

Paediatric regional anaesthesia, a survey of practice in the United Kingdom

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Background. A variety of techniques and drugs, many unlicensed, is used in paediatric regional anaesthesia. This study is the first to survey paediatric anaesthetists about the techniques and drugs used in paediatric regional anaesthesia. The aim is to provide a record and benchmark of UK practice.

Methods. A postal questionnaire was sent to all members of the Association of Paediatric Anaesthetists residing in the UK. Information was requested on the type of hospital worked in, years of practice, paediatric anaesthesia workload, regional anaesthesia techniques used, and drugs used in regional anaesthesia.

Results. A total of 220 responses from 264 questionnaires (83.3%) were received. Of these respondents, 155 (70%) practised paediatric anaesthesia as more than 50% of their workload, and 10 had retired or returned blank forms. Two hundred and two of 210 (96%) use caudal anaesthesia and 151 (72%) use caudal, epidural and peripheral block. One hundred and ninety-two of 210 (91%) have no lower age limit for using caudal anaesthesia. One hundred and twenty-three of 210 anaesthetists (58%) used adjuvants with local anaesthetics in caudal block, the most common being fentanyl [44/210 (21%)], clonidine [55/210 (26%)], diamorphine [27/210 (13%)] and ketamine [67/210 (32%)]. Those working in specialist centres or teaching hospitals or who had a greater paediatric anaesthesia workload were more likely to use a greater variety of regional anaesthesia techniques.

Conclusions. Caudal anaesthesia is widely used for patients of all ages by almost all practitioners. Most anaesthetists at all hospital types and experience levels use adjuvants with local anaesthetics when performing caudal anaesthesia. Those with more experience in paediatric anaesthesia and those in specialist centres commonly use other neuraxial and peripheral block techniques.

Br J Anaesth 2002; **89**: 707–10

Keywords: anaesthesia, paediatric; anaesthetic techniques, epidural; anaesthetic techniques, regional

Accepted for publication: July 9, 2002

Anecdotal evidence suggests that a large variety of techniques and drugs, including many unlicensed for this use, is commonly used in the practice of paediatric regional anaesthesia. Little is known about how consultant colleagues perform paediatric regional anaesthesia, especially outside of one's own institution. This study aimed to discover the patterns of usage of drugs and techniques in

regional anaesthesia by paediatric anaesthetists in the UK in order to present the current state of practice.

Methods

After approval by the Audit Department, Royal Manchester Children's Hospital and the Secretary of the Association of

Table 1 Drugs added to local anaesthetic solutions in paediatric caudal anaesthesia, frequency of usage and doses used

Drug added to local anaesthetic	Frequency of use by 210 respondents (%)	95% confidence intervals for percentage	Dose range (mode)
Epinephrine	24 (11)	7.5, 16.5	1: 200,000
Fentanyl	44 (21)	15.7, 27.1	0.5–4.0 µg ml ⁻¹ (2.0 µg ml ⁻¹)
Diamorphine	27 (13)	8.7, 18.2	20–50 µg ml ⁻¹ (20 µg ml ⁻¹)
Clonidine	55 (26)	20.4, 32.7	0.5–2.5 µg ml ⁻¹ (2.0 µg ml ⁻¹)
Ketamine	67 (32)	25.7, 38.7	0.25–1.00 mg ml ⁻¹ (0.50 mg ml ⁻¹)
Bicarbonate	7 (3)	1.4, 6.8	Not specified
Morphine	4 (2)	0.5, 4.8	50–100 µg ml ⁻¹ (50 µg ml ⁻¹)
Midazolam	1 (0.5)	0, 2.6	0.5 µg ml ⁻¹

Paediatric Anaesthetists, a postal questionnaire was sent to all members of the Association of Paediatric Anaesthetists residing in the UK. Information was sought on the type of hospital worked in, paediatric anaesthesia workload, years of practice as a consultant in paediatric anaesthesia, regional anaesthesia techniques used and drugs used in the practice of regional anaesthesia. Specific questions were asked about doses of drugs for which at least two articles describing their use in paediatric regional anaesthesia had been published in at least two major anaesthesia journals, based on a Medline search.

A follow-up questionnaire and covering letter were sent to non-respondents 1 month later. Data were coded anonymously and entered into a Microsoft Access database by the Audit Department, Royal Children's Hospital, Manchester. Those interpreting the data had no information on the identity of respondents. Statistical analysis was performed using SAS statistical programs and StatXact-4. Differences between groups were tested using Fisher's exact test. Trend analysis was done using the Jonckheere–Terpstra test; 95% confidence intervals are given in Table 1. $P < 0.05$ was considered to be statistically significant.

Results

Replies were received to 220 of the 264 (83.3%) questionnaires sent. No bias was detected in the characteristics of the respondents. Ninety-seven of 220 (44%) had more than 90% of their workload in paediatric anaesthesia; 155 (70%) had more than 50% of their workload in paediatric anaesthesia. Ninety-three of 220 (42%) worked in a specialist paediatric centre, 79 (36%) worked in a teaching hospital, 10 (5%) worked in both a specialist paediatric centre and a teaching hospital, and 26 (12%) worked in a district general hospital. Two were solely private practitioners. Nine respondents had retired and one returned a blank questionnaire. These 10 responses were not considered in the analysis of clinical practice.

Eleven of 220 (5%) respondents practised paediatric anaesthesia for two or fewer sessions a week, 58 (26%) for 3–5 sessions a week and 141 (64%) for more than six sessions a week. One hundred and fourteen (52%) had practised in paediatric anaesthesia for fewer than 10 yr and

96 (44%) for 10 yr or more. The type of hospital worked in was significantly associated with the number of sessions devoted to paediatric anaesthesia and the percentage workload in paediatric anaesthesia (Jonckheere–Terpstra, $P < 0.001$): specialist paediatric centre > teaching hospital > district general hospital.

Of 210 practising respondents, 202 (96%) used caudal anaesthesia, 151 (72%) used caudal, epidural and peripheral nerve block, 24 (11%) used only caudal and peripheral nerve block, 14 (7%) used only caudal and epidural block, 13 (6%) used caudal anaesthesia as their only regional technique, and 8 (4%) used no regional anaesthesia. Practitioners were more likely to use caudal, epidural and peripheral nerve block if a greater percentage of their workload was in paediatric anaesthesia (Fisher's exact test, $P < 0.001$), if they had more than three paediatric anaesthesia sessions a week ($P = 0.02$), or they worked in a teaching hospital or specialist paediatric centre ($P = 0.002$). Practitioners who used only caudal anaesthesia and no other paediatric regional anaesthesia techniques were more likely to work in a district general hospital ($P < 0.001$).

One hundred and ninety-two of 210 practising respondents (91%) considered there to be no minimum age of patient suitable for caudal anaesthesia. The ten anaesthetists who used a minimum-age cut-off stated it as being in the range from 40 weeks post-conception to 3 yr.

Of 210 practising respondents, 198 (94%) used bupivacaine as the local anaesthetic in caudal anaesthesia, and 28 (13%) used ropivacaine. Mixtures of local anaesthetics were used by 22 (10%). The use of adjuvant drugs for caudal anaesthesia is shown in Table 1. Eighty-seven respondents used additive drugs with local anaesthetics in peripheral nerve block: 59 (28%) used opioids and 30 (14%) used epinephrine.

A complete set of the data in SAS and Microsoft Excel format can be obtained from the author.

Discussion

Relationships between characteristics of respondents show predicted internal consistencies that help to validate the data. The number of sessions a week doing paediatric anaesthesia parallels the percentage workload in paediatric

anaesthesia. Those working in specialist paediatric centres have a greater paediatric workload than those in teaching hospitals, who in turn have a higher workload than those in district general hospitals. The number of years of practice as a paediatric anaesthetist did not vary between groups.

Members of the Association of Paediatric Anaesthetists were chosen as the target of the survey. Although their practice might not represent the practice of all anaesthetists in the UK, as consultants in paediatric anaesthesia, it could reasonably be considered as representative of the practice and opinions of experts in paediatric anaesthesia in the UK. This special interest could explain the high response rate to the questionnaire: 220 of 264 (83.3%).

Caudal anaesthesia, used by 96% of respondents, is the most widely used of the regional anaesthesia techniques in children. It is a relatively easy and safe technique, with a rate of catastrophic complications of about 1:40 000¹ and an overall rate of complications of 1.5:1000.² There is an increased risk of complications, especially unrecognized intravascular and intraosseous injections, in children weighing less than 10 kg.³ This explains the reluctance of some to use this technique in the very young, although this study shows that the majority (91%) of anaesthetists have no lower age limit for patients to receive caudal anaesthesia. This reflects previously described practice in which caudal blocks were the most common, accounting for nearly 60% of all regional blocks and were performed in all age groups.² Of the eight anaesthetists not using caudal anaesthesia, six were in subspecialties for which they considered it inappropriate (cardiac, burns and ambulatory), although the use of caudal anaesthesia in these subspecialties is well documented. No information was sought on whether the regional anaesthesia was used primarily for intraoperative or postoperative considerations. It is assumed that those who added adjuvants to their local anaesthetic solutions did so to alter the quality of or to prolong the analgesia, which would be useful in the postoperative phase.

Bupivacaine is the most commonly used local anaesthetic drug in paediatric regional anaesthesia. Its long action, availability and well-documented use out-weigh its toxic effects. Particular care must be taken in dosing and re-dosing infants.⁴ Ropivacaine is also used commonly and its use may be growing in popularity. Ropivacaine has been shown to be as effective in paediatric caudal anaesthesia,⁵ to have fewer side-effects,⁵ and less cardiac⁶ and central nervous system⁷ toxicity than bupivacaine.

The drugs most commonly added to local anaesthetic solutions—opioids,⁸ clonidine,⁹ and ketamine,¹⁰—have all been shown to increase safely the duration and quality of analgesia when administered neuraxially with local anaesthetics. Few anaesthetists use morphine as an agent for caudal anaesthesia: 4 of 210 (2%), compared with 27 (13%) who use diamorphine and 44 (21%) who use fentanyl, even though far more literature exists discussing the use of morphine in paediatric regional anaesthesia, and its

neuraxial mechanism is better understood. Lipophilic opioids such as diamorphine and fentanyl may have fewer side-effects for an equi-analgesic dose but still require postoperative respiratory monitoring. *S(+)*-ketamine has been used as a sole agent for caudal analgesia with good effect and minimal side-effects.¹¹

One hundred and seventy-five of 210 (84%) of respondents use peripheral block and 59 (28%) added opioids to the local anaesthetic solution. No attempt was made in this survey to determine which peripheral blocks were used. Evidence for the use of adjuvants in peripheral local anaesthetic block is inconsistent and the topic is little studied in children. Combining opioids¹² or clonidine¹³ and local anaesthetics for peripheral nerve blocks does not appear to be consistently effective. Opioids combined with local anaesthetics have proven to be of clinical benefit when used for infiltration¹⁴ or intra-articular injection,¹⁵ where they can act on the peripheral opioid receptors, which are primarily found at the distal terminals of afferent fibres. Clonidine, in addition to its primary site of action as an agonist at central alpha-2 adrenoceptors, may also enhance peripheral block by a direct depressant effect on A- and C-fibre conduction.

There is a large similarity in the techniques and drugs used, although environment influences the types of regional anaesthesia blocks used. Those who have a greater part of their practice in paediatric anaesthesia or who work in specialist paediatric centres or teaching hospitals are more likely to perform a greater variety of blocks. This may be because they have more opportunity to develop a large repertoire of techniques or because they work in an environment more conducive to expanding their technical practice. Having more experienced colleagues and peri-operative support could provide the confidence needed to use a wide range of techniques. Interestingly, the use of drugs and adjuvants is not related to site or extent of paediatric practice. Use of drugs can be learned easily from reading and discussion or extrapolated from adult practice and is a skill that is highly transferable between practitioners. Development of manual skills requires practice and a supportive environment and as such is not a highly transferable skill so may be more difficult to develop in a relatively isolated setting.

There is a need for further study on the safety profiles and dose-response characteristics of drugs that are added to local anaesthetic solutions for neural block, especially ketamine, which is commonly used but unlicensed, and diamorphine, which is commonly used but little studied. The use of additives in peripheral block needs much investigation. It would also be interesting to see if skill-based knowledge, such as block technique, is affected by hospital variables such as perioperative facilities and policies or skills of one's colleagues. Insight into this has implications for teaching and learning of skills for anaesthetists at all levels.

Acknowledgements

The author would like to thank Clifford Qualls, Professor of Statistics, Emeritus, University of New Mexico and the Audit Department, Royal Manchester Children's Hospital.

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