Original Article

An Audit of 829 Paediatric Epidurals in a Tertiary Singapore Hospital: Complications and Conundrums

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Abstract

Introduction: The incidence of complications related to epidural analgesia remains less well defined in the paediatric population as compared to adults. A retrospective review of prospectively collected data was performed to review and quantify risks of both adverse events and complications related to epidural analgesia in our Singaporean paediatric population. Materials and Methods: Data from the Acute Pain Service (APS) was prospectively collected over 19 years. Details included the age of the patients, level of insertion of the epidural catheter, number of attempts, staff grade of the practitioner, adverse events and complications. Results: Collectively, 829 epidurals were performed from 1 June 1997 to 31 May 2016. No deaths or major complications occurred within the 16-year period. There were 5 instances of dural puncture (0.6%). The incidence of minor postoperative complications was 3.1% with the majority of postoperative events comprising catheter-related problems (n = 161, 22.4%). Prolonged use of the catheter beyond 3 days is associated with a statistically significant increase in the frequency of skin infective/ inflammatory changes (P <0.01). We highlight common complications and conundrums faced. Conclusion: Epidural analgesia has been shown to be associated with a relatively low risk of complications both in the adult and paediatric populations, albeit with a fourfold increased risk in the latter cohort. Adverse events reported are largely related to catheter problems and have minimal impact upon the patient.

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Introduction

Providing excellent paediatric epidural analgesia remains a challenge to the anaesthetist, not least due to the technical difficulties inherent in managing patients with weight disparities (ranging from 2.5 kg or less to an excess of 100 kg), the myriad variables in prescription (from additives used to dosing limits), as well as the risk of missing subtle signs of local anaesthetic toxicity in the non-verbal child.

Of all the potential adverse events, major permanent neurological complications are amongst the most devastating. "Awake epidurals" are recommended routinely in adults (in order to minimise the risk of neurological injury) but are impractical and precluded in young children, particularly those less than 6 years old, wherein the alternative option of patient-controlled analgesia (PCA) may not be feasible.

Recent adult data from 707,455 central neuraxial blocks (CNBs) in the United Kingdom estimates the risk of permanent neurological injury from CNBs at 2.0-4.2/100,000 (estimated 0.002% to 0.004%), with risk of paraplegia or death ranging from 0.7-1.8/100,000 (0.0007% to 0.0018%).[1] Data on paediatric CNBs, whilst not amounting to a population size of 16,000[2,3,4] have shown epidural analgesia to be safe but with a higher complication rate (up to 7 times that in adults). There is consistent evidence of a significantly higher morbidity risk associated with paediatric CNBs, approximately 1.5/1000[5] which is about 6 times of that associated with peripheral nerve blocks (PNBs), and complications are 4 times more likely to occur in those younger than 6 months of age.[6] Consequently, there has been a global increase in the use of PNBs and a decline in CNBs to optimise postoperative analgesia in both the adult and paediatric populations.

Some variation exists in the incidence of complications between the different international populations studied. Direct comparisons are difficult because of complexities

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and variations in their classification. Recent studies have predominantly been conducted in Caucasian populations, but there remains a paucity of large data audits in the Asian population. We aimed to both quantitatively and qualitatively review the risks of adverse events and complications related to epidural analgesia in Singapore's multi-ethnic paediatric population.

Materials and Methods

Since its inception in 1997, the Department of Paediatric Anaesthesia has prospectively followed up every epidural performed as part of its Acute Pain Service (APS) audit. Data documented in the APS forms include patient demographics, surgery performed, level of epidural catheter placement, technical/procedural challenges and problems encountered, prescription, quality of pain relief and subsequent modifications, including plans for alternative analgesia. Initial data is entered by the anaesthetist who inserted the epidural. The APS team follows up patients at least twice a day, up to and including 24 hours after catheter removal or until all issues related to the epidural have been resolved.

Analgesic quality is regularly assessed by way of frequent pain assessment using age-appropriate scores. Observational information (e.g. impact on sleep/rest cycle, mood, social interaction and activity) is integrated with these scores and inform subsequent management. Mandatory examinations include daily inspections for evidence of catheter site complications, catheter migration, neurological deficits, evidence of infection and other cardiorespiratory complications. Adjustments in epidural drug concentration and rate of infusion, as well as the use of analgesic adjuncts are also noted. Any complications or adverse events are recorded and followed up until their resolution.

The prospective data was then retrospectively reviewed for the incidence of complications and adverse events. Our review included all children on epidural catheters from 1 June 1997 to 31 May 2016 and encompassed thoracic, lumbar, trans-sacral and caudal approaches. Single shot caudal epidurals were excluded. Patients were subdivided into the following age groups: a) neonates <28 days old, b) infants <1 year old, c) toddlers 1 to 2 years of age, d) preschoolers 3 to 6 years of age, e) children 7 to 12 years of age, and f) adolescents >12 years of age.

Data on all minor problems related to the epidurals, adverse events and complications were collected. Complications were divided into intraoperative (procedural) and postoperative events and incidents were graded in severity. Where significant complications were identified, the medical records of the patient were traced to obtain further details about the presentation as well as the progress until resolution.

Classification of Incidents

Grades 1 to 3 describe complications/serious events while Grade 4 describes adverse/undesirable events with no patient harm or sequelae:[2]

- Grade 1: Any life threatening event or any complication resulting in permanent deficit (e.g. permanent neurological deficit; meningism/epidural abscess; serious cardiac or respiratory event).

- Grade 2: Resolved with intervention (e.g. neurological damage with late recovery [up to 1 year]; deep infection requiring surgical intervention).

- Grade 3: Resolved with minimal/no intervention (e.g. transient neurological symptoms with recovery by the time of discharge; transient cardiac/respiratory events; local infection requiring antibiotics).

- Grade 4: Adverse effects with no sequelae (e.g. local skin inflammation resolving spontaneously without intervention, within 24 hours of catheter removal; recognised dural and vascular punctures; unilateral/inadequate block; failed block).

Statistical analysis was undertaken using IBM SPSS Statistics version 20.

Results

Demographics

A total of 829 epidurals were performed (Table 1). Mean duration that the epidural catheter was left in situ was 2.3 days, with a range of 0 to 6 days (95% confidence interval [CI], 2.21 to 2.35).

Complication Rate

A total of 334 events were recorded, ranging from mild catheter-related problems to complications requiring medical attention (Table 2). These were divided into procedure-related events (n = 53) and postoperative events (n = 281) (Fig. 1). Cases with more than 1 complication or adverse event were counted twice.

Procedure-related Events (n = 53)

There were 53 separate intraoperative events (6.4%) which occurred in 52 children (Table 3) (Fig. 2). There were 5 instances of dural puncture (0.6%). Four incidents of dural puncture were recognised at the time of insertion of the Tuohy needle. In each case, the Tuohy needle was removed and the epidural successfully re-sited. In the fifth case, a suspicion of a miniscule fluid leak was observed insufficient to assay and distinguish from residual-aspirated saline used for loss of resistance. This persisted after the catheter was inserted and in view of a possible dural tap, no drugs were given via the epidural catheter, which was

Table 1. Patient Demographics

Gender	n	%	Weight	(Kg)
Male	476	57.4	Mean	19.6 (95% CI 18.63 – 2062)
Female	353	42.6	Range	2.5 – 108
Age		**n**		**%**
Neonates <28 days		15		1.8
Infants, 1 – 12 months		115		13.9
Toddlers,1 – 2 years		191		23.0
Pre-schoolers, 3 – 6 years		229		27.6
Child, 7 – 12 years		195		23.5
Adolescent, >12 years		84		10.1
Segmental Approach		**n**		**%**
Thoracic		311		37.5
Lumbar		432		52.1
Sacral		51		6.2
Caudal		35		4.2
Proceduralist		**n**		**%**
Specialist/Consultant		615		74.2
Trainee		214		25.8
Epidural Drugs		**n**		**%**
Local anaesthetic used				
Bupivacaine		803		96.9
Levo-bupivacaine		25		3
Ropivacaine		1		0.1
Additive used				
None		117		14.1
Fentanyl		664		80.1
Morphine		19		2.3
Clonidine		29		3.5

Table 2.Complications by Level and Age Group

Age Group	No. of Epidurals	No. of Patients with Procedure-related Complications (%)	No. of Patients with Postop Complications
Neonate, <28 days			
Thoracic	1	1 (100.0)	1 (100.0)
Lumbar	8	0 (0)	3 (37.5)
Caudal	6	0 (0)	3 (50.0)
Total	15	1 (6.7)	7 (46.7)
Infant, 1 – 12 months			
Thoracic	30	3 (10.0)	6 (20.0)
Lumbar	61	4 (6.6)	25 (40.9)
Sacral	12	1 (8.3)	4 (33.3)
Caudal	12	1 (8.3)	3 (25.0)
Total	115	9 (7.8)	38 (33.0)
Toddler, 1 – 2 years			
Thoracic	64	6 (9.4)	21 (32.8)
Lumbar	94	7 (7.4)	19 (20.2)
Sacral	27	3 (11.1)	10 (37.0)
Caudal	6	0 (0)	2 (33.3)
Total	191	13 (6.8)	52 (27.2)
Preschooler, 3 – 6 years			
Thoracic	107	8 (7.5)	32 (29.9)
Lumbar	105	8 (7.6)	34 (32.4)
Sacral	10	0 (0)	2 (20.0)
Caudal	7	1 (14.3)	2 (28.6)
Total	229	16 (7.0)	70 (30.6)
School-going children, 7 – 12 years			
Thoracic	71	0 (0)	29 (40.8)
Lumbar	118	3 (2.5)	34 (28.8)
Sacral	2	0 (0)	0 (0)
Caudal	4	0 (0)	0 (0)
Total	195	3 (1.5)	63 (32.3)
Adolescent, >12 years			
Thoracic	38	1 (2.6)	9 (23.7)
Lumbar	46	5 (10.9)	10 (21.7)
Total	84	6 (7.1)	19 (22.6)
Total			
Thoracic	311	19 (6.1)	98 (31.5)
Lumbar	432	27 (6.3)	124 (28.7)
Sacral	51	4 (7.8)	16 (31.4)
Caudal	35	2 (5.7)	10 (28.6)
Total	829	52 (6.3)	249 (30.0)

then removed postoperatively.

None of the cases resulted in an inadvertent spinal block or high block. Subsequent to the dural puncture, none of the affected children developed a postdural puncture headache.

Of note, 4 out of the 5 cases of dural tap occurred in younger children <6 years of age who presented technically more challenging procedures requiring more than 2 attempts to eventually identify the epidural space. Three were lumbar epidurals and 2 were thoracic epidurals. All 5 cases were performed by a specialist paediatric anaesthetist.

Postoperative Events (n = 281)

There were a total of 281 postoperative events (33.9%) occurring in 249 children (Table 3) (Fig. 3). Our study revealed no major complications (grades 1 or 2).

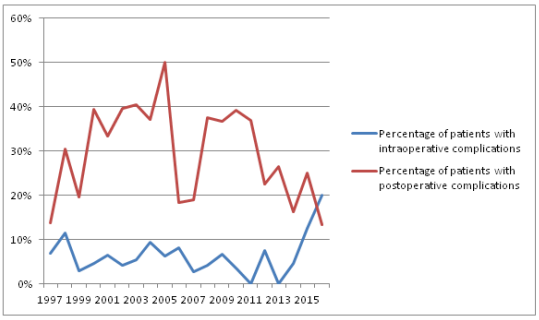

Fig. 1. Chart showing the incidence of intraoperative and postoperative events among all epidurals done per year.

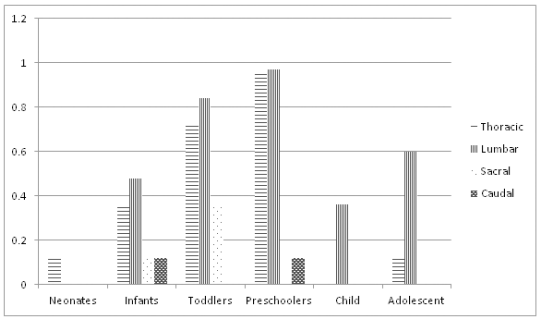

Fig. 2. Chart showing the percentage of intraoperative events out of all epidurals.

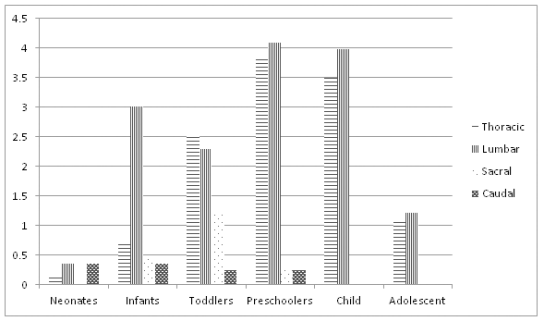

Fig. 3. Chart showing the percentage of postoperative events out of all epidurals.

Table 3. Incidence of Individual Complications

Procedure-related Complications	**Incidence**	**% of Total Epidurals (95% Confidence Interval)**
Vascular puncture	33	4.0 (2.85 – 5.54)
Inability to thread catheter	10	1.2 (0.66 – 2.21)
Dural puncture	5	0.6 (0.26 – 1.40)
Failed insertion	5	0.6 (0.26 – 1.40)
Total	53	6.4 (4.92 – 8.27)
Postoperative Complications	**Incidence**	**% of Total Epidurals (95% Confidence Interval)**
Catheter-related		
Leak	55	6.6 (5.13 – 8.54)
Slipped out	73	8.8 (7.06 – 10.9)
Disconnected	21	2.5 (1.66 – 3.84)
Contaminated	11	1.3 (0.74 – 2.36)
Kinked	8	1.0 (0.49 – 1.89)
Occluded	8	1.0 (0.49 – 1.89)
Total	176	21.2 (18.58 – 24.14)
Skin inflammation	39	4.7 (3.46 – 6.37)
Unilateral/inadequate/ excessive motor block	35	4.2 (3.05 – 5.82)
Neurological	19	2.3 (1.47 – 3.55)
Back pain	4	0.5 (0.19 – 1.23)
Cardiovascular	4	0.5 (0.19 – 1.23)
Respiratory	1	0.1 (0.02 – 0.68)
Local anaesthetic toxicity	3	0.4 (0.01 – 1.1)
Total	281	33.9 (30.75 – 37.19)

Grade 3 Complications

There were 27 (3.3%) (95% CI, 2.3% to 4.7%) minor/Grade 3 complications, including 19 transient neurological symptoms, 4 cardiovascular events, 1 respiratory event and 3 possible cases of local anaesthetic (LA) toxicity. The cases of LA toxicity and respiratory compromise were likely concurrent events not directly attributable to the use of an epidural catheter.

1) Transient Neurological Symptoms (2.3%)

Nineteen children experienced transient neurological symptoms with the epidural catheter still in situ. Of these, 14 occurred in lumbar, 3 in thoracic, 1 in sacral and 1 in caudal epidurals. These cases required catheter removal as neurological symptoms did not abate after the withdrawal of a short segment of the epidural catheter or reduction in the concentration or rate of local anaesthetic infusion. The symptoms mostly involved unilateral lower limb weakness. One patient suffered right foot parasthesia (0.1%). All cases, however, resolved within 48 hours of removal of the epidural catheter with no permanent neurological sequelae.

2) Cardiovascular Events (0.5%)

This was defined as any abnormalities in cardiovascular parameters such as heart rate, rhythm or systemic blood pressure. Four children evinced adverse cardiovascular events, of which 2 manifested bradycardia and 2 developed hypotension (Table 4). Of the 2 cases of bradycardia, 1 was attributed to epidural fentanyl and another was found to be unrelated to the epidural. Of the 2 cases of hypotension, 1 was due to postoperative hypovolaemia and the second was related to the systemic vasodilatory effects of the epidural LA.

Table 4. Logistic Regression of Factors Predicting Procedure-related and Postoperative Complications

Factors Affecting Procedure-related Complications	**Odds Ratio**	***P* Value**
Number of attempts*	**4.1**	**0.00**
Involvement of trainee	**1.4**	**0.36**
Age group of child†	**0.8**	**0.11**
Segmental approach of epidural‡	**1.0**	**0.84**
Factors Affecting Postoperative Complications	**Odds Ratio**	***P* Value**
Number of attempts*	1.2	0.51
Involvement of trainee	0.9	0.69
Age group of child†	0.9	0.28
Segmental approach of epidural‡	0.9	0.47

*Number of attempts: ≤2 or >2.
†Age group of child: neonates <28 days old; infants <1 year old, toddlers 1-2 years old, preschoolers 3-6 years old, children 7-12 years old and adolescents >12 years old.
‡Segmental approach of epidural: thoracic, lumbar, sacral and caudal.

3) Concurrent Respiratory Event

This was found to be the result of a lung collapse/consolidation following thoracotomy and lung resection (it was unrelated to the epidural infusion).

4) Possible LA Toxicity

i) Cardiovascular event – A neonate was administered bupivacaine at an inadvertently high infusion rate, but manifested only relative bradycardia in the range of 100-110 beats/minute coupled with somnolence; ii) Respiratory event: A transient episode of apnea and cyanosis occurred in a 1-month-old infant. This was felt to be more likely due to postoperative apnea or breath holding; iii) Neurological event: A 3-year-old remained uncharacteristically very drowsy, apathetic and sweaty even 8 hours after the general anaesthesia, which was possibly related to the epidural infusion.

Grade 4 Complications

There were a total of 254 grade 4 events (30.6%). The majority of postoperative events consisted of catheter-related problems (n = 176, 21.2%). The most common of these were catheters that had dislodged or slipped out (n = 73).

Thirty-nine postoperative events were cases of transient localised skin inflammation (4.7%). This usually consisted of superficial skin erythema over the epidural site. Of these, 7 patients were found to have a small pustule at the epidural site (0.8%). There were no other features of infection such as tenderness and warmth over the skin. One patient was found to have a yellowish discharge from the epidural site which was sent for culture. Although moderate growth of *Acinetobacter baumanii* was found, the patient remained clinically well and asymptomatic and all evidence of infection/inflammation resolved within 24 hours without any antibiotic therapy. This suggested colonisation rather than an infection. All cases resolved spontaneously without antibiotics within 24 hours of catheter removal. There were no cases of meningism, abscess or deep infection.

There were 35 cases (4.2%) of Grade 4 neurological symptoms responding to simple interventions such as withdrawal of the epidural catheter or change in the concentration or rate of local anaesthetic infusion, and did not require removal of the epidural catheter. The patients presented with symptoms such as unilateral block, excessive motor block and inadequate/patchy block.

Analysis of Factors Contributing to Complications

We conducted a logistic regression analysis to try to predict procedural and postoperative complications using number of attempts (≤2 or >2), involvement of trainee, age group, and level of epidural as predictors. Only the number of attempts was statistically significant, indicating that it is a reliable predictor of procedural complications ($P<0.001$). The odds ratio is 4.1 if the number of attempts exceeds 2.

None of these factors were shown to have a statistically significant effect on the rate of postoperative complications. Compared to short-term use (≤3 days), prolonged use of the catheter beyond 3 days is associated with a statistically significant increase in the frequency of skin infective/inflammatory changes (odds ratio 4.5, $P<0.001$). We found no significant difference between the rate of infections in caudal catheters compared with catheters placed at other levels.

In our institution, most paediatric epidurals are inserted by consultant specialist anaesthetists (Table 5). Trainees insert a smaller percentage of epidurals in children aged below 3 years. Of these, 83% were sited in the lumbar levels. Trainees performed 33% of lumbar epidurals in children of all ages.

Discussion

We demonstrated a fall in the overall incidence of paediatric epidural analgesia over the last 19 years, which is consistent with international data. It mirrors an increasing preference for peripheral nerve blocks, which are known and documented to have a superior safety profile.[6,7] Most of the complications documented in our audit occurred in the postoperative period. Regression analysis revealed no statistically significant factors associated with postoperative complications in general. This is in contrast to the other studies done internationally, which demonstrates a higher

Table 5. Anaesthetists Performing the Epidurals

Age Group	Anaesthetist Performing the Epidural (% of Total)		
	Specialists	Trainees	Total
Neonate	13 (87%)	2 (13%)	15
Infant	102 (89%)	13 (11%)	115
Toddler	153 (80%)	38 (20%)	191
Preschooler	164 (72%)	65 (28%)	229
Child	124 (64%)	71 (36%)	195
Adolescent	59 (70%)	25 (30%)	84
Total	615 (74%)	214 (26%)	829

incidence of complications in infants compared to older children.[2,6]

Previous studies have demonstrated an increased risk of neurological complications in children even when compared to epidurals performed in anaesthetised adults.[2-4,6] The incidence of complications of paediatric epidurals is known to range from 29 in 10,000[6] to 76 in 10,000[3], with an overall risk of 0.66% (95% CI, 0.6% to 0.7%).[8] In comparison, a study done on anaesthetised adults found an incidence of approximately 14 in 10,000 of neurological symptoms, all of which were subsequently found to be unrelated to the epidural catheter.[9]

Sensations of paraesthesia or pain upon epidural bolus injection are key clinical indicators associated with an increased risk of postoperative neurological complications.[10] This feedback, whilst valuable in awake adult patients, is lacking in most paediatric patients who are already anaesthetised or deeply sedated during epidural insertion. There is no demonstrable increased risk of neurological complications when regional anaesthesia is performed under general anaesthesia in children,[11] as is our practice in the majority of cases. Our study revealed no major complications over 19 years (95% CI, 0% to 0.46%) and this is consistent with the very low rate of complications also found by other similar studies,[2-4] but may not be a true reflection of incidence due to the relatively small population size.

Our overall incidence of dural puncture was 0.6%, which is comparable with the PRAN study (0.9%). Published data suggests an incidence of 0.05% of postdural puncture headache (PDPH) after epidural analgesia.[2] We found no cases of PDPH, which may be due in part to a small sample size, or under-reporting by children who were not able to communicate their symptoms.

The incidence of minor or Grade 3 complications (27 patients, 3.3%) is comparable to similar studies done abroad.[4] There were 19 cases of transient neurological symptoms necessitating catheter removal, all of which recovered within 24 hours. Although the risk of transient neurological symptoms was higher than that of other studies,[2,6] none of our patients suffered prolonged neurological deficits beyond 24 hours.

The incidence of hypotension was 0.36%, comparable to that found by the PRAN.[4] Two out of 3 episodes of hypotension occurred in children with thoracic epidurals, which is in keeping with the findings by the PRAN in which 6 out of 7 cases of hypotension occurred with thoracic epidurals.

While our incidence of major complications is low, our incidence of adverse events appears to be higher than in previous studies done in predominantly Caucasian populations. A plausible reason for this difference may lie in our definition of adverse events, which includes a broader definition of catheter-related problems, encompassing even the cases where the event (e.g. leaking catheter) did not result in any deleterious effect on the patient. A similarly broad definition was used in a 1994 Canadian study showing a 67% incidence of side effects and complications.[10]

Of the adverse events, 39 (4.7%) were cases of transient localised skin inflammation resolving spontaneously without requiring antibiotics. There were no cases of severe infections such as meningism or deep infection. Our results are consistent with other studies previously reporting a very low incidence of infection after epidural catheters used for postoperative analgesia.[12] A Boston study on epidural catheter-associated infections in children identified a 0.12% incidence of infections.[13] Of these cases, epidural catheters inserted for the management of chronic pain were associated with a significantly higher risk of infection compared to those inserted for postoperative pain, which occurred only in immunosuppressed children.

Further analysis revealed a statistically significant increase in the rate of skin inflammation in catheters kept beyond 3 days. This supports our preferred policy to remove epidural catheters within 72 hours of placement as a routine (unless special indications dictate otherwise) so as to minimise the risk of infection. Similar results were demonstrated in previous studies, which showed that the rate of infection was increased with prolonged duration of epidural catheterisation.[13]

Caudal catheters appear to present no demonstrably increased risk of infection, a finding corroborated by our own audit.[2] This is in spite of a potential for bacterial colonisation from faecal soilage of caudal catheters, especially since caudal catheters are more commonly used among younger children who are not yet toilet trained.[12] We (the authors) prefer the utilisation of the trans-sacral approach to a caudal epidural as opposed to the traditional more caudad approach

via the sacral hiatus, simply because this allows secure transfixation of the epidural catheter at a distance that is further removed from the anus and similarly further from potential faecal contamination. This approach is not ubiquitously taught in all paediatric anaesthetic centres and varies with regional practice as well as the anaesthetist's preference or familiarity. Its use is further limited to patients 8 years and younger, before complete sacral ossification occurs.

The majority of postoperative events consisted of catheter-related problems, most commonly dislodgements or migrations, followed by leaks around the epidural site. Catheter-related problems may predispose to premature termination of epidural analgesia[4,10] and in adults, these can in fact account for 12% of premature terminations of epidural analgesia.[9] The frequency of leakage around the epidural has been reported to be 15%.[14] An obvious predisposing cause of this is that the epidural catheters are inserted through the Tuohy needles, and are of smaller diameter. In our study, 18-19G Tuohy needles were used with 20-23G catheters. A larger difference in size between the needle and catheter may predispose the patient to a greater leakage around the catheter site. This may compromise the integrity/sterility of the dressing and contribute to catheter dislodgement and/or contamination. Proactive attempts at addressing this problem include utilising topical skin adhesives at the insertion site to seal the leak and implementation of mandatory inspection and redressing the epidural site with sterile occlusive dressings when required, before reversing and extubating the patient. Other common problems include disconnection of the catheter from the filter and contamination of the epidural catheter, usually due to the inadvertent removal of the dressing. Sacral and lumbar catheters were the most likely to slip out, accounting respectively for 15.8% and 9.3% of problems at that level. This is in contrast to the PRAN study which showed a higher incidence of catheter-related problems at the thoracic level.[4]

Drug errors have been found in other studies to have an incidence of 10-13:10,000.[2-4] There was only 1 documented drug error in our study (0.1%), which may reflect either safe and effective drug administration systems both in the operating rooms and in the wards, or under-reporting. With the commencement of pain incident reporting in 2014 as part of the APS audit, further regulatory measures were introduced to promote a culture of quality, safety and communication via intra- and inter-departmental discussions and incident reporting to effect the necessary changes and improvements.

In view of the higher complication rates and risks involved in neonatal and young infant regionals, we recommend that these epidurals be inserted by consultant specialist anaesthetists. Close supervision of senior trainees or junior staff is mandatory. Since neither experience nor training preclude the incident of an inadvertent dural tap, senior staff should maintain vigilance at all times. Senior staff need to consciously incorporate epidural analgesia (where applicable) in their practice and whilst it is inspiring to teach, the practical balance of risks versus benefits to both patient and staff members should also be carefully considered and not marginalised.

The lack of serious morbidity in our series should not encourage complacency but drive a heightened sense of responsibility to prevent any such occurrence. Strict protocols, vigilant monitoring and follow-up as well as consultant grade supervision are all important measures to maintain safety standards and quality assurance. Expedient management with attentive supervision by senior staff may avert potentially serious or permanent sequelae and optimise pain control, particularly in the less than perfectly working epidural.

Although our collection of 829 cases is modest in comparison to international data, it mirrors similar practice trends and morbidities encountered globally. It is the first comprehensive local audit and represents an Asian, as opposed to a largely Caucasian, population. This allows a review of our past and current safety standards and practice. We acknowledge that practices may have changed over the course of the 19 years of data collection. Regular departmental review of adverse events in the past may have given rise to safer practices.

However, our study was subject to several limitations. Firstly, the small sample size may have resulted in a falsely reassuring incidence of major complications. Secondly, being a retrospective study, specific details were not available. These included details on preparation and cleaning, use of perioperative antibiotics, and the number of years of experience of the operator. Thirdly, the study was limited to a single institution, whose practices and conclusions may not be readily extrapolated to a wider population. Finally, whilst the subsequent follow-up of postoperative events were done by a team of doctors, the details of epidural insertion and intraoperative events were self-reported, possibly affecting the true rate of events.

Conclusion

Both international and local data support evidence that epidural analgesia is largely safe in the paediatric population. Adverse effects incurred are largely minor ones resulting in minimal or no long-standing sequelae, such as catheter-related complications, cutaneous inflammatory changes at insertion site and transient neurological symptoms. However, there remains a small risk of serious, long-lasting and potentially devastating adverse events.

Advocates of paediatric epidurals stand correct in extolling the advantages of superior postoperative analgesia and the relatively low risk of complications. However, if there is a viable option of PNB over CNB, the ideal choice would be the former in terms of risk-benefit.[6]

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