Cardiology in the Young

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The current practice and care of paediatric patients post cardiac catheterisation

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Original Article

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Abstract

Background: Literature is lacking to guide standardised care and assessment practices for paediatric patients post cardiac catheterisation. In response to this gap, we sought to describe the current state of practice in cardiology programmes performing paediatric cardiac catheterisations procedures in the United States of America. *Materials and methods:* A web-based survey was distributed to the Congenital Cardiovascular Interventional Study Consortium Listserv, with representation from 113 identified institutions. A 36-question survey, including fixed-choice and open-ended questions, was developed and piloted for reliability and validity before distribution. Data were summarised descriptively with count and frequency or median and range. *Results:* Of the 113 identified institutions, 52% (n = 59) responded to the survey. Manual pressure is used to achieve haemostasis by 94.9% of the respondents. Pressure dressings are used by a majority of the facilities and the length of time for bed rest is variable, with the majority using 6 hours for arterial access and 4 hours for venous access. Predominantly, respondents use the time of haemostasis as the start time of bed rest while a third of respondents reported using the time the sheath was removed. *Conclusion:* In this study, variation in a number of post catheterisation care and assessment practices for paediatric patients was noted across cardiology programmes. Information from this assessment identifies key opportunities to collaborate in developing standardised practices for the care and assessment of the paediatric patients post catheterisation.

Diagnostic and interventional cardiac catheterisation is a common procedure used to evaluate and treat children with CHD and cardiovascular disease. However, information related to paediatric care and assessment in the post catheterisation period is insufficient to guide a standardised practice. Literature relating to paediatric catheterisation is primarily focussed on procedures and outcomes related to intervention.[1,2] For the care of the adult patient undergoing diagnostic and interventional cardiac catheterisation, evidence is available to guide methods in achieving haemostasis and required time of immobilisation post procedure.[3–8] The Association of periOperative Nurses practice guidelines for post anaesthesia care provides a generalised description of clinical assessment for patients across the lifespan, with the aid of sedation scoring tools guiding the determination of the patient's return to baseline.[9]

Paediatric patients differ from adult patients because of their ability to understand and cooperate with instructions to how their bodies respond to similar procedures.[10] Paediatric patients differ in size, body surface area, vessel compliance, co-morbidities, and frequency of repeat catheterisations. In addition, cardiac catheterisation for CHD is a different procedure than diagnostic heart catheterisation or percutaneous coronary interventions most commonly performed on adults. The American College of Cardiology Foundation Task Force reports that three-fourths of all paediatric cardiac catheterisations are therapeutic, rather than purely diagnostic, and involve procedures that are unique to paediatrics such as an atrial septostomy.[10] Diagnostic catheterisations performed in the paediatric congenital heart patient are more extensive than for patients with normally structured hearts because they are used to define the anatomic structures and abnormalities. This often results in multiple interventions, numerous sheath exchanges/sizes, and longer procedures, all of which contribute to the greater instability and risk of adverse events. To address this gap in the literature, an inter-professional team was convened to explore the current state of practice for post paediatric catheterisation care used by cardiovascular programmes.

Materials and methods

In the fall of 2013, an electronic survey was e-mailed to the Congenital Cardiovascular Interventional Study Consortium Listserv representing 113 institutions. Congenital

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Table 1. Demographic information for participating programmes.

	Count (%) n = 59 institutions
Location of the hospital (n = 49)	
International	3 (6.1)
United States	46 (93.9)
United States Regional Location* (n = 46)	
Northeast	7 (15.2)
South	11 (23.9)
Midwest	21 (45.7)
West	7 (15.2)
Type of hospital (n = 50)	
Paediatric freestanding	36 (72.0)
Combined paediatric and adult	14 (28.0)
Number of beds (n = 48)	
<100	1 (2.1)
100–200	6 (12.5)
201–300	14 (29.2)
>300	27 (56.3)
Dedicated nursing staff caring for post cardiac catheterisation patients (n = 48)	26 (54.2)
Dedicated technologist staff caring for cardiac catheterisation patients (n = 47)	31 (66.0)
	Median (range)
Cases performed in the past calendar year (n = 43)	500 (60–2500)
Proportion of cases that were interventional (n = 33)	63.3 (20.0–83.3)

*Northeast: New England/Mid-Atlantic; South: East South Central/West South Central/South Atlantic; Midwest: East North Central/West North Central; West: Mountain/Pacific

Cardiovascular Interventional Study Consortium is a "not-for-profit organization dedicated to the advancement of science and treatment of infants, children, and adults requiring surgical/interventional procedures for the treatment of congenital heart disease".[11]

The 36-question survey included multiple-choice and open-ended questions. Before distribution, the survey was piloted among internal staff and two external programmes to establish reliability and validity. Of the 36 questions, 12 were demographic and the remaining 24 were divided into the following subtopics: care and management at the end of the procedure including achievement of haemostasis; catheterisation site dressings; use of vascular closure devices; care practices around post procedure bed rest; and post catheterisation recovery care and length of stay among paediatric patients. All questions were specific to the care and management of paediatric patients.

Survey responses were collected through Research Electronic Data Capture (REDCap). REDCap is a secure, web-based software designed to support data capture for quality improvement projects and research studies. For analysis, data were summarised

Table 2. Questions regarding end of a catheterisation procedure/achieving haemostasis.

End of catheterisation procedure	Count (%)
Reverse heparin at the end of the procedure	
Always	1 (1.7)
Most of the time	1 (1.7)
Sometimes	34 (57.6)
Never	23 (39.0)
Check an activated clotting time	
Always	12 (20.3)
Most of the time	9 (15.3)
Sometimes	34 (57.6)
Never	4 (6.8)
Timing of sheath removal contingent on last activated clotting time	
Yes – needs to be <250	7 (12.1)
Yes – needs to be <200	9 (15.5)
Yes – physician preference	2 (3.4)
Yes – depends on patient	2 (3.4)
No	38 (65.5)
Achieving haemostasis	
Method used to achieve haemostasis	
Manual pressure	56 (94.9)
Topical coagulant	2 (3.4)
Haemostasis dressing with manual pressure	2 (3.4)
Vessel closure device	1 (1.7)
Protocol to achieve haemostasis	22 (37.3)
Protocol when using manual pressure	
Until haemostasis is achieved	10 (45.5)
> 10 minutes	6 (27.3)
> 15 minutes	3 (13.6)
> 20 minutes	3 (13.6)
Pressure held by	
Attending physician	23 (39.0)
Fellow	32 (54.2)
Nurse	41 (69.5)
Technologist	42 (71.2)
Pressure held on	
Catheterisation table	59 (100)
Patient's bed	1 (1.7)

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Table 3. Questions regarding dressings, vascular closure devices, and bed rest.

Dressings and vascular closure devices	Count (%)
Materials used to manage catheterisation sites	
Pressure dressing	36 (61.0)
Gauze and transparent film	23 (39.0)
Topical haemostasis accelerator	8 (13.6)
Vascular plug or sealer	5 (8.5)
Safeguard	13 (22.0)
External compression device	1 (1.7)
Plastic adhesive dressing	11 (18.6)
Bed rest	
Starting point of bed rest	
Sheath removal	18 (33.3)
Haemostasis	28 (51.9)
Bandage application	2 (3.7)
Arrival to the recovery area	5 (9.3)
Patient level of cooperation	1 (1.9)
	Median (range)
Length of bed rest after femoral arterial access (in hours)	6.0 (1.0–7.0)
For patients who did not receive heparin	4.0 (1.0–6.0)
Length of bed rest after venous only access (in hours)	4.0 (1.0–6.0)
For patients who did not receive heparin	4.0 (1.0–6.0)

descriptively using SPSS statistical software with count and frequency or median and range reported for each question.

Results

Of the 113 institutions invited to participate, 59 institutions responded for a 52% response rate. The majority of respondents represented hospitals within the United States of America (93.9%) (Table 1). Among hospitals located in the United States America, the majority were located in the South and Midwest (23.9 and 45.7%, respectively). Respondents represented a heterogeneous cross-section of patient care facilities with 72% being paediatric facilities and 28% are combined paediatric and adult facilities. The majority of respondents represented large hospitals with more than 300 beds that have dedicated nursing and technologist staff caring for cardiac catheterisation patients.

At the end of the catheterisation procedure, heparin reversal was not a standard practice and there was wide variation in use of activated clotting time to guide sheath removal (Table 2). Manual pressure was the primary practice (94.9%) used to achieve haemostasis and was performed before leaving the procedure table (100%). Most facilities did not report having an established protocol to achieve haemostasis. Of those who had a protocol, 45% held pressure until haemostasis was achieved rather than using a predetermined length of time. The majority of the facilities reported using nurses, technologists, and/or fellows to hold manual pressure.

Standard pressure dressings consisting of gauze and surgical foam tape were used by the majority of facilities (61.0%); however, gauze with transparent film, topical haemostatic accelerators, vascular plugs, Safeguard® dressings, and plastic adhesive dressings were used regularly as well (Table 3). External compression devices were rarely used in the paediatric population represented in this survey.

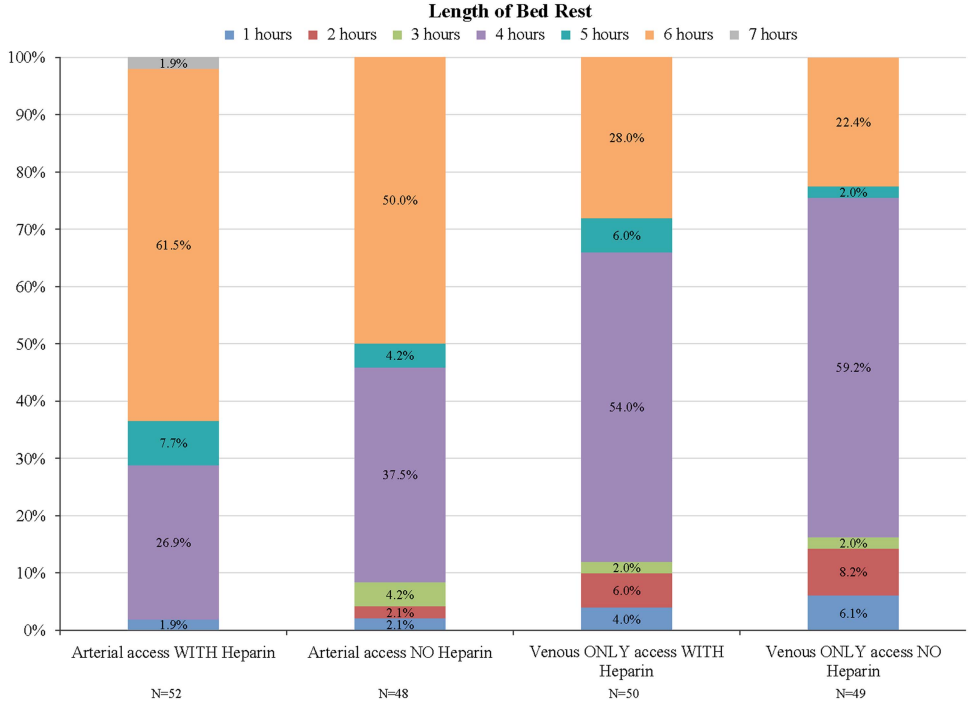

Figure 1. Length of bed rest following catheterisation.

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Table 4. Questions regarding post catheterisation recovery care and length of stay.

Length of stay	Count (%)
Length of hospital stay for only haemodynamic catheterisation	
6 hours	35 (64.8)
8 hours	10 (18.5)
12 hours	3 (5.6)
Overnight	2 (3.7)
Length of hospital stay for routine interventional procedure	
6 hours	7 (13.2)
8 hours	3 (5.7)
Overnight	39 (73.6)
Dependent on procedure	3 (5.7)
Location of recovery immediately following the procedure	
General post-anaesthesia care unit	28 (52.8)
Cath lab recovery room	22 (41.5)
ICU	5 (9.4)
Inpatient unit	2 (3.8)
Length of stay in this location	
30 minutes	7 (13.5)
1 hour	18 (34.6)
2 hours	6 (11.5)
>2 hours	8 (15.4)
Based on return to baseline with a post procedural scoring system	9 (17.3)
No separate recovery and short stay areas	3 (5.8)

The starting point of bed rest varied among respondents. Reported factors that influenced the length of bed rest included sheath size, patient age, and use of a vascular closure device. Length of bed rest following catheterisation varied from 1 to 7 hours, with a median of 6 hours for arterial access and 4 hours for venous access (Fig 1).

At 64.8% of institutions, the hospital stay for only haemodynamic catheterisations was 6 hours; 73.6% required overnight hospitalisation for routine interventions (Table 4). The majority of post catheterisation patients recovered in a general post anaesthesia care unit (52.8%) or a catheterisation lab recovery room (41.5%).

Immediate recovery stays in the post anaesthesia care unit or recovery room varied. Approximately 35% reported a 1 hour stay and 17.3% reported the length of stay was determined by the patient's return to baseline based on Aldrete or a similar post sedation score (Table 4).

Routine protocol for vital signs post anaesthesia and procedural sedation varied. The majority responded that vital signs were assessed every 15 minutes for the first hour (87.0%), every 30 minutes the second hour (81.1%), and then hourly starting at hour three (Fig 2). Approximately 11% reported vital signs assessed every 5 minutes during some portion of the first hour. Approximately 26% of the respondents reported using the following routine protocol: assessment every 15 minutes for 1 hour, every 30 minutes for the second hour, and then every hour after 4 hours.

Discussion

Results generated from this assessment provide a description of the state of practice and care of paediatric patients post cardiac catheterisation across a number of cardiology programmes. The results identify variation in both post catheterisation care and assessment practices for paediatric patients. These variations included timing of sheath removal with activated clotting time status, approach to achieving haemostasis, materials used to cover femoral site, and length of monitoring/bedrest.

It was a standard practice among respondents to use manual pressure on the catheterisation table when establishing haemostasis post cardiac catheterisation. Practices varied among programmes regarding checking an activated clotting time before sheath removal, timing of sheath removal based on activated clotting time result, and use of heparin reversal at the end of a procedure. In the absence of published evidence guiding best practices in the paediatric cardiac catheterisation population, our results highlight the variation in dressing methods, vital sign assessment protocols, and length of bed rest.

Research suggests that the clotting ability of paediatric patients is markedly more affected by cardiac catheterisation than their adult counterparts and places them at greater risk for both bleeding and clotting complications post cardiac catheterisation.[1] Given this finding, timing sheath removal with a prescribed activated clotting time value may reduce the potential for blood loss post catheterisation. Despite this evidence, routine testing of activated clotting times at the end of procedures before removing sheaths was not reported by most respondents. In centres where sheath removal was contingent on the last activated clotting time, the activated clotting time value varied and was sometimes reliant on age or size of patient or physician preference. In addition, most respondents did not have a set protocol for obtaining haemostasis.

Complication rates are reported to be higher in paediatric patients because of compromised haemodynamic states and the nature of the interventions.[2,10] Adverse events in paediatric catheterisation cases are reported in 16% overall, 10% related to diagnostic catheterisations, 19% related to interventional procedures, and death is reported in 0.9%.[10] Paediatric catheterisations as compared with adult catheterisations are more likely to involve deep sedation or anaesthesia and typically require an overnight hospitalisation.[10] Our results are in agreement with the literature where the majority of respondents in our study indicated overnight hospital admissions as a standard of care for paediatric patients after interventions. Though longer stays were also noted, length of stay post haemodynamic catheterisation was typically 6 hours and are longer than bed rest times for adults following left heart catheterisation.[6,12] The literature for bed rest times among adults greatly varies between 1 and 24 hours and typically use only femoral arterial access as opposed to arterial and venous access.[6,7,12] In addition to variance in overnight stays in paediatric

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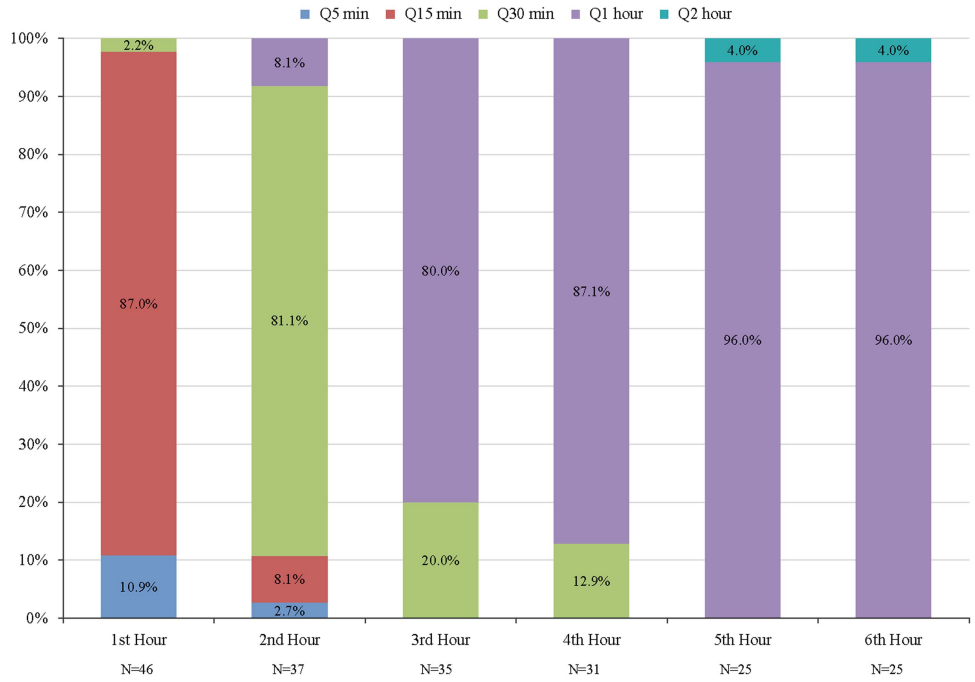

Figure 2. Frequency of vital sign assessment per hour. *Frequencies are based on the number of institutions that assess vital signs within each hour.

versus adult patients, the location of recovery post catheterisation in paediatric patients was also variable. Most reported using either a generalised multi-disciplinary post-anaesthesia care unit or designated catheterisation laboratory recovery room with the remainder in the ICU or inpatient unit. Establishing evidence-based guidelines regarding the minimum level of care will help guide bed rest requirements, duration of observation, and optimal location for recovery post catheterisation.

Given the wide variation in post catheterisation practice and care of the paediatric patient, there is opportunity to determine the rationale behind the current practice across cardiology programmes. Evaluating the similarities among programmes performing cardiac catheterisations in the congenital heart patient will allow for the benchmarking and standardising of practice. Once a standard practice can be identified, outcomes such as the frequency of access site bleeding after haemostasis can be achieved.

Limitations

The survey was distributed to the Congenital Cardiovascular Interventional Study Consortium Listserv, which is comprised solely of physicians at the various participating institutions. Further, while the survey requested that nursing leadership or nursing educators respond, the survey did not query the role of the individual who responded.

Conclusion

Paediatric post catheterisation care and assessment practices vary across cardiovascular programmes. This data may serve to inform efforts to standardise post catheterisation care, particularly in methods used to achieve haemostasis, required time of immobilisation, frequency of patient assessment, and duration of observation.

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Conflicts of Interest. None.

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