Subdural Administration of Opioids

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Numerous case reports have described the inadvertent subdural extra-arachnoid placement or migration of epidural catheters as well as the clinical characteristics seen after injection of local anesthetics.1-8 However, when the subdural placement was either presumed or proven radiologically in these reports, the catheters were removed. The following case report is unique not only in that the subdural catheter was left in place for long-term use but also that opioids instead of local anesthetics were administered subdurally.

**CASE REPORT**

A 40-yr-old 70-kg male with metastatic squamous cell carcinoma of the penis was referred to our pain service for intractable pain. The patient was treated surgically with penectomy 2.5 yr previously but subsequently developed metastatic lesions to the pelvis and groin, which were treated with chemotherapy and radiation therapy. Initially, the pain was treated with oral morphine elixir. This became inadequate because the lesions worsened and tachyphylaxis developed. At the time of referral, he was taking up to 1,000 mg of oral morphine daily with poor to fair pain control. He was admitted for a trial of epidural opioids and for possible insertion of a long-term, externalized epidural catheter. A temporary epidural catheter was inserted for instillation of morphine as a trial for pain treatment. The epidural dosage of preservative-free morphine was titrated from 10 mg to 20 mg bid, which led to adequate pain relief and the decision to insert the long-term epidural for home morphine administration.

On arrival to the operating room, the previously inserted temporary epidural catheter was injected with 20 ml of 0.5% bupivacaine. Good segmental anesthesia was assurred over the lower thoracic and upper lumbar regions, and the catheter was removed. The DuPen* externalized, long-term, epidural catheter was inserted through a 5-cm lumbar paravertebral incision. A 14-G Touhy needle was inserted into the epidural space via a paramedian approach, and the silastic catheter was threaded cephalad. The externalized portion was tunneled subcostally from the anterior axillary line to the paravertebral incision, spliced to the epidural catheter, and sutured to the intraspinal ligament. Fluoroscopy confirmed the cephalad tip of the catheter at T12. A 5-ml test dose of 1.5% lidocaine with 1:200,000 epinephrine had no perceptible increase of lower extremity weakness or heart rate. The incisions were closed.

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As recommended by the manufacturers, an epiduralagram was performed immediately postoperatively in the radiology department with a total of 20 ml of omnipaque. It demonstrated the classic “railroad track” appearance of the subdural, extra-arachnoid space (figs. 1 and 2). The decision was made to leave the catheter in place rather than subject the patient to a second surgical procedure to change catheter position. Because of the relative flimsiness of the arachnoid membrane with the possibility of subarachnoid migration, we chose a dose of morphine in the range usually injected into the subarachnoid space (0.75 mg with a concentration of 1 mg/ml). This was increased to 1.25 mg per dose over the next three days. This dose provided excellent pain relief without associated side effects. During this time the patient still required occasional supplemental oral morphine but in much reduced doses of 60-120 mg bid. After being counseled on the use and care of the catheter, which included strict sterile technique, dressing changes, and frequent 0.22-μm filter replacements, the patient was discharged to home on the seventh postoperative day with weekly follow-up by our pain service. At home the patient used 1.25 mg of morphine with a concentration of 0.5 mg/ml. This was the same total dose but twice the volume of that used in the hospital. The lower concentration was used because of the unavailability of 1 mg/ml morphine. Pain relief.

![Fig. 1. Anteroposterior view of postoperative subduralagram showing typical “railroad track” appearance of radiopaque.](Image)
was decreased, necessitating increased oral morphine elixir. Ultimately, the subdural dose was increased to 1.5 mg/ml. At this dosage he had adequate relief but eventually needed to increase the frequency of injections to qid. The patient continued to take oral morphine elixir throughout the entire period in the dose range of 120–240 mg daily. By 2.5 months after insertion of the catheter, the patient required hospitalization for his deteriorating medical status including weakness, anorexia, and inability to ambulate. During this admission he received 5 mg morphine qid through the subdural catheter because he was unable to take oral supplements. Pain relief continued to be adequate until his death approximately 3 months after catheter insertion.

DISCUSSION

The subdural space is the potential space between the arachnoid and dura mater. It contains a minute quantity of serous fluid. The space ends at the lower border of S-2 and extends into the cranial cavity. The subdural space has more potential capacity posteriorly, laterally, and cranially. In contrast, the epidural space ends at the foramen magnum by the fusion of the dura to the periosteum and extends to the sacral hiatus caudally.

Contrast media injected into the epidural and subdural spaces provides characteristic x-ray findings. On epiduragram the contrast displays a tree-like appearance as the dye spreads paravertebrally along the nerve roots toward the intervertebral foramina. The subduragram can appear as an amorphous sheet-like collection of contrast that lies predominantly dorsally on lateral view, or it may show the classic “railroad track” appearance on an anteroposterior (AP) view. This is similar to the epidural AP view, except that the subduragram lacks the tree-like branchings of dye characteristic of epiduragrams. The radiographs of our patient exhibit the typical appearance of a subduragram (figs. 1 and 2).

The possibility of cannulating the subdural space was confirmed by Blomberg in his spinaloscopy study at autopsy. He not only viewed the subdural space with an endoscope but also advanced a Touhy needle and epidural catheter into the subdural space under direct visualization.

Numerous case reports have cited subdural migrations of functioning epidural catheters as well as direct inadvertent subdural catheterizations. All these cases describe the possible effects of subdural local anesthetics. Only one report used bupivacaine and meperidine in a continuously functioning epidural catheter, which then migrated subdurally. After radiographic confirmation of subdural placement, the catheter was injected only with bupivacaine.

Epidural and intrathecal opioids have been used for postoperative incisional pain and for chronic pain in cancer patients. The opioid dosage for these two techniques is markedly different with subarachnoid techniques requiring one-tenth to one-sixteenth the epidural dose. The reason for the difference in dosage is not precisely known. The decision of which dosage to give our patient necessarily arose after we decided to leave his subdural catheter in place. Because the only barrier to cerebrospinal fluid was the arachnoid mater with subarachnoid migration was possible, a dose in the usual subarachnoid range was chosen. This proved adequate initially when administered bid.

Our patient did not experience any side effects from either subdural opioids or the subdural placement of the catheter. We specifically monitored for typical spinal opioid sequelae, including pruritis, urinary retention, and respiratory depression, as well as long-term catheter placement complications, such as infection. The subdurally placed catheter afforded good to excellent pain relief over 3 months. A markedly reduced dose of morphine was required when compared with that required via the epidural route.

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FIG. 2. Lateral view of postoperative subduragram.
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 postconceptional age of 44 weeks, and perhaps even later.1-4 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 0.375% 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 cryopexy for retrorenal 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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