Lesson 304: Perioperative Pain Management of the Patient With Chronic Pain—Part 1

Written by: David B. Turk, MD, Anesthesiology Resident, Department of Anesthesiology, Einstein College of Medicine/Montefiore Medical Center, New York, New York; Karina Gritsenko, MD, Assistant Professor, Department of Anesthesiology, Pain Medicine and Regional Anesthesiology Division, Einstein College of Medicine/Montefiore Medical Center, New York, New York

Reviewed by: Elizabeth A.M. Frost, MD, Clinical Professor, Department of Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, New York

REVIEW DATE: April, 2013

Read this article, reflect on the information presented, then go online and complete the lesson post-test and course evaluation before the termination date below. (CME credit is not valid past this date.) You must achieve a score of 80% or better to earn CME credit.

TIME TO COMPLETE ACTIVITY: 2 hours
RELEASE DATE: June 1, 2013
TERMINATION DATE: May 31, 2014

COPYRIGHT: This material is subject to copyright ©2013 Icahn School of Medicine at Mount Sinai. All rights reserved.

Professional Gaps

This 2-part series reviews the perioperative management of pain. Part 1 will define pain and the descriptors of pain terminology. Appropriate evaluation of the chronic pain patient is outlined and alternatives for anesthetic plans presented. The concept of multimodal analgesia is discussed and a conversion table for commonly used analgesic agents is presented.

In Part 2 (available at www.mssm.procampus.net in July 2013), narcotic metabolism and toxicity will be delineated and perioperative adjuvants discussed. Additional sections will deal with the special concerns of postoperative analgesia in the obese patient and drug interactions caused by concomitant administration of St. John’s wort. Finally, the differences between addiction, pseudoaddiction, tolerance, and secondary gain will be presented.

Learning Objectives

At the end of this activity, the participant should be able to:

1. Classify types of pain
2. Be conversant with definitions of pain terminology
3. Conduct a preoperative evaluation of a chronic pain patient
4. List the pros and cons of various intraoperative anesthetic options
5. Explain the concept of multimodal analgesia
6. Understand opioid analgesic conversions
7. Differentiate between neuropathic and nociceptive pain
8. Subdivide acute pain according to anatomic origin
9. List adverse effects (AEs) related to polypharmacology in chronic pain management
10. Be aware of the differences between spinal cord stimulators and intrathecal pumps
Case History

A 65-year-old man was scheduled for multilevel laminectomies and instrumentation. Suffering from severe back pain for years, he had been receiving chronic methadone therapy, opioid patches, and oxycodone/acetaminophen. His pain specialist had prescribed several antidepressants, and the patient reported that he also self-administered several herbal preparations, including St. John’s wort. His underlying disease limited his exercise tolerance. Although there was no formal diagnosis of obstructive sleep apnea, his wife reported that he snored loudly and often stopped breathing for a few seconds at night. He weighed 265 lb (120 kg) and was 69 inches (175.26 cm) tall. He was very concerned about pain and postoperative pain control.

The International Association for the Study of Pain defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.” This definition acknowledges the many facets of the human experience with regard to pain: the sensory and physiologic components, the subjective aspect, and the emotional and psychological components.

Pain can be acute or chronic. Acute pain generally results from nociceptive pathways, whereas chronic pain often also involves behavioral and psychological phenomena that must be addressed in order to provide the patient with an all-encompassing, effective therapy.

Pain also can be characterized as nociceptive or neuropathic. Nociceptive pain, such as the pain of surgical incision, is modulated by activated or sensitized receptors and transmitted by peripheral neurons to the central nervous system (CNS). Neuropathic pain, such as diabetic neuropathy or radiculopathy from bone metastasis in a patient with cancer, occurs secondary to injury or damage sustained by the peripheral or CNS anatomy.

Acute pain can be further classified as to its anatomical origin, somatic versus visceral; somatic pain can be further subdivided as “superficial” or “deep.” Superficial somatic pain arises from pain receptors in the skin, subcutaneous tissues, and mucous membranes, whereas deep somatic pain originates in the muscles, tendons, joints, or bones. Superficial somatic pain often is described by patients as having sharp, stabbing, or throbbing qualities, whereas deep somatic pain usually is described as having a dull, aching quality that is poorly localized.

Visceral pain arises from the internal organs and/or the overlying fascia, pleura, or peritoneal tissues. Visceral pain, therefore, can be described as “true” visceral or parietal in nature, and can be further categorized as local or referred. Alternatively, visceral pain can be described as dull and diffuse or as sharp, stabbing, and localized, with its intensity and localization varying to some extent based on the degree of involvement of parietal coverings. For example, pain may arise from the pancreas and be referred to a distant site such as the shoulder. Pain also can be characterized by its etiology, including postoperative pain, neuropathic pain secondary to a systemic illness, chronic low back pain resulting from a herniated disk, cancer pain resulting from inflammatory cytokine release, and mass effect on adjacent structures.
Descriptors of Pain Terminology

Descriptive terms used in pain management help to further define the patient’s symptomatology, which can sometimes be confused by the patient’s own subjective psychological experience, emotional factors, and language barriers (Table 1).

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allodynia</td>
<td>Perception of a normally nonpainful stimulus as painful</td>
</tr>
<tr>
<td>Analgesia</td>
<td>Absence of the perception of pain</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>Absence of all sensations</td>
</tr>
<tr>
<td>Anesthesia dolorosa</td>
<td>Pain in an area lacking sensation</td>
</tr>
<tr>
<td>Dysesthesia</td>
<td>Adverse or abnormal sensation with or without a stimulus</td>
</tr>
<tr>
<td>Hypoalgesia (hypalgnesia)</td>
<td>Decreased response to painful stimulus</td>
</tr>
<tr>
<td>Hyperalgesia</td>
<td>An exaggerated or extreme response to painful stimulus</td>
</tr>
<tr>
<td>Hyperesthesia</td>
<td>Increased sensitivity to any stimulus (eg, pain, heat, cold, or touch)</td>
</tr>
<tr>
<td>Hyperpathia</td>
<td>Presence of hyperesthesia, hyperalgesia, and allodynia, typically accompanied by persistence of the sensation after removal of the stimulus</td>
</tr>
<tr>
<td>Hypoesthesia</td>
<td>An abnormally reduced sense of sensation (eg, touch, pressure, or temperature)</td>
</tr>
<tr>
<td>Neuralgia</td>
<td>Pain caused by damage to or malfunctioning of a nerve and often following the course of the involved nerve(s)</td>
</tr>
<tr>
<td>Paresthesia</td>
<td>Abnormal sensation without an apparent stimulus</td>
</tr>
</tbody>
</table>

*Definitions are adapted from International Association for the Study of Pain (IASP) taxonomy site.

Managing the Chronic Pain Patient: Preoperative Evaluation

The patient with chronic pain poses unique challenges in the perioperative setting. In addition to the usual anesthetic considerations, these patients can present with complex narcotic regimens at high doses, alternative delivery modalities (ie, intrathecal pump therapy), and implanted interventional devices such as spinal cord stimulators. Each situation presents unique risks, including AEs secondary to polypharmacy, tolerance to anesthetics, or narcotic withdrawal (eg, a patient on buprenorphine provided with acetaminophen/oxycodone postoperatively). In preparation for the narcotic-tolerant patient, the pain physician, surgeon, and anesthesiologist should devise a multimodal perioperative plan and present it to the patient. Such a plan must combine both the chronic analgesic requirements of the patient and address new acute pain needs.

Initial assessment of a patient with chronic pain should employ a systematic approach. First, a global history and physical examination should be explored to document pain generators, psychosocial stressors, and comorbidities. A complete medication list should be compiled, including both long- and short-acting opioid pharmacotherapy. Opioid therapy may include short-acting analgesics such as oxycodone as needed; long-acting analgesics such as sustained-release morphine, a fentanyl patch, or methadone; or partial-agonist agents such as buprenorphine. The dose, strength, frequency, and route of administration must be documented clearly and verified with the patient’s primary care physician or
pharmacy, or by inspecting medication bottles. Reactions to specific narcotics should be documented to avoid inadvertent use in the postoperative setting.

Drug interactions also may result from therapy with nonsteroidal anti-inflammatory drugs (NSAIDs), antispasmodic agents such as baclofen, antidepressants (particularly tricyclic antidepressants [TCAs] such as nortriptyline), anticonvulsants such as pregabalin, and other therapies. It is important to differentiate between AEs and true allergic reactions.

Pharmacogenetic differences among patients should be considered. Not all drugs work equally well for all patients, and some individuals may benefit from continuing the opioid regimen that has been working well for them.2,3 For example, a patient who has been managed well on chronic morphine therapy may state a preference for morphine over the hydromorphone that is on the hospital formulary.

Pharmacologic interventions are only part of the therapeutic repertoire. Spinal cord stimulators deliver analgesia via electrical pulses from electrodes implanted in the epidural space and their anatomic location must be noted. Intrathecal pumps deliver small quantities of medication, such as baclofen, morphine, or ziconotide, directly into the spinal fluid, which in theory minimizes but does not eliminate the side effects associated with higher systemic dosages of these drugs. Neuraxial devices can limit the options for neuraxial anesthesia and can be important depending on the surgical procedure planned, as there can be untoward complications from inadvertent device manipulation, including catheter fracture or dislodgement on the operating table and a subsequent postoperative pain crisis.

The Anesthetic Plan

A preoperative conversation with the patient regarding choice of anesthetic—general anesthesia (GA), neuraxial anesthesia (NA), peripheral regional anesthesia (RA), or a combination—entails discussion of the risks and benefits of each, especially the assessment of expected pain control.

General Anesthesia

GA often is the default option in many patients’ minds for surgery. Its benefits include good intraoperative analgesia, amnesia, and unconsciousness. These factors may serve the patient well in cases where surgical intervention is of variable or unknown duration. Drawbacks may include unreliable postoperative analgesia (unless a plan has been set up in advance, eg, patient-controlled analgesia [PCA]); reliance on opioids and/or other IV agents for analgesia with accompanying side effects (ie, depressed consciousness, urinary retention, pruritus, constipation, and ileus), as well as shivering and nausea in the post-anesthesia care unit (PACU).
Neuraxial Anesthesia

NA includes spinal, epidural, and caudal blocks. Depending on the case, NA may be used as the sole anesthetic, in conjunction with GA, or for postoperative analgesic plan. NA has an excellent safety profile; studies show reductions in perioperative morbidity and mortality, and decreased risk for deep venous thrombosis and pulmonary embolism in many instances in which NA is used.4,5 NA may mitigate the hypercoagulable state associated with surgery, provide for better tissue blood flow, and suppress the neuroendocrine response.4,5 In a 2003 review of NA, Moraca et al found significant reductions in several areas, including cardiac morbidity, pulmonary infections, and pulmonary embolism.5 NA, particularly epidural PCA, may be associated with shorter duration of mechanical ventilation after surgery, reductions in intensive care unit and hospital lengths of stay (LOS), and subsequent decreased hospitalization costs,6 as well as greater patient satisfaction and decreased use of opioids.7

Contraindications to NA may include the use of certain anticoagulant regimens,8 a history of coagulopathy or bleeding diathesis, infection at proposed spinal injection site, severe aortic or mitral stenosis, elevated intracranial pressure, and severe hypovolemia. Relative contraindications may include sepsis, preexisting neurologic deficits or demyelinating lesions, stenotic valvular heart disease, severe spinal deformities, and history of trauma or back surgeries.

In this particular vignette involving a patient for multilevel laminectomies, NA would not commonly be used for several reasons (prone position, variable operating time, different approaches, fluid shifts), although there are case–control analyses discussing use of intrathecal medications in lieu of GA for lumbar decompression.9 However, the technique is not popular, and is even less so in this patient due to possible difficulty with placement of an intrathecal dose in an obese patient, as well as long surgery with greater hemodynamic instability and blood loss. Potential AEs of NA include backache, urinary retention, “high” block, total spinal anesthesia, anterior spinal artery syndrome, nerve injury, intraspinal bleed or epidural hematoma, dural puncture, catheter retention, infection, and local anesthetic drug toxicity.

Peripheral Nerve Blocks

Peripheral RA, like NA, may offer superb targeted anesthesia and decreased use of systemic opioids. Patients receiving nerve blocks report greater overall satisfaction, and may demonstrate decreased cognitive impairment.10 Use of continuous peripheral nerve blocks may improve anesthesia-related workflow and reduction of time spent in the PACU compared with GA. Anesthesia-related costs also may be reduced, as a result of reduced rates of postoperative nausea and vomiting, and fewer in-hospital days.11

Complications of RA include local anesthetic toxicity, blockade of the wrong nerve, and nerve damage. Relative contraindications to peripheral nerve blocks include uncooperative patients, bleeding diathesis, disseminated infection, and peripheral neuropathy.

Multimodal Analgesia

Pain transmitted from peripheral nociceptors is perceived in the CNS, which also might further modulate pain sensation and development of chronic pain syndromes. Chronic pain mechanisms involve transduction, transmission, modulation (and changes in neuroplasticity), and perception by the
CNS. Selecting modes of analgesia based on pain mechanisms may help in multimodal management of acute-on-chronic pain (Table 2).

<table>
<thead>
<tr>
<th>Anatomy</th>
<th>Action</th>
<th>Examples of Analgesic Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain</td>
<td>Perception of pain</td>
<td>Opioids, α₂-agonists, TCAs, SSRIs, SNRIs</td>
</tr>
<tr>
<td>Spinal cord descending modulation</td>
<td>Modulation of pain transmission; may augment or inhibit</td>
<td>TCAs, SSRIs, SNRIs</td>
</tr>
<tr>
<td>Spinal cord ascending modulation</td>
<td>Transmission of pain from peripheral nerves to CNS</td>
<td>Local anesthetics, Opioids</td>
</tr>
<tr>
<td>Tissue peripheral nociceptors</td>
<td>Transduction of pain via nociceptors to peripheral nerves</td>
<td>Local anesthetics, Capsaicin, Anticonvulsants, NSAIDs, ASA, APAP</td>
</tr>
</tbody>
</table>

Prevention of acute pain is important, not only for the short-term postoperative experience, but also to prevent the development of long-term chronic pain syndromes because development of chronic pain conditions can affect activities of daily living and cause inability to return to work. Acute pain exacerbations might lead to neural sensitization and release of neuroendocrine mediators, both peripherally and centrally.¹²

Multimodal analgesia occurs when multiple drugs, including analgesics or adjuvants, are given in combination to relieve acute or chronic pain. This therapy may include acetaminophen, short-term NSAID use, ketamine, and/or dexmedetomidine. Multimodal analgesia also may involve agents such as gabapentin, pregabalin, and injectable capsaicin; indeed some studies have found an analgesic effect from the preoperative administration of gabapentin.¹³

Pain control can be achieved through 3 approaches:

1. Modulating the pain transmitted to the CNS using local anesthetics, NSAIDs, acetaminophen, anticonvulsants, and capsaicin.
2. Mitigation of CNS pain perception using opioids, α₂-agonists, and TCAs.
3. Regulation of descending inhibitory pathways using tramadol, selective serotonin reuptake inhibitors, and clonidine.
Nevertheless, insufficient data exist to prove definitively that multimodal analgesia significantly improves postoperative outcome. This may be due in part to an insufficient number of cases to detect statistically significant differences in currently low incidences of postoperative complications. Alternatively, drug–drug interactions may exert deleterious effects on patient outcomes. For example, the sedative effects of methadone and diazepam can be exacerbated as both are metabolized by the same cytochrome P450 enzymatic system. In geriatric patients, age-related changes in pharmacokinetics and drug metabolism also may play a role. Providing an elderly patient with even a small amount of opioid analgesia in combination with TCA therapy can bring about clinically significant constipation. Multimodal analgesia, therefore, might best be conceived as part of a balanced approach to postoperative care, with additional multidisciplinary inputs, such as physical therapy and postdischarge rehabilitation.

**Converting Between Opioid Agents**

When deciding on choice of opioid and dose, several questions may arise. For example, if the patient’s home medication list includes 35 mg of oxycodone per day, should the postoperative dose simply be increased to account for acute perioperative pain? An important concept to emphasize is that unimodal treatment of opioid-tolerant patients is not the best approach for postoperative pain.

Studies suggest that undertreating acute pain may decrease analgesia subsequently derived from opioid analgesics, frustrating future pain control. Thus, daily opioid treatment requirements must be met before attempting to achieve analgesia.

No predictions of opioid requirements can be made for individual patients. Even patients requiring modest opioid doses preoperatively may require more than twice the amount of opioids typically used for adequate pain control in opioid-naive patients, increasing the likelihood of opioid-induced AEs such as sedation and respiratory depression.

In a unimodal analgesia paradigm, the preoperative needs of an opioid-tolerant patient should first be tabulated; equianalgesic doses of other opioids can then be substituted, depending on the analgesic plan of the provider (Table 3). The clinician also should consider the oral and IV conversion for a particular drug when calculating perioperative requirements.

Patients on chronic methadone or buprenorphine often require special consideration. Oral methadone doses often are reduced significantly when given intravenously. When acute-on-chronic opioid treatment is involved, providers should be wary of the potential for opioid overdose to develop as acute pain wanes. Different classes of analgesics using different routes of administration may be preferable.
### Table 3. Opioid Conversion Table, Relative Potency Compared With Morphine

<table>
<thead>
<tr>
<th>Opioid Agent</th>
<th>Potency vs Morphine</th>
<th>$t_\frac{1}{2}$</th>
<th>Initial Dose in Opioid-Naive Patient</th>
<th>Side Effects; Special Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methadone</td>
<td>~2 to 3.5 - 20+</td>
<td>Duration of analgesia ~8 h May increase to 24-48 h after repeated dosage</td>
<td>5-10 mg IV; 20 mg PO 24-h oral morphine/ methadone ratio: &lt;30 mg 2:1 31-99 mg 4:1 100-299 mg 8:1 300-499 mg 12:1 500-999 mg 15:1 1,000-1,200 mg 20:1 &gt;1,200 mg CONSIDER CONSULT (1.5 mg oral dose): 2 mg methadone PO=1 mg methadone IV</td>
<td>Low cost. NMDA antagonist effects may provide additional analgesic benefit. Risk for QT prolongation</td>
</tr>
<tr>
<td>Buprenorphine</td>
<td>~20+</td>
<td>2.2-3 h IV duration lasts ~6 h</td>
<td>0.3 mg every 6-8 h as needed</td>
<td>Agonist-antagonist; can precipitate withdrawal. Should not be given to patients on traditional opioids. Risk for QT prolongation at higher doses. Pain specialist or physician familiar with its use should be consulted</td>
</tr>
<tr>
<td>Pentazocine</td>
<td>0.3</td>
<td></td>
<td>30 mg</td>
<td>Agonist-antagonist; partial agonist at κ, μ, δ receptors; can precipitate withdrawal. Slow dissociation from receptors causes long duration of action</td>
</tr>
<tr>
<td><strong>Intermediate-acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morphine</td>
<td>1</td>
<td>2-4 h</td>
<td>5-10 mg IV every 4 h as needed</td>
<td>ER formulations may provide analgesia for 8-24 h. Active metabolite; provider should consider alternative agents (eg, hydromorphone) in patients with renal failure</td>
</tr>
<tr>
<td>Meperidine</td>
<td>0.1</td>
<td>2.5 h</td>
<td>1.1-2 mg/kg IM or SubQ Reduced dose (eg, 0.8 mg/kg) may be given IV</td>
<td>Accompanied by sympathomimetic effects such as tachycardia. Should be given with caution to patients on serotonergic agents to avoid precipitating life-threatening serotonin syndrome. Active metabolite can accumulate with repeated doses, hepatic or renal insufficiency</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>5-7</td>
<td>2-3 h</td>
<td>0.2-1 mg every 3-4 h as needed</td>
<td>Commonly given PCA; oral ER formulations also available</td>
</tr>
<tr>
<td>Oxymorphone</td>
<td>3</td>
<td>Duration of analgesia 3-6 h</td>
<td>~0.5 mg IV</td>
<td>Chemically similar to hydromorphone</td>
</tr>
</tbody>
</table>
### Opioid Agent

<table>
<thead>
<tr>
<th>Opioid Agent</th>
<th>Potency vs Morphine</th>
<th>t½</th>
<th>Initial Dose in Opioid-Naive Patient</th>
<th>Side Effects; Special Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short-acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td>~100</td>
<td>30-60 min</td>
<td>1-2 mcg/kg or 25-100 mcg/dose</td>
<td>Short-acting, but increased duration of dose results in increased duration of effects (context-sensitive half-life)</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>200-500</td>
<td>10-20 min</td>
<td>0.02-0.1 mcg/kg/min Titrate as needed</td>
<td>Ultrashort-acting; decays rapidly in blood irrespective of amount given</td>
</tr>
<tr>
<td>Sufentanil</td>
<td>500-1,000</td>
<td>10-20 min</td>
<td>0.01-0.1 mcg/kg/min May also be given epidurally in local anesthetic solution</td>
<td>Short-acting but intermediate to fentanyl and remifentanil. After prolonged administration, elimination half-life can increase significantly</td>
</tr>
</tbody>
</table>

ER, extended release; IM, intramuscular; NMDA, N-methyl-D-aspartate; PCA, patient-controlled analgesia; SubQ, subcutaneously

*Data accrued from several sources in the literature; conversion may vary depending on source.*

**Management of the Case Presented**

Please see Part 2 of this series, available at www.mssm.procampus.net in July 2013.

**Conclusion**

The plan for postoperative pain management in the chronic pain patient must start well before the day of surgery and involve many disciplines. The regimen should be individualized to the patient according to his or her medical history and current pain management protocols. Multimodal techniques should be explored and discussed as a team and approved by the patient. Because various schemes can prove ineffective in some patients, equivalent medications should be sought and substituted.

---

*Dr. Elizabeth A.M. Frost, who is the editor of this continuing medical education series, is clinical professor of anesthesiology at The Icahn School of Medicine at Mount Sinai in New York City. She is the author of Clinical Anesthesia in Neurosurgery (Butterworth-Heinemann, Boston) and numerous articles. Dr. Frost is past president of the Anesthesia History Association and former editor of the journal of the New York State Society of Anesthesiologists, Sphere. She is also editor of the book series based on this CME program, Preanesthetic Assessment, Volumes 1 through 3 (Birkhäuser, Boston) and 4 through 6 (McMahon Publishing, New York City).*
REFERENCES

Visit www.mssm.procampus.net today for instant online processing of your CME post-test and evaluation form. There is a registration fee of $15 for this non–industry-supported activity. For assistance with technical problems, including questions about navigating the Web site, call toll-free customer service at (888) 345-6788 or send an e-mail to Customer.Support@ProCEO.com. For inquiries about course content only, send an e-mail to ram.roth@mssm.edu. Ram Roth, MD, is director of PreAnesthetic Assessment Online and assistant professor of anesthesiology at The Icahn School of Medicine at Mount Sinai, New York, NY.

Post-test

1. Rank the following opioids in terms of their potency, from greatest to least:
   a. Hydromorphone, oxymorphone, morphine, meperidine
   b. Oxymorphone, hydromorphone, meperidine, morphine
   c. Hydromorphone, morphine, oxymorphone, meperidine
   d. Morphine, hydromorphone, meperidine, oxymorphone

2. A patient’s home opioid regimen includes 30 mg of morphine 6 times per day. What would be a comparable dose if the patient were converted to methadone?
   a. Ratio is 2:1. Give the patient 15 mg of methadone 6 times per day.
   b. Ratio is 2:1. Give the patient 15 mg of methadone 3 times per day.
   c. Ratio is 8:1. Give the patient 20 mg of methadone over a 24-hour period.
   d. Ratio is 8:1. Give the patient 20 mg of methadone twice daily.

3. An 85-year-old woman is scheduled for pelvic floor surgery and requests an epidural. She appears healthy. Physical exam is notable for a chronic heart murmur. Her hematocrit is 33. She has not taken clopidogrel for almost 2 weeks, but takes aspirin 81 mg daily. What additional study would most assist the anesthesiologist preoperatively?
   a. Clotting studies
   b. Echocardiogram
   c. Hemoglobin electrophoresis
   d. Electrocardiogram

4. A 35-year-old volunteer fireman is brought to the emergency room sustaining third-degree burns to his hands. He does not appear upset and says it only hurts “a little.” A concerned nurse taps his hand lightly and he reports sensation. This is an example of _____.
   a. hypoesthesia
   b. hypoalgesia
   c. analgesia
   d. anesthesia
5. A patient is complaining of constant burning pain on the left side of her face for the past several months after a procedure to treat her trigeminal neuralgia. The primary medical doctor palpates and lightly pricks her face to assess sensation but the patient reports numbness. This is an example of _____.

a. dysesthesia  
b. anesthesia dolorosa  
c. hyperalgesia  
d. paresthesia

6. A patient with unresectable pancreatic cancer reports sharp, stabbing pain in her shoulder and occasional severe nausea. Physical exam reveals an apparently normal-appearing shoulder; range of motion is normal and shoulder x-ray is normal. Full body magnetic resonance imaging is significant for non-contour-deforming pancreatic mass and omental spread. The etiology of her pain is likely _____.

a. metastatic spread of tumor to shoulder joint  
b. deep superficial pain from muscular spread  
c. visceral pain from the parietal coverings  
d. withdrawal from opioids

7. Neuraxial anesthesia for perioperative pain control in opioid-tolerant patients is associated with all of the following except _____.

a. decreased cost  
b. decreased risk for urinary retention  
c. decreased length of in-hospital recovery  
d. decreased pulmonary infections

8. A histrionic, morbidly obese 45-year-old woman presents for laminectomy and fusion of multiple herniated disks. She states that due to her chronic back pain she has been taking morphine 240 mg per day, and low-dose thioridazine (75 mg) for anxiety, but now wants a more potent analgesic. How much methadone should she be placed on perioperatively?

a. Ratio is 24:1, dose 10 mg.  
b. Ratio is 12:1, dose 20 mg.  
c. Ratio is 8:1, dose 30 mg.  
d. This patient is at risk for adverse effects and should not be placed on methadone.
9. For which patient would neuraxial anesthesia likely be contraindicated?
   a. A 25-year-old man with history of gum bleeding requiring transfusion after wisdom tooth removal; hematocrit today is 35%.
   b. An 80-year-old woman with history of aortic stenosis, now status post-valve replacement with normal echocardiographic studies.
   c. A 34-year-old man positive for HIV with history of meningitis 3 years ago but no sequelae.
   d. A 45-year-old Korean-speaking woman who initially refused spinal anesthesia but after discussion with a hospital interpreter has now consented.

10. A 66-year-old man with glioblastoma multiforme on chemotherapy describes burning pain in the right buccal region. He says he feels constant sharp pain, worsened by eating, drinking, talking, and swallowing. Pricking the face with a probe elicits tremendous pain, as does light palpation. Five minutes later, he is still wincing from pain. This is an example of _____.
   a. hyperalgesia
   b. hyperpathia
   c. hyperesthesia
   d. dysesthesia