CHAPTER 11
Anesthetic Agents

OBJECTIVES
After studying this chapter, the student will be able to:
1. Differentiate the characteristics of the four stages of general anesthesia
2. Discuss major therapeutic actions and adverse effects of the most commonly used preanesthetic agents
3. Discuss major therapeutic actions and adverse effects of the most commonly used anesthetic agents
4. Apply the nursing process for clients receiving each of the major classes of anesthetic and preanesthetic agents
5. Discuss the client needs and appropriate nursing interventions for a client with malignant hyperthermia
6. Successfully complete the games and activities in the online student StudyWARE
Aesthetic agents are drugs that interfere with nerve conduction and thereby diminish pain and sensation. There are two major classes of anesthetic agents, general anesthetics and regional anesthetics. General anesthetics are drugs causing a partial or complete loss of consciousness. They also produce analgesia and muscle relaxation. Such anesthetic agents are used when profound muscle relaxation and loss of consciousness are desirable—for example, during abdominal surgery such as removal of the gallbladder. Regional anesthetic agents block nerve conduction in the specific area to which they are applied, and these agents do not cause a loss of consciousness. They are used in situations in which loss of consciousness and/or widespread muscle relaxation are not necessary or desirable, such as during childbirth or for hip replacement surgery for a client with respiratory insufficiency.

ANESTHESIA

The relief of surgical pain has been an objective of medical science for thousands of years. Many ancient documents have revealed ingenious but often cruel techniques used to render surgical clients temporarily unconscious. Such procedures ranged from asphyxiation to cerebral concussion and frequently caused more pain and suffering than the actual surgical procedure. In later years, the use of narcotics such as opium (laudanum [tincture of opium]) as well as hashish and alcohol was commonplace and represented the only means for reducing the pain of surgery. Although the anesthetic properties of nitrous oxide gas were first described in the middle of the eighteenth century, it was not until the mid-nineteenth century that gaseous anesthetics, namely nitrous oxide (laughing gas), ether, and chloroform became popular. In the 100 years to follow, many general anesthetics were developed. Oliver Wendell Holmes Sr., a nineteenth-century physician and poet, was the first to coin the word anesthesia.

The choice of type of anesthesia is influenced by a number of factors. These include type and duration of surgery, the area of the body having surgery, the client’s previous responses and reactions to anesthesia, safety issues to decrease the risk of injury (airway management), whether the surgery is an emergency, time since the client last ate or drank anything, any medications the client is taking, client position for the surgical procedure, whether the client must be alert enough to follow instructions after surgery, and the type of postoperative pain management planned for the client. All of these factors are considered when deciding which type and which agent is best for the client.

GENERAL ANESTHESIA

A number of theories have been proposed to describe the mechanism of action of the general anesthetics. Many of these have contributed to the understanding of anesthesia. Overton and Meyer in 1901 proposed one of the earliest and most popular theories. They suggested that the more fat soluble an anesthetic drug is, the more rapidly it will enter the central nervous system (CNS) (via the reticular activating system) and the more pronounced its CNS-depressant action will be. This theory describes why anesthetics rapidly enter the brain but does not explain why all lipid-soluble substances do not exert anesthetic activity. The current understanding is that general anesthetics inhibit neuron impulses, and thus nerve conduction, by altering the movement of ions in and out of nerve cells, thereby interfering with the conduction of nerve impulses either along the nerve fiber or across the synaptic space in several areas of the central nervous system (Ignatavicius & Workman, 2010).

Clients receiving general anesthesia pass through a progression of four stages of anesthesia. Stage 3 (surgical anesthesia) is divided into four planes. These planes represent the gradual progression of this stage from Plane 1 to Plane 4. (Plane 4 should not be reached, as this represents extreme hemodynamic and respiratory compromise.) During Plane 1, muscle tone decreases: eyelid, gag, and swallow reflexes are lost. This plane is appropriate for such surgeries as craniotomies, reduction of small fractures, and mastectomies. During Plane 2, muscle tone continues to decrease, pauses occur between respirations, and there is a slight change in the pupils. This plane is used for large-bone surgeries, amputations, and thoracic surgeries. Plane 3 results in markedly decreased muscle tone and pupil dilation. Rectal surgeries, upper abdominal surgeries, and hernioplasties are performed in this plane. Finally, during Plane 4, which should not be reached, pupils are widely dilated and do not respond to light, intercostal muscles are paralyzed resulting in respiratory paralysis, and pulse and blood pressure decrease. This plane is quickly followed by Stage 4—medullary paralysis—in which the client is near death. All stages are summarized in Table 11-1. By observing the client for the characteristics of these stages, the anesthesiologist can gauge the proper time for surgery to begin and the point at which overdosage takes place. The nurse uses this knowledge to prepare the client by providing information in response to inquiries, reducing anxiety, and promoting quality care through client education and nursing intervention.

GENERAL ANESTHETIC AGENTS

General anesthesia is a reversible state of unconsciousness as a result of pharmacological agents inhibiting the neuronal impulses in areas of the CNS. It can be administered by inhalation or by injection. The most commonly used route is IV injection, which provides rapid (10–20 seconds) loss of consciousness. This rapid induction avoids the excitatory stage (Stage 3), thus reducing the complications associated with general anesthesia. General anesthesia induces CNS depression that is characterized by analgesia, amnesia, and loss of consciousness without serious respiratory compromise. This type of anesthesia historically was used for any type of general surgery. Now it is primarily used for head and neck, thoracic, extensive abdominal surgery, and in certain situations involving clients who are unable to cooperate with the administration of other types of anesthesia.

The advantages of using general anesthesia include:

- Makes no psychosocial demand on the client
- Allows for adequate muscle relaxation for prolonged periods of time
- Facilitates complete control of the airway, breathing, and circulation by the anesthesiologist
- Permits simultaneous surgeries to take place in widely separated areas of the body
- Available for use in clients with sensitivity to local anesthetic agent
- Can be administered to the client in the supine position

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# Table 11-1 Changes in Body Function during Stages and Planes of Anesthesia

<table>
<thead>
<tr>
<th>BODY FUNCTION</th>
<th>STAGE 1 (ANALGESIA)</th>
<th>STAGE 2 (EXCITEMENT OR DELIRIUM)</th>
<th>STAGE 3 (SURGICAL ANESTHESIA)</th>
<th>STAGE 4 (MEDULLARY PARALYSIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plane 1</td>
<td>Plane 2</td>
<td>Plane 3</td>
<td>Plane 4</td>
</tr>
<tr>
<td>Consciousness</td>
<td>Conscious</td>
<td>Lost</td>
<td>Unconscious</td>
<td>—</td>
</tr>
<tr>
<td>Respiration</td>
<td>Normal or slightly increased</td>
<td>Rapid and irregular</td>
<td>Regular</td>
<td>Normal</td>
</tr>
<tr>
<td>Pupil size</td>
<td>Moderately dilated</td>
<td>Widely dilated</td>
<td>Somewhat constricted</td>
<td>Normal or slightly dilated</td>
</tr>
<tr>
<td>Eye movement</td>
<td>Normal</td>
<td>Rapid</td>
<td>Absent</td>
<td>—</td>
</tr>
<tr>
<td>Corneal reflex</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
<td>—</td>
</tr>
<tr>
<td>Pharyngeal (gag) reflex</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
<td>—</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Increased</td>
<td>Increased</td>
<td>Decreased or normal</td>
<td>Increased</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Normal or slightly elevated</td>
<td>Elevated</td>
<td>Normal</td>
<td>Decreased</td>
</tr>
<tr>
<td>Skeletal muscle response</td>
<td>Normal tone</td>
<td>Increased tone</td>
<td>Some muscle relaxation</td>
<td>Complete muscle relaxation</td>
</tr>
<tr>
<td>Note:</td>
<td>This stage suitable for some dental procedures and second stage of labor.</td>
<td>Incontinence, laryngospasm, and other reflex responses may occur.</td>
<td>Most surgical procedures are done while the client is in Plane 2 or just passing into Plane 3.</td>
<td>This is the toxic stage of anesthesia. Respiratory collapse is followed by complete circulatory collapse.</td>
</tr>
</tbody>
</table>

Some characteristics may be different when using different anesthetic agents.
Anesthetics Administered by Intravenous Injection

These agents are generally used for induction of anesthesia before balancing the anesthesia with inhaled agents. They provide a rapid sedative action and are very helpful for clients who might become apprehensive when a mask is placed over their face. The duration of IV anesthetics is short, so they are augmented with inhalation anesthetics, such as nitrous oxide as well as oxygen. They also allow for the administration of lower concentrations of inhalation anesthetics. Anesthetic induction with these agents occurs rapidly. Commonly used classes of injectable anesthetics are the ultrashort-acting nonbarbiturates, such as propofol, and barbiturates, such as thiopental sodium and methohexital sodium. Because of their brief duration of action, these agents are frequently used for minor surgical procedures. When administered intravenously, they are excellent for the induction and maintenance of surgical anesthesia. They are, however, poor analgesics and generally are used in combination with inhaled anesthetics. Barbiturates tend to depress the circulatory and respiratory systems, as well as the CNS. This may be hazardous for clients with preexisting cardiovascular or respiratory disease. General anesthetics are potentiated by alcohol and CNS depression-producing agents that with concurrent use increase the risk of respiratory depression and hypotension.

Ketamine HCl (Ketalar) is a nonbarbiturate, injectable general anesthetic that has been used for more than 40 years. Unlike the barbiturates, ketamine does produce both general anesthesia and extensive analgesia. In addition to its analgesic qualities, ketamine is a rapid-acting general anesthetic characterized by normal pharyngeal-laryngeal reflexes, normal or slightly enhanced skeletal muscle tone, cardiovascular and respiratory stimulation, and occasional transient and minimal respiratory depression. Ketamine produces anesthesia within 30 seconds following injection. It permits smoother anesthetic induction and supplements low-potency inhaled anesthetics such as nitrous oxide. Its duration of action is approximately 45 minutes, with a half-life of 10–15 minutes. Ketamine has found wide acceptance for use in diagnostic and surgical procedures that do not require skeletal muscle relaxation. These indications for use include debridement, painful dressing changes, and skin grafting in burn clients; neurodiagnostic procedures such as pneumonencephalograms, ventriculograms, myelograms, and lumbar punctures; diagnostic and operative procedures of the eye, ear, nose and mouth, including dental extractions; diagnostic and operative procedures of the pharynx, larynx, or bronchial tree; cardiac catheterization; sigmoidoscopy and minor surgery of the anus and rectum, and circumcision; gynecological procedures such as dilatation and curettage; and orthopedic procedures (e.g., closed reductions, manipulations, femoral pinning, amputations, and biopsies). It is indicated as an anesthetic for high-risk clients with respiratory and cardiac dysfunction.

Although ketamine may be used either intramuscularly or intravenously, most often it is administered intravenously either as monotherapy, in conjunction with preanesthetic sedation, or prior to the use of inhaled anesthetics. Some clients may experience emergence reactions consisting of hallucinations, confusion, excitement, and irrational behavior. Such reactions may last a few hours but may recur up to 24 hours postoperatively. The use of lower dosages and intravenous (IV) midazolam or diazepam may reduce the severity of such reactions. Ketamine use is contraindicated in clients with severe hypertension because ketamine causes an elevation of blood pressure and tachycardia if used alone for anesthesia. If used concurrently with barbiturates or opioids, recovery time from anesthesia may be prolonged.

Etomidate (Amidate) is a hypnotic nonbarbiturate, injectable anesthetic for use in adults and children 10 years old and older. It acts like the injectable barbiturates by producing rapid induction of anesthesia (usually within 60 seconds following injection), but it has a duration of only 3–5 minutes and has no analgesic effects. It does not, however, produce significant cardiovascular or respiratory depressant effects or the “hangover” effects characteristic of barbiturates (Ignatavicius & Workman, 2010). It can cause pain at the injection site, and, although rare, can cause laryngospasm. It is approved only for intravenous administration and is intended for prolonged infusion. If fentanyl is administered prior to induction, the immediate recovery period may be shortened (Gahart & Nazareno, 2011). Midazolam HCl (Versed) is an injectable benzodiazepine chemically related to diazepam (Valium) and other benzodiazepines. When administered intravenously, midazolam HCl induces anesthesia within 1.5–2.5 minutes, depending on whether an opioid agent has been administered at the same time. It commonly is administered with fentanyl citrate for more rapid induction. The drug is administered intravenously to produce preoperative sedation or to produce conscious sedation prior to short diagnostic or endoscopic procedures. In addition, midazolam produces amnesia of the event in most clients (MedlinePlus, 2011).

Propofol (Diprivan) is classified as a nonbarbiturate (alkylphenol) and is one of the most popular IV general anesthetic agents. It is approved for use in more than 50 countries. Administered intravenously in conjunction with other anesthetics to induce and maintain general anesthesia, its hypnotic effect is generally produced within 40 seconds after administering a rapid IV bolus dose. It is 98% protein bound. Anesthesia can be maintained by administering propofol by infusion or by intermittent IV bolus injection. Although its anesthetic action has a short duration, levels of propofol may remain in the body for 2–24 hours following administration (FDA, 2008a).
Propofol is a respiratory depressant, and decreases cerebral blood flow, cerebral metabolic oxygen consumption, and intracranial pressure as well as increasing cerebrovascular resistance. To achieve this, it acts by potentiating GABA-A receptors, resulting in a slowing of channel closing time and blocking sodium channels. Recent research indicates that the endocannabinoid system may significantly contribute to propofol’s anesthetic action. Historically it was believed that propofol had no analgesic qualities (Miner & Burton, 2007), but more recent studies indicate that clients receiving propofol anesthesia experience less pain postoperatively (Cheng, Yeh, & Flood, 2008).

As propofol is an emulsion, it must not be used if there is evidence of separation of the phases of the emulsion. Although the drug is compatible with many IV diluting fluids, it should only be administered into a running IV catheter. It is characterized by rapid induction and recovery, and can cause vein irritation (especially in small veins) at the site of the injection, hypotension, and transient apnea during induction and drowsiness and dizziness during recovery. Although serious adverse effects are rare, it can cause propofol infusion syndrome (PrIS) involving severe metabolic acidosis, rhabdomyolysis, hyperkalemia, acute renal failure, and cardiovascular collapse. Propofol is contraindicated in clients with allergies to eggs or soy products. Dose adjustment may be required for individuals with liver or renal dysfunction, or seizure disorders. Also, the emulsion vehicle of this agent may aggravate disorders in lipid metabolism (e.g., hyperlipidemia) or pancreatitis. Drug interactions are characteristic of injectable general anesthetics, and droperidol may compete with propofol for binding sites in the chemoreceptor trigger zone, decreasing its effectiveness.

Fospropofol (Luseda) is a water-soluble prodrug approved by the FDA in late 2008 (FDA, 2011). It is classified as a sedative/hypnotic and is rapidly metabolized by alkaline phosphatase to form propofol. This new formulation has properties believed to be superior to propofol in that it is more readily injectable and may not cause the pain at the injection site characteristic of propofol injection. It produces sedation with minimal excitations, decreases intraocular pressure and systemic vascular resistance, and suppresses cardiac output and respiratory drive. Like propofol, fospropofol is 98% protein bound (FDA, 2010a).

Thiopental sodium (Pentothal) is a barbiturate general anesthetic that depresses the CNS to produce hypnosis and anesthesia without analgesia. Hypnosis occurs within 10–40 seconds, and muscle relaxation occurs approximately 30 seconds following loss of consciousness. It can cause depression of respiratory and cardiac function. Respiratory depression is dose related and is potentiated by opioid premedication. It depresses laryngeal reflexes with deep levels of anesthesia. Thiopental must not be mixed in solution with succinylcholine, tubocurarine, or other drugs with an acid pH (Gahart & Nazareno, 2011). Dosage adjustments should be made for older adults. In addition to its use in anesthesia, it is used in the treatment of traumatic brain injury (TBI) to decrease intracranial pressure and cerebral ischemia (Huyhn, Mabasa, & Ensom, 2009).

Methohexital sodium (Brevital) is a rapid, ultra-short-acting barbiturate general anesthetic agent. It may be administered by infusion or intermittent injection in adults and rectal or intramuscular for children older than 1 month of age (FDA, 2008b). The indications for its use include intravenous induction of anesthesia prior to the use of other general anesthetic agents; intravenous induction of anesthesia as an adjunct to subpotent inhalational anesthetic agents (such as nitrous oxide in oxygen) for short surgical procedures; for use with other parenteral agents, usually narcotic analgesics; to supplement subpotent inhalation anesthetic agents (such as nitrous oxide in oxygen) for longer surgical procedures; and as intravenous anesthesia for short surgical, diagnostic, or therapeutic procedures associated with minimal painful stimuli (FDA, 2008). Adverse effects include bradycardia, hypotension, anxiety, coughing, drowsiness, flushing, headache, hiccups, pruritus, muscle twitching, nausea, vomiting, pain at the injection site, restlessness, and increased oral secretions. Other more serious adverse effects also can occur. Concurrent use of amiodarone, droxidopa, ethanol, opioid analgesics (e.g., codeine), or sodium oxybate (GHB) increase the risk of adverse effects, and use with other barbiturates or phenytoin may decrease the effectiveness of methohexital.

The greatest advantages in the use of IV anesthetics include:

- Rapidity and ease of action
- Relative inability to stimulate salivation
- Lower incidence of nausea and vomiting than with inhaled anesthetics
- Nonvolatile nature

Their major disadvantages include:

- Ability to cause apnea, coughing, laryngospasm, and bronchospasm
- Difficulty in controlling adverse effects because the drug cannot be removed from the bloodstream
- Possibility of drug interactions

Table 11-2 lists the properties of the injectable general anesthesia agents used in the United States.

**Anesthetics Administered by Inhalation**

Certain drugs that are gases or volatile liquids at room temperature are administered by inhalation in combination with air or oxygen. These usually are used in conjunction with IV general anesthetics (for rapid induction) to provide prolonged anesthesia. They may be administered in two ways: semiclosed method and closed method.

**Semiclosed Method**

A gas mixture from a reservoir containing the anesthetic is provided through a mask that is connected to it. Exhaled gases escape through a system of valves to the environment, so that rebreathing of the anesthetic gas mixture is prevented. Although this technique does provide good control of the anesthetic dose, the expulsion of exhaled gases into the environment may create a hazardous situation.

**Closed Method**

This method can be used with volatile liquids or gases. It consists of a completely closed system, generally as part of an anesthetic machine that fits over the face of the client and provides an anesthetic gas mixture that can be carefully regulated by the anesthetist by the use of accurate flowmeters. By a complex process, carbon dioxide and moisture can be removed from exhaled gases and may be rebreathed. Such a closed system enables the anesthetist to monitor the client carefully and control the anesthesia, while preserving the safety of those working around the client as well.
### Table 11-2 General Anesthetics Administered by Injection

**Note:** Carefully monitor vital signs.
Ensure physical safety and patency of airway.
Any CNS depressants used concommitantly with IV general anesthetics increase the risk of respiratory and cardiovascular depression (●) indicates Canadian trade name.

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ROUTE(S)</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
</table>
| etomidate (et-OH-TOM-ih-dayt) (Amidate) | IV       | Most common: pain at venous injection site; transient skeletal muscle movements (myoclonus, averting movements, eye movements), slight elevation of arterial PaO₂ with induction | Administration of fentanyl, midazolam, or diazepam before induction decreases skeletal muscle movements; if used in combination with etomidate, succinylcholine-induced dysrhythmias may occur (Gahart & Nazareno, 2011) | • Induces anesthesia within 1.5–2.5 minutes.  
  • No “hangover” effect.  
  • Monitor level of consciousness and airway when client admitted to postanesthesia care unit (PACU). |
| fentanyl citrate and droperidol (FEN-tah-nil SIH-trayt and droh-PER-ih-dohl) (Innovar) | IV       | Respiratory depression (fentanyl); serious prolonged QT interval and torsade de pointes, chills, dizziness, hallucinations, hypotension, restlessness, shivering, tachycardia (droperidol); in combination form: hypotension, decreased pulmonary artery pressure | Should not use with other agents that can cause QT prolongation including class IA, class III, antidysrhythmics/antiarrythmics, bretylium, dofetilide, ibutilide, sotalol, anticonvulsants, antidepressants, antihistamines, antimalarials, antineoplastics, azole antifungals, benzodiazepines, or IV opioids; concurrent use with volatile anesthetics, benzodiazepines, or IV opioids can cause prolonged QT syndrome; concurrent use with diuretics, laxatives, mineralocorticoids may alter electrolyte balance (hypokalemia, hypochloremia, hypomagnesemia); concurrent use with vasodilating agents can cause orthostatic hypotension (Gahart & Nazareno, 2011) | • Anesthesia adjucnt to prevent perioperative nausea and vomiting should be administered.  
  • Because of potential dysrhythmias associated with droperidol, this is only used when other drugs have been ineffective.  
  • Currently not manufactured in the United States (FDA, 2011).  
  • Although technically not an anesthetic, this combination provides potent analgesic and tranquilizing action without resulting in loss of consciousness.  
  • If postoperative analgesia is required, the dosage of the analgesic should be decreased. Postanesthesia effects may include hypotension, emergence delirium, nausea, vomiting, and shivering. |
| fospropofol (fos-proe-POE-fol) (Lusedra) | IV       | Paresthesia, hypotension, pruritus, hypoxia                                                                                                                                                                | Additive depressive effects if used concurrently with benzodiazepines, opioid analgesic agents (FDA, 2010a) | • Classified as sedative/hypnotic.  
  • Modify dose in older adults.  
  • Supplemental oxygen must be used.  
  • Continuously monitor with pulse oximetry. |
<table>
<thead>
<tr>
<th>Anesthetic Agent</th>
<th>Route(s)</th>
<th>Side Effects</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ketamine HCl</strong></td>
<td>IM, IV</td>
<td>Occasional transient and minimal respiratory depression; emergent reactions with delirium and hallucinations up to 24 hours following administration; hypertension, tachycardia</td>
<td>Supplemental doses only for clients with purposeful movements. Monitor level of consciousness and airway when client admitted to PACU. Produces anesthesia within 30 seconds of IV injection. Duration approximately 45 minutes. Indicated for procedures that do not require skeletal muscle relaxation. May produce an increase in blood pressure. IV administration should occur over a minimum of 60 seconds. Incompatible with barbiturates; use separate syringes. To minimize emergence reactions, place client in quiet environment and disturb as little as possible; during emergence, use benzodiazepines.</td>
</tr>
<tr>
<td><strong>Methohexital Sodium</strong></td>
<td>IV</td>
<td>Bradycardia, hypotension, anxiety, coughing, flushing, headache, hiccups, itching, muscle twitching, nausea, vomiting, pain at the injection site, restlessness, increased oral secretions</td>
<td>Solutions of drug must be clear and colorless. Do not mix solutions of the drug with acidic solutions. Reconstituted solution is stable for 24 hours at room temperature.</td>
</tr>
<tr>
<td><strong>Midazolam HCl</strong></td>
<td>IM, IV</td>
<td>Cardiorespiratory adverse effects occur more often in clients undergoing procedures involving the upper airway; coughing; drowsiness; fluctuations of vital signs; headache; hiccups; nausea; vomiting; nystagmus; irritation, redness, pain, induration at IV injection site (Gahart &amp; Nazareno, 2011)</td>
<td>Do not use in clients with open-angle glaucoma unless the client is receiving appropriate glaucoma therapy. Contraindicated in clients with acute narrow-angle glaucoma. Administer drug slowly.</td>
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</tbody>
</table>

*Continues*
### Table 11-2 General Anesthetics Administered by Injection (Continued)

See Note at beginning of table.

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ROUTE(S)</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>propofol</td>
<td>IV</td>
<td>Although serious adverse effects are rare, it can cause propofol infusion</td>
<td>Droperidol may compete with propofol for binding sites in the chemoreceptor</td>
<td>• Product is an emulsion. Shake well before use. If phase separation is evident,</td>
</tr>
<tr>
<td>(PROH-poh-fohl)</td>
<td></td>
<td>syndrome (PrIS) involving severe metabolic acidosis, rhabdomyolysis,</td>
<td>trigger zone, decreasing its effectiveness; premedication with parenteral opioids</td>
<td>discard product.</td>
</tr>
<tr>
<td>(Diprivan)</td>
<td></td>
<td>hyperkalemia, acute renal failure, and cardiovascular collapse; the emulsion</td>
<td>can decrease induction dose requirements of propofol; benzodiazepines, barbiturates,</td>
<td>• Protect from light.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vehicle of this agent may aggravate disorders in lipid metabolism (e.g.,</td>
<td>sedative/hypnotics may increase propofol effects (FDA, 2008a)</td>
<td>• Monitor client for apnea bradycardia.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hyperlipidemia) or pancreatitis, hypotension (FDA, 2008a)</td>
<td></td>
<td>• Must be injected into a running IV.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Propofol is contraindicated in clients with allergies to eggs or soy products.</td>
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<td></td>
<td></td>
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<td></td>
<td>• Use of larger veins of the forearm or antecubital fossa can decrease pain</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>associated with infusion (FDA, 2008a).</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• May require dose adjustment in individuals with liver or renal dysfunction, or</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>seizure disorders.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Must maintain strict asepsis during all handling of this agent (FDA, 2008a).</td>
</tr>
<tr>
<td>thioental sodium</td>
<td>IV, rectal</td>
<td>With average dose: depression, dermatitis, facial edema, hypotension, fever,</td>
<td>Must not be mixed in solution with succinylcholine, tubocurarine, or other drugs</td>
<td>• Vital signs must be monitored every 3–5 minutes.</td>
</tr>
<tr>
<td>(thy-oh-PEN-tal SOH-dee-um)</td>
<td></td>
<td>hypoventilation, thrombocytopenia purpura</td>
<td>with an acid pH; anesthetic effects potentiated by probenicid, sulfisoxazole</td>
<td>• Hypnosis produced 30–40 seconds after IV injection or 8–10 minutes after rectal</td>
</tr>
<tr>
<td>(Pentothal)</td>
<td></td>
<td></td>
<td>(Gahart &amp; Nazareno, 2011)</td>
<td>administration.</td>
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<td></td>
<td></td>
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<td></td>
<td>• Solutions for IV administration must be used within 24 hours of preparation and</td>
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<td></td>
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<td>should be refrigerated.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Test dose should be given to assess client response to drug.</td>
</tr>
</tbody>
</table>
General anesthetics administered by inhalation, because of their action on many organ systems, may produce a number of adverse effects. Some of these effects are minor, but others may be serious. Many gaseous anesthetics may produce nausea and vomiting because of their action on the CNS. In addition, some agents produce alterations of cardiac rhythm, alteration of respiratory rate and cardiac output, and lower blood pressure. Several anesthetics may alter liver function and may cause the development of hepatotoxicity.

Nitrous oxide (N₂O) is the most common gaseous anesthetic agent used. It has been in use in dentistry since the 1800s and has anxiolytic, amnesic, and analgiesic actions. The advantages of nitrous oxide sedation are its rapid onset and rapid recovery, “both typically less than 5 minutes” (Farrell et al., 2008, p. 30). It is administered in combination with oxygen. It is a colorless, odorless, and nonirritating gas that provides analgesia equivalent to 10 mg of morphine sulfate and only occasional episodes of nausea and vomiting.

It provides rapid induction and recovery and is useful in shorter procedures. Minimal respiratory and cardiovascular depression occurs with nitrous oxide. The two most prominent disadvantages to its use are that (1) it is a fairly weak anesthetic and that (2) hypoxia can occur at high concentrations or if the client does not receive oxygen support.

Volatile liquids have been used for their anesthetic qualities for more than 150 years. Some of those currently in use include desflurane, enfurane (Ethrane), halothane (Fluothane), isoflurane (Forane), and sevoflurane (Sevorane). These halogenated volatile ethers are associated with the potential for cardiorespiratory depression. Nausea, vomiting, shivering, and hypotension are common adverse effects of this drug classification. In addition, these agents sensitize the heart to the effects of catecholamine agents, so concurrent use should be avoided. Use of MAO inhibitors concurrently with any of these agents increases the risk of alterations in blood pressure (hypotension, hypertension). The term volatile is a chemically based description as these agents are neither explosive (in usual doses) nor flammable.

Desflurane (Suprane) was approved in 1992 and is indicated for both induction and maintenance of general anesthesia for inpatient and outpatient surgery (FDA, 2010b, 2011). It is not recommended for induction in pediatric clients because of the high incidence of moderate to severe upper airway complications. Its onset of anesthesia is 2–4 minutes. The most common adverse effects of desflurane are coughing, nausea, vomiting, and breath-holding, and this agent can cause hepatotoxicity. Drug interactions are categorized according to potentiating the actions of three classifications of agents: (1) the hypotensive effects of amiodarone, antihypertensive agents, diuretics, beta-adrenergic blocking agents; (2) the increased pulse rate and decreased blood pressure effects of sympathomimetics in some clients; and 3) CNS depressants. In addition, agents used to treat myasthenia gravis (cholinergics) decrease the neuromuscular blocking activity of desflurane.

Enflurane (Ethrane) is one of the older inhalation anesthetics (approved in 1972). It provides for both rapid induction and rapid recovery (FDA, 2010c). In addition to the adverse effects characteristic of these agents (see desflurane), enflurane lowers the seizure threshold and may not be the most appropriate general anesthetic for clients with seizure disorders. Shivering, nephrotoxicity (in addition to hepatotoxicity), and intraoperative hyperkalemia have been reported in clients receiving enfurane. Induction and recovery are rapid.

Halothane is another volatile halogenated ether indicated for the induction and maintenance of general anesthesia. Current information from the FDA (2011) indicates that halothane is not manufactured in the United States; however, it still retains its FDA approval. This information is updated daily, and this status may change. The high incidence of halothane-induced hepatotoxicity, some life-threatening, may be the reason for its decline in use in the United States. Its use in third world countries continues, perhaps because of its lower cost compared to other related agents. Halothane provides rapid induction and recovery. It progressively depresses respirations (reduced tidal volume and alveolar ventilation) with resultant tachycardia, lowers blood pressure, bradycardia, obtunds pharyngeal and laryngeal reflexes, and causes bronchodilation. In deep anesthesia with halothane, hypoxia, acidosis, and aspnea can occur.

Two primary types of hepatotoxicity are associated with halothane administration. Type I hepatotoxicity is benign, self-limiting, and occurs in 25–30% of clients receiving halothane. This type is not associated with clinically evident hepatocellular disease. “It does not occur following administration of other volatile anesthetics because they are metabolized to a lesser degree and by different pathways than halothane” (Peralta, Poterack, & Guzofski, 2010p. 1). Halothane hepatitis (Type II hepatotoxicity) “is associated with massive centrilobular liver necrosis that leads to fulminant liver failure; the fatality rate is 50%” (p. 1). The incidence of Type II hepatotoxicity with halothane is one in 6,000–35,000 clients. According to the World Health Organization, halothane is one of the top 10 most likely medications to cause fatal hepatic necrosis worldwide (p. 1). Although this type of hepatotoxicity is possible with volatile anesthetics other than halothane, the occurrence is rare.

Isoflurane (Forane) is one of the oldest of the halogenated volatile general anesthetics, having been in use since its approval in 1972. Isoflurane is always administered with air and/or oxygen. Because of its pungent odor, it most often is used for maintenance of anesthesia induced by another agent. It acts by binding to GABA receptors, glutamate receptors, and glycine receptors; it also inhibits conduction in activated potassium channels.

Sevoflurane (Sejourn, Ultane) is the most recent in this group of volatile liquids, being approved in 1995. It provides all of the benefits of desflurane, but with less coughing (one of the main adverse effects of desflurane) experienced by the client. It is indicated for the induction and maintenance of general anesthesia in adult and pediatric clients. Sevoflurane is not associated with hepatotoxicity, but occasional elevations in liver enzymes have occurred. The most common adverse effect is nausea; during the maintenance phase, hypotension has been noted. It has fewer drug interactions than any of the other halogenated inhalation agents and is compatible with barbiturates, propofol, and other commonly used anesthetic agents.

Table 11-3 provides a comparison of the properties of general anesthetics administered by inhalation.

**Balanced Anesthesia**

Balanced anesthesia is the term used to describe a combination of inhalation and IV medications used to obtain specific anesthesia results, and it is the most commonly used practice of administering general anesthesia. Previously, this term referred to the use of a number of inhalation agents in combination or
### TABLE 11-3 General Anesthetics Administered by Inhalation

**Note:** Carefully monitor vital signs of all postanesthesia clients.
Respiratory depression can result from inhalation anesthesia. Clients must be continuously monitored.
CNS depressants used concurrently increase the risk of respiratory depression.
Halogenated volatile anesthetics sensitize the heart to the effects of catecholamine agents, so concurrent use should be avoided.
MAO inhibitors should be discontinued 10–14 days prior to use of halogenated anesthetics. Monitor closely for blood pressure changes.
Halogenated inhalation anesthetics may trigger malignant hyperthermia. Dantrolene has been used to prevent and treat this condition (see Chapter 29).
Ensure the physical safety and patency of airway in all persons who are receiving or who have received anesthetic agents.

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ROUTE(S)</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
</table>
| desflurane            | Volatile liquid | Coughing, nausea, vomiting, apnea, breath-holding, tachycardia, hepatic toxicity, peripheral vasodilation, depresses myocardial function, dose-dependent hypotension, airway irritation (FDA, 2010b) | Anesthetic requirement may be increased in presence of chronic alcohol use; desflurane increases the hypotensive effects of amiodarone, antihypertensive agents, diuretics, beta-adrenergic blocking agents; agents used to treat myasthenia gravis (cholinergics) decrease the neuromuscular blocking activity of desflurane; in some clients taking sympathomimetics that increase the heart rate and blood pressure may experience exaggeration of these effects (FDA, 2010b) | • Avoid use in clients in whom increases in heart rate or blood pressure are not desired.  
• Not for use in pediatric clients.  
• Administer only using special vaporizer designed for desflurane administration. |
| enflurane             | Volatile liquid | See desflurane; lowers seizure threshold, malignant hyperthermia, nephrotoxicity, intraoperative hyperkalemia, muscle group twitching or jerking (FDA, 2010c) | See desflurane; action of nonpolarizing neuromuscular blocking agents is potentiated by enflurane (FDA, 2010c) | • May provide moderate muscle relaxation.  
• Can sensitize heart to action of sympathomimetic agents (e.g., epinephrine).  
• May cause renal damage or may damage impaired kidneys due to release of fluoride from drug.  
• Not flammable.  
• Should be used with caution in clients who may be more susceptible to cortical stimulation produced by enflurane. |
| **halothane**  
(HAL-oh-thayn)  
(Fluothane,  
Somnothane 🌿) | **Volatile liquid** | **Hepatic necrosis, cardiac arrest, hypotension, respiratory arrest, cardiac arrhythmias, hyperpyrexia, shivering, nausea, emesis** | Use with theophylline bronchodilators increases the risk of tachydysrhythmias; use with antihypertensives and diuretics increases the risk of potentially fatal hypotension; use with fluoroquinolones can cause prolongation of QT interval; use with MAO inhibitors increases the risk of alterations in blood pressure (hypotension, hypertension); avoid use with Class 1A antidysrhythmics because of risk of ventricular arrhythmia  
- Most metals are corroded or tarnished by halothane.  
- Halothane is a poor analgesic and must often be supplemented with analgesics during surgery.  
- Not flammable.  
- May cause changes in heart rate and rhythm.  
- May cause potentially fatal halothane hepatitis (Peralta et al., 2008).  
- Atropine may be used to reverse bradycardia.  
- Provide for warmth as shivering is common during recovery period. |
| **isoflurane**  
(eye-soh-FLUR-ayn)  
(Forane) | **Volatile liquid** | **Shivering, nausea, vomiting, paralytic ileus, respiratory depression, hypotension, cardiac dysrhythmias, hepatotoxicity (rare)** | Avoid use with Class 1A antidysrhythmics because of risk of ventricular dysrhythmias; concurrent use of opioids decreases the needed amount of inhalation agents; calcium channel blockers may potentiate the cardiac depressant and hypotensive effects of isoflurane; potentiates the muscle relaxant effect of all muscle relaxants, especially non-depolarizing muscle relaxants  
- Monitor respiration carefully while client receives this drug. |
| **nitrous oxide**  
(NIGH-trus OX-eyed)  
(laughing gas) | **Gas** | **Drowsiness; rare: nausea; mild tingling of hands and feet; warm sensations** | When used with opioids and/or midazolam, diazepam, reduce dose of nitrous oxide  
- Most popular anesthetic gas.  
- Has anxiolytic, amnesic, and analgesic effect (Farrell et al., 2008).  
- Since it is a weak anesthetic, nitrous oxide is generally used in combination with other anesthetics.  
- 30–70% oxygen should be administered with nitrous oxide to prevent hypoxia.  
- Cylinders containing nitrous oxide are always blue.  
- Not explosive. |
| **sevoflurane**  
(seh-VO-FLUR-ayn)  
(Sojourn, Ultane) | **Volatile liquid** | **Nausea, vomiting, apnea, hypotension, occasional changes in hepatic function, transient elevation in serum glucose, seizures, malignant hyperthermia (FDA, 2010d)** | Anesthetic requirement may be increased in presence of chronic alcohol use; it is compatible with barbiturates, propofol, and other commonly used general anesthetics; potentiates the effects of neuromuscular blocking agents (FDA, 2010d)  
- Rapid induction, recovery, awakening.  
- Causes less coughing and laryngospasm than with desflurane. |
various combinations of IV anesthetic medications balanced to provide complete general anesthesia while decreasing the adverse effects and potential for the client to reach Plan 4 medullary paralysis. Balanced anesthesia provides an effective and controlled level of anesthesia that is safe especially for older adults and those at high risk for pulmonary problems.

The characteristics of balanced anesthesia include providing analgesia, hypnosis, amnesia, muscle relaxation, and relaxation of the neurological reflexes with only minimal alteration in their physiological function. An example of balanced anesthesia is using midazolam HCI (Versed) intravenously as a premedication and for its amnesic qualities, a barbiturate intravenously for anesthesia induction, nitrous oxide by inhalation for amnesia, IV morphine sulfate for analgesia, and IV fentanyl citrate or pancuronium for additional muscle relaxation. Other combinations for balanced anesthesia also are used and may include 70% nitrous oxide for anesthesia induction and maintenance and 30% oxygen to maintain oxygen saturations within prescribed parameters, an opioid (morphine sulfate or fentanyl citrate), and a muscle relaxant. The decisions concerning the use of balanced anesthesia and the agents used are made by the anesthesiologist in collaboration with the surgeon and the client.

### Adjuncts to General Anesthesia

Most clients can be anesthetized quickly and safely without passing through each of the stages previously described. This is done by the judicious use of medications before, during, and following anesthesia, as well as by the proper combination of general anesthetics.

A number of drugs may be used in conjunction with general anesthetics to enhance the actions of the anesthetic or to provide another useful pharmacological action. Some of these agents (e.g., sedatives, analgesics, anticholinergics, and neuromuscular blocking agents) may be used before, during, and after surgical procedures, as their actions facilitate the induction and maintenance of the anesthetized state and help prevent unpleasant adverse effects as the client enters the recovery stage.

Preanesthetic medications are used prior to the administration of an anesthetic to facilitate induction of anesthesia and to relieve anxiety and pain. They may also be used to minimize some of the undesirable aftereffects of anesthetics, such as excessive salivation, bradycardia, nausea, and vomiting. To accomplish these objectives, several drugs are often used at the same time. The following drugs are commonly used as preanesthetic medications: sedative-hypnotics, antianxiety agents, opioid analgesics, and anticholinergics.

### Sedative-Hypnotics

The most common agents used to produce sedation are the benzodiazepine anxiolytics. These include diazepam (Valium), lorazepam (Ativan, Novo-Lorazem), and midazolam (Versed), which is the most frequently used of these agents. These all have a variety of effects including sedative, hypnotic, antianxiety, muscle relaxation, and amnesic effects. They provide a feeling of detachment without loss of consciousness. Any of these medications may be used as part of balanced IV anesthesia or conscious sedation. Conscious sedation frequently is used for diagnostic tests such as endoscopy and colonoscopy in conjunction with an opioid analgesic.

### Opioid Analgesics

Opioid analgesics, such as morphine sulfate, fentanyl (Sublimaze), alfentanil, and sufentanil (Sufenta), are commonly used to augment inhalation anesthesia as well as being primary agents in regional anesthesia. These agents provide analgesia to counteract preoperative and operative pain that would interfere with smooth induction of anesthesia. They also reduce the amount of anesthetic required to produce surgical anesthesia. Fentanyl is particularly useful in brief procedures because of its short duration. Morphine sulfate provides 4–6 hours of analgesic effect.

In lower doses, fentanyl and sufentanil result in analgesia; however, in higher doses, they can be used as anesthetic agents. Fentanyl, as noted in Chapter 10, has 100 times the potency of morphine, and sufentanil is 5–7 times as potent as fentanyl in producing rapid induction of anesthesia. Following the use of these agents, close monitoring of client respirations and maintenance of a patent airway are necessary due to the risk for respiratory depression associated with their use. Sufentanil frequently is used for cardiac surgery involving an open-chest approach, and clients need to be monitored for bradycardia and decreased cardiac output following the use of this agent.

### Anticholinergics

These belladonna alkaloids (e.g., atropine, scopolamine) diminish salivation and can prevent laryngospasm and reflex slowing of the heart (bradycardia) during general anesthesia. They are not used as frequently as they were because of the risk of cardiac rhythm changes (tachycardia). Although they must be used with great caution in clients with fever, because they depress the sweating mechanism, anticholinergics have been found to be relatively safe to use in most surgical clients; however, they are generally not used in clients before open heart surgery because of the cardiac effects of these agents, nor are they appropriate premedications for clients with myasthenia gravis.

### Neuromuscular Blocking Agents

Neuromuscular blocking agents, such as succinylcholine chloride and pancuronium bromide (Pavulon), are used to relax the jaw and throat muscles immediately following induction so an endotracheal tube can be placed to maintain a patent airway and facilitate alveolar ventilation during surgery. Furthermore, these agents are used throughout the surgical procedure when complete relaxation of the abdominal muscles is desired.

Neuromuscular blocking agents act by interfering with nerve impulse transmission at the neuromuscular junction of skeletal muscles. They are administered intravenously in small amounts and may cause circulatory compromise and respiratory muscle paralysis during the surgery. As a result, some means of artificially ventilating the client must be provided. They are discussed in more detail in Chapter 29.

Table 11-4 lists the drugs commonly used as adjuncts to general anesthesia currently in clinical use. Chapter 29 reviews the properties of the neuromuscular blocking agents.

### REGIONAL ANESTHESIA

Regional anesthetics are drugs that reversibly block nerve conduction when applied locally to nerve tissue. The extent of their action is dependent on the area to which they are applied, the drug concentration used, and the duration of contact with nerve tissue. A number of different types of regional anesthesia currently are in use. The most common of these are summarized in
### Table 11-4  Drugs Used as Adjuncts to General Anesthesia

**Note:** Always record name and amounts of preanesthetic drugs given to the client.  
Provide for the safety of clients who have received these drugs (side rails up, bed in low position if preoperative). 
Other CNS depressants (benzodiazepines, antidepressants, antihistamines, barbiturates, haloperidol, inhalation anesthetics, opioids, phenothiazines used concurrently with adjunct medications that cause CNS depression increase risk of respiratory depression. Closely monitor client.  
Monitor vital signs.  
(*) indicates Canadian trade name. 

<table>
<thead>
<tr>
<th>DRUG</th>
<th>PHARMACOLOGICAL CATEGORY</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
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</table>
| **alfentanil HCl**<br>(al-FEN-tah-nil hy-droh-KLOR-eyed) (Alfenta) | Opioid analgesic | Prolonged recovery in clients with impaired liver function and in older adults; bradycardia, hypotension, respiratory depression, agitation, blurred vision, bradypnea, chest wall rigidity, headache, hypercapnia, hypersensitivity reaction, hypertension, skeletal muscle rigidity, nausea, vomiting, postoperative confusion, shivering, sedation; increased intracranial pressure, delayed gastric emptying (Gahart & Nazareno, 2011) | Diazepam administered just prior to or in conjunction with high doses of alfentanil causes vasodilation, hypotension, and delayed recovery; cimetidine, erythromycin decrease alfentanil clearance; increases respiratory depression associated with neuromuscular blocking agents (pancuronium, succinylcholine); may cause severe hypertension if used with MAO inhibitors; prolonged action if used concurrently with drugs that inhibit hepatic enzymes (azole antifungals, beta-blocking agents, calcium-channel blocking agents, fluoroquinolones); increased risk of respiratory depression with use of protease inhibitors (Gahart & Nazareno, 2011) | • Dose may vary considerably depending on use.  
• Closely monitor clients postoperatively for delayed respiratory depression.  
• Alfentanil-induced bradycardia is treated with atropine.  
• Do not use in children under 12.  
• Multiple drug interactions. |
| **atropine sulfate**<br>(AT-roh-peen SUL-fayt) | Anticholinergic | Anticholinergic psychosis, blurred vision, tachycardia, constipation, pupil dilation, mouth dryness, flushing, nausea, vomiting, postural hypotension, urinary retention, paralytic ileus (Gahart & Nazareno, 2011) | Potentiated by other agents that have anticholinergic action (amantadine, anti-Parkinson’s agents, glycopyrrolate, phenothiazines, tricyclic antidepressants); decreases antipsychotic effects of phenothiazines; decreases absorption of many oral agents due to it causing delayed gastric emptying; antagonizes cholinergic agents used to treat myasthenia gravis (Gahart & Nazareno, 2011) | • Monitor body temperature of client to avoid serious hyperthermia.  
• Use with caution in older adult clients as they may react with excitement, agitation, and/or other symptoms.  
• Monitor for tachyarrhythmias.  
• May cause flushing. |
### TABLE 11-4  Drugs Used as Adjuncts to General Anesthesia (Continued)

See Note at beginning of table.

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<thead>
<tr>
<th>DRUG</th>
<th>PHARMACOLOGICAL CATEGORY</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
</table>
| diazepam                  | Antianxiety agent         | Apnea, ataxia, blurred vision, bradycardia, coughing, confusion, cardiovascular collapse, respiratory depression, decreased reflexes, dyspnea, headache, hic-ups, hyperventilation, neutropenia, venous thrombosis, phlebitis at IV injection site (Gahart & Nazareno, 2011) | May increase serum levels of digoxin, phenytoin; concurrent use with ritonavir contraindicated because of increased risk of prolonged sedation, respiratory depression; agents that inhibit liver metabolism (beta-blocking agents, cimetidine, disulfiram, estrogen-containing oral contraceptives, fluoxetine, isoniazid, itraconazole, ketoconazole, omeprazole, valproic acid) increase serum level due to slowed hepatic metabolism; increases toxicity of zidovudine; decreases effectiveness of levodopa; rifampin, theophyllines, smoking, grapefruit juice decrease diazepam effects (Gahart & Nazareno, 2011) | • If used by IV route, drug should not be mixed with other solution or IV fluids.  
• IV injection should be made slowly to avoid local irritation and vascular complications.  
• Older adults are more sensitive to effects and adverse effects.  
• Provides surgical amnesia if IV. |
| droperidol                | Antiemetic                | Abnormal EEG (electroencephalogram), chills, shivering, dizziness, hallucinations, hypotension, palpitations, tachycardia, prolonged QT, restlessness, anxiety | Contraindicated with concurrent use of any drug that can cause prolonged QT (class 1A antidysrhythmic agents, class IIIA antidysrhythmic, anticonvulsants, antidepressants, antihistamines, antimalarials, antineoplastics, azole antifungals, calcium-channel blocking agents, neuroleptics, benzodiazepines, volatile anesthetics, IV opioids); use with fentanyl can cause hypotension and decreased pulmonary artery pressure; concurrent use with diuretics, laxatives, mineralcorticoids may cause hypovolemia, hypokalemia, hypomagnesemia; increased risk of hypotension if used concurrently with other drugs that can induce hypotension | • May cause hypotension and/or tachycardia.  
• Commonly used in combination with fentanyl citrate.  
• Contraindicated in clients with known or suspected prolonged QT. |
### Fentanyl Citrate
*(Fen-tah-nil Sih-trayt)* (Sublimaze)

**Opioid Analgesic**

- Most common with injection: bradycardia, circulatory depression, hypotension, diaphoresis, dizziness, nausea, vomiting, chest wall/muscle rigidity, blurred vision, respiratory depression, may markedly decrease pulmonary ventilation in older adults (Gahart & Nazareno, 2011).
- If fentanyl used concurrently with diazepam, nitrous oxide, increased risk of cardiovascular depression; use with nortriptyline, neuromuscular blocking agents, and beta-adrenergic blocking agents increase the risk of CNS toxicity; use with droperidol causes hypotension and decreased pulmonary artery pressure; protease inhibitors increase the CNS and respiratory depression; ritonavir increases fentanyl’s effects (Gahart & Nazareno, 2011, Spratto & Woods, 2011).
- May cause respiratory depression and muscle rigidity.
- Commonly used in combination with droperidol.
- Protect from light.

### Glycopyrrolate
*(gly-koh-PIR-roh-layt)* (Robinul)

**Anticholinergic**

- Anticholinergic psychosis, blurred vision, tachycardia, constipation, pupil dilation, mouth dryness, flushing, nausea, vomiting, postural hypotension, urinary retention, paralytic ileus, anaphylaxis, hypertension, malignant hyperthermia, muscle weakness, palpitations, photophobia, seizures, urticaria, pruritus, weakness, respiratory arrest (Gahart & Nazareno, 2011).
- Potentiated by other agents that have anticholinergic action (amantadine, anti-Parkinson’s agents, atropine, phenothiazines, tricyclic antidepressants); decreases antipsychotic effects of phenothiazines; concurrent use with potassium chloride (KCl) in wax matrix may increase risk and severity of GI lesions; potentiates action of atenolol, digoxin; antagonizes cholinergic agents used to treat myasthenia gravis (Gahart & Nazareno, 2011).
- Used IV during surgical procedures.
- Monitor for anticholinergic adverse effects.

### Meperidine HCl
*(meh-PER-ih-deen hy-droh-KLOR-eyed)* (Demerol HCl)

**Opioid Analgesic**

- Nausea, vomiting, constipation, headache, pruritus with parenteral dosing; increased intracranial pressure, orthostatic hypotension, seizures, arrhythmias, dizziness, flushing rash, restlessness, diaphoresis, syncope.
- Additive CNS depression including respiratory depression, hypotension, profound sedation, and coma can occur in presence of alcohol, opioid analgesics, antidepressants, barbiturates, sedatives, hypnotics, histamine-2 (H2) antagonists, chlorpromazine; anticholinergic agents and antidiarrheals increase risk of constipation and paralytic ileus; hypotensive effects increased with concurrent use of diuretics, antihypertensive agents, antidepressants, benzodiazepines, adrenergic blocking agents, calcium channel blockers; potentiated by acyclovir, antacids, anticholinergics.
- May cause constipation, respiratory depression, hypotension, nausea, and vomiting.
- Is considered outdated for pain management (Ignatavicius & Workman, 2010).
- Converts to potentially toxic metabolite called normeperidine.
- Not appropriate for use in older adults due to risk of toxicity (Ignatavicius & Workman, 2010).

(Continues)
### TABLE 11-4  Drugs Used as Adjuncts to General Anesthesia (Continued)

See Note at beginning of table.

<table>
<thead>
<tr>
<th>DRUG</th>
<th>PHARMACOLOGICAL CATEGORY</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
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</table>
| cimetidine, tricyclic antidepressants, isoniazid, neostigmine, neuromuscular blocking agents, oral contraceptives, phenothiazines, general anesthetics; contraindicated with MAO inhibitors (may cause cardiovascular collapse); may inhibit action of hydantoin anticonvulsants; increases adverse effects of isoniazid; should not use concurrently with protease inhibitors (Gahart & Nazareno, 2011; Spratto & Woods, 2011) | • Contraindicated for individuals with impaired renal function.   
• Is effective management of postoperative shivering.  
• Constipation worse than with most other opioids (Gahart & Nazareno, 2011).  
• Do not administer in same syringe with barbiturates.                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                            |
| morphine sulfate          | Opioid analgesic         | Primary adverse effect is constipation; headache, pruritus with parenteral dosing; refer to Chapter 10 | Additive CNS depression including respiratory depression, hypotension, profound sedation, and coma can occur in presence of alcohol, opioid analgesics, antidepressants, barbiturates, sedatives, hypnotics, histamine-2 (H₂) antagonists, chlorpromazine increases risk of respiratory depression; anticholinergic agents and antidiarrheals increase risk of constipation and paralytic ileus; hypertensive effects increased with concurrent use of diuretics, antihypertensive agents, antidepressants, benzodiazepines, adrenergic blocking agents, calcium channel blockers; buprenorphine antagonizes effects of morphine; may inhibit action of metoclopramide; use with neuromuscular blocking agents may prolong neuromuscular blockade; do not use with zidovudine due to risk of toxicity of both agents; smoking decreases morphine analgesia; increases warfarin anticoagulant effect (Gahart & Nazareno, 2011; Spratto & Woods, 2011) | • Monitor vital signs.                                                  |
### pentazocine lactate

**Trade Name(s):** Talwin  
**Chemical Name:** pentazocine lactate  
**Pharmacologic Class:** Opioid analgesic

- **Common Side Effects:** Constipation, apprehension, blurred vision, cardiovascular depression, confusion, abdominal cramps, depression, dizziness, diplopia, dry mouth, risk of dependence, dyspnea, euphoria, facial edema, flushing, headache, hypersensitivity reaction, nervousness, nausea, vomiting, urinary retention, altered taste, diaphoresis, pruritus, respiratory depression, seizures, nervousness, tachycardia

- **Additive CNS depression can occur in presence of:** alcohol, cimetidine, general anesthetics, anticholinergic agents, opioid analgesics, antidepressants, barbiturates, antihistamines, sedatives, hypnotics, psychotropic agents, MAO inhibitors, neuromuscular blocking agents; may decrease effects of opioid analgesics—do not use concurrently; delayed effects with tobacco use (Gahart & Nazareno, 2011; Spratto & Woods, 2011)

- **Not recommended for pediatric use.**
- **Parenteral doses of 30–60 mg of pentazocine are equivalent in analgesic action to about 10 mg of morphine or 75–100 mg of meperidine.**
- **May cause tissue necrosis at injection site.**
- **Must dilute.**

### promethazine HCl

**Trade Name(s):** Phenergan, Histantil (mapleleaf), etc.  
**Chemical Name:** promethazine HCl  
**Pharmacologic Class:** Sedative-hypnotic, antiemetic, antihistamine

- **Common Side Effects:** With average dose: blurred vision, dizziness, dryness of mouth, hypersensitivity reactions, hypotension, photosensitivity, nightmares, spastic upper extremity movements, somnolence, confusion, disorientation, insomnia, seizures, hallucinations; IV administration of promethazine can cause tissue necrosis at the injection site

- **Additive CNS respiratory depression and hypotension can occur in presence of:** alcohol, general anesthetics (propofol), anticholinergic agents, opioid analgesics, antidepressants, barbiturates, antihistamines, sedatives, hypnotics, MAO inhibitors, antihypertensive agents, neuromuscular blocking agents; use decreased dose of opioids if given together; additive prolongation of QT segment and cardiac depression if used concurrently with amiodarone, cisapride, disopyramide, erythromycin, procainamide, quinidine; if used concurrently with antidepressants, tricyclic antidepressants, MAO inhibitors may cause increased effects of both agents; contraindicated in use with epinephrine, quinidine, sibutramine due to increased risk of cardiotoxicity; concurrent use with lithium may result in encephalopathic syndrome; may lower seizure threshold; does not potentiate opioid analgesics; delayed effects with tobacco use (Gahart & Nazareno, 2011; Spratto & Woods, 2011)

- **May discolor urine pink or reddish brown.**
- **May cause photosensitivity.**
- **May be combined with reduced dose of opioid analgesic.**
- **Risk of fatal respiratory depression if used in children less than 2 years old.**
- **IV use in same line as lactated Ringer’s solution will cause precipitate to form; flush line before and after IV promethazine.**
- **Maximum of 25 mg, diluted with a minimum of 10 mL of diluent and administered at the farthest port, should be used for IV bolus.**
### Table 11-4  Drugs Used as Adjuncts to General Anesthesia (Continued)

See **Note** at beginning of table.

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</thead>
<tbody>
<tr>
<td>sufentanil citrate</td>
<td>Opioid analgesic</td>
<td>Most common: pruritis, bradycardia, hyper/hypotension,</td>
<td>Increased risk of bradycardia and hypotension if used concurrently with beta-</td>
<td>• May be administered in higher doses for induction and maintenance of anesthesia.</td>
</tr>
<tr>
<td>(soo-FEN-tah-nil</td>
<td></td>
<td>urinary retention, chest wall rigidity, nausea, vomiting,</td>
<td>adrenergic blocking agents or calcium channel blocking agents; increased risk of</td>
<td>• Administer with nitrous oxide and oxygen.</td>
</tr>
<tr>
<td>SIH-trayt)</td>
<td></td>
<td>sedation, respiratory depression, neck and extremities</td>
<td>cardiovascular depression with nitrous oxide; pancuronium may cause tachycardia;</td>
<td></td>
</tr>
<tr>
<td>(Sufenta)</td>
<td></td>
<td>muscle rigidity</td>
<td>increased CNS and cardiovascular effects magnified in clients receiving</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>barbiturates, anxiolytics, other opioids, general anesthetics, other CNS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>depressants (Spratto &amp; Woods, 2011)</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 11 Anesthetic Agents

Table 11-5 Common Types of Regional Anesthesia

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topical anesthesia</strong></td>
<td>Topical anesthesia is performed by applying an anesthetic agent directly onto the surface of the skin, mucous membranes, or eye to prevent or relieve pain. It is frequently used in relieving pain associated with minor skin irritation or in permitting easy examination of the eye.</td>
</tr>
<tr>
<td><strong>Infiltration (local) anesthesia, regional</strong></td>
<td>This form of anesthesia is used in situations in which superficial anesthesia is required (e.g., suturing wounds or in dental surgery). It is accomplished by the injection of small amounts of anesthetic solution into tissue surrounding the operative site. As only small amounts of anesthetic are required for such procedures, there is generally little danger of systemic toxicity developing with its use.</td>
</tr>
<tr>
<td><strong>Nerve block anesthesia</strong></td>
<td>Such anesthesia is accompanied by injection of anesthetic solution along the course of a nerve before the nerve reaches the tissue to be anesthetized. This form of anesthesia permits an area of the body (e.g., a leg) to be anesthetized by injection into a single site.</td>
</tr>
<tr>
<td><strong>Spinal anesthesia</strong></td>
<td>In spinal anesthesia, an anesthetic solution is injected into the subarachnoid space or into the epidural space surrounding the spinal cord. Depending on the location of the injection, a variety of different nerves may be anesthetized, for example, if the anesthetic is administered at the base of the spine (epidural), anesthetic effects may be evident only in the pelvic region and legs. Such an action may be desirable in performing obstetrical procedures or during surgery involving the rectum. If the anesthetic solution is injected into the lower spinal area while the client is seated, only those portions of the body that would be in contact with a saddle would be affected, hence the name saddle block. If the anesthetic is administered at higher areas of the spinal column, anesthetic effects will be evident in wider areas of the body. This may be appropriate for abdominal surgery. Epidural anesthesia is commonly used in obstetrics during both labor and delivery. Injecting the anesthetic into the epidural space provides pain control with minimal effect on motor function.</td>
</tr>
</tbody>
</table>

Cocaine, an agent extracted from the leaf of the coca plant, was the first local anesthetic to be discovered. Because of the addicting properties of cocaine, many synthetic substitutes have been introduced since its use was first advocated in the nineteenth century.

Regional anesthetics act by preventing the generation and the conduction of the nerve impulse. They do so by changing the permeability of a nerve’s cell membrane to sodium, potassium, and calcium, and thereby altering the nerve’s ability to conduct an electrical impulse. Although ideally these drugs should only provide a regional anesthetic action, many of these agents affect other organs in which conduction of nerve impulses occur. Regional anesthetics are capable, therefore, of causing CNS stimulation, resulting in restlessness, tremors, and/or clonic seizures. This effect may be followed by CNS depression, respiratory depression, and death.

If significant amounts of regional anesthetic enter the systemic circulation, cardiovascular collapse may occur. A small percentage of the client population also will exhibit a hypersensitivity to some of these agents. This effect may appear as allergic dermatitis, respiratory distress, or anaphylaxis.

Most of the drugs used as local and regional agents are the “caines”; the names end in “caine.” These are divided into two broad classes, the amines and the esters. It is important to understand this, especially as it relates to hypersensitivity reactions. Esters were the first class of injectable local anesthetics, invented at the end of the nineteenth century, and contain such drugs as cocaine, procaine, tetracaine, oxybuprocaine, chloroprocaine, and benzocaine. Novocain, a brand name of the adding...
Figure 11-2 An epidural catheter is frequently inserted in one of the two sites indicated.

for procaine, remains on the FDA approved list but is no longer manufactured in the United States and no longer used in dentistry (its primary use field) because it is highly allergenic. This class is most likely to cause hypersensitivity reactions because of a para-aminobenzoic acid (PABA) metabolite (Amado, Sood, & Taylor, 2007).

The amines (e.g., lidocaine, mepivicaine, bupivicaine, etidocaine, ropivicaine, dibucaine, prilocaine, and combinations of these agents) have all of the anesthetic benefits of esters but have the advantage of being predominantly nonallergenic because they do not undergo PABA metabolism. Some allergists estimate that less than 2% of the world’s population is allergic to lidocaine. Individuals with contact reactions to a drug like lidocaine may not be hypersensitive to the lidocaine but rather to the preservatives or additional agents (e.g., epinephrine) present in the lidocaine preparation. Although hypersensitivity reactions generally do not cross classes, clients allergic to an ester local anesthetic would be expected to be allergic to other ester agents, and a client hypersensitive to lidocaine would most likely be allergic to mepivicaine as well.

To minimize the likelihood of a toxic effect caused by regional anesthetics, several precautions should be taken. It is important to administer the smallest dose that will be effective in a client. Several small doses of these agents are generally less likely to result in adverse effects than one large dose. Epinephrine may be used with regional anesthetics to promote local vasoconstriction and thereby delay their systemic absorption. Epinephrine may, however, cause restlessness, tachycardia, and anxiety, which can be misinterpreted as a toxic effect of the regional anesthetic.

Special Note about Topical Anesthetics

In January 2009, the FDA issued a public health advisory to remind clients and health care professionals about the potential hazards, which can be severe, associated with using topical anesthetics to treat the pain of mammography and other medical tests and conditions. When applied to a large area of skin and the area is covered, these products can cause arrhythmias, seizures, breathing difficulties, coma, and possibly death (FDA, 2009).

Systemic toxicity of the local anesthetics requires aggressive and immediate treatment. Drug-induced convulsions can be treated by the administration of an IV dose of a barbiturate or sedative with anticonvulsant action, such as phenobarbital or diazepam (Valium). Respiratory depression may be treated with artificial ventilation, and cardiovascular collapse may require the use of closed-chest cardiac massage, drugs to raise blood pressure (pressor drugs), and/or equipment delivering an electric current to the heart to reestablish normal heart rhythm (defibrillation).

The intended use of topical anesthetics is to provide local anesthesia to small areas prior to an intramuscular injection, intravenous access placement, or venous blood draws (see Figure 11-1). It is not approved for use on large skin areas.

Another FDA concern involves compounding topical anesthetics. Compounding performed by licensed pharmacies to obtain substances not commercially available because of specific client needs (hypersensitivity) is permitted by the FDA. However, independently compounded topical anesthetics (benzocaine, lidocaine, tetracaine, and prilocaine) can have serious consequences, even fatal ones. When these agents are combined by unlicensed companies or individuals, the results may be (1) higher concentrations than normal, (2) potentially unsafe combinations, or (3) packaging that contains insufficient information for the client. In addition, independent compounding is not subject to FDA safety and efficacy (Sisson, 2007).

In late 2006, “the FDA issued warning letters to five compounding pharmacy firms, advising them to confine their business to the usual practice of compounding topical anesthetic creams” (Sisson, 2007, p. 29). In addition to usual practice, these companies were compounding to make generic products to be sold OTC. The FDA warnings were in response to two deaths that occurred after clients were given 30g tubes of 10% lidocaine, 10% tetracaine, and an unknown quantity of phenylephrine in preparation for laser hair removal (Sisson, 2007).

To prevent serious adverse effects secondary to systemic absorption of topical anesthetics, clients need to be instructed concerning the appropriate dose to use, the appropriate size of the area to be anesthetized, and the appropriate duration the substance should be in contact with the skin or mucous membranes. In addition to those instructions, the nurse should provide clients with information about other factors that could result in systemic absorption, including applying heat to the area where the drug is applied or applying an occlusive dressing and leaving it on longer than prescribed.

Because of the wide variety of regional anesthetics available, the selection of the proper agent should be based on the following factors:

- Area to be anesthetized
- Agent’s duration of action
- Client’s history of allergies
- Health care provider’s prior experience with the drug

Table 11-6 compares the properties of regional anesthetics in common use.
<table>
<thead>
<tr>
<th>DRUG</th>
<th>ROUTE(S)</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>benzocaine</td>
<td>Topical</td>
<td>Hypersensitivity reaction, burning, stinging, headache, weakness, dyspnea, tachycardia</td>
<td>Do not apply any other topical agent at the same site that benzocaine is applied</td>
<td>• May cause hypersensitivity reaction.                                                                                               • Not for ophthalmic use.                                                                                                                             • Can absorb through the skin and mucous membranes and cause potentially fatal reactions if large amount used.                                             • Because of the risk of methemoglobinemia due to incorrect use of benzocaine sprays, caution should be exercised if used for numbing mucous membranes of the mouth and throat.     • Carefully assess for manifestations of methemoglobinemia (e.g., pallor, headache, lightheadedness, dyspnea, anxiety, fatigue, tachycardia) (FDA, 2010e).                                                                                     • For topical use only.</td>
</tr>
<tr>
<td>bupivacaine HCl</td>
<td>Injection (epidural)</td>
<td>See Special Note about Topical Anesthetics; hypersensitivity reactions, transient edema, and puffiness in area of injection; toxic blood concentrations: depressed cardiac conduction and excitability resulting in cardiac dysrhythmias (atrioventricular block, ventricular dysrhythmias, and cardiac arrest) that can lead to death; myocardial contractility decrease and peripheral vasodilation occurs, leading to decreased cardiac output and arterial blood pressure</td>
<td>If other CNS depressants are used (e.g., anxiolytics), doses of these drugs should be reduced; avoid use of product combined with epinephrine following halogenous general anesthetics (could result in cardiac arrhythmias)</td>
<td>• Relatively long acting (4–5 hours). Not for use in children under 12.                                                                                                                                       • Available with and without epinephrine.                                                                                                             • Peak reached 30–45 minutes following injection.                                                                                                         • Monitor respiratory status hourly when used as epidural analgesia.</td>
</tr>
</tbody>
</table>
### Table 11-6 Regional Anesthetic Agents (Continued)

See Note at beginning of table.

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ROUTE(S)</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
</table>
| chloroprocaine HCl        | Injection (caudal, epidural)       | Hypersensitivity reactions, transient edema, and puffiness in area of injection; toxic blood concentrations: CNS toxicity; excitation and/or depression, restlessness, anxiety, dizziness, tinnitus, blurred vision or tremors, seizures; cardiovascular toxicity: myocardial depression, hypotension, bradycardia, ventricular arrhythmias, cardiac arrest | Inhibits the action of sulfonamides; avoid concurrent use of local anesthetic solutions containing epinephrine or norepinephrine to clients receiving monoamine oxidase inhibitors; tricyclic antidepressants or phenothiazines may cause severe, prolonged hypotension or hypertension; concurrent administration of vaspressor agents (for the treatment of hypotension related to spinal blocks) and ergot-type oxytocic agents may cause severe, persistent hypertension or cerebrovascular accidents | • Discard partially used vials.  
• Keep resuscitation equipment on hand.  
• To avoid intravascular injection, the anesthesia clinician must aspirate to ensure drug will not enter vasculature.  
• Closely monitor cardiac and respiratory function.  
• Use in epidural for healthy children 3 years old and older. |
| lidocaine HCl             | Topical, injection                 | Hypersensitivity reactions; toxic blood concentrations: CNS toxicity; excitatory and/or depressant responses (light-headedness, nervousness, apprehension, euphoria, confusion, dizziness, drowsiness, tinnitus, blurred vision, diplopia, vomiting, sensations of heat, cold, or numbness, twitching, tremors, seizures, unconsciousness, respiratory depression and arrest; cardiovascular toxicity: hypotension, bradycardia, cardiac arrest | Inhibits the action of sulfonamides; avoid concurrent use of local anesthetic solutions containing epinephrine or norepinephrine to clients receiving monoamine oxidase inhibitors; tricyclic antidepressants or phenothiazines may cause severe, prolonged hypotension or hypertension; concurrent administration of vaspressor agents (for the treatment of hypotension related to spinal blocks) and ergot-type oxytocic agents may cause severe, persistent hypertension or cerebrovascular accidents; reduction or reversal of pressor effect of epinephrine if used concurrently with phenothiazines and butyrophenones | • Injection available with and without epinephrine.  
• 1–2% solutions. |
### lidocaine 2.5% / prilocaine 2.5% (eutectic mixture of local anesthetics) (EMLA)

| Topical | See Special Note about Topical Anesthetics; hypersensitivity reactions, paleness, erythema, edema, bradycardia; toxic doses: hypotension, CNS excitement or depression; lightheadedness; nervousness; apprehension; euphoria; confusion; dizziness; drowsiness; sensations of hot, cold, or numbness; twitching; tremors; seizures, unconsciousness; respiratory depression and arrest. | Class I antiarrhythmic agents may produce additive or synergistic toxic effects. | Adverse effects: blanching, erythema. | Indicated for peripheral, midline, or PICC (peripherally inserted central catheter) lines, venipuncture, groin preparation for cardiac catheterization, lumbar puncture, circumcision. | Apply to intact skin under occlusive dressing (Tegaderm) 1–2 hours prior to procedure (EMLA), 60–90 minutes (LMX4, LMX5). | Provides local dermal analgesia to 0.5 mm depth. | EMLA approved for use in neonates (from 34 weeks) and infants; can be used for circumcision. | Monitor for effectiveness. |

### lidocaine 4% (LMX4)

| Topical | | | | |

### lidocaine HCl monohydrate (Zingo)

| Topical | | | | |

### lidocaine 5% / dextrose 7.5%

| Spinal | Hypotension, prolonged atrioventricular (AV) conduction; CNS toxicity: restlessness, anxiety, tinnitus, dizziness, blurred vision, tremors, depression, drowsiness. | No other medication should be administered in the same syringe; avoid concurrent use of local anesthetic solutions containing epinephrine or norepinephrine to clients receiving monoamine oxidase inhibitors, tricyclic antidepressants, or phenothiazines may cause severe, prolonged hypotension or hypertension; concurrent administration of vaso depressor agents (for the treatment of hypotension related to spinal blocks) and ergot-type oxytocic agents may cause severe, persistent hypertension or cerebrovascular accidents. | Monitor closely for adverse effects. | Monitor hepatic function prior to administration; liver dysfunction can double the half-life. | Closely monitor vital signs before and after injection. | Monitor for hypersensitivity reactions. | Not for pediatric use (in children under 16 years of age). | |

### mepivacaine HCl (meh-PIV-ah-kayn hy-droh-KLOR-eyed)

| Injection (Epidural) | See Special Note about Topical Anesthetics; hypersensitivity reactions, abnormal skin sensations, anxiety, back pain, headache, inability to urinate or defecate, lightheadedness, numbness in the lower extremities, tinnitus, sexual dysfunction, twitching, weakness; toxic doses: hypotension, CNS excitement or depression; lightheadedness; nervousness; | Avoid concurrent use of local anesthetic solutions containing epinephrine or norepinephrine for clients receiving monoamine oxidase inhibitors or tricyclic antidepressants; may cause severe, prolonged hypertension; concurrent administration of vaso depressor agents (for the treatment of hypotension related to spinal blocks) and ergot-type oxytocic agents may cause severe, persistent hypertension or cerebral vascular accidents. | Monitor fetal heart rate when used for paracervical block during delivery. | Protect agent from light. | Monitor respiratory status hourly when used as epidural analgesia. | |

(Continues)
TABLE 11-6 Regional Anesthetic Agents (Continued)

See Note at beginning of table.

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ROUTE(S)</th>
<th>ADVERSE EFFECTS</th>
<th>DRUG INTERACTIONS</th>
<th>NURSING IMPLICATIONS</th>
</tr>
</thead>
</table>
| pramoxine HCl       | Topical  | See Special Note about Topical Anesthetics; hypersensitivity reactions, angioedema, contact dermatitis, burning, stinging | Concurrent use with anticholinesterase agents may result in increased systemic toxicity because anticholinesterases inhibit the breakdown of procaine hydrochloride; use with antmyasthenics may result in worsening of myasthenia symptoms; CNS depressants may result in additive depression; concurrent use with neuromuscular blocking agents may result in prolongation or enhancement of the neuromuscular blockade; inhibits the action of sulfonamides; acetazolamide may extend the plasma half-life of procaine; physically incompatible with aminophylline, chloramphenicol, chlorothiazide sodium, magnesium sulfate, nitrofurantoin, phenytoin sodium, amphotericin, sodium bicarbonate, sodium iodide, sulfadiazine, thiopentone | • May be safely used in many clients who are allergic to other local anesthetics.  
  • Should not be applied to large areas.  
  • Must not be used on children less than 2 years old.  
  • Used in a variety of OTC products.  
  • Onset of action 2–5 minutes. |
| pramoxine HCl       | Topical  |                                                                                   |                                                                                  |                                                                                      |
| procaine HCl        | Injection| Hypersensitivity reactions, hypotension (epidural); toxic blood concentrations (CNS toxicity); excitatory and/or depressant responses, lightheadedness, nervousness, apprehension, euphoria, confusion, dizziness, drowsiness, tinnitus, blurred vision, diplopia, vomiting, sensations of heat, cold, or numbness, twitching, tremors, seizures, unconsciousness, respiratory depression and arrest; cardiovascular toxicity: hypotension, bradycardia, cardiac arrest | Concurrent use with anticholinesterase agents may result in increased systemic toxicity because anticholinesterases inhibit the breakdown of procaine hydrochloride; use with antmyasthenics may result in worsening of myasthenia symptoms; CNS depressants may result in additive depression; concurrent use with neuromuscular blocking agents may result in prolongation or enhancement of the neuromuscular blockade; inhibits the action of sulfonamides; acetazolamide may extend the plasma half-life of procaine; physically incompatible with aminophylline, chloramphenicol, chlorothiazide sodium, magnesium sulfate, nitrofurantoin, phenytoin sodium, amphotericin, sodium bicarbonate, sodium iodide, sulfadiazine, thiopentone | • Not as frequently used today due to increased use of lidocaine.  
  • Its advantage is that it causes vasoconstriction at the site, resulting in decreased bleeding. |
| procaine HCl        | Injection|                                                                                   |                                                                                  |                                                                                      |
NURSING CARE FOR CLIENT RECEIVING ANESTHESIA

Assessment

Nurses are actively involved in the care of clients requiring anesthesia, from just before administration of the anesthetic to full recovery from anesthesia. Before clients receive anesthesia, the nurse is responsible for checking vital signs. This check provides information on preexisting conditions, such as infection or hypertension, that might affect the decision to carry out the surgical procedure and the agent to be used. It also alerts others to possible problems that could result from anesthetizing the client. In addition, the preanesthetic vital signs provide a baseline against which the client’s vital signs may be compared during and following anesthesia. The client’s weight should be measured, as some drug dosages are based on weight. The nurse also questions the client and/or family about a history of allergy to any substances, but particularly to drugs. Clients should be questioned about whether they are taking any drugs for the treatment of mental or physical health problems. Note: All allergies and the names of drugs the client takes at the time, particularly antihypertensives, sedatives and tranquilizers, corticosteroids, and cardiac drugs, should be prominently displayed on the chart that accompanies the client. Such notations are frequently made on a preanesthetic checklist. Allergies are listed in bold red letters on the front cover of the client’s treatment record.

Nursing Diagnoses

Nursing diagnoses include but are not limited to:

Preoperative:
1. Risk for injury related to central nervous depressive effects of preanesthetic agents
2. Anxiety related to the unknown, risks of surgery, and new experience
3. Deficient knowledge related to preanesthetic agents and safety precautions

Intraoperative:
1. Risk for injury related to adverse effects or drug interactions of anesthesia
2. Hypothermia related to decreased metabolic rate and exposure to cool environmental temperature
3. Risk for injury: malignant hyperthermia related to response to general anesthesia

Refer to care plan for postoperative care

NOC

Preoperative:
1. Risk Control, Safety Status
2. Anxiety Control, Coping
3. Knowledge: Personal Health, Treatment Regimen

Intraoperative:
1. Risk Control, Safety Status
2. Thermoregulation
3. Thermoregulation

BOX 11-1

PREOPERATIVE CLIENT TEACHING

- Complete a list of all medications—prescription and OTC, including herbal preparations, that the client is taking and when each medication was last taken.
- Identify and report any factors that would increase the risks of anesthesia—obesity, smoking, respiratory disease, heart disease, diabetes.
- Reinforce health care provider’s explanation of the procedure and what to expect before, during, and after the procedure. This will help decrease anxiety.
- Complete client teaching (and return demonstration) of postoperative exercise, such as turning, coughing, deep breathing, and use of incentive spirometry, which are designed to prevent respiratory complications of surgery.
- Explain to the client such surgical routines as NPO status, preanesthetic medications, time the client will spend in the presurgical (hold area) area before surgery, and tubes and equipment (and the rationales for their use) that the client may see or feel, or both.
- Stress to client and family the importance for the client to be proactive about need for analgesics, as well as address any unfounded concerns they may have about “becoming addicted to pain killers.”

Although dependency on opioids can occur if they are used for an extended time, this is unlikely with usual postoperative use. Long-term misuse is more likely to occur if acute postoperative pain is not effectively managed.
- Ask clients regarding any food or drug allergies and explain why this information is important for the health care team to know prior to surgery.
- Stress importance of safety measures after preanesthetic agents are given.

(Continues)
Planning/Goals

- Client will not sustain any injuries resulting from depressive effects of preanesthetic agents.
- Client will demonstrate use of coping mechanisms when dealing with fear/anxiety.
- Client will verbalize understanding of preoperative instructions.
- Client will not sustain any injuries resulting from use of anesthetic agents.
- Client's temperature will be maintained within defined limits (WDL) for surgical experience.

NIC

Preoperative:
1. Environmental Management: Safety
2. Anxiety Reduction, Health Education
3. Health Education

Intraoperative:
1. Surveillance Safety
2. Temperature Regulation: Intraoperative
3. Malignant Hyperthermia Precautions

SAFE NURSING PRACTICE 11-1

Preanesthetic General Nursing Care

1. Measure vital signs to be used as a baseline.
2. Record on the client's chart all allergies and drugs the client currently takes.
3. Dentures, eyeglasses, contact lenses, jewelry, and hairpins are removed. Makeup is also removed.
4. Ensure informed consent for the surgery/invasive procedure has been signed by the client. Client's signature must be obtained prior to administration of preoperative sedation.
5. Meperidine HCl and barbiturates cannot be mixed in the same syringe.
6. After preanesthetic medications are given, the nurse ensures the client's safety and arranges for safekeeping of the client's possessions (e.g. given to family, logged and placed in facility safe, client did not bring jewelry to facility).
7. Clients who have received anticholinergics may experience an atropine flush, urinary retention, excitement, delirium, or hallucinations.
8. Client should void prior to administration of preanesthetic medication.

Implementation

The nurse usually is responsible for administering preanesthetic medications. In hospitalized clients, a sedative or hypnotic may be prescribed to be given at bedtime the evening before anesthesia is scheduled. The purpose of these drugs is to reduce anxiety and to promote rest and sleep. On the morning of the scheduled procedure, the nurse may administer other medications prescribed by the health care provider. The purpose is to prepare the client for anesthesia by reducing anxiety, decreasing respiratory secretions and salivation, and providing pain relief, thereby reducing the amount of anesthetic that must be administered. Of the commonly prescribed preanesthetic medications, morphine sulfate and atropine sulfate may be mixed in the same syringe. Meperidine HCl and promethazine HCl may be mixed in one syringe; however, midazolam must not be mixed in the same syringe with any other drug.

The nurse needs to be sure the surgical/procedural informed consent has been signed by the client prior to administration of preanesthetic agents. Exceptions to this include victims of multiple trauma and/or those who must undergo emergency surgery, clients who are unconscious (in this situation, the person with power of attorney/guardian should sign consent), and clients who are cognitively unable to provide informed consent.

At the time that these preanesthetic medications are given, the nurse takes measures to provide for the client's personal safety and the safekeeping of the client's possessions. Prior to administering preanesthetic medications, the nurse explains in simple language the purpose of the medications and what reaction the client can expect. (For example, "Mr. Jones, I am going to give you some medication that Dr. Greenburg wants you to have to prepare you for your surgery. It might make you feel relaxed and sleepy. It may cause you to have a dry mouth, but do not drink anything. After I give you this medication, I am going to put up your siderails and ask you to stay in bed. If you need to go to the bathroom or need a nurse for any reason, please use your call bell.") The nurse makes certain the client is comfortable, has voided, and is appropriately dressed for the operative procedure. Dentures and eyeglasses or contact lenses must be removed for the client's safety. Jewelry and hairpins are removed. All possessions should be stored securely. Female clients should remove makeup and fingernail polish (according to facility protocol) so that accurate assessment of color and circulation can be made. Clients are allowed nothing by mouth (NPO) for about 12 hours before any anesthesia, but especially for general anesthesia. The nurse should be certain that these procedures have been carried out.

After checking vital signs, the nurse should administer the preanesthetic medication, make the client comfortable, and minimize environmental distractions. Periodic checks on clients should be made to determine their response to the medication. One of the reactions a client might experience is what is often called an atropine flush or fever. In response to the administration of anticholinergics (e.g., atropine sulfate), a client may become flushed and develop

(Continues)
a fever because of the drug’s ability to inhibit the sweat glands. Clients who have received preanesthetic anticholinergics also may experience urinary retention, as well as excitement, delirium, and hallucinations. The nurse should reassure the client that these symptoms are responses to the drug. A safe, quiet environment should be provided.

Young children may be held by their parents rather than confined to their beds following preanesthetic medication. The parents should be instructed not to provide liquids to the child and not to allow the child to walk. They should be instructed to call for the nurse if they need assistance or have any questions.

Nurse-Administered Propofol Sedation (NAPS)

The use of NAPS in critical care areas on adult clients who are intubated and being maintained on mechanical ventilation has been in practice for a number of years. The nurses in critical care who are trained in this practice have provided propofol sedation safely in these clients with protected airways. Nurses need to be aware of the following issues as they may have to make practice decisions concerning NAPS.

The continuing debate revolves around whether nurses administering propofol, a respiratory depressant, to clients without protected airways to produce sedation for endoscopic and other diagnostic procedures is a safe practice. This practice is gaining momentum in a growing number of hospitals, outpatient surgery centers, and health care providers’ offices (Institute for Safe Medication Practices [ISMP], 2005). The American Association of Nurse Anesthetists (AANA) and the American Society of Anesthesiologists (ASA) have issued a joint statement against NAPS, but the American College of Gastroenterology, American Gastroenterological Association, the American Society for Gastrointestinal Endoscopy, the American College of Emergency Physicians, and the Emergency Nurses Association support NAPS (Harrington, 2006).

The primary concern about NAPS is client safety. According to the ISMP, “propofol offers many advantages over other drugs used for sedation because it has a rapid onset (about 40 seconds) and a short duration of action; allows patients to wake up, recover, and return to baseline activities and diet sooner than some other sedation agents; [and] reduces the need for opioids, thus resulting in less nausea and vomiting” (ISMP, 2005). The debate about whether nurses can safely administer propofol to clients with unprotected airways resulted in creation of the Anesthetists for the Safe Administration of Propofol (ASAP) organization. The ASAP stated, “The problem with propofol (brand name Diprivan) is that it is considered by the FDA to be an anesthetic agent, and should be administered by persons trained in the administration of general anesthesia. So right now we have some states that have said explicitly that administration of propofol for sedation is not within the scope of practice for RNs (e.g., Florida), some that say that it is within the scope of the RN to administer drugs such as propofol for sedation, but no anesthetic agents for anesthesia (e.g., Maine)” (ASAP, 2006, p. 1). Further, Jan Odom-Forren, MS, RN, CPAN, FAAN, a doctoral student at the University of Kentucky’s College of Nursing, and co-editor of the Journal of Perianesthesia Nursing, stated, “No state board of nursing (BON) has determined that administration of moderate sedation is not within that scope of practice for a registered nurse (RN)” (ASAP, 2006, p. 1). This statement, however, does not specifically address the issue of NAPS.

Nurses have been administering other agents (e.g., midazolam) for many years to provide conscious sedation for clients with unprotected airways. Again, we are back to what classification of agent nurses can safely administer.

Ultimately, the BON of each individual state determines whether NAPS is within the scope of nursing practice. Each nurse must know the state’s BON definition of scope of practice, and traveling nurses must extend their knowledge to any state in which the nurses practice. For those states that allow NAPS, the common threads in their statements include that the nurse be able to demonstrate competence and that the nurse must have specialized education (Pigg, 2008). Pigg offers the following criteria for nurses prior to practicing NAPS. Nurses should:

- Understand the objectives and definitions of sedation
- Understand the continuum of sedation and analgesia
- Understand the ASA classification system
- Know when to seek a consult
- Maintain Advanced Cardiac Life Support (ACLS) certification
- Receive conscious sedation training, certification, and credentials
- Be current with state and organizational sedation policy
- Understand the most appropriate monitoring techniques
- Become involved in a peer review and process improvement program
- Be current with national and local nursing standards of accepted practices
- Demonstrate continuing education specific to his or her field
- Understand core principles established by national specialty societies involved in sedation and anesthesia
- Foster communication between all members of the sedation team and others teams in the community
- Join and be involved in specialty professional associations

Clients with Malignant Hypothermia

Malignant hyperthermia is an unexpected fever occurring while the client is anesthetized and possibly when exposed to intensive exercise and certain other stressors. It is a life-threatening condition. When succinylcholine or anesthetic agents are administered, the susceptible client rapidly develops muscle rigidity, tachycardia, and elevated temperature (105°F/41°C or higher). The skin is warm and often mottled, and respiratory and metabolic acidosis develop. If not treated promptly, the client may develop cardiac arrhythmias and vascular collapse and may die. The cause of this condition is apparently a sudden release of calcium by the sarcoplasmic reticulum into contractile muscle causing a high level of intracellular calcium.
7. Teach the client and family about malignant hyperthermia.

6. Monitor the client’s vital signs carefully for 24–48 hours. Administer dantrolene as prescribed.

5. Assist with procedures such as insertion of a Foley catheter, irrigation of body cavities with chilled fluids, and administration of medications.

4. Take measures to lower the body temperature.

3. Monitor vital signs.

2. Dantrolene (Dantrium) is administered intravenously to block the release of calcium from the sarcoplasmic reticulum. The nurse reconstitutes the dantrolene with sterile water and rotates the vial until the fluid is clear. This may take a few minutes. The nurse also obtains equipment to lower the body temperature. This may include a hypothermia blanket, ice packs, chilled IV fluids, and chilled fluids for irrigation of body cavities, such as gastric lavage. Generally, a Foley catheter is inserted for measurement of urinary output. Arterial and central venous catheters may also be inserted, and a number of drugs, such as sodium bicarbonate, will be given intravenously. The client will be attached to a cardiac monitor and arrhythmias will be treated with drugs such as lidocaine or procainamide (see Chapter 16).

After the client’s condition has been stabilized, the nurse continues to monitor urinary output, vital signs, and general condition. Malignant hyperthermia does not always occur during surgery. It may occur hours after surgery and may recur up to 3 days after the initial episode. Usually the client receives dantrolene during this period to prevent recurrence. Because the susceptibility to developing this condition seems to be inherited, the nurse should always take a thorough client and family history regarding multiple drug allergies and any reactions the client or close family members have ever had to anesthesia. It is believed that malignant hyperthermia may be a reaction to stress, and the nurse should attempt to minimize preanesthesia stress by such means as formation of a therapeutic relationship, providing easily understandable instructions and answering questions simply, promoting confidence in the health care provider, and facilitating rest and sleep. Clients at risk for malignant hyperthermia receive dantrolene the night before and the morning of surgery.

Finally, family members must be taught about malignant hyperthermia and instructed to let health care personnel know of a positive family history. The Malignant Hyperthermia Association of the United States (2009) can provide additional information.

**SAFE NURSING PRACTICE 11-2**

**Malignant Hyperthermia**

1. This is a life-threatening condition requiring immediate treatment.

2. Dantrolene is administered intravenously to block the release of calcium. When reconstituting dantrolene, always rotate the vial until the fluid is clear.

3. Monitor vital signs.

4. Take measures to lower the body temperature.

5. Assist with procedures such as insertion of a Foley catheter, irrigation of body cavities with chilled fluids, and administration of medications.

6. Monitor the client’s vital signs carefully for 24–48 hours. Administer dantrolene as prescribed.

7. Teach the client and family about malignant hyperthermia and the necessity of reporting a family history of this problem.

**NURSING CARE FOLLOWING GENERAL ANESTHESIA**

**Assessment**

After surgical intervention under general anesthesia, the client is usually transported to the postanesthesia care unit (PACU), where intensive care can be provided. When the client arrives in the PACU, the nurse checks to see that the client has an adequate airway. The nurse then receives a report from the operating room nurse or anesthesiologist. This report includes information such as the client’s identity, procedure done, type of anesthetic used, any problems encountered, pertinent medical history, and a review of the client’s vital signs and fluid and electrolyte status. The operating room nurse or anesthesiologist frequently reviews the placement and function of various drainage tubes and equipment with the nurse. See Nursing Care Plan.

**Implementation**

Following the anesthesia report, the nurse checks the vital signs and monitors other bodily functions (e.g., checks urinary drainage, arterial pressure, drainage from wounds). The client is usually positioned in a side-lying position, to ensure an adequate airway. Pertinent observations are recorded initially on admission and frequently thereafter.

When there are signs of regaining consciousness (e.g., restlessness, moaning, attempts to swallow), the client is told that he or she is in the postanesthesia care unit or that the procedure is completed. Some clients may need to be told this information repeatedly. It is well for the nurse to remember that, in anesthetized clients, hearing is usually the last sense to fade and the first to return. Although apparently unconscious, the client may be able to hear. When the swallowing reflex returns, the airway may be removed, but attention must still be paid to the possibility of respiratory depression, vomiting with resulting airway obstruction, and the development of emergency situations (such as cardiac arrest).

Two problems frequently occurring in clients following anesthesia are pain and shivering. Pain medication may be administered as prescribed, provided that the vital signs are stable. Occasionally pain medications are withheld because of low blood pressure (hypotension). The nurse should assess the client’s condition carefully...
because the hypotension could be due to pain. In some instances, the health care provider will approve the administration of less than the full dose of analgesia to allow for assessment of its effects on blood pressure and on the pain experienced. The second problem, shivering, is due to peripheral vasodilation resulting from the anesthetic agent used. Clients who shiver should be provided with a warmed blanket and be reassured that the shivering will soon pass.

Clients who have received ketamine hydrochloride (Ketalar) may have emergence reactions, including delirium, hallucinations, confusion, and excitement. These reactions may occur immediately on emergence from anesthesia and may last for several hours. In some clients, a recurrence of the reaction has occurred up to 24 hours postanesthesia. Note: To minimize such reactions, place clients who have received this anesthetic in a quiet place and disturb them as little as possible during emergence from anesthesia.

SAFETY AND ANESTHETIC AGENTS

For many years, safety precautions have been taken in surgical suites (operating rooms) to prevent leaks and explosions of anesthetic gases. More recently, concern has been developing about the health of personnel who work in settings where anesthetic agents are regularly used. Research studies have indicated that surgical suite staff may have higher rates of hepatic and renal diseases, as well as spontaneous abortion and birth defect rates in excess of the general population. Studies have shown that some anesthetic agents can be exhaled by the client for 10–20 days following surgery, thus exposing nursing staff to small amounts of gases over long periods of time.

The following safety precautions are indicated for nurses who are exposed to inhalation general anesthetic agents over long periods:

- Be sure the area where you work is well ventilated.
- Avoid direct exposure to the mouths of clients expiring anesthetic agents.
- Report your symptoms, such as headache, dizziness, slowed reflexes, and sleepiness to the health service.
- Personnel with high levels of exposure to general anesthetic agents should be checked every 3 months for levels of halogenated anesthetics and nitrous oxide.
- The exposure of pregnant personnel to inhalation general anesthetic agents should be limited.

Evaluation

- Client does not sustain any injuries resulting from depressive effects of preanesthetic agents.
- Client demonstrates use of coping mechanisms when dealing with fear/anxiety.
- Client verbalizes understanding of preoperative instructions.
- Client does not sustain any injuries resulting from use of anesthetic agents.
- Client’s temperature is maintained within defined limits (WDL) for surgical experience.

NURSING CARE FOLLOWING REGIONAL (LOCAL) ANESTHESIA

The nursing care given to clients following regional anesthesia will depend on the area to which the anesthetic has been applied and the extent of the resulting anesthesia. Regional anesthetics applied to the eye, for example, are generally short acting. The major nursing responsibility is to see that the eye is not damaged during recovery.

Few reactions except itching are noted as a result of local anesthesia confined to a limited area of the body in which the drug is placed directly around the area to be anesthetized (such as infiltration anesthesia). This procedure, useful for repair of lacerations, for example, may be...
associated with allergic reactions or with CNS stimulation if a sufficient amount of the drug enters the bloodstream. The client should be reassured that this CNS stimulation will gradually decrease over time. Following the use of a local anesthetic, the nurse checks the local circulation before dressing the wound. The client is instructed in proper care of the wound and indications of infection, which should be reported promptly.

Regional anesthetics can pass through the placenta, and excessive amounts may produce bradycardia (slow heartbeat) in the fetus. Before regional anesthetic agents are used, therefore, the nurse should inquire (1) whether the client has received such agents before; (2) whether there have been any adverse responses, including allergic reactions; and (3) whether female clients might be pregnant.

More intensive nursing care is required for clients in whom regions of the body are anesthetized; for example, the lower extremities. An example of this type of anesthesia is epidural anesthesia, which may be used during labor and delivery; the drug is placed in the spinal canal area. Another example is spinal anesthesia in which the drug is placed in the subdural space. The latter procedure is sometimes used for clients having surgery on the lower extremities, for some types of abdominal surgery, or when clients are unable to tolerate general anesthesia. The major nursing measures following spinal anesthesia are checking vital signs, positioning the client, and providing general supportive care. To prevent headaches that follow spinal anesthesia, the client is generally kept in a recumbent position for 6–8 hours and is provided with adequate fluid replacement. The exception to this is epidural anesthesia. After recovery from spinal anesthesia, just as with recovery from general anesthesia, clients should be supervised during their first attempts to ambulate. Some clients will initially experience hypotension and dizziness.

Another type of regional anesthesia is continuous extravascular infusion (CEI). In CEI, a small amount of local anesthetic is delivered continuously over a period to a particular body part. This technique is used to treat chronic pain. A small catheter is placed in one of several body areas; for example, in the epidural space, for the treatment of pain in the trunk or lower extremities or in the brachial plexus for the treatment of pain in the upper extremities. Following the insertion of the catheter, a small volume of local anesthetic in an appropriate amount of normal saline is infused through the catheter. An electronic infusion device (see Chapter 3) is used to control the rate of infusion. Nursing responsibilities include monitoring the client’s level of pain, limiting activity to prevent catheter displacement, preventing infection at the catheter site, and providing emotional support for the client. See Nursing Care Plan 10-B for a discussion of the care of a client with an epidural catheter. Vital signs are monitored closely, as hypotension, respiratory depression, and bradycardia may indicate systemic absorption of the anesthetic or toxicity. The nurse should stop the infusion and report client complaints of metallic taste, blurred vision, or ringing in the ears. Also, whenever epidural or caudal blocks are used, the nurse monitors the client for urinary retention, abdominal distention, or fecal incontinence.

**SAFE NURSING PRACTICE 11-5**

**Nursing Care for Regional Anesthesia**

1. Before the use of a regional anesthetic, obtain a history of prior anesthetic exposure, response to local anesthetics, and/or pregnancy status.
2. Check vital signs and provide supportive care.
3. Supervise ambulation after caudal or spinal anesthesia has been used.
4. Report indications of systemic absorption or toxicity when the client is receiving continuous extravascular infusion.
5. Following spinal or epidural anesthesia, the client must not be placed in Trendelenburg position because this can cause respiratory muscle paralysis.
6. Monitor closely for hypotension following spinal or epidural anesthesia.

**OVERALL ASSESSMENT**

Regardless of the anesthetic agent used, the nurse can play an important role in providing for the safety and comfort of the client. Whenever general anesthesia or extensive regional anesthesia has been used, the nurse observes the client for:

- **Hypotension**, which may be caused by (1) depression of the vasomotor center in the brain, (2) loss of blood and body fluids that have been inadequately replaced, or (3) opioid agents administered for management of pain
- **Rapid pulse rate**, which may indicate internal bleeding
- **Gastrointestinal upset**, including postoperative nausea and vomiting and intestinal distention, which may occur several days after surgery
- **Difficulty with urination**, including inadequate urinary output, urinary retention, and loss of bladder tone
- **Body temperature**, as sudden elevations may signal the development of malignant hyperthermia
- **Respiratory depression** and difficulty with gaseous exchange (e.g., hypoventilation)
- **Injury to nerves** due to problems associated with regional anesthesia or to malpositioning of the client during surgery
- **Pain, heat, and/or redness over a vein**, indicating possible phlebitis or formation of a blood clot
- **Extreme anxiety or other behavioral changes**, which may indicate impending shock
- **Changes in skin temperature and/or color**, which may indicate impending shock (particularly cold, clammy skin with pallor)

Additional observations are related to the type of surgery the client has experienced, as well as the age and general physical condition of the client. Refer to a medical-surgical nursing text for a more thorough discussion of the care of postoperative clients.
### NURSING CARE PLAN

#### A Postsurgical Client

Duncan MacDonald, age 73, has had a resection of his colon because of a tumor. In the operating room, he received propofol to induce sleep, fentanyl to block pain response, succinylcholine to permit ease of endotracheal tube insertion, and a mixture of oxygen and nitrous oxide. He is brought to the postanesthesia care unit (PACU) to recover. He is receiving intravenous fluids, has a dry sterile dressing on his abdomen, and has a Foley catheter.

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Intake and output; abdominal dressing; vital signs and skin turgor</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURSING DIAGNOSIS</td>
<td>Risk for deficient fluid volume related to surgical loss and decreased intake</td>
</tr>
<tr>
<td>NOC</td>
<td>Fluid and Electrolyte Balance, Hydration</td>
</tr>
<tr>
<td>PLANNING/GOALS</td>
<td>Client will maintain fluid and electrolyte balance.</td>
</tr>
<tr>
<td>NIC</td>
<td>Fluid/Electrolyte Management, Fluid Monitoring, Intravenous Therapy</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>Monitor intravenous fluid administration and urinary output.</td>
</tr>
<tr>
<td></td>
<td>Record intake and output.</td>
</tr>
<tr>
<td></td>
<td>Check surgical site for bleeding.</td>
</tr>
<tr>
<td></td>
<td>Monitor vital signs and tissue turgor.</td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Fluid and electrolyte balance maintained. No excess bleeding, nausea, or vomiting experienced. Vital signs are stable and tissue turgor is maintained.</td>
</tr>
</tbody>
</table>

#### ASSESSMENT

Level of consciousness

<table>
<thead>
<tr>
<th>NURSING DIAGNOSIS</th>
<th>Impaired environmental interpretation related to decreased level of consciousness secondary to anesthesia and central nervous system depressant use</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOC</td>
<td>Neurologic Status: Consciousness</td>
</tr>
<tr>
<td>PLANNING/GOALS</td>
<td>Client will return to baseline state of consciousness.</td>
</tr>
<tr>
<td>NIC</td>
<td>Cerebral Perfusion Promotion, Neurologic Monitoring</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>Assess level of consciousness every 15 minutes.</td>
</tr>
<tr>
<td></td>
<td>Orient client to location.</td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Client awakened with no untoward effects. Transferred to his room 1.5 hours after arrival in PACU.</td>
</tr>
</tbody>
</table>

#### ASSESSMENT

Airway patency; skin integrity

<table>
<thead>
<tr>
<th>NURSING DIAGNOSIS</th>
<th>Risk for injury related to decreased sensations secondary to anesthesia and medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOC</td>
<td>Risk Control; Safety Status: Physical Injury</td>
</tr>
<tr>
<td>PLANNING/GOALS</td>
<td>Client will not sustain injury during decreased consciousness.</td>
</tr>
<tr>
<td>NIC</td>
<td>Risk Identification, Surveillance Safety</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>Maintain client airway.</td>
</tr>
<tr>
<td></td>
<td>Remove plastic airway when swallowing reflex returns.</td>
</tr>
<tr>
<td></td>
<td>Keep siderails up until client is fully awake.</td>
</tr>
<tr>
<td></td>
<td>Assess skin integrity and provide position change and skin care prn.</td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Client returns to consciousness without experiencing any untoward events.</td>
</tr>
</tbody>
</table>

(Continues)
### NURSING CARE PLAN (Continued)

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Pain level</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURSING DIAGNOSIS</td>
<td>Acute pain related to surgical procedure</td>
</tr>
<tr>
<td>NOC</td>
<td>Pain Control, Pain Level</td>
</tr>
<tr>
<td>PLANNING/GOALS</td>
<td>Client maintains pain control of 2–3/10 (scale) as evidenced by verbalization and assessment of nonverbal data.</td>
</tr>
<tr>
<td>NIC</td>
<td>Analgesic Administration, Pain Management</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>Routinely assess level of pain. Administer pain medication on routine schedule to maintain pain control.</td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Client verbalizes pain control of 2–3/10 scale.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Position; ease of respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURSING DIAGNOSIS</td>
<td>Risk for injury related to increased secretions during unconsciousness</td>
</tr>
<tr>
<td>NOC</td>
<td>Risk Control; Safety Status: Physical Injury</td>
</tr>
<tr>
<td>PLANNING/GOALS</td>
<td>Client will be protected from injury during decreased consciousness.</td>
</tr>
<tr>
<td>NIC</td>
<td>Environmental Management: Safety; Surveillance Safety</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>Ensure comfortable position that facilitates gas exchange and does not put undue pressure on any body part. Maintain client in head-down position or turned to side to prevent drainage of secretions. Suction secretions while client is unable to control them.</td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Client returns to consciousness and controls own secretions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Body temperature; blood pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURSING DIAGNOSIS</td>
<td>Risk for hypothermia: chills related to vasodilation secondary to medications and environment</td>
</tr>
<tr>
<td>NOC</td>
<td>Thermoregulation</td>
</tr>
<tr>
<td>PLANNING/GOALS</td>
<td>Client will be restored to body temperature within normal limits.</td>
</tr>
<tr>
<td>NIC</td>
<td>Temperature Regulation</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>Take vital signs frequently (every 4 hours). <strong>Note:</strong> While client is in PACU, the vital signs are monitored more frequently. The same is true after the client’s initial return to the surgical nursing unit. Provide additional blankets and keep client from contact with drafts.</td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Note evidence of shivering. Client’s body temperature is gradually returned to normal.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>Vital signs; verbalizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURSING DIAGNOSIS</td>
<td>Anxiety related to surgical procedure and hospital environment</td>
</tr>
<tr>
<td>NOC</td>
<td>Anxiety Control, Coping</td>
</tr>
<tr>
<td>PLANNING/GOALS</td>
<td>Client will express concerns and receive answers to control anxiety.</td>
</tr>
<tr>
<td>NIC</td>
<td>Anxiety Reduction, Health Teaching</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>Provide explanations, support, and reassurances. Orient client to time and place (at completion of surgery and in PACU).</td>
</tr>
<tr>
<td>EVALUATION</td>
<td>Client experiences minimal anxiety.</td>
</tr>
</tbody>
</table>
1. Discuss the influence of an active history of smoking on a client who is to undergo general anesthesia.

2. Discuss the special needs of a pediatric client and family before, during, and after anesthesia. You may want to talk with a pediatric surgical nurse.

3. Discuss which of the following complications can occur as a result of anesthesia in the older adult because of physiological changes—CNS excitation, atelectasis, polydypsia, aphasia—and why complications would occur.

4. Discuss the various measures nurses should take at the time of the administration of preanesthetic medications to ensure client comfort and safety and safekeeping of personal belongings. Design a checklist to be used at that time to be certain that appropriate nursing tasks are completed.

CASE STUDY 11-1

Carmen Alvarez, a 50-year-old truck driver, is admitted to the hospital for removal of hemorrhoids (hemorrhoidectomy). He has been bothered by hemorrhoids for the previous 2 years and has been using Preparation H for relief of burning and itching. In the past month, the discomfort increased and the health care provider suggested that surgery be scheduled. Medications Mr. Alvarez currently is taking po include Atenolol 50 mg once every day, HCTZ 25 mg once every day, and aspirin 81 mg once every day.

On admission to the hospital, the following preoperative medication prescriptions are written:

- temazepam (Restoril) 30 mg by mouth, prn, HS
- midazolam 2.5 mg IV on call to the operating room (OCTOR)
- fentanyl citrate 150 mcg IV OCTOR

Mr. Alvarez received his preoperative medications and was transferred to the surgical suite about 8:15 AM. There he was strapped to the table, a blood pressure cuff was placed on his left arm, and an IV infusion was begun in his right arm. The anesthetist administered thiopental sodium through this IV line. Following loss of consciousness, the closed method of administration was used to give the client nitrous oxide gas and oxygen.

After completion of the surgery, Mr. Alvarez was transferred to the PACU, where the anesthetist gave a report to the PACU nurse.

Questions for Discussion

1. What kind of drug is Preparation H, and why would it be used in the treatment of hemorrhoids?
2. Why do preoperative medication prescriptions often contain a prescription for a hypnotic to be administered the night before surgery? In this case, the hypnotic has been ordered prn. What would you, as the nurse, do about administering this drug?
3. What is the purpose for administering the midazolam HCl and fentanyl citrate OCTOR? To what drug classifications do these agents belong? Can these drugs be given in the same syringe? What nursing care is associated with the administration of these agents before surgery?
4. What impact will these agents have on the amount of general anesthesia administered?
5. What kind of drug is thiopental sodium? Why is it used?
6. What information about the surgery and the client does the PACU nurse need from the operating room nurse or anesthesiologist during the PACU report?
7. What nursing care will be required for Mr. Alvarez in the PACU until he regains consciousness?
1. General anesthesia works by inhibiting the neuronal impulses in the:
   a. Sympathetic nervous system
   b. Central nervous system
   c. Peripheral nervous system
   d. Respiratory center of the brain

2. The most commonly used gaseous anesthetic agent is:
   a. Nitrous oxide
   b. Fentanyl citrate
   c. Propofol
   d. Lidocaine

3. The conscious stage of anesthesia is:
   a. Stage 1
   b. Stage 2
   c. Stage 3
   d. Stage 4

4. Complete muscle relaxation initially occurs in what stage and plane?
   a. Stage 1; Plane 3
   b. Stage 2; Plane 4
   c. Stage 3; Plane 3
   d. Stage 4; Plane 1

5. Complete dilation of the pupils and respiratory paralysis occurs in which stage?
   a. Stage 1
   b. Stage 2
   c. Stage 3
   d. Stage 4

6. Sevoflurane is an example of what type of anesthetic agent?
   a. Injectable for general anesthesia
   b. Injectable regional anesthetic
   c. Inhalation general anesthetic
   d. Balanced inhalation anesthetic

7. Propofol belongs to what classification?
   a. Beta-agonist
   b. Alkylphenol
   c. Diazepine
   d. Opioid

8. Balanced anesthesia is the most commonly used practice of administering general anesthesia because it:
   a. Provides deep anesthesia for all types of surgery
   b. Provides a safe, effective, and controlled level of anesthesia
   c. Is the easiest method of administering general anesthesia
   d. Never induces respiratory compromise in older adults

9. Diazepam, lorazepam, and midazolam are used as adjuncts to anesthesia because they:
   a. Produce unconsciousness
   b. Produce complete muscle relaxation
   c. Produce sedation and amnesia for the event
   d. Increase client awareness

10. Prior to administering an IM injection, the nurse should:
    a. Prepare the intramuscular site with povidone
    b. Tell the client that the injection is not painful
    c. Apply LMX4 cream to intramuscular site
    d. No client preparation is needed

11. Which of the following anesthetic agents carries the greatest risk for anesthesia-induced respiratory depression?
    a. Morphine sulfate
    b. Midazolam
    c. Fentanyl citrate
    d. Sufentanil

12. Prior to a client receiving anesthesia, the nurse is responsible for:
    a. Obtaining the surgical consent
    b. Assessing the client’s vital signs
    c. Prescribing preanesthetic agents
    d. Describing the surgical procedure to the client and family

13. By providing client and family teaching, the nurse addresses which of the following nursing diagnoses before surgery?
    a. Deficient knowledge related to medical condition
    b. Risk for injury, malignant hyperthermia
    c. Hypothermia related to decreased metabolic rate
    d. Fear/anxiety related to the unknown

14. The highest priority preoperative assessment the nurse should include when she interviews the client is which of the following?
    a. Social history
    b. Allergies
    c. Food preferences
    d. Height

15. The nurse understands that clients receiving anticholinergic agents before surgery may experience:
    a. Urinary retention
    b. Respiratory depression
    c. Sedation
    d. Anticholinergic-induced anxiety

16. Following the administration of preoperative midazolam, the nurse should:
    a. Instruct client not to get out of bed
    b. Ensure side rails are down
    c. Tell family members they need to leave the client’s room
    d. Notify the health care provider
17. Dantrolene is used to treat malignant hyperthermia because it:
   a. Reverses the action of the anesthetic agent
   b. Blocks the release of calcium
   c. Inhibits the functioning of the emetic center
   d. Produces sedation
18. The priority nursing goal when receiving the client in the PACU is to:
   a. Perform cardiac monitoring
   b. Monitor urinary output
   c. Maintain patent airway
   d. Assess for bleeding
19. EMLA is used to reduce pain associated with:
   a. Intravenous access insertion
   b. Inhalation anesthesia
   c. Eye surgery
   d. Abdominal surgery
20. Clients receiving epidural or spinal anesthesia should be closely monitored for:
   a. Urinary retention and bradycardia
   b. Hypotension and sedation
   c. Urinary retention and sedation
   d. Hypotension and bradycardia

REFERENCES


SUGGESTED READINGS

Food and Drug Administration. www.fda.gov
Malignant Hyperthermia Association of the United States. www.mhaus.org

Nurse’s PDR Resource Center. www.nursespdr.com