Postoperative pain, nausea and vomiting following paediatric day-case tonsillectomy

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Summary

More than 30% of all surgical activity for children in England and Wales is accounted for by routine ENT operations. There is known to be a high incidence of postoperative pain, nausea and vomiting following paediatric tonsillectomy with or without adenoidectomy. This prospective study examined the incidence of these complications in 100 children admitted for routine, elective day-case tonsillectomy, with or without adenoidectomy. The children were anaesthetised in accordance with our standard paediatric day-case protocol. The incidence of vomiting on the day of surgery was significantly less in the group anaesthetised in accordance with the protocol, compared to those in previously published studies. Postoperative pain was well controlled, with 88% of the children having minimal pain on the day of surgery, and reporting a pain score of 0–2. Modifying the anaesthetic care to a protocol designed to reduce postoperative pain, nausea and vomiting achieved measurable improvements in the recovery of this group following surgery. It has enabled us to evolve from a 100% inpatient stay for these operations to 98% day-case discharge rate, with minimal post anaesthetic or surgical morbidity. We describe the protocol and discuss the implications of implementing such a protocol for children undergoing these common operations.

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Tonsillectomy, with or without adenoidectomy, is one of the most frequently performed surgical procedures in children.

Ear, nose and throat (ENT) day surgery rates have slowly increased from 21% in 1991 to 33% in 1998. In 1993, the Chief Medical Officer for England and Wales set a target, aiming for 50% of surgery to be day cases by 2000. Despite this guidance, the majority of paediatric adenotonsillectomies are performed as in-patient procedures in the great majority of institutions [1]. Over the past 5 years, our multidisciplinary children's day surgery service has achieved a 98% day-case discharge rate for children undergoing routine elective ENT procedures. The day-case protocol is presented in Table 1.

The benefits of day surgery include cost effectiveness, reduced pressure on inpatient beds and less psychological trauma for parents and for children undergoing surgery. Parental attitude favours going home on the day of operation rather than staying in hospital [2, 3]. Conversely, limitations on day-case surgery treatment include managing unplanned admissions postoperatively and the consequences of delayed treatment of complications. There are also medical, social and geographical constraints that may preclude eligibility for day-case tonsillectomy.

Published data indicate that admission to hospital following ENT day surgery is due to vomiting (30%), inadequate recovery from anaesthesia (22%), bleeding (20%), inadequate pain control (14%) and pyrexia (9%). The overall re-admission rate for adult and paediatric ENT day-case surgery was found to average 2.8% in a national audit of 121 surgeons and nearly 4000 operations [4]. Postoperative haemorrhage is rare, but is occasionally life threatening. Since reactionary haemorrhage usually occurs within the first 6 h following surgery, afternoon operating sessions limit the ability to discharge children following tonsillectomy on the same day. The Royal College of Surgeons of England has published guidance for day surgery, to encourage patient safety, efficiency and an expected re-admission rate of no higher than 2–4% [5].

The incidence of postoperative nausea and vomiting (PONV) following paediatric surgical procedures is high, and up to 41% of patients may be affected [1, 6, 7]. In

Table 1 Epsom children's ENT day-case anaesthetic protocol.

Protocol
  Clear fluids allowed until 2 h pre-operatively
  EMLA® Cream or Ametop® over 2 suitable veins
  Propofol 4 mg.kg^{-1}
  Intravenous ondansetron 0.1 mg.kg^{-1}
  Maintenance with sevoflurane in air and oxygen
  Reinforced LMA in children 3 years and above
  Spontaneous breathing via a suitable breathing system
  Dexamethasone 0.25 mg.kg^{-1}
  Rectal diclofenac 1 mg.kg^{-1}
  Rectal paracetamol 20 mg.kg^{-1}
  Intramuscular codeine phosphate 1 mg.kg^{-1}
  Intravenous infusion with crystalloids 10 ml.kg^{-1} (4–5 ml.kg^{-1}.h^{-1})
  Return to ward with free fluids and food on demand
  Nursing observations for 6 h postoperatively
  Postoperative consultant led ward round
  Nurse led discharge 6 h postoperatively.

Discharge medications
  Azithromycin 10 mg.kg^{-1} for 3 days
  Ibuprofen 5–10 mg.kg^{-1} tds for 1 week
  Soluble paracetamol 15 mg.kg^{-1} qds for 1 week
  Codeine linctus 0.75–1 mgkg^{-1} qds for 1 week.

a study examining PONV in 16 commonly performed children's operations, adenotonsillectomy had the highest rate of PONV (54%) [8]. Trigeminal nerve stimulation, swallowed blood causing gastro-intestinal irritation and the use of diathermy are all factors particular to ENT operations that are associated with an increased incidence of postoperative nausea and vomiting. Tracheal intubation and the use of opioids and nitrous oxide have all been implicated as anaesthetic factors increasing the rate of PONV [9]. Although the efficacy of serotonin (5HT$_3$) antagonists in reducing PONV is well-established [9–11], the incidence of PONV remains unacceptably high [9]. Potential blood loss which is swallowed into the stomach postoperatively, necessitates close monitoring and observation. There is concern that prophylactic anti-emetic treatment may mask postoperative bleeding [12, 13]; however, this has not been our experience.

Pain from the throat or referred to the ear is very common following tonsillectomy. This varies with the method of surgery, administered analgesia and individual patient factors. Diathermy dissection of the tonsils is associated with more pain compared with cold dissection [14]. Pain generally increases over the 2–4 days following the operation and then slowly recedes over the following 10 days [15].

Methods

Following local ethical committee approval and informed consent we undertook a prospective study of 100 children (47 males and 53 females) between the ages of 2–14 years admitted for day-case tonsillectomy with or without adenoidectomy. The project was explained to parents at the time of admission and, where appropriate, to the child. Informed consent for inclusion in the study was obtained. The parents were given a copy of the Wong–Baker faces pain scale (Fig. 1), and the scoring [16, 17] was explained.

The children were admitted to a dedicated paediatric day-case ward. All children were ASA 1 or ASA 2 and
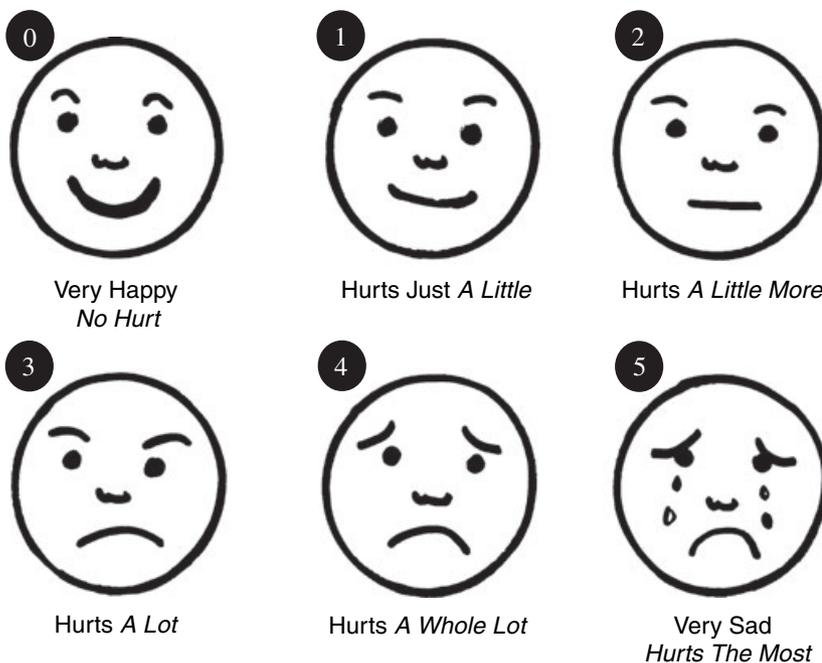

Figure 1 Wong–Baker Faces Pain Scale.

satisfied the medical and social criteria for discharge on the day of surgery [18].

Children undergoing tonsillectomy with or without adenoidectomy and grommet insertion were scheduled for surgery at the beginning of the morning operating list. Those having other procedures (e.g. grommets alone) were placed on the list for later surgery unless there were medical considerations (e.g. type 1 diabetes mellitus). This allowed children undergoing tonsillectomy the maximum time for recovery.

EMLA® cream was applied over two suitable sites 1 h pre-operatively. Following the establishment of intravenous access, anaesthesia was induced using propofol 4 mg.kg^{-1} and was maintained using sevoflurane in air and oxygen. A correctly sized reinforced laryngeal mask airway (rLMA) was used in children 3 years or older. In the two children younger than 3 years, anaesthesia was induced using propofol and maintained with 8% sevoflurane in oxygen until the depth of anaesthesia was adequate to allow tracheal intubation with an appropriately sized RAE tube. Muscle relaxants were not used. Pollution was minimised by the use of the Humphrey ADE breathing system, or the circle breathing system in the older children. Our normal practice is to raise the operating room temperature for paediatric lists. The breathing system always incorporated an HME filter. Lastly, the intravenous fluids were placed in a warming cupboard prior to administration.

The surgical author (P.R.) operated on 62 of the children. Experienced, non-trainee surgeons operated on the remaining 38 children. A 'hot' tonsillectomy technique was used for all operations in this series. Tonsillectomy alone was performed in 35% of the children, and multiple procedures in 65%. The operating time ranged from 9 to 58 min, with a mean of 20 min.

On return to the ward, all children were offered free fluids initially, and if tolerated, food on demand. They were then asked to tick one of the six faces that best depicted their pain. Any pain scores of 2 or greater was treated with oral ibuprofen suspension at a dose of 5 mg.kg^{-1}. Any nausea or vomiting was recorded. All children had a faces pain score of 0–1 at the time of discharge 6 h postoperation.

A verbal questionnaire was completed postoperatively, and by telephone on day 3 following discharge. This included specific questions about pain, nausea and vomiting following surgery and any general comments.

Results

The mean age of children in this study was 6.6 years (range 2–14 years) (Fig. 2) and the mean weight 26.2 kg (range 13–79 kg) (Fig. 3).
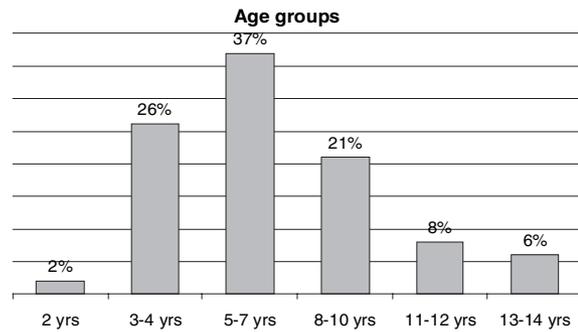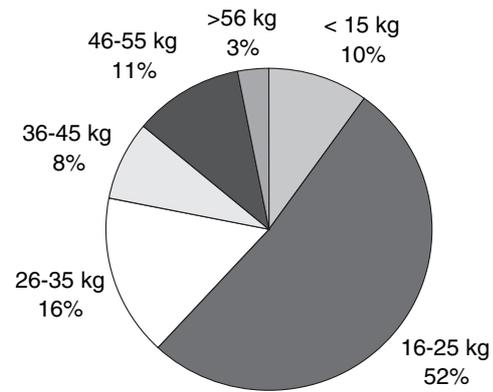

Figure 2 Ages of the children.

Figure 3 Weight of the children.

Induction of anaesthesia was with propofol in 94% of children (mean dose 4 mg.kg^{-1} range 3.5–4.5 mg kg^{-1}). The remainder underwent a gas induction using sevoflurane in air and oxygen, due to patient and or parental choice.

Two children suffered mild nausea on the day of surgery (D_0). No child vomited on D_0. The incidence of nausea and vomiting from D_{0-3} is shown in Fig. 4.

The pain score of 88% of children was 0–2 on D_0. Pain scores over the monitoring period D_{0-3} are shown in Figs 5 and 6.

One of the parents of all children in the study was at home during the postoperative convalescent period and was willing to complete the postoperative telephone questionnaire. This meant we were able to achieve a high response rate to our questionnaire.

Discussion

Nausea and vomiting

The brainstem vomiting centre has important input from the chemoreceptor trigger zone (CTZ), which lies in the area postrema on the floor of the fourth ventricle,
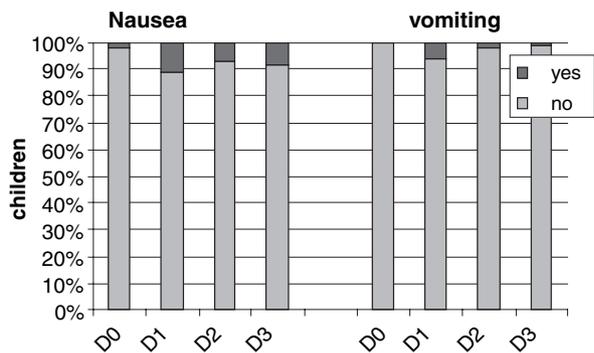
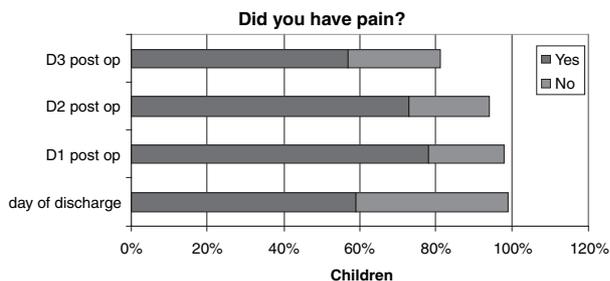**Figure 4** Nausea and vomiting on day of discharge (D_0) and subsequent days $D_1 - D_3$.

Figure 5 The incidence of pain on day of discharge and subsequent days $D_1 - D_3$.
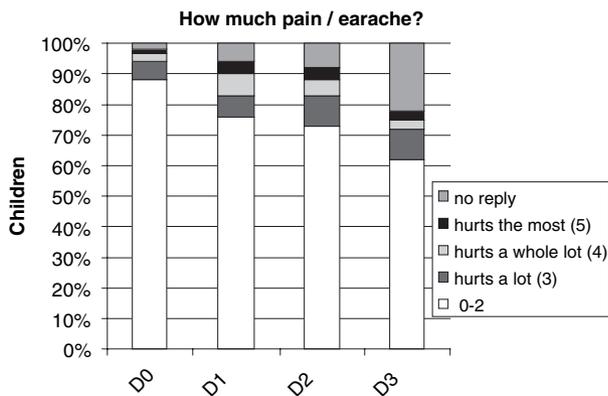

Figure 6 Pain scores on day of discharge and subsequent days $D_1 - D_3$.

functionally outside the blood brain barrier. The CTZ is rich in dopamine and serotonin receptors. Ondansetron is a selective $5HT_3$ receptor antagonist and a potent anti-emetic. Dexamethasone has also been shown to reduce postoperative vomiting, but the mechanism of action is not known [19, 20]. The anti-inflammatory effect of dexamethasone also appears to reduce pain and facilitate

increased postoperative fluid intake [21]. The children were observed postoperatively for excessive swallowing and increased pulse rate. Experienced nursing staff checked the child's mouth regularly for active bleeding. Intravenous fluids were routinely administered during and after surgery until regular oral fluid intake was established. Fluid administration was particularly beneficial, as the majority of children had fasted for several hours despite written instructions to allow clear fluids until 2 h pre-operatively.

Nitrous oxide is well recognised as a cause of vomiting in adult volunteers [22]. A meta-analysis by Divatia *et al.* [23] concluded that the omission of nitrous oxide from general anaesthesia reduced the risk of PONV by an average 28% with a pooled odds ratio of 0.63 (0.53–0.75). Avoidance of nitrous oxide is easily achieved with new inhalational agents such as sevoflurane, as the potentiating effect of nitrous oxide is unnecessary. Piped air is universally available as a carrier gas for sevoflurane.

In contrast, however, a randomised, controlled, double-blind study of 60 children undergoing tonsillectomy and adenoidectomy reported no increase in PONV in the nitrous oxide group [24].

Positive pressure ventilation was avoided because of the potential to distend the stomach and contribute to PONV. This is particularly true in children who are intubated with an uncuffed tube. Sevoflurane itself is associated with lower PONV rates when compared to halothane as an inhalational agent [25].

Sevoflurane used in conjunction with propofol also appears to result in a calmer recovery from general anaesthesia. While the recovery is longer compared to sevoflurane alone, this did not delay or affect discharge home [26].

Reinforced Laryngeal Mask Airway

Clinical opinion remains divided regarding the use of the reinforced laryngeal mask airway for adenotonsillectomy. A meta-analysis of the use of the rLMA concluded that the rLMA is a safe alternative to intubation, but emphasised the close co-operation of the anaesthetist and surgeon that is required in managing the shared airway [27]. Most ENT surgeons and all anaesthetists are familiar with shared airway surgery, whether with a tracheal tube or rLMA. There is, however, a learning-curve in the safe and effective use of the rLMA for these procedures. The use of single use or 'nearly expired' rLMA overcame concerns about cross-infection, including potential prion protein contamination and transmission.

In our experience over the last 5 years in many hundreds of children, and during this study, the accurate

Figure 7 View of the pharynx with a rLMA *in situ* before tonsillectomy.
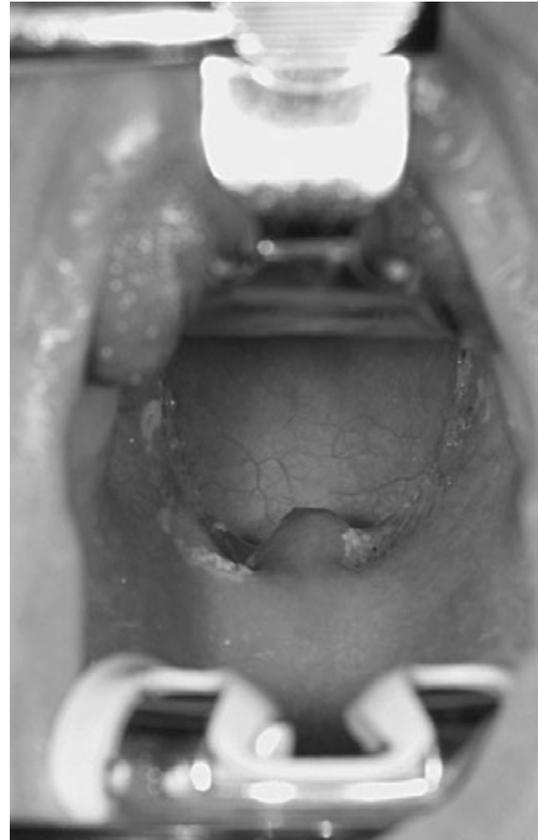

Figure 8 View of the pharynx with a rLMA *in situ* following tonsillectomy.

insertion of the correct size rLMA does not obscure the operative field in children as young as 3 years of age. Figures 7 and 8 show the view of the pharynx with an rLMA *in situ* before and after tonsillectomy, respectively. The inflated cuff forms an effective barrier to soiling of the trachea and larynx by blood and debris [28], and this may offer a benefit over the standard, uncuffed tracheal tube.

A comparative study in children comparing rLMA and tracheal tube [29] confirmed our own experience that adequate depth of anaesthesia is an essential prerequisite for safe and effective use of the rLMA in this type of paediatric ENT surgery.

From a surgical perspective, it may be necessary to use a slotted Doughty blade that is one size larger than anticipated. This avoids compression of the rLMA on the posterior third of the tongue and consequent obstruction of the airway. Care must be taken not to cause mucosal trauma to the posterior pharyngeal wall. For these reasons, we now avoid the use of the rLMA in children under the age of 3 years undergoing tonsillectomy, as there is insufficient room in a small mouth for the gag with a larger Doughty blade and for the stem of the rLMA.

Analgesia

We have found the combination of codeine phosphate, paracetamol and diclofenac to provide effective analgesia in these children. In an earlier pilot study we found that fentanyl and particularly morphine were associated with increased PONV and sedation without significant improvement in analgesia.

Conclusions

Modifications to the anaesthetic technique can improve the outcomes of pain and postoperative nausea and vomiting in children undergoing day-case tonsillectomy surgery. Same-day discharge is more predictable, and unexpected admission from the day care ward unusual.

Achieving optimum outcomes requires a meticulous approach to a basic operation by the anaesthetist and surgeon working together. The patient journey from admission to discharge on the same day is achieved by an experienced paediatric day surgery nursing team. Achieving a positive day-care mind-set of both parents and child is essential.

Further work is required to assess pain control following discharge, including compliance with prescribed medications.

We found that the rLMA was a satisfactory and safe alternative to tracheal intubation in most children undergoing this type of surgery. The limitations relate to pharyngeal size. In very young children with a small oropharynx, the surgical view may be limited and intubation may be required for surgical access.

It is likely that individual components of the protocol have only small measurable effects, whereas a significant improvement will be obtained when all or most of the components of the protocol are implemented.

Acknowledgements

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