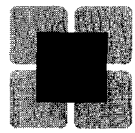

Patient-controlled analgesia for postcholecystectomy pain: a pilot study

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■ Patient-controlled analgesia (PCA) is designed to avoid both excessive and inadequate analgesia in postoperative pain by allowing the patient self-administration of intravenous narcotics within a range of parameters established by the physician. Of 24 patients undergoing elective cholecystectomy referred to our study over a 12-month period, 11 were assigned to PCA and eight successfully completed the study. Most of them had good analgesia, were satisfied with PCA, and had no evidence of confusion, psychic distress, or visual-motor impairment. Serum morphine concentrations of 10–30 ng/mL were sufficient to obtain good analgesia in six of eight patients. Complications included severe respiratory depression and abdominal cramps.

□INDEX TERMS: ANALGESIA; PAIN, POSTOPERATIVE □CLEVE CLIN J MED 1990; 57:57–59

EFFECTIVE relief of pain after surgery is a major problem in clinical practice. Recent reviews have documented the inadequacy of current standard methods of administering parenteral narcotics.[1,2] Conventional perioperative doses of intramuscular analgesics result in excess sedation in approximately half the patients.[3] Because optimal pain control (ie, adequate pain relief without significant adverse effects) with narcotic analgesics represents a compromise between severe pain and sedation with attendant respiratory depression, physicians frequently err on the side of underdosage with these drugs.

Patient controlled analgesia (PCA) is a promising technique for controlling postoperative pain. A microprocessor-controlled infusion pump is programmed with dose and lockout interval. When pain occurs, the patient can depress a button and receive an intravenous dose of narcotics. This maintains the blood level of the narcotic within the therapeutic range, minimizing the bolus effect of large, conventional doses.

Published studies of PCA have shown that the technique offers excellent analgesic efficiency and safety, minimal sedation, decreased narcotic requirements, and little or no respiratory depression.[4,5] In a carefully controlled, randomized study of PCA *v* conventional intramuscular therapy, PCA-treated patients required significantly less narcotic to achieve analgesia during the first 48 hours after joint replacement surgery[6]; however, the PCA group required parenteral analgesics for longer periods after surgery.

There are few studies of the relationship between plasma morphine concentrations and pharmacological effects in postoperative patients using the PCA device. Dahlström et al[7] reported a minimum effective concentration of 20 ng/mL postoperatively.[7] Graves et al,[8] in a clinical study of 12 patients using PCA therapy for post-

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TABLE 1
STUDY PARAMETERS

Test administered	24 Hours postop	48 Hours postop
Visual pain analog scale	q 2 hours	q 4 hours
Respiratory rate	q 2 hours	q 6 hours
Trails B	√	√
Jacobs Cognitive Capacity Screening Examination	√	√
Profile of Mood States	√	√
Patient satisfaction scale	√	√
*Serum morphine sulfate concentration	q 6 hours	q 6 hours

*Morphine sulfate dose was also monitored over a 24-hour period.

operative pain, noted that morphine was consistently effective at plasma concentrations of 40 ng/mL or greater.

To date, no studies to our knowledge have described the psychological benefits of PCA. Recent publications have described alternative approaches for on-demand analgesia, including epidural PCA[9,10] and subcutaneous PCA.[11] More comparative studies are needed to assess the cost-effectiveness of PCA before it becomes the standard method for controlling acute pain.

This study of PCA for postcholecystectomy pain was a combined effort of the Anesthesia, General Surgery, Laboratory Medicine, and Psychiatry Departments at the Cleveland Clinic Foundation.

Its purposes were 1) to acquire experience in PCA; 2) to compare PCA with intramuscular morphine on the following variables: analgesia, sedation, cognitive impairment, patient satisfaction, length of stay following surgery, respiratory complications following surgery, and narcotic requirements; and 3) to determine whether there is a therapeutic blood level of morphine that provides satisfactory analgesia without the complications of obtundation, intellectual clouding, and respiratory impairment. We were unable to meet the second objective because of the small number of patients available.

PATIENTS AND METHODS

Subjects were literate adults who had accessible veins and were able to operate the PCA device. Those with a history of chemical abuse or major psychiatric disorder, narcotic allergy, respiratory disease, pain of neuropathic or bone origin or severe metabolic abnormalities were excluded. Cognitively impaired patients and those who had received narcotics within 48 hours preceding the operation were also excluded. Impaired renal function was added to the list of exclusion criteria after a patient suffered hazardous complications.

After signing an informed consent form, all patients received a history and physical examination with determination of type of pain, and were asked specifically about chemical use and psychiatric problems. Laboratory studies included SMA-16, complete blood count, urinalysis, and radiographs. Several psychological tests were administered in an effort to develop a battery of tests that would be sensitive to comfort, quality of life, and impairment issues in patients requiring analgesics. They included the Jacobs Cognitive Capacity Screening Examination,[12] which is a 30-item dementia screening test; Trails B,[13] a test of visual impairment that also reflects visual motor coordination and cognition; and Profile of Mood States (POMS),[14] a 65-item self-assessment of tension, depression, anger, vigor, fatigue, and confusion.

All subjects underwent elective cholecystectomy through a subcostal incision. Anesthetic agents were standardized as follows: 1) diazepam, 0.1–0.2 mg/kg preoperatively; 2) pretreatment with pancuronium bromide, 1 mg IV; 3) induction by thiopental, 4–5 mg/kg; 4) succinylcholine, 100 mg IV to facilitate intubation; 5) maintenance anesthesia with nitrous oxide, oxygen, and enflurane; 6) pancuronium bromide 0.05 mg/kg IV for muscle relaxation and as needed.

The Bard Harvard PCA pump was used and the PCA syringe was programmed to deliver 1 mg of morphine with a lockout interval of 10 minutes. Study parameters are described in *Table 1*.

From December 1986 until November 1987, 24 patients were referred to this study. Of these, 10 either refused to participate or did not meet inclusion criteria. The first five suitable patients were assigned to PCA to familiarize the staff with PCA procedures. Of the remainder, three were randomly assigned to the control group (IM morphine), and six to the PCA group. Of the six, two received a narcotic in the recovery room and therefore were disqualified from the study. One developed severe abdominal cramps postoperatively and PCA was terminated a few hours after surgery.

Of the 11 patients assigned to PCA, two were men and nine were women; mean age was 36 years. A total of eight patients successfully completed the study.

RESULTS

Psychological tests

The following are the results on the psychological tests administered to this group preoperatively and at 24 and 48 hours postoperatively:

On the Trails B, the mean preoperative score was 1.30 compared to 1.40 and 1.25 at 24 hours and 48 hours, re-

spectively, suggesting that there was no clinically significant visual-motor impairment with PCA.

On the Profile Of Mood States, there were no clinically important changes in tension, depression, anger, vigor, fatigue, or confusion scales. T scores ranged between 35 and 60 (30–80 is the normal range).

On the Jacobs Cognitive Capacity Screening Examination, all patients scored within the range of 20–30 preoperatively and at 24 and 48 hours postoperatively, suggesting that no patients were cognitively impaired with PCA therapy. A score of less than 20 is considered abnormal.

Other findings

Mean morphine levels for six of the eight patients ranged 10–30 ng/mL. The other two patients had mean morphine levels of 50 ng/mL and 72 ng/mL. The six patients with the lowest serum morphine levels were all women; the patient with the highest morphine level was an alcohol abuser.

All patients checked "10" on a 0–10 satisfaction scale.

COMPLICATIONS

The first patient was a 44-year-old woman with diabetes and end-stage renal disease who was maintained on hemodialysis. She was admitted for cholecystectomy and placement of catheter for peritoneal dialysis. Preoperative creatinine level was 6.1 mg/dL, BUN 57 mg/dL, and albumin 3.0 g/dL. She underwent dialysis the night before surgery and peritoneal dialysis was scheduled for the first postoperative day.

After 15.5 hours of PCA she had received 28 mg of morphine and had a respiratory rate of 5/min. She was obtunded but responded to verbal stimulation with conversation and accelerated respiration. IV naloxone reversed respiratory depression and sedation. Serum morphine concentration was 72.8 ng/mL and morphine-6-glucuronide was 415 ng/mL. The latter is an active metabolite of morphine that is excreted by the kidneys, and it was probably responsible for the potentially life-threatening complications of morphine in this patient.

The other complication was in a 27-year-old man who, a few hours after surgery, suffered severe postoperative cramps that were relieved only by diazepam. He was, therefore, disqualified from the study.

CONCLUSIONS

Intravenous PCA provides excellent postoperative pain control with high patient acceptance. PCA does not produce lethargy, confusion, psychic distress, or visual-motor impairment in most subjects.

The 6-glucuronide metabolite of morphine has opiate-like activity and accumulates with renal impairment. Renal failure, therefore, may be a contraindication to morphine administration by PCA and requires greater than usual vigilance and observation for toxicity. Also, serious complications in PCA are unlikely in healthy patients.

Lastly, serum morphine concentrations in the range of 10–30 ng/mL were sufficient to obtain good analgesia in six of eight patients. The patient with the highest serum morphine concentration was an alcohol abuser, suggesting the possibility that patients with a history of substance abuse may use PCA excessively or require higher than normal narcotic doses for analgesia. Also, there was no correlation between morphine levels and pain relief, supporting reports in the literature that there is no blood morphine level that is therapeutic for all patients.

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