Postoperative Apnea after Caudal Anesthesia in an Ex-premature Infant

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Preterm infants are prone to develop respiratory and cardiovascular complications following general anesthesia for even minor surgical procedures.1 These children may develop a life-threatening episode of apnea with bradycardia and/or cyanosis in the immediate postanesthetic period.2 The risk for postanesthetic apnea remains high until a postconceptual age of 44 weeks, and perhaps even later.1,3-4 Regional anesthesia without sedation has been recommended as an acceptable alternative to general anesthesia for high-risk infants to avoid intraoperative tracheal intubation, the hazards of postanesthetic apnea, and consequent mechanical ventilation. Spinal5,6 and caudal epidural7 anesthesia have been used in awake babies undergoing lower body procedures, such as herniorrhaphy, orchiopexy, and circumcision. We report a case of a high-risk infant who developed two life-threatening apneic episodes in the postoperative period following a herniorrhaphy performed under caudal epidural anesthesia.

CASE REPORT

This 3.9-kg, 4-month-old (42 wk postconception) male infant was brought to the operating room for a bilateral inguinal herniorrhaphy. Past medical history was remarkable for a premature delivery at 27 wk gestation; respiratory distress syndrome (RDS) requiring 46 days of mechanical ventilation and 68 days of supplemental oxygen; ligation of a patent ductus arteriosus at 11 days of age; and bilateral subependymal hemorrhages, which were slowly resolving. The infant did have apnea and bradycardia spells in the neonatal ICU, but the last documented spell was 2 months prior to surgery. All medications had been discontinued and the child had been at home for 1 month prior to the procedure.

The infant did not receive any preanesthetic drugs. The caudal injection was performed using a 23-G 2.5-cm standard needle and a "no touch" technique described by Broadman.§ One milliliter per kilogram of 0.575% bupivacaine was injected into the caudal epidural space after repeated aspiration for blood and cerebrospinal fluid. Within 6 min adequate analgesia was obtained up to the T6 level, as demonstrated by the absence of movement and crying following pinching of the skin at that dermatome.

During the hernia repair, there were no changes in heart rate, blood pressure, or oxygen saturation. Following the herniorrhaphy, the infant underwent orchiopexy for retrotelial fibroplasia, after topical proparacaine anesthesia. Pressure on the eyeball with the cryoprobe caused two episodes of bradycardia to 100/min, with a return to normal rates of 150/min on withdrawal of the probe. Three hours later the infant was discharged to his room when he would withdraw his legs after a toe pinch, demonstrating that the epidural analgesia had regressed.

Twelve hours after surgery the infant was sucking a pacifier while his mother was changing a diaper in the presence of a nurse. The baby had not received any sedation or analgesic medications after surgery. The nurse noted the presence of intercostal retractions, which was followed by cyanosis and then cessation of respiratory movements. No pulse could be felt and cardiopulmonary resuscitation was instituted with mouth-to-mouth respiration and chest compressions. Within 60 s the infant turned pink, started crying, and resumed normal respiration. Vital signs including temperature were normal on arrival in the intensive care unit, 10 min after the episode.

A complete blood count, arterial blood gas tensions, serum electrolytes, glucose, calcium, and blood urea nitrogen drawn 15 min after the apneic episode were within age-related normal limits. A chest x-ray did not reveal any changes in the 2-month interval between dis-

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charge from the neonatal ICU and surgery. Blood, urine, cerebrospinal fluid, and nasal secretion cultures did not reveal any pathogens. An immunofluorescent stain of nasal secretions was negative for respiratory syncytial, influenza, parainfluenza, and adenoviruses. A 24-h Holter EKG did not record any cardiac arrhythmias, and the EEG was normal for the age. A head ultrasound examination revealed old healing subependymal hemorrhages. A fiberoptic examination of the nasopharynx did not reveal any anatomic airway abnormalities.

A CT scan was performed 48 h after the apneic episode using intramuscular pentobarbital (5 mg/kg) for sedation. It revealed a small collection of intraventricular blood and local white matter disease or an old infarct in the right temporo-parietal cortex. During the scan the infant had regular respiration and normal oxygen saturations by pulse oximetry. After the scan the patient accepted a bottle without any choking spells. Two hours after the administration of pentobarbital, and 45 min after feeding, the infant was lying in his grandmother’s arms when the apnea monitor alarmed. The baby was noted to be apneic, cyanotic, but with a normal heart rate. He did not respond to vigorous stimulation and then the heart rate slowed. After 2 min of bag and mask ventilation, he was awake and alert with normal vital signs and in no distress. During a two-day observation period in the intensive care unit he had no additional apneic episodes. He was discharged after arrangements were completed for apnea monitoring at home.

DISCUSSION

The reported incidence of apnea following general anesthesia in preterm infants is 12–40%, depending on the gestational age, number of cases studied, type of surgery, type of anesthetic management, and the method and duration of recording apnea. The risk is highest in infants younger than 44 wk postconceptional age and is not necessarily predicted by a previous history of apnea. Postanesthetic apnea may occur in the immediate hour following a general anesthetic or may not appear until 2–12 h after surgery. Early onset apnea may be explained by the depressant effects of residual halothane on the chemoreceptor response to hypoxemia. These effects are seen at low blood halothane concentrations. Delayed onset apnea seen hours after surgery cannot be explained by low concentrations of halothane because elimination of inhaled anesthetics should be almost complete by this time. Other explanations that have been suggested include diaphragmatic fatigue and the effects of endorphins released in response to surgical trauma. The mechanism of apnea following general anesthesia is unknown but probably resembles that of apnea of prematurity because the incidence of both increase with decreasing gestational age. Although apneic episodes in preterm infants can occur during sleep, one-third of all occurrences are seen in awake infants during periods of increased motor activity. During such “squirming” spells the infant has a distinctive breathing pattern characterized by a reduced minute volume, obstructed inspiratory efforts, intermittent Valsalva-type maneuvers, and cyanosis. These apneic spells can be precipitated by noxious stimuli.

Our patient had been free of apneic spells for 2 months prior to the surgery. The first episode occurred while the mother was raising the legs to change the diaper. We can speculate that the movement caused pain at the surgical site and thus precipitated apnea. The cause of the second episode is unclear. Because the blood barbiturate concentration was not measured, we cannot completely rule out excessive sedation from pentobarbital as a factor in the second episode. Clinically, the infant did not appear excessively sedated; he had actively sucked a bottle before the episode, and he responded rapidly to bag and mask ventilation. A second “squirming” apneic spell could have occurred. We found no evidence of other known causes of apnea including metabolic derangements, hypothermia, anemia, sepsis, anatomic airway abnormalities, respiratory infections, cardiac rhythm disturbances, and seizures.

The dose of bupivacaine without epinephrine used in our patient (3.75 mg/kg) is higher than the usually recognized maximum of 3 mg/kg. However, bupivacaine has a much larger volume of distribution in children compared with that in adults, and peak concentrations after caudal injection of 2.5–3 mg/kg are far below the lowest concentrations at which CNS toxicity is seen in adults. Cardiovascular and CNS toxicity after local anesthetics are rarely seen in children, and should occur within the first hour of injection. It is therefore extremely unlikely that the dose of bupivacaine used played a role in the subsequent apneic episode 12 hours after surgery.

In view of the complications associated with general anesthesia in this age group, interest in regional anesthesia has increased. Spinal and caudal epidural anesthesia are acceptable alternatives to general anesthesia for lower body procedures in infants. The ventilatory response to hypercapnia is increased following caudal anesthesia in children and spinal anesthesia in adults. This improved responsiveness may result in a decreased incidence of immediate postanesthetic apnea following regional anesthesia in high-risk children, compared with that following general anesthesia, at least during the period of neural blockade. In three studies of regional anesthesia in awake children, perioperative apnea with bradycardia was not noted. Harnik et al. reported apnea after spinal anesthesia in only two of 20 children; one developed inadvertent hyperventilation and the other had up to 12 preoperative spells daily.

If our hypothesis that delayed onset postoperative apnea is similar to pain-induced “squirming” apnea is true, the incidence of this form of apnea should not be affected by the type of anesthetic used. Further study is necessary to determine if regional anesthesia is superior to general anesthesia in a high-risk group of infants undergoing hernia repair because it has not been proven that the incidence of postanesthetic apnea is reduced by regional anesthesia. This study will need to involve multiple cen-
ters because most centers see only 15–20 such patients a year. Until data from such a study are available, postoperative monitoring for apnea is imperative in the high-risk group, regardless of the anesthetic technique used.

In summary, we have described an infant of 42 wk postconceptional age who had two episodes of life-threatening apnea in the postoperative period after an awake, caudal epidural anesthetic for a hernia repair.

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Oral Transmucosal Fentanyl Citrate for the Treatment of Breakthrough Cancer Pain: A Case Report

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It is estimated that 29% of patients with cancer suffer from moderate to severe pain even when receiving analgesic therapy.1 In addition, many patients who receive long-acting potent opioids for the management of severe cancer pain suffer from adverse effects such as oversedation, constipation, nausea, and periods of inadequate pain relief. A noninvasive means of administering a rapidly absorbed potent analgesic with a relatively short duration would be desirable for the treatment of breakthrough pain experienced by these patients.

It has recently been documented that fentanyl, a potent synthetic opioid, can be absorbed transmucosally through administration in lollipop form (Oral Transmucosal Fentanyl Citrate (OTFC)).2,3 We report the use of OTFC for the treatment of breakthrough pain in a patient with metastatic carcinoma of the lung.

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