# Acute postoperative pain management

MICHAEL A. E. RAMSAY, MD

CME

**CME, Part 3 of 3**

**Target audience:** All physicians

**Learning objectives:**

1. Review proper pain assessment approaches.
2. Understand how to minimize the side effects of pain therapy.
3. Explore the advantages and disadvantages of different pain treatment modalities.

**Faculty credentials/disclosure:**

Michael A. E. Ramsay, MD, is medical director of the Department of Anesthesiology and Pain Management. Dr. Ramsay receives grant support from Abbott Laboratories.

*Before beginning this activity, please read the instructions for CME on p. 321. This page also provides important information on method of physician participation, estimated time to complete the educational activity, medium used for instruction, date of release, and expiration. The quiz, evaluation form, and certification appear on pp. 321–323 as well.*



Effective postoperative pain control is an essential component of the care of the surgical patient. Inadequate pain control, apart from being inhumane, may result in increased morbidity or mortality (1, 2). Evidence suggests that surgery suppresses the immune system and that this suppression is proportionate to the invasiveness of the surgery (3, 4). Good analgesia can reduce this deleterious effect. Data available indicate that afferent neural blockade with local anesthetics is the most effective analgesic technique. Next in order of effectiveness are high-dose opioids, epidural opioids and clonidine, patient-controlled opioid therapy, and nonsteroidal anti-inflammatory agents (5).

The advantages of effective postoperative pain management include patient comfort and therefore satisfaction, earlier mobilization, fewer pulmonary and cardiac complications, a reduced risk of deep vein thrombosis, faster recovery with less likelihood of the development of neuropathic pain, and reduced cost of care.

The failure to provide good postoperative analgesia is multifactorial. Insufficient education, fear of complications associated with analgesic drugs, poor pain assessment, and inadequate staffing are among its causes.

## ASSESSMENT

A proper approach to acute postoperative pain management must include an appropriate assessment tool. A 10-point pain assessment scale, where 1 is no pain and 10 is the worst possible pain imaginable, has been nationally accepted. The rating given to the patient's pain depends on the observer. If a patient puts on a good face when the attending physician makes rounds, a low score may be given, when in fact a higher score would have resulted if the patient was carefully questioned after the physician left. Therefore, the assessment of pain requires not only a subjective report by the patient but also an objective observation by a pain therapist. The influence of the pain therapy on clinical function—such as the ability to take a deep breath, cough, and move—can be ascertained. An important part of the evaluation is a documented follow-up assessment to note the efficacy of the therapy and the patient's satisfaction with it.

The natural history of the pain should be understood, so that therapy can be adjusted when needs change. The source of the pain, as well as its severity, should be noted. Pain symptoms that are inappropriate in site or severity should be investigated for a potential confounding pathology. Anxiety, fear, and cultural influences should be understood and either treated or accommodated as necessary.

The goal of pain management must be determined with each patient. The goal may not be a score of 1; the patient may be satisfied and functional with a score of 3, preferring to manage some pain and thereby avoid unpleasant side effects of therapy, such as sedation, nausea, or pruritus. The key is to reassess the patient and determine if he or she is satisfied with the outcome. A satisfaction score should be obtained together with a pain score. This combination will help ensure that unrelieved, unwanted pain does not go unnoticed. Responsive analgesia management with good patient communication is the key to a successful program.

## SIDE EFFECTS

The goal of postoperative pain management is to relieve pain while keeping side effects to a minimum. After hundreds of years

From the Department of Anesthesiology and Pain Management, Baylor University Medical Center, Dallas, Texas; and the Department of Anesthesiology and Pain Management, The University of Texas Southwestern Medical Center at Dallas.

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**Corresponding author:** Michael A. E. Ramsay, MD, Department of Anesthesiology and Pain Management, Baylor University Medical Center, 3500 Gaston Avenue, Dallas, Texas 75246 (e-mail: docram@baylordallas.edu).

of advances, the mainstay of pain therapy is still the opioids. While they are very effective analgesics, opioids also carry with them many undesirable side effects: sedation, respiratory depression, nausea and vomiting, hypotension and bradycardia, pruritus, and inhibition of bowel function. The treatment of complications such as nausea and pruritus may include the administration of antihistamines, which have an additive effect on sedation and respiratory depression.

Respiratory depression is the major life-threatening complication of opioids. The incidence of severe respiratory depression with patient-controlled analgesia pumps has been reported to be as high as 1 per 10,000 patients. These events are usually associated with an error in management (6, 7).

No highly sensitive instrument is available to monitor respiratory depression in the extubated patient. The pulse oximeter may be used to monitor respiratory depression in the postanesthesia recovery unit or on the ward when continuous infusions of narcotics are being given, but pitfalls are associated with its use. The pulse oximeter is a poor measure of hypoventilation when the concentration of inspired oxygen is high (8). Since many postoperative patients receive added oxygen, the pulse oximeter detects respiratory depression very late. The additional oxygen maintains the oxygen saturation while the arterial carbon dioxide pressure may rise to >100 mm Hg.

End-tidal carbon dioxide monitoring in the extubated patient is also not very accurate. It depends on adequate ventilation and air movement so that the carbon dioxide level in the nose or mouth reflects that in the alveoli. Depressed ventilation results in paradoxical breathing and little air movement; therefore, the end-tidal carbon dioxide concentration may be artificially low (9). Respiratory rate measurement also correlates poorly with respiratory depression.

The only noninvasive and readily available monitors of respiratory depression are the observation of paradoxical breathing and the level of consciousness or sedation of the patient. Therefore, respiratory pattern and sedation score should be documented in the charts of patients on opiates.

## SEDATION SCORES

Many groups have strongly recommended recording pain measurement as the fifth vital sign on the patient's chart. I believe that concomitant with this should be a sixth vital sign, a sedation score. This is a matter of patient safety, as respiratory depression resulting from sedation and narcotic use is insidious and can very easily occur unnoticed, with potentially disastrous results. Sedation scores test the arousability of the patient and can help prevent oversedation. More than 30 sedation scores have been published, all with certain advantages or disadvantages. The first was published >25 years ago and is accepted internationally as the gold standard *(Table)* (10, 11). There are 3 important components of a sedation scoring system: it should cause minimal disturbance to the patient, be simple to use, and be part of routine assessment of the patient.

**Table. Ramsay Sedation Scale**

| | |
|---|---|
| **1** | Anxious, agitated or restless, or both |
| **2** | Cooperative, oriented, and tranquil |
| **3** | Responds to commands only |
| **4** | Brisk response to a light glabellar (forehead) tap or auditory stimulus |
| **5** | Sluggish response to a light glabellar (forehead) tap or loud auditory stimulus |
| **6** | No response |

## THERAPEUTIC MODALITIES

### Systemic opioids

Opioids act as agonists on central and peripheral opioid receptors. They may be administered by many different routes: oral, rectal, sublingual, transdermal, subcutaneous, intramuscular, intravenous, or neuroaxial. The intramuscular route is very often prescribed; however, it is an unpredictable delivery system because of wide swings in drug concentration. Therefore, it requires careful reassessment of the patient. Intravenous infusion administration results in a more constant blood level.

The drugs commonly used are morphine, meperidine, fentanyl, and hydromorphone. All of the narcotics, with the exception of remifentanil, have active metabolites that can result in an enhanced effect with impaired excretion or prolonged use. The metabolites of meperidine may cause seizures as they accumulate, and in the elderly patient, meperidine may cause psychosis or delerium as a result of its atropine-like effect on the central nervous system.

Patient-controlled analgesia is used widely for the management of postoperative pain. The advantages of this modality are that the patient can obtain pain relief without waiting for a caregiver, no painful injections are required, and the patient retains a certain amount of control (12). The safety of this system depends on the proper functioning of the pump and its use by the patient alone, not someone else such as a well-meaning family member. The patient has to be conscious to activate the system. If a continuous infusion mode is used, a better level of analgesia may be provided, but the safety factor may be lost. In this mode, it would be prudent to carefully reassess the patient with a sedation score.

Oral opioids can be very effective and can be used to rapidly wean a patient off parenteral therapy, thereby allowing earlier discharge from the hospital. Oxycodone as a controlled-release tablet can provide good pain control for up to 12 hours. This may be supplemented by oxycodone immediate-release concentrated solution or capsule for breakthrough pain.

### Nonsteroidal anti-inflammatory drugs

Nonsteroidal anti-inflammatory drugs are used widely to treat pain and inflammation. They do not carry the same side effects of the opiates; therefore, although they are less potent than the narcotics, they can act as opiate-sparing agents.

The development of more potent and parenteral nonsteroidal anti-inflammatory analgesics such as ketorolac has led to an increase in their use. These drugs are particularly useful in managing the pain associated with minimally invasive surgery. However, associated side effects include peptic ulcer disease, gastrointestinal hemorrhage, renal dysfunction, altered liver function, and platelet dysfunction. These side effects limit the

use of these agents in many patients during the perioperative period.

Nonsteroidal anti-inflammatory drugs act by inhibiting the enzyme cyclooxygenase (COX), which is responsible for the synthesis of prostaglandins. Prostaglandins are responsible for pain, fever, and vasodilatation in response to trauma. The major drawback of these medications is that they also block the beneficial effects of the prostaglandins: the decrease in the tissue inflammatory response to surgical trauma and the concomitant reduction in peripheral nociception and pain perception.

### COX-2 inhibitors

There are 2 isoforms of COX: COX-1 and COX-2. COX-1 is found in various tissues. The prostaglandin it produces protects gastric mucosa, limits acid secretion, enhances renal perfusion, and preserves platelet function. COX-2, instead, is induced by pain and inflammation. Therefore, COX-2 inhibitors can alleviate pain and inflammation without the deleterious side effects of the regular nonsteroidal drugs, which block both enzymes (13).

These COX-2 inhibitors are now available for oral use. A parenteral preparation is under clinical trial for postoperative pain control and has been shown to be comparable to ketorolac in analgesia potency but without its deleterious side effects (14). This new group of analgesics may be safer and may eventually play a more extensive role in the management of acute postoperative pain.

### Regional techniques

Epidural and spinal analgesia have been shown to improve surgical outcomes by decreasing intraoperative blood loss, postoperative catabolism, and the incidence of thromboembolic events, and by improving vascular graft blood flow and postoperative pulmonary function (15). Epidural and spinal opioids provide better analgesia than systemic opioids, but the side effects are still present and therefore monitoring protocols are necessary. The neuroaxial narcotics may cause insidious delayed respiratory depression, and pruritus may occur in a significant number of patients.

Local anesthetics may cause hypotension and muscle weakness that may slow down mobilization. To reduce the narcotic side effects, low concentrations of local anesthetic, such as ropivacaine 0.2%, may be added to the infusion. This concentration is weak enough to avoid motor weakness.

One of the most dangerous complications in the placement of an epidural catheter is the development of a spinal hematoma. The risk of this complication is increased in patients receiving anticoagulant therapy (16). In patients receiving thromboprophylaxis with low-molecular-weight heparin, epidural catheter placement or removal should be delayed until 12 hours from the last administration. Anticoagulant therapy and surgery should also be delayed 12 hours in patients who have suffered a "bloody tap" during placement of the catheter (16).

Close neurological monitoring is required for patients who have had an epidural catheter inserted, so that an epidural hematoma will be detected early in its development. If a hematoma is suspected, magnetic resonance imaging should be performed immediately. Evacuation of the epidural clot within 8 hours of symptom onset is crucial for recovery of neurological function (16).

The increasing use of perioperative anticoagulant therapy and the increase in nursing surveillance required for neuroaxial analgesic techniques have promoted the resurrection of the paravertebral block. Although first described in 1905 by Hugo Sellheim of Leipzig (1871–1936), the paravertebral block has only recently become popular (17). The paravertebral space is a wedge-shaped area between the heads and necks of the ribs. The contents of each space include the spinal nerve, its dorsal ramus, the rami communicantes, and the sympathetic chain. Therefore, an accompaniment of the somatic block is a localized unilateral sympathetic block. This block is particularly effective for unilateral surgical procedures such as thoracotomy, breast surgery, cholecystectomy, and renal surgery. There is a low incidence of adverse effects, and patients require no additional nursing care. This block can be performed safely in patients on anticoagulants. Because of its low side effect profile, the paravertebral block contributes to accelerated postoperative mobilization.

### Nonpharmacologic techniques

Opioid and nonopioid analgesics all come with potential side effects. Therefore, alternative therapies have been explored with varying success. Electrical stimulation of peripheral nerves may influence pain inhibitory pathways, inhibit substance-P release, and perhaps cause the release of endogenous opiate substances (18). The efficacy of these modalities in reducing the requirement for conventional pain medications is still controversial.

## PEDIATRIC PAIN MANAGEMENT

Children experience pain differently than adults do. Their emotional development, previous experiences, and ability to communicate and understand are all imponderable variables. A needle stick to an adult may be just an isolated unpleasant event, whereas to a child it may be the epitome of the evil of their disease (19).

Pain assessment in children is more challenging than in adults. Children are not malingerers; they are very open about expressing their feelings. Nevertheless, it may not be easy for the pain therapist to differentiate between pain and distress.

As the emotional component of pain is very strong in children, psychological support is very important. Minimal separation from parents, holding, nurturing, and distraction are all important modalities.

Nonopioid analgesics such as acetaminophen or nonsteroidal anti-inflammatory agents are useful for mild pain control and as an opiate-sparing measure. Oral, rectal, or intravenous routes are the preferred methods of administration of analgesics—children do not care for intramuscular injections. Intravenous fentanyl, morphine, and meperidine are the most popular opiates. Patient-controlled analgesia has been used successfully even with very young children. Regional analgesia performed while the patient is under general anesthesia can provide excellent early postoperative pain relief.

## PREEMPTIVE ANALGESIA

Analgesia administered before the painful stimulus occurs may prevent or substantially reduce subsequent pain or analge-

sic requirements. This hypothesis has prompted numerous clinical studies, but few robust studies have clearly demonstrated its efficacy. A recent study examined the administration of epidural fentanyl or bupivacaine prior to surgical incision in patients undergoing radical prostatectomy. The study group experienced less postoperative pain and at follow-up 9 weeks later were more active sooner compared with the control group (20). This study supports the concept that protecting the nervous system preemptively reaps rewards later.

## THE FUTURE

As a result of a better understanding of the mechanisms and physiology of acute pain and nociceptors, the goal of a stress-free anesthetic with minimal postoperative discomfort is attainable. No single therapy can achieve this goal. A multimodal approach using different drugs and techniques can reap the highest benefit and reduce the side effects. Some newer agents that may offer better therapeutic benefits are dexmedetomidine and remifentanil.

### Dexmedetomidine

Dexmedetomidine is a highly selective, centrally active alpha-2-adrenergic agonist that provides both sedation and analgesia without significant ventilatory depression. Phase III studies in postoperative patients have shown that a continuous infusion of 0.2 to 0.7 μg/kg/hr easily maintains a patient at a Ramsay Sedation Score of 3 with a significant morphine-sparing effect and, most importantly, with no evidence of respiratory depression (21). The properties of this novel drug indicate it could be used intravenously even into the recovery period, with more safety than many presently available sedatives and analgesics. It may lend itself as a sole anesthetic agent for conscious sedation.

### Remifentanil

Remifentanil is a very potent μ-opioid receptor agonist that is rapidly metabolized by circulating nonspecific esterases and rapidly cleared. It can provide very controllable analgesia depending on infusion rate. However, there are 2 potential dangers: it is a very potent narcotic and will cause respiratory depression, and its rapid metabolism means that its analgesic effect will dissipate rapidly once the infusion is terminated.

In the intensive care setting, remifentanil can be carefully titrated to provide total analgesia to postoperative patients. However, in the extubated patient, the window between good analgesia and significant respiratory depression is small. We have demonstrated that it is as effective as a thoracic epidural analgesic in the postoperative management of lung transplant patients (22).

## CONCLUSION

Advances in pharmacology, techniques, and education are making major inroads into the management of postoperative pain. Nursing education, patient care, and physician responsiveness will be key to the success of any pain management improvement initiative.


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