**UNIT 9 / Responses to Altered Cardiac Function**

**NURSING CARE OF THE CLIENT HAVING A** Coronary Artery Bypass Graft

**PREOPERATIVE CARE**
- Provide routine preoperative care and teaching as outlined in Chapter 4.
- Verify presence of laboratory and diagnostic test results in the chart, including CBC, coagulation profile, urinalysis, chest x-ray, and coronary angiogram. These baseline data are important for comparison of postoperative results and values.
- Type and crossmatch four or more units of blood as ordered.
- Blood is made available for use during and after surgery as needed.
- Provide specific client and family teaching related to procedure and postoperative care. Include the following topics.
  - Cardiac recovery unit; sensory stimuli; personnel; noise and alarms; visiting policies
  - Tubes, drains, and general appearance
  - Monitoring equipment, including cardiac and hemodynamic monitoring systems
  - Respiratory support: ventilator, endotracheal tube, suctioning; communication while intubated
  - Incisions and dressings
  - Pain management

Preoperative teaching reduces anxiety and prepares the client and family for the postoperative environment and expected sensations.

**POSTOPERATIVE CARE**
- Provide routine postoperative care as outlined in Chapter 4.
- In addition to the care needs of all clients having major surgery, the cardiac surgery client has specific care needs related to open-heart and thoracic surgery. These are outlined under the nursing diagnoses identified below.

**Decreased Cardiac Output**
Cardiac output may be compromised postoperatively due to bleeding and fluid loss; depression of myocardial function by drugs, hypothermia, and surgical manipulation; dysrhythmias; increased vascular resistance; and a potential complication, cardiac tamponade, compression of the heart due to collected blood or fluid in the pericardium.

- Monitor vital signs, oxygen saturation, and hemodynamic parameters every 15 minutes. Note trends and report significant changes to the physician. Initial hypothermia and bradycardia are expected; the heart rate should return to the normal range with rewarming. The blood pressure may fall during rewarming as vasodilation occurs. Hypotension and tachycardia, however, may indicate low cardiac output. Pulmonary artery pressure (PAP), pulmonary artery wedge pressure (PAWP), cardiac output, and oxygen saturation are monitored to evaluate fluid volume, cardiac function, and gas exchange. Hemodynamic monitoring is further discussed in Chapter 32.
- Auscultate heart and breath sounds on admission and at least every 4 hours. A ventricular gallop, or $S_3$, is an early sign of heart failure; an $S_4$ may indicate decreased ventricular compliance. Muffled heart sounds may be an early indication of cardiac tamponade. Adventitious breath sounds (wheezes, crackles, or rales) may be a manifestation of heart failure or respiratory compromise.
- Assess skin color and temperature, peripheral pulses, and level of consciousness with vital signs. Pale, mottled, or cyanotic coloring, cool and clammy skin, and diminished pulse amplitude are indicators of decreased cardiac output.
- Continuously monitor and document cardiac rhythm. Dysrhythmias are common, and may interfere with cardiac filling and contractility, decreasing the cardiac output.
- Measure intake and output hourly. Report urine output less than 30 mL/h for 2 consecutive hours. Intake and output measurements help evaluate fluid volume status. A fall in urine output may be an early indicator of decreased cardiac output.
- Record chest tube output hourly. Chest tube drainage greater than 70 mL/h or that is warm, red, and free flowing indicates hemorrhage and may necessitate a return to surgery. A sudden drop in chest tube output may indicate impending cardiac tamponade.
- Monitor hemoglobin, hematocrit, and serum electrolytes. A drop in hemoglobin and hematocrit may indicate hemorrhage that is not otherwise obvious. Electrolyte imbalances, potassium, calcium, and magnesium in particular, affect cardiac rhythm and contractility.
- Administer intravenous fluids, fluid boluses, and blood transfusions as ordered. Fluid and blood replacement helps ensure adequate blood volume and oxygen-carrying capacity.
- Administer medications as ordered. Medications ordered in the early postoperative period to maintain the cardiac output include inotropic drugs (e.g., dopamine, dobutamine) to increase the force of myocardial contractions; vasodilators (e.g., nitroprusside or nitroglycerin) to decrease vascular resistance and after-load; and antidysrhythmics to correct dysrhythmias that affect cardiac output.
- Keep a temporary pacemaker at the bedside; initiate pacing as indicated. Temporary pacing may be needed to maintain the cardiac output with bradydysrhythmias, such as high-level AV blocks.

**PRACTICE ALERT**
Assess for signs of cardiac tamponade: increased heart rate, decreased BP, decreased urine output, increased central venous pressure, a sudden decrease in chest tube output, muffled/distant heart sounds, and diminished peripheral pulses. Notify physician immediately. Cardiac tamponade is a life-threatening complication that may develop postoperatively. Cardiac tamponade interferes with ventricular filling and contraction, decreasing cardiac output. Untreated, cardiac tamponade leads to cardiogenic shock and possible cardiac arrest.

**Hypothermia**
Hypothermia is maintained during cardiac surgery to reduce the metabolic rate and protect vital organs from ischemic damage. Although rewarming is instituted on completion of the surgery, the client often remains hypothermic on admission to cardiac recovery. Gradual rewarming is necessary to prevent peripheral vasodilation and hypotension.
- Monitor core body temperature (e.g., tympanic membrane, pulmonary artery, bladder) for the first 8 hours following surgery. Oral and rectal temperature measurements are not reliable indicators of core body temperature during this period.
Acute Pain
Following a CABG, pain is experienced due to both the thoracic incision and removal of the saphenous vein from the leg. Dissection of the internal mammary artery (usually the left IMA) from the chest wall also causes chest pain on the affected side. Chest tube sites are also uncomfortable. The leg from which the saphenous vein graft was obtained may be more painful than the chest incision.

Frequently assess for pain, including its location and character. Document its intensity using a standard pain scale. Assess for verbal and nonverbal indicators of pain. Validate pain cues with the client. Pain is subjective, and differs among individuals. In incisional pain is expected; however, anginal pain also may develop. It is important to differentiate the type of pain.

PRACTICE ALERT
Promptly report anginal or cardiac pain. Cardiac pain may indicate a perioperative or postoperative myocardial infarction.

Administer analgesics on a scheduled basis, by PCA, or by continuous infusion for the first 24 to 48 hours. Research demonstrates that adequate pain management in the immediate postoperative period reduces complications from sympathetic stimulation and allows faster recovery. Pain causes muscle tension and vasoconstriction, impairing circulation and tissue perfusion, slowing wound healing, and increasing cardiac work.

Premedicate 30 minutes before activities or planned procedures. Premedication and the subsequent reduction of pain improves client participation and cooperation with care.

Ineffective Airway Clearance/Impaired Gas Exchange
Atelectasis due to impaired ventilation and airway clearance is a common pulmonary complication of cardiac surgery. Gas exchange may also be affected by blood loss and decreased oxygen-carrying capacity following surgery. Phrenic nerve paralysis is a potential complication of cardiac surgery which may also contribute to impaired ventilation and gas exchange.

Evaluate respiratory rate, depth, effort, symmetry of chest expansion, and breath sounds frequently. Pain, anxiety, excess fluid volume, surgical injury, narcotics and anesthesia, and altered homeostasis can affect respiratory rate, depth, and effort postoperatively. Decreased chest expansion or asymmetrical movement may indicate impaired ventilation of one lung, and needs further evaluation.

Note endotracheal tube (ETT) placement on chest x-ray. Mark tube position and secure in place. Insert an oral airway if an oral ETT is used. The chest x-ray documents correct ETT placement above the bifurcation to the right and left mainstem bronchus. Marking its appropriate placement allows evaluation of potential tube movement. Secure the tube firmly in place to prevent slippage or inadvertent removal. An oral airway helps prevent obstruction of an oral ETT by biting.

Maintain ventilator settings as ordered. Monitor arterial blood gases (ABGs) as ordered. Mechanical ventilation promotes optimal lung expansion and oxygenation postoperatively. ABGs are used to evaluate oxygenation and acid–base balance.

Suction as needed. Suctioning is performed only as indicated to clear airway secretions.

Prepare for ventilator weaning and extubation, as appropriate. The client is removed from the ventilator and extubated as soon as possible to reduce complications associated with mechanical ventilation and intubation.

After extubation, teach use of the incentive spirometer, and encourage use every 2 hours. Encourage deep breathing; advise against vigorous coughing. Teach use of a “cough pillow” to splint chest incision and decrease pain. Frequently turn and encourage movement. Dangle on postoperative day 1. Deep breathing, controlled coughing, and position changes improve ventilation and airway clearance and help prevent complications. Vigorous coughing may excessively increase intrathoracic pressure and cause sternal instability.

Risk for Infection
Following an open chest procedure, a sternal infection may develop that can progress to involve the mediastinum. Incisions for removal of the saphenous vein also may become infected. Clients with IMA grafts, who are diabetic, older, or malnourished, are at high risk: Harvesting of IMA disrupts blood supply to the sternum, and these clients have impaired immune responses.

Clients with IMA grafts who are diabetic, older, or malnourished are at high risk. Harvesting of IMA disrupts blood supply to the sternum, and these clients have impaired immune responses and healing.

Assess sternal incision and leg wounds every shift. Document redness, warmth, swelling, and/or drainage from the site. Note wound approximation. These assessments provide indicators of inflammation and healing.

Maintain a sterile dressing for the first 48 hours, then leave the incision open to air. Use Steri-Strips as needed to maintain approximation of the wound edges. The sterile dressing prevents early contamination of the wound, whereas exposing the incision after 48 hours promotes healing.

Report signs of wound infection: a swollen, reddened area that is hot and painful to the touch; drainage from the wound; impaired healing, or healed areas that re-open. Evidence of infection or impaired healing requires further evaluation and treatment.

Culture wound drainage as indicated. Identifying the infective organism facilitates appropriate antibiotic therapy.

Collaborate with the dietitian to promote nutrition and fluid intake. Good nutritional status is vital to healing and immune function.
The majority of deaths from MI occur during the initial period after symptoms begin: approximately 60% within the first hour, and 40% prior to hospitalization. Heightening public awareness of the manifestations of MI, the importance of seeking immediate medical assistance, and training in cardiopulmonary resuscitation (CPR) techniques are vital to decrease deaths due to MI.

Myocardial infarction rarely occurs in clients without pre-existing coronary heart disease. While no specific cause has been identified, the risk factors for MI are those for coronary heart disease: age, gender, heredity, race; smoking, obesity, hyperlipidemia, hypertension, diabetes, sedentary lifestyle, diet, and others. See the previous section of this chapter on coronary heart disease for further discussion of these risk factors.

Pathophysiology
Atherosclerotic plaque may form stable or unstable lesions. Stable lesions progress by gradually occluding the vessel lumen, whereas unstable (or complicated) lesions are prone to rupture and thrombus formation. Stable lesions often cause angina (discussed in the previous sections); unstable lesions often lead to acute coronary syndromes, or acute ischemic heart diseases. Acute coronary syndromes include unstable angina, myocardial infarction, and sudden cardiac death (Braunwald et al., 2002).

Myocardial infarction occurs when blood flow to a portion of cardiac muscle is completely blocked, resulting in prolonged tissue ischemia and irreversible cell damage. Coronary occlusion is usually caused by ulceration or rupture of a complicated atherosclerotic lesion. When an atherosclerotic lesion ruptures or ulcerates, substances are released that stimulate platelet aggregation, thrombin generation, and local vasomotor tone. As a result, the vessel constricts and a thrombus (clot) forms, occluding the vessel and interrupting blood flow to the myocardium distal to the obstruction.

Cellular injury occurs when the cells are denied adequate oxygen and nutrients. When ischemia is prolonged, lasting more than 20 to 45 minutes, irreversible hypoxic damage causes cellular death and tissue necrosis. Oxygen, gly co gen, and ATP stores of ischemic cells are rapidly depleted. Cellular metabolism shifts to an anaerobic process, producing hydrogen ions and lactic acid. Cellular acidosis increases cells’ vulnerability to further damage. Intracellular enzymes are released through damaged cell membranes into interstitial spaces.

Cellular acidosis, electrolyte imbalances, and hormones released in response to cellular ischemia affect impulse conduction and myocardial contractility. The risk for dysrythmias increases, and myocardial contractility decreases, reducing stroke volume, cardiac output, blood pressure, and tissue perfusion.

The subendocardium suffers the initial damage, within 20 minutes of injury, because this area is the most susceptible to