Continuing Medical Education

The prevention of post-operative pain

Carol A. Moote MD FRCPC

Patients want safe and effective analgesia. Our goal is to prevent postoperative pain in an efficient and cost effective manner. For most patients, the pain can be managed using simple, non-invasive and inexpensive analgesic techniques. Given the current economic climate, cost will become increasingly important. There will be financial pressure to expand the scope of ambulatory surgery. There will be pressure to discharge patients as soon as they are able to take oral medications. Outpatient analgesia is the oldest and most widespread form of patient-controlled analgesia – We already have the knowledge and the analgesics necessary to prevent postoperative pain. What we need now is logical, rational, and universal application of this information.

Le patient s'attend à une analgésie efficace et sans danger. Nous devons viser à prévenir efficacement et au meilleur coût la douleur postopératoire. La plupart du temps, la douleur peut être contrôlée par des techniques simples, non effractives et peu coûteuses. Dans le climat économique actuel, le coût deviendra un facteur de plus en plus important. La question financière nous forcera à élargir les limites de la chirurgie ambulatoire. Nous devrons aussi libérer les patients dès qu'ils sont aptes à prendre une médication orale. La chirurgie ambulatoire constitue la méthode la plus ancienne et la plus répandue d'analgésie auto-contrôlée. Nous avons déjà à notre disposition les analgésiques requis pour prévenir la douleur postopératoire. Il faut maintenant appliquer cette connaissance universellement, de façon logique et rationnelle.

Key words
ANAESTHETICS, LOCAL:
ANALGESIA: postoperative;
ANALGESICS.

From the Department of Anaesthesia, University Hospital, University of Western Ontario, London, Ontario.

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> "For nearly 30 years I have studied the reasons for inadequate management of postoperative pain, and they remain the same ... inadequate or improper application of available information and therapies is certainly the most important reason for inadequate postoperative pain relief."
> John J. Bonica 1990[1]

The word anaesthesia means without feeling, without pain. It was for the explicit purpose of relieving pain that both anaesthetic agents and the specialty of anaesthesia were developed. Every anaesthetist should be an expert in pain management. Our goal is the prevention of pain. While this goal is almost universally achieved in the operating room, the same guarantee cannot be made for postoperative pain. We already have the knowledge and the medications required to prevent postoperative pain. Complete patient comfort is limited more by a lack of commitment to this issue rather than a lack of potent analgesic agents.

There has been an international explosion of interest in patient-controlled and epidural analgesia. These techniques can produce superb analgesia. However they are not universally available. They require substantial financial and human resources and even the development of an Acute Pain Service. Analgesia can also be achieved with simple, noninvasive techniques, using analgesics that are available in every hospital and can be administered by any nurse. Patients who learn to assess their pain and communicate their analgesic needs will have more control over the dose and delivery of analgesic agents regardless of the route of administration. Simple techniques that require no additional equipment, no additional human resources and no additional financial resources will be especially important in the years ahead as we are continually asked to do more with less.

The problem

Despite the availability of effective analgesic agents, between 30 to 70% of patients continue to suffer severe postoperative pain. The undertreatment of postoperative

TABLE I Reasons for inadequate postoperative pain relief

Variability in patient's perception of pain.
Variability in pharmacodynamics of opioid analgesics.
Variability in analgesic requirements.
Inadequate dose - too little.
No rescue analgesia provided.
Excessive dosing interval - too late.
Reliance on unimodal analgesia - opioids only.
Concern for opioid addiction.
Concern for respiratory depression.
Patient stoicism and reluctance to request analgesia.
Lack of preoperative patient education regarding postoperative analgesia.
Tendancy to underestimate patient's pain.
Lack of frequent assessments of pain in the early postoperative period.
Control drugs are kept under lock and key and require documentation.
Inadequate staffing to frequently assess pain and administer analgesia.
Lack of accountability for adequate pain management.

TABLE II Tips for preventing postoperative pain

Discuss postoperative pain with patients before surgery.
Instruct patients preoperatively in the use of verbal pain scale from 0-10.
If using premedication consider an analgesic; NSAID or opioid.
Use balanced multimodal analgesia; local anaesthetics, opioids, and NSAIDs to provide adequate analgesia at the end of surgery.
Assess pain using verbal rating scale before transferring patient to the PACU nurse and don't leave until the pain in under control
Prescribe adequate postoperative analgesia.
Prescribe analgesia for breakthrough pain.
Remember that potent analgesia can be administered orally.
Prevent and treat side effects of analgesia particularly nausea.
Frequent reassessment to determine the efficacy of analgesia and any side effects which require treatment.
Be extra cautious with the elderly.
Remember that all analgesics are potentially lethal.

pain has been identified as one of the most serious deficiencies in pain management today.

Opioids are prescribed by the physician, administered by the nurse, accepted by the patient. The system in which these interactions occur must promote the timely delivery of analgesics. Patients commonly do not receive the medication they need, even when adequate analgesic has been prescribed. The analgesia many patients receive is simply too little too late. (Table I)

The solution - guidelines

The problem of inadequate pain management has been addressed by various organizations including:

- World Health Organization,[2]
- International Association for the Study of Pain,[3]
- United States Department of Health and Human Services,[4]
- American Pain Society,[5]
- Canadian Pain Society,[6] and the
- Canadian Cancer Society.[7]

These organizations represent a diverse multidisciplinary group of professionals, spanning different countries and cultures. Yet their guidelines are surprisingly similar. They acknowledge and emphasize several basic issues:

- the importance of adequate analgesia and prevention of pain,
- the tremendous variability in analgesic requirements,
- the benefits of regular scheduled dosing of analgesic agents,
- the need to provide rescue analgesia for breakthrough pain,
- the importance of oral analgesia - convenient and inexpensive,
- the benefits of multimodal analgesia and
- the importance of frequent assessment of pain.

This paper will focus on the issues raised in these guidelines and describe simple solutions that can be easily incorporated into daily practice to improve the management of all surgical patients using inexpensive, noninvasive analgesic techniques. (Table II)

Opioids

Intramuscular, *prn*, opioid analgesia is the most commonly used method of postoperative pain management. Pain is a subjective and extremely variable experience. There is a large variation in absorption, distribution, metabolism and elimination of opioids. Variability in the patient's perception of pain coupled with variability in the pharmacokinetic behaviour of intramuscular opioids results in a tremendous variation in analgesic requirements. Yet we commonly see the same prescription of morphine 10 mg *im* q4h *prn*, regardless of age, height, weight, sex, or surgical procedure. Picture the scenario of a patient given morphine 10 mg *im* with only moderate pain relief. One hour later the pain is severe but no other analgesia can be given for three more hours. This is unacceptable and unnecessary. Inadequate dosing is one of the major causes of inadequate analgesia.

The cost of opioids is reviewed in Table III. The older agents, with a longer duration of action are considerably cheaper. Morphine 10 mg costs 20 cents, in comparison 10 ml of sodium chloride for injection costs 18 cents.

Dosing schedule

The routine prescription of analgesia on an "as needed," *prn* basis is one of the most important factors contributing to the inadequacy of postoperative pain management. This encourages the cycle of recurring pain, and may increase the dose of opioid required to relieve pain. In the early postoperative period, the effectiveness of opioid analgesia is improved by regular around-the-

TABLE III Cost of opioid analgesics

Generic name	*Dose*	*Cost*
Oral tablets		
Morphine	20 mg	$0.19
Meperidine	50 mg	$0.29
Codeine	30 mg	$0.07
Codeine	60 mg	$0.20
Hydromorphone	4 mg	$0.26
Oral solution		
Morphine	20 mg	$0.20
Codeine	30 mg	$0.12
Hydromorphone	2 mg	$0.19
iv/im		
Morphine	10 mg	$0.20
Meperidine	100 mg	$0.19
Codeine	30 mg	$0.20
Hydromorphone	2 mg	$1.26
Fentanyl	100 μg	$1.85
Sufentanil	50 μg	$6.20
Alfentanil	1.0 mg	$7.00

All prices as per University Hospital Formulary Information 1993–4. Prices subject to change and vary in different hospitals.

clock dosing to prevent the recurrence of severe pain. In a Canadian study of pain after total hip arthroplasty, regular dosing of morphine produced better analgesia than morphine administered on a *prn* basis.[8] Patients had lower pain scores and fewer requests for rescue analgesia. If we simply eliminated "*prn*" from the prescription there would be a marked improvement in postoperative analgesia.

Route of administration

In decades past we have focused on the pursuit of the ideal analgesic agent. We have now abandoned that in search of the ideal route of administration. Numerous studies debate the relative benefits of intramuscular, intravenous and epidural opioids for postoperative pain. And yet, patients with severe cancer pain are typically managed with oral opioids. Oral analgesia is simple and cheap. The administration of oral analgesics can begin as soon as the patients can tolerate oral fluids. Many patients return to diet as tolerated in the immediate postoperative period. If patients are having soup for supper and are taking other medications orally, there is little reason to give their analgesics parenterally.

In the same study of pain after total hip arthroplasty described above[8] around-the-clock oral morphine was compared with on demand intramuscular morphine. They concluded that regular dosing of oral morphine provided superior analgesia. After major surgery, oral morphine provided good analgesia, with average pain scores of 2–3 out of 10. The dose and dosing interval are more important factors in determining the efficacy of analgesia than the route of administration. The cost of oral morphine for 48 hr was $0.89, "$0.77 for 12 doses of oral morphine and $0.12 for 12 medicine cups." The total cost of providing analgesia after total hip arthroplasty was forty five cents per day.

Oral administration is safer for nursing personnel since the risk of needle stick injury is eliminated. From a cost perspective, a medicine cup is cheaper than a needle and syringe and alcohol swab. Oral administration is also environmentally friendly. Contaminated needles and syringes must be stored in special "sharps" containers and disposed of in specially designated landfill sites. Waste disposal is an additional cost which is often overlooked when determining the total cost of an analgesic technique.

One of the features of intravenous patient-controlled analgesia that patients enjoy most is the fact that they are spared the pain of needles. For patients who wish to avoid needles, a small butterfly needle can be placed subcutaneously, secured with tape, and left in place for three to ten days. This technique is commonly used in palliative care.[7] Opioids, nonsteroidal anti-inflammatory drugs (NSAIDs) and antiemetics can all be injected through the butterfly without discomfort for the patient.

Prevention of nausea and vomiting

Nausea and vomiting associated with opioid analgesia can be severe. Some patients will refuse opioid analgesia, preferring pain rather than nausea. Prevention of nausea by the simultaneous administration of antiemetics and opioids may be beneficial. For decades, nurses have mixed opioids and antiemetics in the same syringe in an attempt to minimize opioid induced nausea. Occasionally more aggressive antiemetic therapy may be necessary in order to provide adequate analgesia and total patient comfort. A combination of antiemetics with different mechanisms of action may be more effective. This approach is used in palliative care.[7] The cost of antiemetics is shown in Table IV. Newer agents are considerably more expensive.

Ondansetron and metoclopramide have minimal sedative properties, other agents such as droperidol may result in profound sedation. The sedative properties of antiemetics must be appreciated with used in combination with opioids. Sedation can be further exaggerated by the concomitant use of other agents which have hypnotic and sedative properties such as the benzodiazepines. Excessive sedation may predispose patients to the respiratory depressant effects of opioids.

Multimodal balanced analgesia

The most effective and efficient method of achieving pro-

TABLE IV Cost of antiemetic agents

Generic name	*Trade name*	*Dose*	*Cost*
Oral			
Dimenhydrinate	Gravol	50 mg	$0.04
Prochlorperazine	Stemetil	10 mg	$0.18
Haloperidol	Haldol	5 mg	$0.03
Metoclopramide	Reglan	10 mg	$0.02
Ondansetron	Zofran	8 mg	$17.72
Rectal suppository			
Dimenhydrinate	Gravol	100 mg	$0.16
Prochlorperazine	Stemetil	10 mg	$0.79
Parenteral iv/im			
Dimenhydrinate	Gravol	50 mg	$0.38
Prochlorperazine	Stemetil	10 mg	$0.55
Droperidol	Inapsine	5 mg	$5.40*
Promethazine	Phenergan	50 mg	$0.41
Haloperidol	Haldol	5 mg	$1.85*
Metoclopramide	Reglan	10 mg	$0.80
Ondansetron	Zofran	4 mg	$17.92

All prices as per University Hospital Formulary Information 1993–4. Prices subject to change and vary in different hospitals.
*Each ampoule contains 5mg, patients may receive a smaller dose, this represents the cost of opening the ampoule.

found analgesia is to combine several different drugs and techniques.[9] Pain may be blocked at a variety of locations. NSAIDs act peripherally at the cellular level, although there is some evidence for a central action. Local anaesthetics act on peripheral nerves or the spinal cord. Opioids are classically considered as centrally acting analgesics. They also act at the level of the spinal cord and there is some evidence for peripheral opioid receptors, since small doses of intraarticular morphine have provided significant postoperative analgesia.

The concept of an analgesic ladder has been advocated by the World Health Organization to promote a stepwise approach to the management of chronic cancer pain.[7] Many of these concepts can be borrowed to develop a similar approach to the treatment of postoperative pain. (Figure) However there are several interesting differences between chronic cancer pain and acute postoperative pain. Cancer pain usually begins as mild pain and grows stronger. Postoperative pain is at its peak immediately after surgery and becomes less severe with time. In palliative care we begin at the bottom of the ladder, adding stronger analgesics as needed. For postoperative pain we start at the top of the ladder with a combination of strong analgesics and step down the ladder using fewer and weaker analgesics over time until the patient has recovered and is pain free.

The ladder or stepped approach is also helpful in conceptualizing the theory of multimodal analgesia. Consider

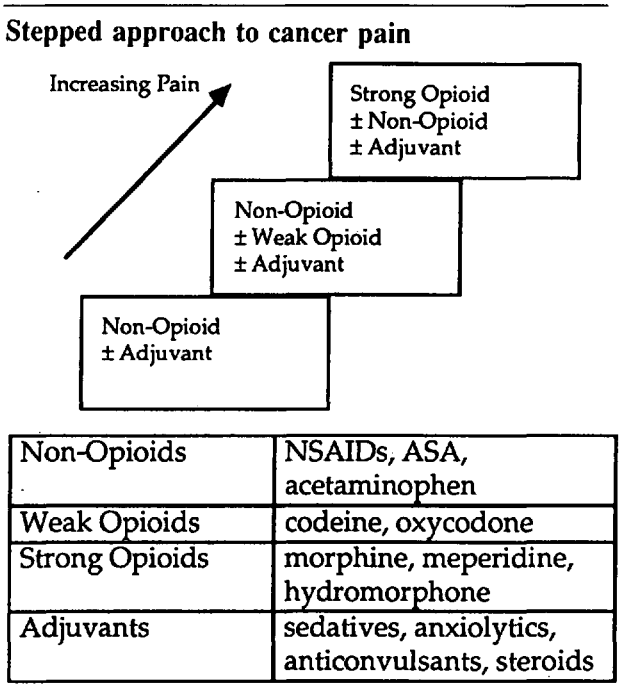

FIGURE Stepped approach in pain management.

the patient undergoing knee arthroscopy. Opioid or NSAID premedication can be prescribed. The procedure could be performed under local, spinal, epidural or general anaesthesia. Intraoperative opioids could be added. The knee could be infiltrated with bupivacaine and or morphine, or a femoral block could be performed. The patient could be given intramuscular or rectal NSAIDs.

In the post anaesthesia care unit intravenous morphine can be titrated to treat any complaints of pain or to prevent pain. Postoperatively oral analgesia can be prescribed with opioids and/or NSAIDs. There are almost limitless possibilities for the combination of local anaesthetics, opioids and NSAIDs, given the variety of routes of administration for each agent. (Table V)

TABLE V Analgesic routes of administration

Local anaesthetics	*NSAIDs*	*Opioids*
Direct application	Oral	Oral
Interstitial infiltration	Intramuscular	Intramuscular
Intraarticular	Intravenous	Intravenous
Peripheral nerve block	Rectal	Intraarticular
Epidural	Topical*	Epidural
Intrathecal	Intraarticular*	Intrathecal

*Research use only.

NSAIDs

NSAIDs have been used extensively for chronic arthritis and while it has been recognized that they are potent anti-inflammatory agents their analgesic properties have been underutilized.[9] The value of NSAIDs as adjuvants in postoperative analgesia has now been widely appreciated. They enhance the quality of opioid analgesia and have a definite role to play in the management of postoperative pain. Even when pain is severe enough to require strong opioids, the addition of NSAIDs will markedly improve pain relief. NSAIDs are ideally suited to supplement opioid analgesics since the side effect profile of these two drugs are entirely different. (Table VI) NSAIDs may reduce the amount of opioid needed and therefore reduce opioid side effects.[9] Furthermore since NSAIDs do not produce sedation or respiratory depression they are ideally suited to a regular dosing scheduled.

TABLE VI Complications associated with analgesic agents

Opioids	*NSAIDs*
Sedation	Gastric ulceration and bleeding
Delirium/hallucinations	Renal insufficiency
Respiratory depression	Anaphylaxis
Hypotension	Bronchospasm (ASA/nasal polyps/ asthma)
Nausea and vomiting	
Constipation	Bleeding
Urinary retention	Water retention, edema
Pruritus	

A selection of commonly used NSAIDs and their cost is shown in Table VII. Again oral medication is the most economical, slow release preparations are slightly more expensive as are rectal suppositories. Ketorolac is unique in that it is available for intramuscular injection, but it is also the most expensive.

TABLE VII Cost of NSAID analgesics

Generic name	*Trade name*	*Dose*	*Cost*
Oral			
Indomethacin	Indocid	50 mg	$0.14
Diclofenac	Voltaren	50 mg	$0.29
Naproxen	Naprosyn	250 mg	$0.09
Naproxen sodium	Anaprox	275 mg	$0.53
Ibuprofen	Motrin	300 mg	$0.02
Ketorolac	Toradol	10 mg	$0.57
Oral slow release			
Indomethacin	Indocid SR	75 mg	$1.04
Diclofenac	Voltaren SR	100 mg	$1.27
Naproxen	Naprosyn	750 mg	$1.33
Rectal suppository			
Indomethacin	Indocid	100 mg	$1.38
Diclofenac	Voltaren	100 mg	$1.33
Naproxen	Naprosyn	500 mg	$1.29
Intramuscular ketorolac	Toradol	30 mg	$1.99

All prices as per University Hospital Formulary Information 1993–4. Prices subject to change and vary in different hospitals.

The nurse

After the doctor's orders are written, pain management becomes an interaction between the patient and the nurse. The importance of the nurse in postoperative pain management cannot be overstated. If orders are written for morphine 5–10 mg q3h *prn* the nurse has many decisions to make. The nurse chooses the dose 5 mg, 7.5 mg or 10 mg. The nurse chooses the dosing interval. The patient may receive analgesic medication every three hours or only if they request medication. The dosing interval may vary from q3h to q6h or longer. If the prescription is inadequate, the nurse has the responsibility to call the physician and request that the analgesic therapy be re-evaluated. The nurse will determine whether the analgesic is delivered promptly or whether the patient waits an additional 30 minutes. If antiemetic therapy is prescribed on a *prn* basis the nurse will decide whether antiemetics are given to prevent nausea or to treatment episodes of vomiting.

Research has documented factors in nursing staff which affect their response to analgesic requests.[4] Nurses who have personally experienced postoperative pain are more liberal with analgesics. Nurses with more years of clinical experience administer less analgesic medication. Concern for patient addiction and respiratory depression remains common. Nurses frequently underestimate the patients perception of pain. The combination of these findings may help to explain the undermedication.

Assessment of pain

Pain is a subjective experience. The only way to monitor pain is to ask the patient. Pain exists when the patient says it does. Accurate assessment of pain is the key to successful pain management. To understand the severity of pain and to determine the adequacy of analgesic therapy, visual analogue or verbal rating scales are used. Using the visual analogue scale patients are asked to rate their pain on a linear scale 10 cm long, where 0 is no pain and 10 is the worst pain imaginable. A mark is made on the scale and the distance from 0 is measured in centimetres. The visual analogue scale requires that the patient can read the scale and make a mark on the scale to locate the pain intensity. Another, more clinically relevant approach is simply to ask the patient to rate their pain on a verbal scale from 0 to 10. The verbal scale is more practical for patients in the immediate postoperative period. Another simple way to assess the adequacy of analgesia is simply to ask the patient, "Are you getting enough, too much or too little pain medicine? Are you satisfied?"

Many hospitals are placing new emphasis on accountability for adequate pain management. For patients with severe cancer pain, or patient-controlled and epidural analgesia nurses commonly chart on a "pain flow sheet." The nurse documents the patient's subjective assessment of pain and records analgesic medication given and vital signs and the occurrence of any side effects such as nausea. The pain flow sheet is a simple and effective way of monitoring pain management from hour to hour and day to day. Such frequent assessment and monitoring of all surgical patients could improve our ability to relieve postoperative pain.

Safety

The benefits of therapy must outweigh the risks. All analgesics have side effects. (Table VI) While complications are rare they do occur and can be serious – even fatal. In reviewing the Ontario Medical Association's adverse drug reaction reporting programme from January to August 1993 there were 19 fatalities overall.[10] Three deaths were due to NSAIDs and three to other analgesics. This represents one third (6/19) of all fatal adverse drug reactions. Safety of the postoperative patient must be our ultimate concern.

Respiratory depression associated with opioids is a rare but real problem.[11] Inadequate analgesia is also an important problem. Although there is considerable room for liberalizing opioid therapy this must be done while paying careful attention to the potential for respiratory depression. Fortunately naloxone is an effective reversal agent for opioid induced respiratory depression. Nurses administering liberal doses of opioids on a regular dosing schedule must be vigilant in monitoring for excessive sedation and respiratory depression.

The side effects of NSAIDs are not so easily reversed; gastrointestinal bleeding and renal failure. Complications of NSAIDs are more easily prevented than treated and fortunately are less common after short term therapy. However, even short term therapy can be complicated by the fact that many surgical patients are already receiving chronic NSAID therapy. For example an 80-yr-old patient receiving ASA for transient ischaemic attacks, diclofenac for osteoarthritis has had an abdominal hysterectomy. Postoperatively her ASA and diclofenac are continued and, in addition, ketorolac is prescribed for postoperative analgesia. Patients who are simultaneously taking three different NSAIDs will undoubtedly experience more NSAID related complications. Screening patients for a history of chronic NSAID use, gastrointestinal ulceration, renal dysfunction, bleeding disorders, or asthmatics with ASA sensitivity, will reduce the complications associated with short term NSAID therapy.

The elderly are more sensitive to anaesthetic agents. They require dose reduction and careful titration of anaesthetic agents. The same is true for analgesic therapy in the elderly. They are particularly prone to develop serious, life threatening complications from both opioids and NSAIDs. With opioids the elderly experience more respiratory depression, hypotension and central effects such as delirium and hallucinations. With NSAIDs the elderly are more prone to gastrointestinal ulceration and renal failure.

Conclusion

Postoperative pain is a simple and straightforward problem. The diagnosis is obvious and the therapeutic solutions have been available for decades. Unfortunately the prevention of postoperative pain remains inadequate. The guidelines offered to improve the management of postoperative pain are worthy of our careful consideration and expeditious implementation.

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Self-assessment questionnaire

FOR EACH OF THE QUESTIONS OR INCOMPLETE STATEMENTS BELOW, ONE OR MORE OF THE ANSWERS OR COMPLETION GIVEN IS CORRECT.

A if only 1, 2, or 3 are correct
B if only 1 and 3 are correct
C if only 2 and 4 are correct
D if only 4 is correct
E if all are correct

1 Complications associated with NSAID therapy include;
1 renal dysfunction
2 gastric ulceration
3 bleeding
4 respiratory depression
5 hypotension

2 Complications associated with opioid therapy include;
1 nausea
2 constipation
3 pruritus
4 respiratory depression
5 sedation

3 Postoperative pain management can be improved by;
1 prescribing an adequate dose of analgesia
2 prescribing regularly scheduled doses of analgesic medication
3 prescribing rescue analgesia for breakthrough pain
4 frequent assessment of pain and analgesic efficacy
5 preoperative patient teaching regarding pain and analgesic therapy

4 NSAIDs;
1 are effective analgesic agents
2 should be used even when pain is severe enough to require strong opioids
3 combined with opioids improve pain relief
4 have no serious side effects
5 cause dose related respiratory depression

5 Which of the following statements are true;
1 analgesic requirements are increased with movement and exercise
2 analgesic requirements are greatest during daytime
3 in general older patients require less opioid analgesia
4 analgesic requirements are directly related to the patient's weight
5 in general females require more opioid analgesia than males

6 Which of the following statements are true;
1 patients are reluctant to request analgesic medication
2 patients fear addiction to opioids
3 assessment of pain using verbal rating scales will help patients communicate the severity of their pain
4 nurses frequently underestimate the severity of pain
5 nurses fear respiratory depression associated with opioids

7 Which route of administration is the least expensive;
A oral
B rectal
C intramuscular
D intravenous
E epidural

8 The most commonly used route of administration for "patient-controlled analgesia" is;
A oral
B rectal
C intramuscular
D intravenous
E epidural

ANSWERS
1 A 3 E 5 A 7 A
2 E 4 A 6 E 8 A