine does not antagonize sevoflurane anesthesia assessed by bispectral index or enhances recovery. *Anesth Analg* 2002; **94**: 569–572.
3. White PF, Song D. New criteria for fast-tracking after outpatient anesthesia: A comparison with the modified Aldrete's scoring system. *Anesth Analg* 1999; **88**: 1069–1072.
4. Taguchi M, Watanabe S, Asakura N, Inomata S. End-tidal sevoflurane concentrations for laryngeal mask airway insertion and for tracheal intubation in children. *Anesthesiology* 1994; **81**: 628–631.
5. Aantaa R, Takala R, Muittari P. Sevoflurane EC50 and EC 95 values for laryngeal mask insertion and tracheal intubation in children. *Br J Anaesth* 2001; **86**: 213–216.
6. Cork RC, Depa RM, Standen JR. Prospective comparison of use of the laryngeal mask and endotracheal tube for ambulatory surgery. *Anesth Analg* 1994; **79**: 719–727.
7. Aime I, Verroust N, Masson-Lefoll C *et al*. Does monitoring bispectral index or spectral entropy reduce sevoflurane use? *Anesth Analg* 2006; **103**: 1469–1477.

Epidural volume extension and role of baricity

doi:10.1017/S0265021508004407

EDITOR:
I would like to congratulate the authors on a well-conducted trial, regarding a relevant clinical implication of epidural volume extension (EVE) [1]. It is concluded by the authors that EVE does not augment the sensory level of subarachnoid block induced with hyperbaric or plain bupivacaine. This is correctly enough inferred from their observation of statistically similar sensory levels at pre-defined time points between Groups A and B, and between Groups C and D. However, it might be more

Correspondence to: Asha Tyagi, University College of Medical Sciences & GTB Hospital, Delhi 110095, India. E-mail: drashatyagi@gmail.com; Tel: +91 9818606404; Fax: +91 11 22590495

Accepted for publication 30 March 2008 EJA 4997
First published online 22 April 2008

