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Postoperative Epidural Morphine Is Safe on Surgical Wards

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The use of epidural morphine for postoperative analgesia outside of intensive care units remains controversial. In this report our anesthesiology-based acute pain service documents experience with 1,106 consecutive postoperative patients treated with epidural morphine on regular surgical wards. This experience involved 4,343 total patient days of care and 11,089 individual epidural morphine injections. On a 0–10 verbal analog scale, patient-reported median pain scores at rest and with coughing or ambulation were 1 (interquartile range 3) and 4 (interquartile range 4), respectively. The incidence of side effects requiring medication were as follows: pruritus 24%, nausea 29%, and respiratory depression 0.2%. There were no deaths, neurologic injuries, or infections associated with the technique. Migration of epidural catheters into the subarachnoid space and into epidural veins each occurred twice. Overall, 1,051 of the 1,106 patients (95%) experienced none of the following problems: catheter obstruction, premature dislodgement, painful injections, catheter migration, infection, or respiratory depression. We conclude that postoperative pain can be safely and effectively treated with epidural morphine on surgical wards. (Key words: Analgesia: postoperative. Analgesics, opioids: morphine. Anesthetic techniques: epidural. Pain: postoperative.)

EFFECTIVE PAIN CONTROL is an important aspect of care of the surgical patient.[1,2] The treatment of postoperative pain with epidural morphine has been demonstrated to provide analgesia superior to that provided by conventional methods in a variety of settings.[3–7] Early postoperative ambulation and improved pulmonary function are among the advantages of epidural morphine analgesia.[6–9] However, potentially serious risks include respiratory depression, infection, and migration of epidural catheters into either the subarachnoid space or epidural veins.[10–12] Based on a number of reports of serious respiratory depression, it remains controversial whether this technique can safely be used only in an intensive care setting or whether it can also be used on regular surgical wards.[13–16]

Our anesthesiology-based Acute Pain Service has used epidural morphine to manage postoperative pain on surgical wards for 5 yr. During that time, ward nurses have administered epidural morphine with adjustments in dosage or injection interval or both to provide each patient optimal comfort.[17] Through experience we have changed our practice in ways that we believe enhance the efficacy and safety of the technique. For this report we examined recent experience with 1,106 consecutive patients receiving intermittent boluses of preservative-free morphine on surgical wards.

Materials and Methods

The anesthesiology-based Acute Pain Service at the University of Washington Medical Center was established to manage postoperative and other forms of acute pain. To make epidural analgesia available 24 h/day to appropriate surgical patients, an educational program was developed jointly by the Department of Anesthesiology and the Nursing Service to teach nurses throughout the hospital the administration of epidural morphine as well as appropriate methods of monitoring these patients.

Postoperative analgesia for individual patients is planned by the operating room anesthesiologist. When epidural morphine analgesia is recommended, an epidural catheter is inserted preoperatively and tested with a local anesthetic to confirm correct placement. Usually injection or infusion of a local anesthetic is used during surgery in combination with either sedation or general anesthesia. An initial epidural morphine dose is given by the operating room anesthesiologist at least a h before the completion of surgery.

Standard orders for postoperative epidural morphine analgesia (Appendix A) include notation of the initial morphine dose, an order for subsequent doses to be given by the ward nurse, monitoring instructions, and orders for the treatment of common side effects. These orders were identical throughout the study. Under the direction of the Acute Pain Service, both the dose of morphine and time interval between injections may be varied to ensure optimal patient comfort. This involves titration for each patient to define the minimum effective epidural morphine dose and the longest interval between doses that maintains satisfactory analgesia. The injection interval is usually between 6 and 12 h. Supplemental epidural fentanyl is used during the first few hours of therapy while the effective morphine dose and injection interval are being defined. Continuous epidural morphine infusions are rarely used in our institution and are not included in this study. Parenteral opioid supplements are not used. Small parenteral doses of benzodiazepines (*e.g.*, midazolam 0.5 mg intravenously every 1 h as required) are prescribed for clinically distressing anxiety. Treatment with epidural

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TABLE 1. Treatment According to Surgical Site

Incision Site	Thorax	Abdomen	Lower Extremity	Perineum
Patients (number)	146	584	322	54
Morphine (mg)	4.2 ± 1.5	3.8 ± 1.1	3.6 ± 1.2	3.4 ± 1.1
Injection interval (h)	7.9 ± 2.8	8.8 ± 3.4	10.7 ± 4.9	11.9 ± 6.1
Morphine (total mg/24 h) (calculated)	12.8	10.4	8.1	6.9
Rest pain	1 (3)	1 (2)	1 (3)	0 (1.25)
Incident pain	5 (4)	4 (4)	4 (4.25)	3 (6)
Duration of treatment (days)	5.4 ± 3.1	4.3 ± 3.0	2.8 ± 2.0	2.4 ± 1.2

Morphine, injection interval, and duration of treatment, mean ± SD; rest pain and incident pain, median and interquartile range (in parentheses).

morphine is continued until a liquid diet is prescribed by the surgeon and pain is effectively controlled by an oral analgesic.

Information was collected by the Acute Pain Service on daily rounds conducted between 8:00 AM and 12:00 PM by one of five faculty anesthesiologists, as follows: 1) epidural morphine dose and time interval between injections; 2) patient-reported incisional pain at rest and during coughing or ambulation, using a 0–10 verbal analog scale (0 = "no pain" and 10 = "worst possible pain"); 3) pruritus and nausea of sufficient intensity to require the treatment available on the standard orders; 4) respiratory depression requiring naloxone, as detected by nurses measuring respiratory rate and applying a bedside sedation scale (Appendix B) hourly for the first 24 h and every 4 h thereafter (all sedation scores for each patient were recorded on a bedside chart); 5) catheter migration into an epidural vein as detected by aspiration of blood or into the subarachnoid space as detected by aspiration of free-flowing cerebrospinal fluid; and 6) the occurrence of infection as detected by examination of the catheter insertion site daily. Because a large proportion of the patients had Foley catheters inserted prior to surgery, no attempt was made to determine the incidence of urinary retention.

With the approval of the Human Subjects Review Committee, from March 1988 to February 1990 inclusive (23 months), these observations were recorded on data collection sheets, checked for completeness, and entered in a computer database. To evaluate the efficacy of epidural morphine after different types of surgery, the patients were grouped according to surgical site: chest, abdomen, perineum, or lower extremity. Values are reported as mean ± standard deviation (SD) or median ± interquartile range (IQ) as appropriate. The predicted maximum risks of complications were calculated using the upper bounds of the 99% confidence intervals.[18,19]

Results

Epidural morphine was used to manage the postoperative pain of 1,106 consecutive patients on surgical wards. Those admitted to the intensive care unit (ICU) were excluded. In our institution there is no mandatory ICU admission policy based on ASA status or age. Observations were derived from 4,343 patient days of treatment and 11,809 individual epidural morphine injections. Patients ranged in age from age 12 to 101 yr. Mean (± SD) age was 49.6 (± 18.1). A summary of patient treatment according to incision area is presented in table 1. The incidence of side effects requiring treatment are reported in table 2. Ninety-five percent of patients experienced no epidural catheter–related problems; those that did occur are listed in table 3.

Four cases involving catheter migration into either the subarachnoid space or epidural veins were detected by ward nurses performing a routine aspiration test before opioid administration. The catheters were removed and the patients treated for pain with intravenous morphine without further incident. Two cases of respiratory depression were treated with naloxone without further sequelae (table 4). There were no cases of infection associated with epidural catheters.

TABLE 2. Side Effects and Complications

Side Effect	Observed Incidence (%)	99% Confidence Interval
Pruritus	25	22, 28
Nausea, vomiting	29	25, 32
Respiratory depression	0.2	0.07, 1
Mortality	0	0, 0.4
Neurologic injury	0	0, 0.4

TABLE 3. Epidural Catheter Problems

Problem	Observed Incidence (%)	Maximum Risk at 99% Confidence (%)
Premature dislodgement	3	5
Painful injection	0.9	2
Obstruction	0.7	2
Intravenous migration	0.2	1
Subarachnoid migration	0.2	1
Infection	0	0.4

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Discussion

Since 1979, after the initial report of clinical efficacy of epidural morphine,[20] the technique has been used to control pain after a wide variety of surgical procedures. Clinical and economic benefits have been demonstrated.[7,9] However, along with early enthusiasm for the technique came case reports of severe, life-threatening respiratory depression.[11–13,21] These reports justifiably have been an ongoing source of concern regarding the use of epidural morphine, particularly outside of the ICU.

A great deal has been learned since the technique was introduced. Contemporary practice typically includes the following features. 1) Currently, smaller morphine doses are used, and doses may be reduced even further in patients with advanced age and poor physical status. The amounts of epidural morphine often used during the period of initial experience with the technique were overdoses in contemporary terms. 2) The importance of avoiding large parenteral opioid doses or large doses of other central nervous system depressants in patients who will receive epidural morphine is now recognized. This combination increases the risk of respiratory depression. 3) The pattern of the respiratory depression that is most likely to occur is now better understood. Particularly noted is its slow and progressive, rather than sudden, nature as an apneic event. Short periods of apnea are common in patients receiving opioids by any route and are common simply during sleep[22]; however, such observations frequently are not clinically relevant and should not be taken as evidence that epidural morphine is dangerous. Under most circumstances there is no need to monitor for "apnea." It has been recognized that respiratory rate alone is not an adequate indicator of ventilatory status in all postoperative patients receiving epidural morphine.[12,23] A more global assessment is necessary, particularly during the first 24 h of treatment.[24] The usefulness of assessment of level of consciousness is now recognized. Increasing sedation (presumably due to a combination of central drug effect and carbon dioxide narcosis) has been noted to occur with increasing respiratory depression.[17,25] Healthy volunteers breathing carbon dioxide mixtures have been observed to lose consciousness at carbon dioxide tensions of about 80 mmHg.[26] It is our experience that simple serial bedside assessment of level of consciousness provides an excellent monitoring strategy that can be used on any hospital ward. Written surveys of our ward nurses indicate they believe this approach does not require additional nursing time.

The actual incidence of respiratory depression in patients receiving epidural morphine is not known. Existing estimations depend on a number of factors, including the populations studied, the way in which they are monitored, and the definitions of respiratory depression used. In a large, multi-institutional Swedish questionnaire survey in 1987, the incidence of events defined as "requiring treatment with naloxone" was 0.09%.[24]

It has been assumed but not verified that the risk of severe respiratory depression is greater after epidural morphine than after opioid administration by more conventional routes. In 860 hospitalized patients receiving morphine orally or parenterally (intravenously, intramuscularly, or subcutaneously), a 0.9% incidence of "life-threatening respiratory depression" was reported.[27]

TABLE 4. Cases of Respiratory Depression

	Case 1	Case 2
Sex, age (yr)	F, 57	M, 30
Weight (kg)	131	60
Surgery		
Duration (h)	Radial vulvectomy 4.5 h	Excision tibial mass 9 h
Epidural catheter site	L3–L4	L3–L4
Epidural morphine dose	3 mg (single dose)	2 mg
Injection interval (h)	—	12
Anesthetic for surgery	Epidural/general	Epidural/general
Time from initial morphine to peak respiratory depression (h)	8.5	19.5
Lowest respiratory rate (breaths per min)	14	6
Blood gas analysis		None
*p*H	7.25	
P_{O_2} (mmHg), % saturation	192, 99	
P_{CO_2} (mmHg)	59	
HCO_3	25	
Treatment	Naloxone iv infusion 0.4 mg/h Reduced morphine dose to 1 mg every 12 h	Naloxone 0.4-mg single dose Continued same morphine dose

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Intensive care facilities are well suited to meet the needs of postoperative patients at special risk (advanced age, serious underlying conditions, or extensive surgery). Does the use of epidural morphine in a healthier patient make ICU admission necessary? The expense and limited availability of these facilities makes this an impractical decision. To require admission to the ICU for the administration of epidural morphine is to deprive some patients of the benefits of the technique. Although not yet demonstrated, it is possible such a decision could result in a greater incidence of complications (*e.g.*, myocardial infarction, pneumonia, deep vein thrombosis, and pulmonary embolus) that may be associated with inadequate analgesia.[7] This report offers evidence that postoperative epidural morphine can safely be offered on conventional hospital wards. Guidelines for safe practice must be followed if this care is to be offered. These guidelines apply within or outside the ICU and have been published previously.[28] Although there remains a small risk associated with using postoperative epidural morphine, with application of current knowledge, it has become an exceedingly high-benefit, low-risk technique.

Our data confirm our clinical impression that to avoid gaps in analgesia, patients require more frequent injections than earlier reports suggested. Teaching ward nurses to inject epidural catheters with morphine has greatly facilitated the use of epidural opioid analgesia. The education they receive prior to performing this duty includes anatomy of the spinal canal, nociceptive pathways, spinal opiate actions, side effects and their treatment, epidural catheter injection technique (including an aspiration test), monitoring skills, and analgesia assessment. Aseptic precautions taught for injection of epidural catheters are the same as those taught for injection of drugs into chronically implanted central venous catheters. The educational package is taught by the Acute Pain Service clinical nurse specialist and is updated as needed. All nurses must receive this training prior to caring for patients receiving epidural opioids. Injection of epidural catheters by new nurses is initially supervised by experienced colleagues to ensure compliance with established techniques. Our experience in nurse education has been compiled in a package (videotape or slides with a cassette, plus a workbook) that has been used to assist in introducing epidural opioid analgesia in a considerable number of other institutions.

Although there has been concern that prolonged epidural catheterization might lead to infection in the epidural space, none occurred in a total experience of 4,343 catheter days. Epidural catheters left in place 1–6 days numbered 941 (85%), 7–14 days 147 (13%), and more than 14 days 18 (2%). The longest time a catheter was left in place was 35 days. No catheters were tunneled in subcutaneous tissue.

Nurses in our hospital learn the importance of an aspiration test and the actions to take if cerebrospinal fluid or blood is seen. Based on our experience, at a confidence level of 99%, the potential maximum risk is less than 1% for migration of a catheter into the subarachnoid space or into an epidural vein.

Two of the patients in this study received naloxone to reverse respiratory depression. These events were readily detected by nurses monitoring the patients according to our protocol. It is possible that episodes of subclinical respiratory depression may have occurred and gone undetected.

The upper bounds of the 99% confidence intervals are presented to reflect the precision in making inferences from our sample estimations about the true rates of complications in the general population of all patients receiving epidural morphine for postoperative analgesia at our institution and perhaps at other centers. The upper bounds represent "worst-case" estimations of the true population risks with which our findings are compatible. We can state with 99% confidence that the risks of these events in the general population are less than these upper bounds. For events in our study with zero incidence, a rate of occurrence of the magnitude of the upper bounds still could be be present in the general population.

Our Acute Pain Service requires significant staffing and training of nurses to manage postoperative pain safely and effectively with epidural morphine. We can recommend use of the technique on surgical wards only to those willing to invest in similar staffing and training. Contraindications to the technique usually are the contraindications to epidural catheter insertion, such as coagulopathy, anticoagulation, or conditions that increase the risk of epidural space infection. Although not demonstrated in this study, we believe that the intraoperative use of large doses of systemic opioids or other long-acting central nervous system depressants may increase the risk of epidural opioid–induced respiratory depression. We recommend avoiding this combination whenever possible. Postoperative pain management with epidural morphine has become our standard of care for patients undergoing appropriate surgical procedures, but each case is considered individually with regard to advantages *versus* risks. Our experience has demonstrated that with the education and training of nurses, careful medical supervision, and appropriate protocols for dosing, monitoring, and the treatment of side effects, epidural morphine can be used effectively and safely to provide postoperative analgesia on surgical wards.

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Appendix A

ACUTE PAIN SERVICE: EPIDURAL NARCOTIC STANDARD ORDERS

1. Operating room dose: Drug _____ Mg _____ Time _____
2. Drug for continuing epidural analgesia:
   A. PF morphine (1 mg/ml) _____ mg every 6–12 h.
   B. Fentanyl (10 μg/ml normal saline) infuse _____ μg (_____ ml)/per h
   C. Other: Drug _____ Concentration _____ Dose _____ Interval _____
3. Fentanyl 50 μg (1.0 ml) into epidural catheter every 3 h as needed for inadequate analgesia with prescribed dose above.
4. Maintain iv access (drip or heparin lock) for 24 h after last dose of epidural narcotic.
5. Naloxone 0.4 mg at bedside.
6. **No narcotics or other CNS depressants** to be given except as ordered by the Acute Pain Service.
7. Monitoring: Respiratory rate and sedation scale every 1 h for 1st 24 h, and then every 4 h.
8. Treatment of side effects:
   A. Call Acute Pain Service if sedation scale = 3.
   B. Call Acute Pain Service if respiratory rate is < 8 breaths per min.
   C. Naloxone 0.4 mg iv stat for sedation scale = 3 plus respiratory rate < 8 breaths per min. Call Acute Pain Service.
   D. Metoclopramide 10 mg iv q 6 h prn for nausea/vomiting. In addition, if age < 60 y, transdermal scopolamine patch to either mastoid area. Change every 72 h as needed.
   E. Diphenhydramine 25 mg iv every 6 h as needed for severe itching.
   F. For urinary retention, "in-and-out" bladder catheter as needed.
9. For inadequate analgesia or other problems related to epidural, call Acute Pain Service.
10. Triazolam 0.125 mg every 1 h as needed. May repeat × 1.

Date _____ _____ M.D.

Dr. _____ on the APS was notified about this patient at _____ h.

Appendix B

Example of Bedside Sedation Scale

Sedation	Description
0 (none)	Alert
1 (mild)	Occasionally drowsy; easy to arouse
2 (moderate)	Frequently drowsy; easy to arouse
3 (severe)	Somnolent; difficult to arouse
S (sleeping)	Normal sleep; easy to arouse

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