Analgesia in fast-track paediatric cardiac patients

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Received 28 June 2010; received in revised form 16 December 2010; accepted 21 December 2010; Available online 20 February 2011

Abstract

Objective: We introduced a fast-track program for our cardiac operations requiring adjustment in anaesthesia techniques to facilitate rapid extubation and discharge from the intensive care unit (ICU). Our objective was to investigate the quality of analgesia in fast-track paediatric cardiac patients. Methods: We performed a retrospective review of the records of all patients who were fast-tracked in our institution between January 2006 and January 2007. Data collected included surgical procedure, anaesthesia technique, intra-operative opioids, ventilation time, intensive care stay, postoperative morphine consumption, pain scores, patient-controlled analgesia/nurse-controlled analgesia (PCA/NCA) duration, supplemental analgesia and incidence of vomiting. Results: Fifty-four patients were studied, with a median age of 5.6 years (8 months–18 years), median weight 15.6 kg (range: 6.4–101 kg), median intensive care unit (ICU) ventilation time 1.1 h (range: 0–8 h) and median ICU stay of 4.1 h (1–52 h). All patients received intra-operative fentanyl, median dose of 16.8 mcg kg⁻¹ (range: 15–20 mcg kg⁻¹). Twenty-three children received a bolus of morphine intra-operatively median dose of 102 mcg kg⁻¹ (range: 50–170 mcg kg⁻¹). Those patients who did not receive a morphine bolus intra-operatively, received a 100 mcg kg⁻¹ loading dose of morphine in the ICU. Twenty-four patients received intravenous paracetamol intra-operatively and five patients were given both paracetamol and diclofenac. Twenty-five children were not given either paracetamol or diclofenac intra-operatively. During the postoperative period, all patients received morphine by infusion administered via either PCA (18%) or NCA (73%). The median PCA/NCA infusion time was 28.9 h. Forty-eight patients received paracetamol and non-steroidal analgesics postoperatively, either diclofenac or ibuprofen. Five patients received only paracetamol and only one patient required no supplemental analgesia. The bedside nurse reported the pain scores on an hourly basis on a 10-point visual analogue score where 0 = no pain and 10 = strongest pain. Pain scores showed that most patients after day 0 (which was the day of surgery) had only mild pain. Conclusions: Our data showed that our program achieves high-quality analgesia in fast-track paediatric cardiac patients.

Keywords: Analgesia; Fast track; Paediatric cardiac surgery

1. Introduction

Early tracheal extubation after cardiac surgery is not a new concept. In recent years, ‘fast-track management’ has become increasingly popular [1–3], with the delivery of cost-efficient care considered as an additional variable when measuring and comparing surgical outcomes [3]. In our institution, the fast-track approach is applied to the whole of the patient’s course from admission to discharge. Key points to this process include reduced ventilation time, same-day intensive care discharge to a high dependency care unit and early ‘de-intensifying’ [4]. Fundamental to the fast-track approach at Great Ormond Street Hospital is management on the high dependency unit on the surgical ward on the night of surgery, early liberalisation of fluids, early mobilisation, effective pain relief and early discharge home.

The fast-track approach at Great Ormond Street has been applied to a selected cohort of low-risk patients since January 2006. We describe our experience in the management of fast-track paediatric cardiac patients, including the anaesthesia technique and the multimodal pain management regimen. The aim of our study was to investigate the quality of analgesia for fast-track patients during a 12-month period.

2. Methods

After approval from our institutional review board, we performed a retrospective review of the records of patients who had been admitted to the fast-track program during a 12-month period, between January 2006 and January 2007. Patients considered suitable for fast-track care were selected prior to surgery after discussion at the weekly...
multidisciplinary planning meeting. The criteria for the selection of fast-track patients included low-risk cardiac surgery and the absence of other associated complex defects, either a weight over 10 kg or at least 6 months of age, the absence of complex non-cardiac issues and no significant history of repeat chest infections or obstructive airway disease. All fast-track patients were planned to be the first case of the day on the surgical list. The trained clinical nurse specialist who would be looking after the child in the immediate postoperative period met the family and child preoperatively and discussed the fast-track process.

Anaesthesia was not managed by a strictly defined protocol. However, our general approach for children considered to be fast track consisted of mask induction with sevoflurane, if intravenous access was not available, or by intravenous induction with propofol (2–3 mg kg$^{-1}$) or thiopentone (4–5 mg kg$^{-1}$). Muscle relaxants were given to facilitate intubation and again before cardiopulmonary bypass (CPB). Intra-operatively, the decision of administering supplemental analgesia was left to the preference of the individual anaesthetist. Throughout the procedure and during CPB, anaesthesia was maintained with isoflurane or an infusion of propofol and remifentanil (0.1–0.2 mcg kg$^{-1}$ min$^{-1}$). Reversal of paralysis (glycopyrrolate 10 mcg kg$^{-1}$ and neostigmine 50 mcg kg$^{-1}$) was administered close to rewarming. Antiemetics (ondansetron 0.1 mg kg$^{-1}$ and/or dexamethasone 0.1 mg kg$^{-1}$) were administered routinely.

Final confirmation of the fast-track plan was made by the multidisciplinary team in the cardiac intensive care unit (ICU), based on the surgical and anaesthetic information at handover. Extubation, either in the operating room or in the ICU, was decided based on clinical evaluation and the following aspects were taken into consideration: bypass time and aortic cross-clamp time, complexity of surgery, necessity of significant inotropic support, haemodynamic stability and the presence of significant bleeding. Analgesic management on the high dependency unit (HDU) was a joint responsibility of the multidisciplinary pain team and the bedside nurse looking after the patient.

During the postoperative period, all patients received morphine by infusion (prepared as following: morphine concentration = 20 mcg kg$^{-1}$ ml$^{-1}$ for children < 50 kg or for children > 50 kg 1 mg ml$^{-1}$) administered either patient-controlled analgesia (PCA) or nurse-controlled analgesia (NCA). The patients were given a morphine infusion between 10 and 30 mcg kg$^{-1}$ h$^{-1}$, which was titrated according to the patient response. Supplemental boluses of 50 mcg kg$^{-1}$ were given if the child was in pain. All patients receiving intravenous opioid analgesia (PCA/NCA) were visited at least once daily by a member of the pain team (clinical nurse specialist and consultant anaesthetist). Pain scores and vital signs were recorded by the bedside nurse, on an hourly basis throughout the day. In some cases when appropriate, pain scores were also recorded by the patient or parent. If the child was considered old enough to report his/her pain scores (using the 0–10 pain scale), these were also recorded. The decision to administer supplemental analgesia was made by the bedside nurse according to the pain scores.

The following data were recorded: surgical procedure, anaesthesia technique, intra-operative opioids, ventilation time in ICU, intensive care stay, postoperative morphine consumption, pain scores, PCA/NCA duration, supplemental analgesia and incidence of vomiting. Patients who did not have complete records from the pain team were excluded from the study. Data are reported as percentages and median values and simple descriptive statistics applied.

### 3. Results

The children included in the review were those who had been successfully fast-tracked during the 12-month period from January 2006 to January 2007. There were a total of 82 patients in the cohort; however, only 54 of these had data collected by the pain team, and data from these patients are described in this study.

The median age of the patients was 5.6 years (range: 8 months–17 years) and median weight was 15.6 kg (range 6, 4–101 kg) (Table 1). The majority of children had surgery for simple cardiac defects such as septal defects (Table 2).

The median surgical duration was 180 min (range: 70–480 min). The shortest procedure was 70 min and was an atrial septal defect (ASD) repair, and the lengthiest procedure (480 min) was an ASD/ventricular septal defect (VSD) repair. The median postoperative ventilation time was 1.1 h (range: 0–8 h). Only one patient was ventilated up to 8 h. Twelve children (22%) were extubated in the theatre and then transferred to the ICU. Twenty-nine patients remained less than 5 h in the ICU. The median length of hospital stay was 3 days (range: 2–10 days) (Table 2).

As induction agents 31 patients received sevoflurane, 22 propofol (dose = 2–3 mg kg$^{-1}$) and one patient received thiopentone (dose = 5 mg kg$^{-1}$).

All patients received intra-operative fentanyl. We administered relatively low doses of intra-operative fentanyl, median 16.8 mcg kg$^{-1}$ (range: 15–20 mcg kg$^{-1}$).

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<th>Table 1. Patient demographics.</th>
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<td><strong>Partial anomalous pulmonary venous connection</strong></td>
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<td><strong>Atrioventricular septal defect</strong></td>
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three children received a bolus of morphine intra-operatively, median dose of 102 mcg kg\(^{-1}\) (range: 50—170 mcg kg\(^{-1}\)). Those patients who did not receive a morphine bolus intra-operatively received a 100 mcg kg\(^{-1}\) loading dose of morphine in the ICU, administered by the bedside nurse. Twenty-four patients received intravenous paracetamol (15 mg kg\(^{-1}\)) intra-operatively and five patients were given both paracetamol and diclofenac (1 mg kg\(^{-1}\)). Twenty-five patients were not given either paracetamol or diclofenac during the intra-operative period.

During the postoperative period, all patients received a morphine infusion. Eighteen percent of children received a PCA or an NCA (73%). Some patients converted from PCA to NCA (5%), or from NCA to PCA (4%). The median PCA/NCA infusion was 28.9 h (range: 10—120 h).

Forty-eight patients received paracetamol and non-steroidal analgesics postoperatively, either diclofenac or ibuprofen. Five patients received only paracetamol and one patient required no supplemental analgesia postoperatively.

The bedside nurse reported the pain scores on an hourly basis on a 10-point visual analogue score where 0 = no pain and 10 = strongest pain. The scores showed that the majority of patients had pain scores below 4 after day 0 (Fig. 1). The overall assessment of pain management is shown in Table 3 and in Fig. 1. Table 3 shows that 85% of the patients had between excellent and satisfactory analgesia. Only four patients (7%) complained of chest drain pain, which corresponded to the day of surgery (Fig. 1). The median dose of 102 mcg kg\(^{-1}\) was also reported only during the first 24 h postoperatively.

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daily reviews by the pain team, as described for the patients in this study.

In the early experience of CPB in children, the use of high-dose opioid techniques was the basis for anaesthesia, with continuance of this strategy during the postoperative period. This was believed to modulate the stress response and improve outcomes. Gruber et al. concluded that a large-dose fentanyl technique was not an important determinant of outcome, nor did it prevent a hormonal or metabolic stress response in infants undergoing cardiac surgery [11]. However, in the era of modern CPB techniques, such protective strategies are no longer required. Recent studies have not validated a link between stress hormone levels and clinical outcomes, even in high-risk infants [11,12]. Some authors advocate the use of regional analgesia and general anaesthesia to facilitate early extubation [13]. We have obtained very good results for our patients using routine general anaesthesia, moderate doses of intra-operative fentanyl, a multimodal analgesia technique and routine follow-up of patients by a specialised pain team.

It should also be noted that the definition in literature of ‘early extubation’, which is a fundamental part of a fast-track approach to cardiac surgery, is not consistent and poorly defined. Generally, the term ‘early extubation’ is used when the endotracheal tube is removed within 6–8 h after the surgery. However, early extubation has been associated with extubation in the operating room and as late as 24 h following surgery [14]. In our series, extubation time (maximum ventilation time 8 h) was consistent with the definition of ‘early extubation’.

There are many benefits to a fast-track approach to cardiac surgery. These include reduction in ventilator-associated infections, reduced risks associated with unplanned extubations, decreased risk of other nosocomial infections, increased patient and parent satisfaction and reduced financial costs [15,16]. Barash et al. claimed psychological benefits of early extubation and decreased pulmonary complications and duration of intensive care stay. The incidence of re-intubation in this series was 4% [17], and none of the patients in this series required re-intubation.

With changing healthcare delivery, ‘fast-track’ care is likely to play an increasingly important role in the management of congenital cardiac surgery. An adequate analgesic regimen contributes to favourable outcomes, which we consider an essential component of the entire fast-track process.

References