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Difficulties with assessment and management of an infant's distress in the postoperative period: Optimising opportunities for interdisciplinary information-sharing

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Abstract

Objectives: The importance of accurate paediatric patient assessment is well established but under-utilised in managing postoperative medication regimens.

Methods: Data for this case report were collected through observations of clinical practice, conduct of interviews, and retrieval of information from the medical record. This case report involving a hospitalised 1-year-old boy demonstrates the difficulties associated with assessing and managing postoperative distress, including pain and other clinical conditions related to the surgical procedure.

Results: Postoperatively, there were difficulties in managing pain and an episode of over-sedation, occasioning opiate reversal with naloxone. In addition, he had decreasing oxygen saturation and increased work of breathing. X-ray showed changes consistent with either atelectasis or aspiration, and he was commenced on antibiotics. The patient experienced respiratory distress and required intervention from the medical emergency team.

Conclusion: This case demonstrated the importance of comprehensive assessment and careful consideration of alternative causes of an infant's distress using the results of assessment tools to aid decision-making. Communication moderates effective patient care, and more favourable outcomes could be achieved by optimising interdisciplinary information-sharing.

Keywords

Pharmacoepidemiology and drug safety, medication management, analgesia, pain, communication, postoperative care

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Introduction

The importance of accurate paediatric patient assessment is well established but under-utilised in managing postoperative medication regimens.[1] In particular, determining the need for analgesics is notoriously difficult following certain procedures, including craniofacial surgery, due to an increased risk of secondary causes of distress, such as respiratory

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complications.[2] This case report demonstrates the difficulties associated with assessing and managing postoperative distress, including pain and other clinical conditions related to craniofacial surgery.

Case report

A 10-kg, 1-year-old boy underwent craniofacial surgery at an Australian children's hospital. Postoperatively, he had a number of issues in the post-anaesthesia care unit (PACU) (Table 1). The issues included difficulties in managing pain with variable pain scores using the Face, Legs, Activity, Cry, Consolability (FLACC) scale ranging from 0 to 6. During the postoperative period, the infant had an episode of over-sedation with a sedation score of 3, using the University of Michigan Sedation Scale (UMSS), which required opiate reversal with naloxone. In addition, he had decreased oxygen saturation, declining to 70% at one point and increased work of breathing. The infant was given continuous positive airway pressure (CPAP). A chest X-ray showed changes consistent with either atelectasis or aspiration, which required antibiotic treatment. The infant had a nasopharyngeal airway in situ.

Following these issues, the anaesthetist wrote progress notes, recommending that the intravenous (IV) morphine infusion should be maintained at the conservative dose of 10 µg/kg/h without bolus or halved if there were further sedation issues. However, he wrote an opioid infusion order in the range of 10–40 µg/kg/h, with a 10 µg/kg bolus (1 mL) of intervals no less than 10 min for pain. One ward nurse retrieved the patient from the PACU at 21:00, and a night duty nurse took over care at 21:30. Overnight, the infant was unsettled and breath-holding and was given a number of boluses of IV morphine and then the morphine infusion dose was doubled. The infant was reviewed by the paediatric intensive care unit (PICU) Outreach Team at 02:30, who made no changes to the treatment plan.

At 7:30, the same nurse who collected the infant from recovery was caring for him again. The specialist surgical team reviewed him shortly after. They suggested to the nurse that the nasopharyngeal airway could be 'corked' or spigotted and documented in the progress notes that the general medical team would review the infant regarding the changes on chest X-ray results, and that the pain management service would review analgesia. It was not documented whether these reviews were also verbally handed over to those teams. The infant was reviewed by the pain management service at 11:05 and at that time the infant appeared settled, with pain scores of 0–1. The pain management service documented a plan to continue the morphine infusion at 20 µg/kg/h but to wean it later in the day and to manage pain with regular oral paracetamol and ibuprofen. At 11:10, his distress escalated and his pain score was documented as 5/10 by the nurse. By 11:25, the infant remained unsettled and as no other analgesia was due, a 10 µg/kg (1 mL) bolus of IV morphine was given with some effect and the infant was asleep after 10 min. At 11:55, the nurse contacted the surgical team's junior doctor regarding the updated medication recommendation. Still asleep, his nasopharyngeal airway was then corked, resulting in an increased work of breathing but no decrease in oxygen saturation. Upon awakening, the infant's pain score was 1, and sedation score was 1. The nurse administered IV tramadol 2 mg/kg (20 mg dose) at 12:30; however, the work of breathing remained high and the nasopharyngeal airway was un-corked. His oxygen saturation began to drop to mid-80%, and increasing supplemental oxygen therapy had little effect. The nurse paged the surgical team twice at 13:03 and 13:18 with no response. The Associate Unit Manager (AUM) attempted to call the surgical team at 13:23, also to no avail. There was no attempt to contact the medical or pain teams.

At 13:25, a medical emergency team (MET) call was made. When the team arrived, the infant had increased work of breathing, an oxygen saturation of 70%, and an audible stridor. The team immediately ceased the morphine infusion and gave sodium chloride (0.9%) nebuliser via a mask. A *stat.* dose of 6 mg IV dexamethasone was administered. Oxygen saturation improved to around 90% with a respiratory rate of 36 breaths/min. An adrenaline nebuliser was given followed by 10 mg of IV parecoxib. The surgical team arrived during the MET call and when over-sedation was suggested, a senior doctor stated that he had explicitly asked that the morphine was to be ceased earlier in the day. This request had not been mentioned to the primary nurse and was not documented in the infant's file.

A chest X-ray showed right lung changes, suggestive of aspiration. An arterial blood gas revealed respiratory and metabolic acidosis. At 13:50, 100 µg of IV naloxone was given (10 µg/kg), resulting in deeper breathing and large cough-clearing, thick secretions. Vital signs improved with an increased oxygen saturation of 95%. Following the MET intervention and management, the infant remained stable and pain was subsequently managed with paracetamol, ibuprofen and tramadol, along with deep suction every 30 min, humidified oxygen, and regular medical review. Two days after surgery, he was still noted to have an increased work of breathing with a nasopharyngeal airway in situ. His oxygen supplementation was gradually weaned and the nasopharyngeal airway was successfully removed 3 days following surgery, and he was discharged from hospital 4 days after surgery.

Discussion

In this case, the infant had respiratory distress and deteriorated after surgery due to airway obstruction and atelectasis. His condition was potentially exacerbated through the use of opioids, albeit within the hospital's infusion guidelines.

An important consideration was the appropriate use of medications for this particular infant and how a comprehensive assessment could have helped to inform and guide individualised medication management. Despite documenting

Table 1. Chronology of events in the perioperative period and overnight stay on the surgical ward.

Time	Clinical condition/assessment	Interventions	Communication
13:45–18:15	Intraoperative	Intraoperative wound infiltration of 0.2% ropivacaine with adrenaline along with a total of 75 µg of intravenous (IV) fentanyl. Received two doses of cefazolin, 250 mg at induction and 250 mg 1.5 h later.	Progress notes documented by surgeon and anaesthetist.
Post-anaesthesia care unit			
18:30–18:50	Airway: patent, no stridor, NPA in situ. Breathing: RR = 24 breaths/min. Circulation: HR = 130 beats/min, SpO_2 = 96. Pain: score = 6. Sedation: score = 2. Infant irritable and crying.	A further 5 µg IV fentanyl was given. IV morphine infusion at 20 µg/kg/h commenced at 18:45. Oxygen therapy wafting 9 L/min.	Anaesthetic review.
18:51–19:00	Airway: patent, no stridor, 'rattling chest'. Breathing: RR = 38 breaths/min, breath-holding episodes with rapid shallow breathing. Circulation: HR = 120 beats/min, BP = 107/68 mmHg, SpO_2 decreased to 90%, 80% on room air. Pain: score = 0, crying. Sedation: score = 2–3, increased sleepiness.	Morphine infusion was ceased. IV paracetamol was given. 10 µg of naloxone IV (1 µg/kg) given. CPAP administered via mask with oxygen (9 L/min).	Anaesthetic review. Reviewed by PICU physician and chest X-ray ordered.
19:10–20:45	Airway: patent, no stridor, chest X-ray showed right upper lobe changes due to atelectasis or aspiration. Breathing: RR = 18–31 breaths/min. Circulation: HR = 150–160 beats/min, BP = 114/62 mmHg, SpO_2 gradually improved to ≥96%. Pain: score not recorded. Sedation: score = 1–2, improved conscious state, parents comforting infant with singing and rocking.	Morphine infusion recommenced at 10 µg/kg/h. CPAP ceased.	Anaesthetist reviewed chest X-ray and made a written plan to restart the morphine infusion without a bolus and if the infant became too sedated, then halve the dose. Handover between PACU and ward nurse.
Ward			
21:00–01:00	Airway: patent. NPA remained in situ, aspiration and atelectasis to right upper lobe. Breathing: RR = 28–32 breaths/min, parents in attendance and report that the infant breath holds when upset. Circulation: HR = 133–154 beats/min, SpO_2 maintained between 97% and 100%. Pain: score = 0. Sedation: score = 1, infant unsettled. Patient had bilateral grommets and needed hearing aids.	Morphine infusion rate increased to 20 µg/kg/h at 22:35. Three morphine boluses administered. Commenced benzylpenicillin 500 mg IV four times daily (50 mg/kg/dose) at 21:00. Required antibiotic due to right upper lobe changes. Given 20 mg (2 mg/kg) of tramadol at 23:30. NPA was suctioned hourly with nil to minimal secretions. Ciprofloxacin ear drops administered.	At 21:30, handover from afternoon-shift ward nurse to night-shift ward nurse.
02:00–07:00	Airway: NPA patent with nil secretions. Breathing: RR = 30–32 breaths/min, SpO_2 stable between 98% and 100%. Circulation: HR = 138–155 beats/min. Pain: score = 0–2. Sedation: score = 0–1, unsettled and crying.	Morphine bolus (20 µg/kg) given at 05:50.	Reviewed by PICU Outreach Team, agreed with rate increase and made no other changes to treatment plan.

IV: intravenous; CPAP: continuous positive airway pressure; HR: heart rate; RR: respiratory rate; SpO_2: oxygen saturation; NPA: nasopharyngeal airway; BP: blood pressure; PICU: paediatric intensive care unit; PACU: post-anaesthesia care unit.
Pain score: the Face, Legs, Activity, Cry, Consolability (FLACC), Sedation score: University of Michigan Sedation Scoring System.

mostly low pain scores and only one moderate pain score, bedside nurses interpreted the child's distress as pain. The FLACC scale, which is a validated scale for pre-verbal paediatric inpatients,[3] has been shown to be efficacious in craniofacial pain assessments.[1,4] However, in this case, it was not used to guide practice. Upon no improvement following morphine administration, the presumed cause of distress turned to opioid over-sedation, rather than attempting to reassess the cause of the patient's symptoms. Over a 15-h period, the patient received 80 μg/kg of morphine, less than what is suggested in the hospital's clinical guidelines.

Opioids are an effective analgesic that minimise postoperative pain following similar craniofacial procedures and reduce the risk of additional swelling and bleeding.[5] They can worsen respiratory complications for this population of patients,[2] but to date, opioids have not been shown to be a contributing factor of adverse events postoperatively in children.[6,7] A continuous morphine infusion is hospital policy for the immediate postoperative period. During this early postoperative period, the infant was constantly observed and received at least hourly assessment of pain and sedation, which permitted careful titration of the analgesic effect in accordance with the pain and sedation response. Past evidence has shown that continuous morphine with nurse-controlled analgesia is effective in managing pain.[1] It is possible that combined use of sedative and non-opioid analgesic agents may have reduced the need for strong opioid medications such as morphine.[8]

The hospital policy advocates use of a morphine infusion at a rate of 10–40 μg/kg/h and boluses within the range of 10–20 μg/kg. These dose levels, which were followed by clinicians, are supported in the literature.[9] The protocol states that a 10-min interval exists between boluses and three boluses can be given in an hour before there is any increase in rate. In this case, the anaesthetist started the infusion at the lower dose range before the infant left the PACU. Differences between intermittent bolus doses and continuous infusions of opioids relate more to the total dose given rather than to the route of administration utilised. There is good evidence indicating that an infusion prevents erratic blood levels to be up and down and therefore pain management to be suboptimal. Furthermore, individual variability in kinetics between children of the same age group can result in twofold to threefold differences in morphine plasma concentration for the same rate of infusion.[10] From a retrospective audit of 886 children conducted by Taylor et al.,[11] they recommend initial infusion rates in toddlers should start at 15 μg/kg/h. As they found an increased dosing variability with increasing age, they suggested subsequent infusion rates depend on results obtained from pain scores, use of adjuvant medications, and adverse effects.

Comparing the same total dose of morphine given via infusion (10 μg/kg/h) and bolus (30 μg/kg every 3 h), Van Dijk et al.[9] found no difference in infants' pain scores. Similarly, in Lynn et al.'s[12] study examining intermittent bolus dosing and continuous IV infusion with morphine, both groups achieved effective analgesia but those in the bolus group showed a higher percentage of infants experiencing distress (32% vs 13%, $p < 0:001$). No differences were found with respect to room air saturation of less than 90% or of mean venous PCO_2 levels. In the continuous infusion group, 4 out of 56 infants (7%) showed adverse ventilatory effects, comprising venous hypercarbia in 2 infants, oximetry desaturation in 1 infant, and venous hypercarbia and oximetry desaturation in 1 infant. In a prospective audit conducted on 10,726 children, data were collected on the incidence, nature, and severity of serious clinical incidents associated with continuous opioid infusion, patient-controlled analgesia, and nurse-controlled analgesia.[13] This study showed 1 grade 1 incident resulting in a cardiac arrest occurred (1:10,726), which involved aspiration pneumonitis, 28 grade 2 incidents occurred, of which half comprised respiratory depression (1:383). A total of 17 grade 3 incidents took place (1:631), which were prescribing or programming errors from the one hospital. Within the current case, in nurses' efforts to address the infant's pain and distress, the opioid infusion was increased, and nurses administered morphine boluses.

In retrospect, the infant's clinical decline following corking of the nasopharyngeal airway, and improvement following the combined interventions of deep suction, medication to reduce airway swelling, humidified oxygen, anti-inflammatories, and naloxone, were all indicators of a cause other than pain. The infant was found to have an upper airway obstruction and required an airway in to maintain patency. Earlier consultation with clinicians, including the pain team, surgical team, medical team or PACU team, would have assisted with relieving this infant's distress and led to improved medication management. In lack of availability of the surgical team, the infant's care was not escalated to receive alternate medical assistance.

This case also involved inadequate and miscommunication between multiple staff members. The anaesthetist from the PACU differed in his recommendation for the morphine dose and the morphine order that he prescribed, and subsequently, the recommendation was not adhered to following transfer of care. There was inadequate contact between the nurses and surgical team, pain management team and general medical teams, as well as the lack of communication between the junior and senior surgical doctor.

Previous qualitative research of health professionals in a paediatric critical care setting has highlighted the problem of fragmented communication among teams, 'unshared mental models' resulting in dys-synchronous perceptions of the issue, goal and expected trajectory, and ambiguity around consulting experts to aid decision-making.[14] When this dynamic occurs, anomalous information may not be recognised and acted upon, hindering the clinical inquiry and clinical forethought required in preventing potential problems. In addition, timely communication for the deteriorating patient is vital, and in this case, it took over 2 h to escalate care. Reluctance to activate the MET system, even when activation criteria are present, and allegiance to the traditional model of contacting the covering or attending doctor

for a deteriorating patient are known barriers to achieving appropriate emergency interventions.[15]

This case highlights the need for close monitoring in paediatric assessment and communication about patient deterioration. Since this event, the hospital has implemented a mandatory escalation of care system through standardised, age-specific, paediatric observation charts where clinicians are provided with clear clinical parameters for when to escalate care. In addition, to help support clinical decision-making, the development of a clinical guideline regarding management of a nasopharyngeal airway is in progress.

Conclusion

This case demonstrates the importance of comprehensive assessment over time, in particular careful consideration of alternative causes of an infant's distress and using the results of assessment tools to aid decision-making. Communication moderates effective patient care, and more favourable outcomes could be achieved by optimising interdisciplinary information-sharing. The following recommendations for improving quality and safety in paediatric postoperative care are suggested:

- Improving problem identification through clinical inquiry and the use of validated assessment tools, which are subsequently interpreted appropriately.
- Improving interdisciplinary communication including consultation for managing complex patients especially with multiple treating teams.
- Considering mandatory escalation of care for predefined clinical deterioration.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval to report this case was obtained from The Royal Children's Hospital Human Research Ethics Committee. Approval no. 33137 B. The ethics committee has approved for this case study to be published.

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Informed consent

Verbal informed consent was obtained from a legally authorised representative(s) for anonymised patient information to be published in this article. The patient's legal guardian (mother) has provided verbal consent for this case study to be published.

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