on prosthesis insertion. A staged insertion of each prosthesis may reduce the bolus of emboli and methylmethacrylate monomer reaching the circulation at any one time. This would minimize the hypoxemia[10] and cardiovascular collapse intraoperatively. Thorough, meticulous lavage of the intramedullary cavity[5] may prevent the embolism of marrow contents and should be performed prior to insertion.

References

1. Deburge A, Guepar: Guepar hinge prosthesis: Complications and results with two years follow-up. Clin Orthop 120:47–53, 1976
2. Gresham GA, Kuczynski A, Rosborough D: Fatal fat embolism following replacement arthroplasty for transcervical fractures of femur. Br Med J 2:617–619, 1971
3. Herndon JH, Bechtal CO, Crickenberger DP: Fat embolism during total hip replacement. J Bone Joint Surg 56(A):1350–1362, 1974
4. Powell JN, McGrath PJ, Lahiri SK, Hill P: Cardiac arrest associated with bone cement. Br Med J 3:326, 1970
5. Peebles DJ, Ellis RH, Stride SDK, Simpson BR: Cardiovascular effects of methylmethacrylate cement. Br Med J 1:349–351, 1972
6. Sherman RMP, Byrick RJ, Kay JC, Sullivan TR, Waddell JP: The role of lavage in preventing hemodynamic and blood-gas changes during cemented arthroplasty. J Bone Joint Surg 65(A): 499–506, 1983
7. Kallos T, Enis JE, Gollan F, Davis JH: Intramedullary pressure and pulmonary embolism of femoral medullary contents in dogs during insertion of bone cement and prosthesis. J Bone Joint Surg 56(A):1363–1367, 1974
8. Yelderman M, New W Jr: Evaluation of pulse oximetry. ANESTHESIOLOGY 59:349–352, 1983
9. Breed AL: Experimental production of vascular hypotension and bone marrow and fat embolism with methylmethacrylate cement. Clin Orthop 102:227–244, 1974
10. Park WY, Balingit P, Kenmore PI, Macnamara TE: Changes in arterial oxygen tension during total hip replacement. ANESTHESIOLOGY 39:642–644, 1973

Anesthesiology
65:216–218, 1986

Nalbuphine Augmentation of Analgesia and Reversal of Side Effects Following Epidural Hydromorphone

SCOTT K. HENDERSON, M.D.,* HARRY COHEN, M.D.†

Inadequate analgesia following single-shot administration of epidural narcotics for postoperative pain relief is readily treated with parenteral narcotics. However, this puts the patient at increased risk of developing respiratory depression, requiring increased vigilance and monitoring. The treatment of side effects following epidural narcotics has generally involved the use of medications to treat the symptoms. Antihistamines such as diphenhydramine and promethazine have been used with varying degrees of success to treat pruritus.[1–4] Antiemetics such as droperidol, prochloperazine, perphenazine, and metoclopramide have been used to treat nausea and vomiting.[2–6] Intravenous administration of small doses of naloxone can also reverse these side effects, while leaving the analgesia intact.[2,6,7] We describe the use of nalbuphine, a narcotic agonist/antagonist, to provide additional analgesia and to reverse the side effects of generalized pruritus and nausea in a patient who received epidural hydromorphone following cesarean section.

Report of a Case

A 34-yr-old, gravida 3, para 2, term parturient was admitted for repeat cesarean section. The patient had two previous cesarean sections under epidural anesthesia without difficulty and desired an epidural anesthetic for this cesarean section as well. The patient described unsatisfactory postoperative analgesia with im meperidine following her first cesarean section. With her second cesarean section she received excellent pain relief from epidural morphine, but had intense generalized pruritus. We therefore planned to give her epidural hydromorphone postoperatively, with the hope of providing adequate analgesia with less pruritus than she had experienced with morphine.

The patient had an uneventful epidural anesthetic with 0.5% bupivacaine, supplemented with 3% 2-chloroprocaine. After delivery of the baby the patient received 200 μg fentanyl and 7.5 mg diazepam iv as supplements to her epidural anesthetic. The operative procedure was complicated by the presence of intraabdominal adhesions secondary to her previous cesarean sections, which required extensive surgical dissection.

After transfer to the recovery room, 1 mg of hydromorphone was given through the epidural catheter when she first complained of pain. The epidural catheter was then removed. This medication provided adequate pain relief, except for a small area of the patient's right lower abdomen where there had been extensive surgical dissection for lysis of adhesions. At that time the patient stated that the pain was mild

* Fellow in Obstetrical Anesthesiology.
† Professor of Anesthesiology.

Received from the Department of Anesthesiology, Northwestern University Medical School, Passavant Pavilion, Room 360, 303 East Superior Street, Chicago, Illinois 60601. Accepted for publication March 3, 1986.

Address reprint requests to Dr. Henderson.

Key words: Analgesics, narcotic: hydromorphone; nalbuphine. Anesthetic techniques: epidural narcotic. Complications: pruritus.

and that additional pain medication was unnecessary. Three hours after administration of the epidural hydromorphone, we were called to see the patient because she was complaining of increased right lower quadrant pain, intermittent nausea, and moderate to intense generalized pruritus. Forty-five minutes previously the patient had received 25 mg of intramuscular diphenhydramine for the pruritus, with little relief. The patient was given 5 mg of nalbuphine iv. Within 10 min the patient had good pain relief, complete relief of nausea, and relief of the pruritus, except for minimal itching of the nose. The itching completely resolved over the next 30 min.

Discussion

Cousins and Mather[8] state that concomitant administration of parenteral opioids and other CNS depressant drugs following epidural narcotic administration predisposes a patient to increased risk of respiratory depression. In treating patients who have received epidural narcotics for postoperative analgesia, occasional patients may require additional pain medication when they are at risk for developing respiratory depression. These patients may also require treatment for pruritus or nausea and vomiting. With the exception of naloxone, most of the medications used to treat these symptoms are also CNS depressants and may increase the risk of respiratory depression. Although naloxone can be used to treat these side effects, including respiratory depression, its use is not appropriate in the patient who is also complaining of pain. This remains a therapeutic dilemma, and few recommendations have been made in the literature for dealing with this problem.

The narcotic agonist/antagonist drug, nalbuphine, may be an appropriate drug for use in this situation. This drug acts as an antagonist at the mu-receptor[9] and effectively reverses postoperative respiratory depression caused by oxymorphone and hydromorphone‡ and fentanyl.[10,11] The use of nalbuphine to effect reversal of delayed-onset respiratory depression following epidural morphine and diamorphine has also been reported.[12,13] In the absence of respiratory depression caused by morphine-like drugs, nalbuphine will induce a limited degree of respiratory depression. However, there appears to be a ceiling to this effect, providing a margin of safety not seen with pure agonist opioids.[14]

The analgesia produced by nalbuphine appears to result from the drug's interaction with the kappa opiate receptor.[15] Although nalbuphine may antagonize analgesia produced by opioid interaction with the mu opiate receptor,[16] analgesia produced following spinal narcotic administration seems to be resistant to antagonism following parenteral administration of an antagonist. Parenteral administration of small bolus doses (0.1–0.8 mg)[2,6,7,17] or low-dose infusions (5–10 $\mu g \cdot kg^{-1} \cdot h^{-1}$)[7] of naloxone are usually ineffective in antagonizing the analgesia produced by epidural or intrathecal narcotics. Nalbuphine (0.1–0.3 mg/kg) has been shown to be ineffective in antagonizing analgesia produced by epidural morphine.[13]

The narcotic receptor systems mediating many of the commonly encountered narcotic side effects have not yet been elucidated. However, because naloxone can reverse these side effects, they may be mediated by interaction between the narcotics and specific receptors. Pruritus is possibly mediated *via* interaction with the mu-receptor. Nalbuphine, which is a mu-receptor antagonist, has been demonstrated to reverse effectively the pruritus caused by epidural morphine.[18] Indeed, rapid, effective reversal of our patient's pruritus was apparent within minutes of nalbuphine administration. The same argument may be made for the effect of the nalbuphine on our patient's complaint of nausea. However, there are no reports to support such a claim. It may simply have been the result of more effective analgesia or it may merely be coincidental that her nausea disappeared following the nalbuphine injection.

Theoretically, nalbuphine appears to be an attractive choice for supplementing epidural narcotic analgesia, because of limited intrinsic respiratory depressant activity and potential reversal of preexisting respiratory depression secondary to the epidural narcotic. This also makes its use attractive for reversal of other side effects, such as pruritus and nausea. Experimental verification of the effect of nalbuphine on respiratory depression and other side effects following epidural narcotics is unfortunately limited. Studies need to be performed in a variety of patient groups and clinical situations to document these effects. With such documentation, nalbuphine may become the drug of choice for treating side effects and supplementing analgesia following epidural narcotics.

‡ Magruder MR, Delany RD, DiFazio CA: Reversal of narcotic-induced respiratory depression with nalbuphine hydrochloride. Anesthesiol Rev 9:34–37, 1982.

References

1. Cohen SE, Woods WA: The role of epidural morphine in the postcesarean patient: Efficacy and effects on bonding. ANESTHESIOLOGY 58:500–504, 1983
2. Kotelko DM, Dailey PA, Shnider SM, Rosen MA, Hughes SC, Brizgys RV: Epidural morphine analgesia after cesarean delivery. Obstet Gynecol 63:409–413, 1984
3. Rosen MA, Hughes SC, Shnider SM, Abboud TK, Norton M, Dailey PA, Curtis JD: Epidural morphine for the relief of postoperative pain after cesarean delivery. Anesth Analg 62:666–672, 1983
4. Torda TA, Pybus DA: Clinical experience with epidural morphine. Anesth Intens Care 9:129–134, 1981
5. Mehnert JH, Dupont TJ, Rose DH: Intermittent epidural morphine instillation for control of postoperative pain. Am J Surg 146:145–151, 1983
6. Stenseth R, Sellevold O, Breivik H: Epidural morphine for postoperative pain: Experience with 1,085 patients. Acta Anaesthesiol Scand 29:148–156, 1985

7. Rawal N, Mollefors K, Axelsson K, Lingardh G, Widman B: An experimental study of urodynamic effects of epidural morphine and of naloxone reversal. Anesth Analg 62:641–647, 1983
8. Cousins MJ, Mather LE: Intrathecal and epidural administration of opioids. ANESTHESIOLOGY 61:276–310, 1984
9. Jasinski DR, Mansky PA: Evaluation of nalbuphine for abuse potential. Clin Pharmacol Ther 13:78–90, 1972
10. Latasch L, Probst S, Dudziak R: Reversal by nalbuphine of respiratory depression caused by fentanyl. Anesth Analg 63:814–816, 1984
11. Baise A, McMichan JC, Nugent M, Hollier LH: Nalbuphine produces side-effects while reversing narcotic-induced respiratory depression. Anesth Analg 65:S19, 1986
12. Hammond JE: Reversal of opioid-associated late onset respiratory depression by nalbuphine hydrochloride. Lancet 2(8413):1208, 1984
13. Penning JP, Samson B, Baxter A: Nalbuphine reverses epidural morphine induced respiratory depression. Anesth Analg 65: S119, 1986
14. Romagnoli A, Keats AS: Ceiling effect for respiratory depression by nalbuphine. Clin Pharmacol Ther 27:478–485, 1980
15. Schmauss C, Yaksh TL: *In vivo* studies on spinal opiate receptor systems mediating antinociception. II. Pharmacological profiles suggesting a differential association of mu, delta and kappa receptors with visceral chemical and cutaneous thermal stimuli in the rat. J Pharmacol Exp Ther 228:1–12, 1984
16. Schmauss C, Doherty C, Yaksh TL: The analgesic effects of an intrathecally administered partial opiate agonist, nalbuphine hydrochloride. Eur J Pharmacol 86:1–7, 1983
17. Gjessing J, Tomlin PJ: Postoperative pain control with intrathecal morphine. Anaesthesia 36:268–276, 1981
18. Wakefield RD, Mesaros M: Reversal of pruritus, secondary to epidural morphine, with the narcotic agonist/antagonist nalbuphine (Nubain®) (abstract). ANESTHESIOLOGY 63:A255, 1985

Anesthesiology
65:218–219, 1986

Anesthetic Management of a Patient with Dutch-Kentucky Syndrome

FREDERICK H. BROWDER, M.D.,* DANIEL LEW, D.D.S.,† TIMOTHY S. SHAHBAZIAN, D.D.S.‡

We describe a patient with Dutch-Kentucky syndrome, a relatively rare condition that is inherited as an autosomal dominant trait and is characterized primarily by extremely limited ability to open the mouth and also by flexion deformity of the fingers that occurs with extension of the wrist.

REPORT OF A CASE

A 13.2 kg (less than fifth percentile for age) 4-yr-old boy with trismus-pseudocamptodactyly (Dutch-Kentucky) syndrome was scheduled for bilateral removal of the coronoid processes of the mandible. Past medical history and review of symptoms were unremarkable with the exception of his genetic disorder. The parents stated that the patient had never been able to eat solid foods nor had he been able to put a fork or spoon in his mouth. Family history revealed three relatives (two cousins, one uncle) with the same genetic syndrome, but no one in the patient's immediate family was affected.

On physical examination, he was a pleasant, apparently socially well-adjusted child who appeared small for his age. His maximum intermaxillary opening was 5 mm (fig. 1). The remainder of the external examination of the airway was unremarkable. Preoperative vital signs included an arterial blood pressure of 100/50 mmHg, heart rate 110 beats/min, respiratory rate of 24 breaths/min, and a temperature of 96.6° F. The preoperative laboratory values, including a clotting profile, were within normal limits.

Following premedication with diazepam, 2.5 mg po (swallowed without difficulty), and atropine, 0.1 mg im, the child was taken to the operating room where blood pressure cuff, precordial stethoscope, and ECG were placed. With a surgeon experienced in pediatric emergency tracheostomy in attendance, an inhalation induction of anesthesia was performed with no problems, using O_2/N_2O and halothane. The patient was easily ventilated *via* a face mask, and no muscle relaxants were used. When a satisfactory plane of anesthesia was achieved, the anesthetic mixture was changed to halothane in 100% O_2.

After three unsuccessful attempts at blind nasotracheal intubation, fiberoptic nasotracheal intubation was successfully performed with a 5.0 uncuffed Sheridan® endotracheal tube over an Olympus® pediatric flexible bronchoscope. Sixty seconds was the maximum time period allowed for each intubation attempt, at which point the patient was again ventilated for 60 s with 100% O_2/halothane *via* face mask. At no time during the ventilation/intubation sequence did bradycardia, hypotension, or cyanosis occur. The decision to limit each intubation attempt to 60 s was an arbitrary one.

Successful endotracheal intubation was confirmed by the presence of equal bilateral breath sounds. Bilateral coronoidectomy was performed in conjunction with stretching of the patient's contractured masseter muscles to 30 mm, accompanied by insertion of a bite block. The vital signs remained stable throughout the procedure, which lasted 4 h, the patient being maintained on O_2/N_2O and isoflurane. One hour into the case, dexamethasone, 2 mg iv, was administered in an attempt to decrease any postoperative airway edema.

The decision had been made to keep the trachea intubated overnight; therefore, fentanyl 75 μg incrementally and droperidol 0.625 mg iv were given as the procedure progressed. Subsequently, the patient was taken to the intensive care unit, and 40% O_2 was administered by T-tube. The trachea was extubated the morning after surgery and several hours later the patient was sent to the ward.

* Assistant Professor of Anesthesiology.
† Associate Professor and Chief, Department of Oral Surgery.
‡ Chief Resident, Department of Oral Surgery.

Received from the Departments of Anesthesiology and Oral Surgery, School of Medicine, Shreveport, Louisiana State University Medical Center, Shreveport, Louisiana 71130-3932. Accepted for publication March 13, 1986.

Address reprint requests to Dr. Browder.

Key words: Anesthesia: pediatric. Genetic: Dutch-Kentucky syndrome. Intubation: fiberoptic.