Using audit to improve provision of analgesia for insertion of permanent pacemakers in children

Pain has an adverse effect on the patient experience in hospital. The authors' institution used audit to improve the use of analgesia in the paediatric population.

The audit cycle was repeated five times. Using education and training the institution was able to improve analgesia provision. A significant reduction in the number of children receiving no analgesia was demonstrated. In addition no further adverse event forms were submitted. Using audit can be an effective way to improve delivery of quality care.

Introduction

Pain has an adverse influence on patient experience in hospital, both physiologically and psychologically. Patients rate vomiting, incisional pain and gagging on endotracheal tubes as the least desirable outcomes of anaesthesia (Macario et al, 1999). The particular issues relating to children were recognized in the National Service Framework for Children (Department of Health, 2004; Cramton and Gruchala, 2012). Barriers to the use of appropriate analgesia in children may include clinician perception that children do not experience pain in the same way as adults, and a lack of time available to ensure analgesia is sufficient following a procedure (Cramton and Gruchala, 2012).

In 2002 two adverse clinical events of inadequate pain relief in children following permanent pacemaker insertion were reported at the authors' institution. It became clear that provision of analgesia during the procedure was inconsistent. This is particularly important as the children have devices placed into pockets beneath the muscle, thus are exposed to the incisional pain which is so distressing (Macario et al, 1999). Similar inconsistencies have been widely reported in the literature (Mathiesen et al, 2012).

Dr Claire Boynton *is ST5 in Anaesthetics and* **Dr Sian I Jaggar** *is Consultant Cardiothoracic Anaesthetist in the Anaesthetic Department, Royal Brompton Hospital, Royal Brompton and Harefield Trust, London SW3 6NP*

Correspondence to: Dr C Boynton (claireboynton@hotmail.com)

The need to address this issue at the authors' trust was identified by both the paediatric electrophysiologist and the anaesthetic lead for paediatric pain relief. The problem was quantified by accessing the paediatric anaesthetic cardiac catheter laboratory database. The actual analgesia documented as being provided to children was then noted. Provision of analgesia during the operation, before the onset of severe pain, is not only preferable to patients, but may reduce later requirements (Moiniche et al, 2002).

An initial study of 40 patients showed a frequent lack of analgesia administered to this patient group perioperatively. The staff involved were from the anaesthetic department, paediatric department and the pain team. An audit was planned, with the support of the anaesthetic trainees and department.

The objective was to improve the provision of multimodal analgesia for children undergoing permanent pacemaker insertion at Royal Brompton Hospital. It was hoped that all procedures would then be covered with optimum pain-relieving agents. By collating information on the analgesia received by children undergoing permanent pacemaker insertion and presentation of results of repeated audit cycles the authors intended to improve prescription of analgesia for these cases (*Figure 1*).

Method

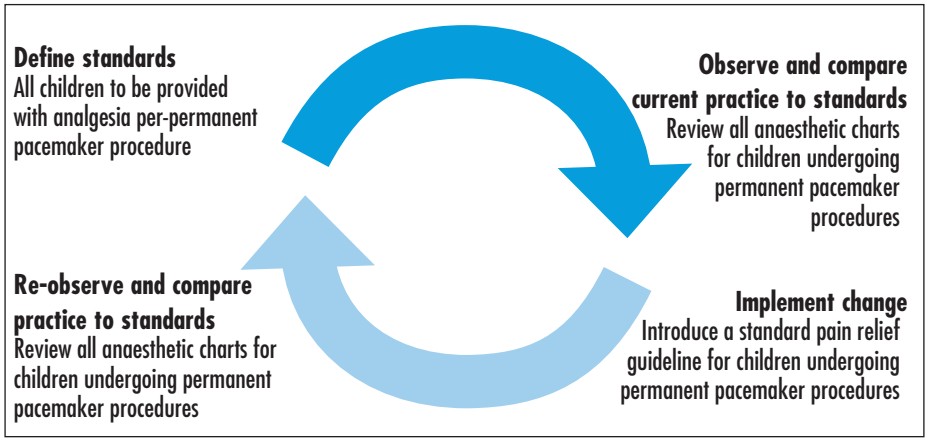
This was a prospective, observational cohort study. It was a quality improvement audit registered with the audit department at the institution, so no additional ethical approval was necessary.

Within the cardiac catheter laboratory, it was identified that the anaesthetist was responsible for prescription of analgesia for the permanent pacemaker procedure. Any intervention would therefore need to address the prescription and delivery of analgesia by the anaesthetist.

Following the initial pilot-data collection, the intervention was the introduction of a set of guidelines for optimal administration of analgesics peroperatively when permanent pacemakers were being implanted in children. Re-audit of analgesia provision and presentation of results was planned in advance.

Analgesia guidelines were developed and produced by the paediatric pain relief team following discussion with anaesthetists, paediatric cardiologists, paediatric intensive care unit physicians and paediat-

Figure 1. Audit cycle planned to address inconsistent perioperative analgesia provision.



ric nursing staff. They used rectal (pr) and intravenous (iv) compounds so that they could be provided under anaesthesia. This avoided relying on potentially inconsistent oral provision during the preoperative period when children and families can be stressed. The guidelines suggested the combined use of:

- Paracetamol 20 mg/kg (pr) – at the beginning of this process the intravenous product was not available. To avoid any confusion, a loading dose (40 mg/kg pr) was not used so that the situation did not arise of some children receiving a loading dose while others did not, or inadvertent duplication of loading doses. Over time this was altered to paracetamol 15 mg/kg (iv) as a result of the introduction of iv paracetamol
- Diclofenac 1 mg/kg (pr or iv)
- Morphine 0.1 mg/kg (iv).

In addition to these systemic drugs, a change in the local anaesthetic agent used for infiltration by paediatric cardiologists was agreed. The longer acting agent, bupivacaine (duration 6–8 hours), was provided rather than lidocaine. The development group felt that this regimen was most likely to provide effective analgesia in the immediate postoperative period. Effective acute pain management is associated with an improved recovery profile.

The audit cycle then continued, with periodic presentation of results and ongoing staff education as to the required standards. Data were collected on a rolling basis from the anaesthetic charts, which were completed by the anaesthetist on duty and collated by the lead anaesthetist for paediatric pain relief. The number of cases, and those with no analgesia, basic analgesia, opioids and multimodal analgesia was routinely recorded in the anaesthetic catheter lab database. Adverse event forms generated from poor analgesia during permanent pacemaker insertion were also collected. Failure to provide analgesia in the authors' paediatric unit has long been considered an adverse event, and is treated as such.

The plan was to perform the initial audit over cycles of 1–2 years with intermittent presentation of results at the regular multidisciplinary clinical governance meetings (held monthly) and weekly departmental teaching sessions, as anaesthetists providing analgesia for permanent pacemaker insertion are reliably present at these meetings. The authors aimed to both inform and educate staff as to their current practice, in a non-confrontational manner. During this period there were minimal changes in surgical practice and the range of analgesics available to anaesthetists was consistent. Statistical comparison was undertaken using a Chi squared test using SPSS v.19.

Results

Data were collected from 270 permanent pacemaker cases performed in the cardiac catheter laboratory over 96 months. These comprise 100% of cases carried out in this time. There were five chronological periods for the purposes of the audit cycle, with the number of cases carried out varying between periods. The analgesia given during the procedures is shown in *Table 1*. Data were collected from all cases, with no missing data. Any omissions in data were routinely addressed within 1 month of administration of the anaesthetic.

The results demonstrate a significant decrease in the number of children receiving no analgesia in the fifth audit (6%) period compared to the first (25%) ($P \leq 0.001$). Furthermore, the use of a multimodal analgesic technique increased over time. Comparing the fifth (61%) to the first (18%) audit period, an increased proportion of children received opioid-sparing drugs (including paracetamol and non-steroidal anti-inflammatory drugs), along with the long-acting opioids (usually morphine) ($P<0.001$).

Although there were improvements in analgesia delivery in four of the five audit periods, this was reversed between the third and fourth periods. There were no further adverse event forms generated during any of the audit periods.

Discussion

The results show that after five cycles of audit, this intervention (education and feedback) has significantly improved the delivery of multimodal analgesia to children undergoing permanent pacemaker procedures. No further adverse event forms have been generated from poor analgesia following permanent pacemaker insertion in this paediatric unit. The authors believe this reflects an important and sustained improvement for children undergoing permanent pacemaker insertion.

In the shortest fourth period (12 months) compliance with practice guidelines deteriorated, potentially related to a reduced awareness of the issues as the generally

Table 1. The number of permanent pacemaker insertion cases performed and the analgesia given over audit periods from January 2002

	Period 1 no. (%) of cases	Period 2 no. (%) of cases	Period 3 no. (%) of cases	Period 4 no. (%) of cases	Period 5 no. (%) of cases
Duration review (months)	18	18	24	12	24
No of permanent pacemaker cases	40	34	74	33	89
Average no of permanent pacemaker cases/month	2.2	1.9	3.5	2.8	4.2
No analgesia provided	10 (25)	6 (17)	4 (5)	5 (15)	5 (6) *
Paracetamol +/- non-steroidal anti-inflammatory drugs	17 (43)	26 (76)	71 (91)	28 (85)	84 (94) *
Long-acting opioids (morphine)	14 (35)	15 (44)	44 (59)	3 (9)	57 (64) *
Long-acting opioids + opioid sparing†	7 (18)	14 (41)	41 (55)	3 (9)	55 (61) *

* $P<0.001$, period 5 cf 1; † opioid sparing = paracetamol + non-steroidal anti-inflammatory drugs

improved practice focused minds elsewhere. This was reversed in the final period (24 months). This fluctuation in standards may be interpreted as highlighting the need for repeat audit to keep important clinical standards in the minds of all clinicians, including anaesthetists. With increasing numbers of guidelines to be remembered, staff may well inadvertently focus only on areas that are of particular interest to them. Thus repeated feedback on a regular basis is likely to be necessary. This was achieved, not only through the regular audit and consultant staff meetings, but also by specific e-mail returns to anaesthetists providing data for individuals in an anonymised manner. This, in particular, appeared to demonstrate to the group the variation in practice by a small number of staff.

However, it is also possible that the enhanced delivery of simple analgesics (paracetamol and non-steroidal anti-inflammatory drugs) in the previous periods encouraged anaesthetists to believe that opioids could be 'spared' to the extent that they were not required. The later increase during the last audit period might therefore suggest that teams now used to effective pain management in this group found this not to be true. However, the small reduction in simple analgesic use in the same period would tend to refute this, suggesting staff had a reduced level of vigilance as regards analgesia provision in this period. Along with raised expectations and internal standards of acceptable levels of discomfort following a procedure, the final period again showed an increased opioid use. While the reason for deviation from guidelines was not a part of the audit undertaken, individual discussions have occurred. These have highlighted the fact that not all individuals had focused on the issues of longer term analgesia during an anaesthetic, considering this to be more the remit of paediatric staff. Such informal discussions are useful and support more formal governance meetings in the ongoing continuing professional development within the department.

There appears to be some association between the number of cases performed in an audit period and the quality of analgesia given. Permanent pacemaker procedures are relatively rare in children when compared to the adult population, but the authors' hospital is a relatively high volume centre for this work (Silvetti et al, 2006). When case numbers were high, analgesic provision appeared more comprehensive. Explanations for this may include greater familiarity with both the paediatric permanent pacemaker analgesic prescribing guidelines and strategies for delivering this when individual anaesthetists were dealing with increased caseloads.

There are limitations to this audit, but the authors wanted a robust dataset from routinely collected data (when audits are undertaken intermittently it is common for practice to improve for the duration of the audit time alone). Therefore, the data are not correlated with pain scores, which, as in many environments (Kavanagh and Watt-Watson, 2007), are collated less consistently in the authors' institution than are details of the agents administered during an anaesthetic. Because of this the authors can make no certain comment on improvement in pain management. However, as time of the audit periods progressed there were no further reported adverse events of inadequate analgesia. While the authors believe this reflects the improved analgesic provision in the catheter laboratory, they do accept that it could also be the result of reluctance on the part of clinicians to report bad outcomes in the cases they have managed. However, permanent pacemaker procedures in children are undertaken on a list immediately before a routine pain relief round on the paediatric ward and no further episodes of particularly poorly controlled pain have been noted during these rounds.

A major problem when attempting to maintain changes in practice is the belief structure of the teams involved. Thus, if teams put a lower priority on analgesia provision than, for example, throughput or antibiotic prophylaxis, it is possible for analgesic standards to slip in relation to antibiotic administration. Time from an education episode is also known to affect skill retention. This has been observed when assessing maintenance of resuscitation skills, which requires at least annual revision (Nicol et al, 2011). The authors have demonstrated the need (using both formal meetings and individual feedback) for similar maintenance when considering the provision of analgesics.

The authors have confirmed the audit cycle to be both integral and effective as a tool in improving the quality of delivered care. In this paediatric population effective analgesic drug provision was enhanced by providing a simple and consistent message regarding optimal practice, and ensuring feedback and education on current practice to those involved in permanent pacemaker insertion. In choosing a single set of guidelines the authors decided to follow the so called KISS principle (keep it simple stupid). This was eloquently described in the 1960s by 'Kelly' Johnson of aeronautical engineering fame. He pointed out that systems work best when they are simple, and unnecessary complexity is avoided. However, this has been appreciated for much longer than that, with Leonardo Da Vinci (1452–1519) stating that simplicity is the greatest complexity. The authors do not suggest that this analgesic regimen is the only one (or even necessarily the best), rather that a robust system that everyone can 'buy into' is likely to have the greatest impact (Nicholl, 2005). They therefore chose a very simple regimen (paracetamol + non-steroidal anti-inflammatory drug + long-acting opioid) and provided easy to remember doses, in a single A4 format.

LEARNING POINTS

- Management of pain is crucial as it is known to have adverse effects both physiologically and psychologically.
- Guidelines have been produced in many settings worldwide, but adherence to such guidelines cannot be assumed to be occurring in an optimum fashion.
- Guideline overload can occur and departments will need to prioritize their activity.
- These data demonstrate the importance of continued, feedback to relevant staff if optimum analgesic delivery is to be achieved.
- Feedback should occur in both formal and informal settings, but always maintaining a non-confrontational approach.

This was a guideline, not a protocol, and anaesthetists were free to deviate from it (particularly in regard to the specific long-acting opioid). However, the authors found that this simple regimen encouraged compliance, with staff finding it easy to engage with.

The authors believe that these results emphasize the key importance of education in improving the quality of a service. The audit cycle is an integral part of this and should be embedded in clinical practice. However, continued efforts are required to ensure sustained improvement in practice as focus shifts to areas where practice is less good. **BJHM**

Conflict of interest: none.

Cramton RE, Gruchala NE (2012) Managing procedural pain in pediatric patients. *Curr Opin Pediatr* **24**(4): 530–8

Department of Health (2004) National Service Framework for Children: standards for hospital services. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/199953/Getting_the_right_start_-_National_Service_Framework_for_Children_Standard_for_Hospital_Services.pdf (accessed 26 February 2014)

Kavanagh T, Watt-Watson J (2007) Paediatric pain education: a call for innovation and change. *Paediatr Child Health* **12**(2): 97–9

Macario A, Weinger M, Carney S, Kim A (1999) Which clinical anesthesia outcomes are important to avoid? The perspective of patients. *Anesth Analg* **89**(3): 652

Mathiesen O, Thomsen BA, Kitter B, Dahl JB, Kehlet H (2012) Need for improved treatment of postoperative pain. *Dan Med J* **59**(4): A4401

Moiniche SH, Kehlet J, Dahl A (2002) Qualitative and quantitative systematic review of preemptive analgesia for postoperative pain relief: the role of timing of analgesia. *Anaesthesiology* **96**: 725–41

Nicholl C (2005) *Leonardo Da Vinci, The Flights of the Mind.* Penguin, London

Nicol P, Carr S, Cleary G (2011) Retention into internship of resuscitation skills in a medical student resuscitation program incorporating an Immediate Life support course. *Resuscitation* **28**(1): 43–50

Silvetti MS, Drago F, Grutter G, De Santis A, Di Ciommo V, Rava L (2006) Twenty years of paediatric cardiac pacing: 515 pacemakers and 480 leads implanted in 292 patients. *Europace* **8**(7): 530–6