# SELECTED NEUROSURGICAL PROCEDURES

*Part of* "Chapter 15 - Management of Patients Undergoing Neurosurgical Procedures"

Three surgical procedures are discussed in this section: transsphenoidal hypophysectomy, carotid endarterectomy, and placement of a ventricular shunt.

## *Transsphenoidal Hypophysectomy*

### Description

The transsphenoidal approach is possible because of the development of microsurgical techniques and equipment (Fig. 15-9). Pituitary adenomas, craniopharyngiomas, and a complete hypophysectomy for control of bone pain in metastatic cancer are the usual conditions for which a transsphenoidal surgical approach is used. The transsphenoidal surgical approach affords access to the pituitary gland by means of an incision made inside the superior upper lip, in front of the hard palate. After the sphenoid sinus floor is dissected, the sella turcica is visible. A portion of the sella floor is removed, and the dura incised. With the aid of a surgical microscope, the pituitary is partially or completely removed or the impinging tumor is excised. A graft of muscle taken from the anterior surface of the thigh or a fat pad (taken from the abdomen or thigh) is then applied to the surgical site as a patch to prevent CSF leakage. Nasal Vaseline packings are inserted to control bleeding and to replace the septal mucosa. A dry, sterile dressing is firmly applied to the donor site (abdomen or thigh).

**Figure 15-9** • Transsphenoidal approach in pituitary surgery. (From Smeltzer, S. C. & Bare, B. G. [1996]. *Brunner and Suddarth's textbook of medical-surgical nursing* [8th ed.] [p. 1738]. Philadelphia: Lippincott-Raven Publishers.)

The specific tissue that is surgically excised depends on the reason for surgery. If surgery was scheduled for removal of a pituitary adenoma, the pituitary gland would be left intact, if possible, and the tumor excised. In a patient who undergoes craniopharyngioma surgery, only the tumor would be excised.

### Palliative Surgery for Pain Secondary to Cancer

Palliative hypophysectomy for cancer necessitates total removal of the pituitary. The surgeon attempts to excise the pituitary in one piece, because cells left at the surgical site continue to secrete hormones and decrease the anticipated relief of pain. It is unclear why a hypophysectomy can alleviate pain or further slow metastasis. Removal of the anterior lobe, with the resultant cessation of prolactin and the growth-stimulating hormone, helps to control breast and prostate cancer. Preoperative preparation begins with patient and family teaching. The patient needs realistic expectations of outcome and the need for drug replacement therapy.

## Postoperative Complications

The major complications associated with transsphenoidal hypophysectomy include CSF leakage (rhinorrhea), DI, sinusitis, and delayed epistaxis. The patient should be monitored for the development of these complications. Of these complications, only DI is discussed.

### *Postsurgical Diabetes Insipidus*

Central DI is defined as the cessation of ADH secretion by the pituitary gland as a result of damage from disease or injury of the hypothalamus, the supraoptic hypophyseal tract, or the posterior pituitary. The most common cause of central DI is neurosurgery. Postsurgical DI can occur up to 2 weeks postoperatively.

Monitoring for the development of DI is a major postoperative nursing responsibility (see Chap. 10 for further discussion).



The symptoms of DI are copious amounts of pale urine (more than 250 mL/hour for 2 consecutive hours) and a low urinary specific gravity (less than 1.005). Therefore, fractional urinary output, specific gravity, and serum osmolality need to be checked every 1 to 2 hours.

Other patients may experience a pattern of transient copious urinary output and low specific gravity. If the patient is able to drink enough fluid to quench thirst and maintain fluid and electrolyte balance, no medical treatment is indicated. Some patients may also experience a period of low urinary output 2 or 3 days postoperatively before permanent DI develops.

In the case of a total hypophysectomy, permanent DI is expected and replacement therapy is begun. With partial resection, DI is not permanent. In the immediate postoperative period, aqueous vasopressin (Pitressin) intramuscularly (IM), subcutaneously, or IV *or* DDAVP subcutaneously or IV titrated to output (see Chap. 11) should be instituted. After the nasal packings have been removed, intranasal DDAVP can be used.13 The patient must be instructed in the safe use of the drug.

- Nasal mucosa irritation may occur; this will interfere with absorption of the drug.
- Overuse of the drug will cause water intoxication (mental confusion, drowsiness). For some patients, it may be more convenient and safer to use vasopressin in oil, 2.5 to 5.0 mg IM every 2 to 3 days, to control DI.
- Daily weight must be monitored.
- Oral intake must be balanced with daily output.

## Hormonal Replacement

In the case of total hypophysectomy, other hormonal replacement is necessary. The usual

drugs ordered include:

- Adrenocorticotropic hormone (ACTH), 25 mg IM in the morning and 12.5 mg IM at night, beginning immediately after surgery.
- Thyroxin, 0.2 to 0.3 mg daily. Thyroid replacement therapy is delayed for 3 to 4 weeks following surgery.
- Cortisone acetate, 100 mg/d IM, beginning 2 days *before* surgery to prevent adrenal insufficiency. The drug is continued postoperatively but at a lower dose than that indicated previously.

## *Patient Teaching for Drug Replacement*

If lifelong replacement drug therapy is necessary, it is most important that the patient and family understand the purposes of drug therapy. The nurse should begin with a basic overview of the pituitary gland to foster an understanding of the rationale for drug replacement therapy. The degree of sophistication with which this information is presented will depend on the learner's level of understanding. To reinforce the verbal explanation, written and visual aids are helpful. The teaching plan should include:

- Specific information to record and submit to the physician, such as daily weight
- Signs and symptoms of undermedication or overmedication
- Side effects of drugs
- Lifestyle alterations necessitated as a result of drug therapy

## *Adrenocorticotropic Hormone*

Certain cells of the anterior pituitary gland produce ACTH, which is stored until the hypothalamus secretes corticotropin-releasing hormone (CRH), which signals the pituitary gland to release ACTH. The target of ACTH is the cortex of the adrenal glands by way of the bloodstream. The following hormones are secreted by the adrenal cortex:

- The glucocorticoids, such as cortisol (hydrocortisone) and cortisone, are the major secretions and are necessary for carbohydrate, protein, and fat metabolism. They also help the body cope with physical and emotional environmental stresses. Cortisone is a hormone that requires daily replacement for survival.
- The mineralocorticoids (particularly aldosterone) control salt and water metabolism by reabsorbing sodium ions in exchange for potassium in the kidney. This hormone does not require replacement on a daily basis.
- Certain male and female hormones play a minor role in comparison with the

secretions of the ovaries and the testes. Replacement therapy is contraindicated if a hypophysectomy was done to control breast or prostate cancer. In other patients, replacement therapy may be necessary on a monthly basis, depending on age and other considerations. This determination will be made by the physician.

High blood levels of corticotropic hormone inhibit secretion of CRH so that no additional ACTH is secreted by the pituitary gland. The body normally produces the largest amount of ACTH in the early morning hours so that the glucocorticoids necessary for carbohydrate, protein, and fat metabolism are available when needed.

During times of physical and emotional stress, individuals require large amounts of cortisol. ACTH is continually produced to meet this need. Under severe stress, ten times the normal amount of cortisol may be required; approximately 25 mg is the daily requirement under normal circumstances.

Following hypophysectomy, the adrenal gland is deprived of stimulation because ACTH that is normally produced by the pituitary gland is absent. The patient will require ACTH replacement or administration of hydrocortisone, the natural glucocorticoid secreted by the adrenal cortex. This drug has some of the mineralocorticoid properties that are provided by adrenal secretion.

The patient receiving **cortisone therapy** should know the following:

- The drug must be taken daily as ordered; failure to take the drug can be life threatening.
- The dosage must be increased during periods of emotional stress, illness, excessive exercise, major changes in daily routine, exposure to high altitudes, tooth extraction, fever, or infection.
- Gastric irritation, a side effect of steroid therapy, can be minimized by taking an antacid (30 mL of magnesium hydroxide) with each dose of the drug.
- The presence of tarry stools indicates gastrointestinal

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hemorrhage, which should be reported to the physician immediately.

- Check blood pressure periodically for HPT (an elevation in blood pressure is common with cortisone therapy); if the patient is taking antihypertensives, adjustments in the dosage may be necessary.
- Check for hyperglycemia; ACTH is associated with diabetes mellitus.
- Behavioral changes, such as euphoria, restlessness, sleeplessness, agitation, and depression are common with cortisone therapy.
- The following are signs and symptoms of *undermedication* (addisonian crisis):
    - Weakness, dizziness, orthostatic hypotension

- Nausea and vomiting
- odium and water retention
- Decreased blood pressure

- Management of cortisone insufficiency requires parenteral hydrocortisone sodium succinate (Solu-Cortef). Failure to treat will lead to circulatory collapse.
- The following are signs and symptoms of *overmedication*:
  - Cushingoid signs (moon face, fat pads, buffalo hump, acne, hirsutism, and weight gain)
  - Psychic disturbances
  - Peptic ulcers
  - Headache, vertigo, cataracts, and increased ICP and intraocular pressure
- A medical alert bracelet must be worn at all times.
- An emergency kit of hydrocortisone sodium succinate must be carried at all times.

## Postoperative Nursing Management After Transsphenoidal Surgery

Specific points regarding the nursing management of the patient undergoing surgery by the transsphenoidal approach are outlined in Chart 15-3. After surgery, minimal pain is noted at the oronasal suture line because the pain receptor fibers have been cut, resulting in loss of pain perception. Nasal mucosa requires at least 1 month to heal satisfactorily. Nasal packings are removed in 3 to 4 days. The senses of smell and taste return in 2 or 3 weeks. Headache, as a result of sinus congestion or ear discomfort related to the nasal packings, is common.

**CHART 15–3 • Nursing Management After Transsphenoidal Surgery**

| Nursing Management | Rationale |
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| **EARLY POSTOPERATIVE MANAGEMENT** | |
| • Frequently monitor vital and neurological signs. | • Provides information for baseline comparisons to indicate trends, deterioration, or complications |
| • Maintain the head of bed at 30 degrees. | • Promotes venous drainage from the brain, controls intracranial |

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| | pressure, and prevents hemorrhage at the operative site |
| • Check the dressing at the donor site on the thigh for evidence of bleeding. | • Detects bleeding for early intervention |
| • Frequently check nasal drains and packing; observe for hemorrhage or cerebrospinal fluid (CSF) drainage from the operative site; the mustache dressing should be observed and changed as necessary. | • Promotes early detection of hemorrhage or CSF and subsequent early intervention |
| **PREVENTION OF COMPLICATIONS** | |
| • Monitor urinary output and specific gravity frequently. | • Monitor for evidence of diabetes insipidus |
| • Monitor electrolyte and osmolarity laboratory values for abnormally high or low readings (serum and urine osmolarity, serum sodium). Normal values are as follows: Serum osmolarity: 280–295 mOsm/L Urine osmolarity: 500–800 mOsm/L Serum sodium: 135–145 mEq/L | • In diabetes insipidus, the serum sodium level is increased, serum osmolarity is increased, and urine osmolarity is decreased; also, serum electrolyte testing can indicate an electrolyte imbalance |
| • Give frequent mouth care, but do not allow the patient to brush teeth if the oral approach was used. | • Prevents injury at the suture line, yet allows the mouth to be refreshed and cleansed |
| • Progress diet from liquid to soft as necessary. | • Prevents injury to the suture line |
| • After packings are removed, caution the patient against blowing the nose or sneezing for at least 1 mo. | • Prevents hemorrhage from fragile nasal tissue at operative site |
| **SUPPORTIVE CARE** | |
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| • Provide for routine hygienic care, such as bathing, hair combing, and nail cutting. | • Maintains general well-being |
| • Offer fluids frequently, as ordered. | • Maintains hydration and moistens the oral mucous membrane, which becomes dry from mouth breathing (required when nasal packings are in place) |
| • Provide eye care (clean and lubricate). | • Prevents infection, inflammation, and drying of the cornea |
| • Apply compresses to the periocular region if periocular edema occurs. | • Controls and alleviates periocular edema |
| **PATIENT TEACHING** | |
| • Prepare and implement a patient teaching plan to outline any adjustments in lifestyle, precautions nec-essary with the drug protocol, and general informa-tion about the patient's health problem. | • Provides for the safety and well-being of the patient and includes the patient as an involved, informed participant in health management |
| • Provide written material to summarize the major points of home management for the patient. | • Reinforces the major points of the teaching plan and reduces the possibility of confusion or questions about home protocol |
| • Include the family in the teaching plan. | • Includes the family in the plan of care so that they can become a knowledgeable support system for the patient |

If the hypophysectomy was performed to control metastasis and bone pain, relief may be evident within hours after surgery; in other patients, it may take days to a few weeks. The surgery is a “last chance” effort to control severe pain that has made ADLs impossible. Many patients express a desire for their families to see them comfortable without the use of drugs and to fulfill certain life goals before death. The nurse's role in such cases is supportive. Clarifying and providing necessary information are vital.

## *Carotid Artery Surgery*

Cerebrovascular insufficiency can result from occlusion of the carotid artery secondary to atherosclerosis. If untreated, this can lead to transient ischemic attacks (TIAs) or stroke. In some instances, even though the internal carotid artery is occluded, the external carotid artery will remain patent as a result of collateral blood flow from the contralateral external carotid artery. In this event, the external carotid artery becomes extremely important in maintaining an adequate blood supply to the brain. Thus, a patient with occlusion of a carotid artery may be asymptomatic because of continued collateral circulation.

### Carotid Atherosclerosis

For reasons unknown, atheromas (atherosclerotic plaques) commonly form in the larger cerebral arteries such as the common carotid artery, especially at the bifurcation of the internal and external carotid arteries. The atheroma gradual narrows the blood vessel, which impinges on adequate cerebral blood flow. The atheroma can become the site for the formation of a thrombus, or it can break off and act as an embolus. Both processes can lead to cerebral ischemia and stroke (cerebral infarction).

### Diagnosis and Treatment

Diagnosis of cerebral vascular insufficiency is made on the basis of a history of TIAs, CT scan, transcranial Doppler studies, or a possible cerebral arteriogram. The most common cerebral revascularization surgical procedure is the carotid endarterectomy (CEA). Superior temporal artery–middle cerebral artery (STA-MCA) anastomosis is ineffective.14

### Carotid Endarterectomy

Carotid endarterectomy is the most frequently performed noncardiac vascular procedure today (Fig. 15-10).15 The first successful CEA dates back to 1953, when it was performed by DeBakey.16 In the United States, the number of CEAs rose from 15,000 in 1971 to 107,000 in 1985.17 However, there was much controversy about the appropriateness and effectiveness of the procedure in light of declining stroke rates, new emphasis on risk factor management, and new antiplatelet pharmacological therapies. Early randomized trials to evaluate results of CEA were disappointing.18,19 By 1989, the number of CEAs performed had declined to 70,000 owing to confusion about efficacy, patient selection, and outcomes.17 Concurrently, a randomized trial to evaluate extracranial-intracranial bypass to prevent stroke found that the procedure was ineffective in preventing stroke.14 Renewed interest in the CEA resulted in new studies.

**Figure 15-10** • Carotid endarterectomy. An oblique cervical incision allows dissection of the carotid bifurcation. Following heparinization, the arteries of the bifurcation are cross-clamped and an arteriotomy is performed. The plaque is dissected precisely in the subintimal plane, with a subsequent closure (primary or via patch reconstruction) of the arteriotomy. Other aspects of the surgery include intraoperative monitoring during cross-clamping, microsurgical technique allowing optimal lighting and magnification, patch angioplasty, shunting, and verification of patency.

The results of a landmark study, the North American Symptomatic Carotid Endarterectomy Trial (NASCET), were reported in 1991.20,21 Patients were randomized to either medical or surgical therapy for TIA or mild disabling stroke ipsilateral to a 70% to 90% narrowing of the internal carotid artery. The CEA group had a clear benefit in reducing the overall risk of fatal and nonfatal ipsilateral stroke, despite any preoperative risk of stroke or death from any cause. Over 26% of the medical group and 9% of the CEA group had a fatal or nonfatal ipsilateral stroke at 24 months. These findings report an absolute risk reduction from CEA of 17% and a relative risk reduction of 65%. Other analysis examined the role of risk factors present (e.g., age, gender, systolic and/or diastolic HPT). It was found that the benefit

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derived from CEA was directly proportional to the risk faced without surgery, and that those with the highest risks at entry gained the most benefit.17 Finally, it was found that patients with 70% stenosis or more benefited from a CEA, whereas it remained unclear about benefit in those with a stenosis of less than 70%. The large European Carotid Surgery Trial (ECST) also demonstrated a clear benefit for CEA for patients with advanced stenosis.22

The NASCET focused on symptomatic patients. In 1992, CEA practice guidelines23 were published followed by American Heart Association (AHA) guidelines in 1995.25 The next question was how best to manage asymptomatic patients with carotid stenosis. Further randomized studies have clarified the indication for surgery in asymptomatic patients. This was addressed in the Asymptomatic Carotid Atherosclerosis Study (ACAS).15

## Asymptomatic Carotid Artery Disease

In the ACAS trial, patients were randomly assigned to a surgical group (*n* = 825) or medical group (*n* = 834). All patients received aspirin (325 mg/day) and risk factor–reduction counseling. Follow-up occurred after 1 month and every 3 months thereafter. Doppler ultrasound was ordered at the initial 3-month follow-up, then every 6 months for 2 years, and annually up to 5 years or until endpoints were reached. Endpoints were defined as death or stroke. The medical group had a lower risk (0.4%) in the 42-day perioperative period, but higher risk (11%) for endpoint criteria after 5 years. Surgery reduced absolute risk by 5.9% and relative risk by 53% at 5 years. The knowledge gained from the ACAS study is reflected in the updated AHA 1998 guidelines for CEA.15 Note that the recommendations are organized around surgical risk. Surgical risk is based on neurological stability, comorbidity, angiographic risk, and is graded from I to IV. Grade I includes patients who are neurologically stable with no medical or angiographic risks, whereas

grade IV comprises neurologically unstable patients with or without medical or angiographic risks.26 In addition, ulcerations are classified from type A to C (Table 15-3).27 Guidelines for proven and acceptable indications for CEA for patients with asymptomatic carotid artery disease are found in Table 15-4.

**Table 15-3** • CLASSIFICATION OF CAROTID ULCERATIONS

**Table 15-4** • RECOMMENDATIONS FOR PATIENTS WITH ASYMPTOMATIC CAROTID ARTERY DISEASE BASED ON SURGICAL RISK

## Update on CEA for Symptomatic Patients

Further analysis of NASCET and the ECST data helps clarify CEA benefits supported by Grade A recommendations that are based on well-designed randomized control trials. The Grade A recommendations support CEA as beneficial for symptomatic patients with recent nondisabling carotid artery ischemic events and ipsilateral 70% to 99% carotid artery stenosis. CEA is not beneficial for symptomatic patients with 0% to 29% stenosis. Uncertainty remains about the potential benefit of CEA for symptomatic patients with 30% to 69% stenosis. ECST data do not support CEA for patients with less than 50% stenosis.22 CEA is *three times* as effective as medical therapy alone in reducing incidence of stroke in patients with symptomatic stenosis of 70% to 99%.22,28,29 However, CEA is not without preoperative risks and complications. To justify CEA, the significant complication



rate should be 3% or lower, according to the above-mentioned studies. Patient selection and the skill of the surgeon and surgical team are important factors in maintaining low surgical complications. In addition, the quality of nursing care is critical in prevention and early recognition of complications and in supporting optimal outcomes.

## Preoperative Concerns

Many patients who have cerebrovascular atherosclerosis also have other concurrent conditions and risk factors, such as coronary artery disease, peripheral vascular disease, renal disease, diabetes mellitus, hyperlipidemia, and HPT. Treatment and stabilization of these and other medical conditions and attention to risk factors are necessary before surgery. In particular, HPT must be controlled before surgery. Table 15-5 lists these risk factors.

**Table 15-5** • STROKE RISK FACTORS, MANAGEMENT, AND RELATIONSHIP TO OUTCOMES AFTER CAROTID ENDARTERECTOMY (CEA)

## Perioperative and Postoperative Complications

Perioperative complications of CEA include stroke, myocardial infarction, and death. Postoperative complications include HPT, hypotension, hyperperfusion syndrome, intracerebral hemorrhage, seizures, nerve injury, cranial nerve injury, and wound hematoma.

### *Postoperative Hypertension (HPT).*

Preoperative HPT is the single most important determinant for the development of postoperative HPT. Poorly controlled HPT increases the risk of wound hematoma and hyperperfusion syndrome. In addition, neurological deficits, intracerebral hemorrhage, and death were more common in those patients who developed postoperative HPT. The first 48 hours after the CEA is the peak time for postoperative HPT. About 21% of normotensive patients may have increased blood pressure after CEA.30 The pathophysiology of postoperative HPT is probably related to surgically induced changes in carotid body baroreceptor sensitivity. Prevention of injury to the vagus nerve and carotid sinus during surgery is important to avoid baroreceptor dysfunction. Unstable blood pressure is common during the first 24-hours after CEA, which occurs in about 73% of patients.31 It is a temporary problem that resolves in most instances. Therefore, frequent monitoring of blood pressure is very important in the postoperative period. Blood pressure must be maintained within a target range to prevent complications previously mentioned.

### *Postoperative Hypotension.*

Postoperative hypotension (i.e., systolic blood pressure less than 120 mm Hg) occurs in approximately 5% of patients.32 A fluid bolus and low-dose phenylephrine infusion are usually effective. It usually resolves in 24 to 48 hours. If significant hypotension persists, a myocardial infarction must be ruled out through serial electrocardiograms and cardiac enzyme measurements. Possible consequences of hypotension include cerebral hypoxia and ischemic stroke; therefore, adequate blood pressure within a targeted range must be maintained. Monitoring central venous pressure in the early postoperative period is helpful.

### *Hyperperfusion Syndrome.*

Patients at risk for hyperperfusion syndrome are those with high-grade stenosis of the internal carotid and those with chronic HPT. The risk is further compounded if a severe contralateral stenosis is present.15 Impairment of autoregulation is the basis for the syndrome. The cerebral hemodynamics are thought to be similar to that of normal perfusion breakthrough as seen after AVM resection.32,33 As a result of the high-grade stenosis, a chronic state of hypoperfusion exists in the hemisphere distal to the stenosis. The smaller blood vessels are in a chronic state of maximal dilation to provide adequate blood flow that results in a loss of autoregulation. After the stenosis has been



corrected, the hypoperfused hemisphere receives blood at a normal or elevated perfusion pressure. If autoregulation is impaired, vasoconstriction cannot occur to protect the capillaries. This results in edema and hemorrhage.15 Clinically, hyperperfusion syndrome

is characterized by a severe unilateral headache, seizures, and altered mental status or focal neurological deficits. Raising the head of the bed will often improve the headache. Strict control of blood pressure is key to prevent or to limit the severity of hyperperfusion syndrome.

### *Intracerebral Hemorrhage.*

Secondary to a hyperperfusion syndrome, the potential exists for intracerebral hemorrhage. This is often fatal (60%); less frequently, it results in poor patient outcomes (25%).34 The risk factors for hemorrhage are the same as for hyperperfusion syndrome, with the addition of advanced age and poor collateral flow on angiography. Control of blood pressure is critical to avoid or control hemorrhage.

### *Seizures.*

The occurrence of seizures is reported at 3%.35 They are related to hyperperfusion syndrome and hypertensive encephalopathy unless infarction or hemorrhage has occurred.

### *Nerve Injury.*

The transverse cervical nerve and the greater auricular nerve are frequently severed or injured during the course of CEA. What results is a permanent ipsilateral numbness of the upper neck, lower face, and lower ear that is generally well tolerated.17 Damage to the cervical sympathetic chain can result in a complete or incomplete Horner's syndrome.

### *Cranial Nerve Injury.*

Injury to the cranial nerves is a potential problem, although it is infrequent. The cranial nerves that are most vulnerable are the facial, glossopharyngeal, vagus, spinal accessory, and hypoglossal.17,26 The surgeon's skill is critical to a good outcome. Postoperative neurological assessment is important for early identification of potential deficits.

### *Wound Hematoma.*

In the NASCET study, a wound hematoma occurred in about 5.5% of patients.29 Most hematomas are small and are not uncomfortable. Larger hematomas can expand quickly and may necessitate emergency surgical evacuation. If the airway has been compromised, the physician may need to open the wound at the bedside during an emergency procedure. Meticulous attention to hemostasis is important to prevention. Therefore, frequent monitoring of the incision for the development of a hematoma is important.

## Postoperative Management

Many potentially life-threatening cardiovascular and cerebrovascular complications exist. Thus, frequent neurological and vital sign monitoring and close medical management of these patients are critical for optimal outcomes. Throughout the country, patients are admitted to areas offering various levels of care after postoperative discharge from the ICU: an intermediate unit or general floor care (after a few hours in a PACU). In the last

few years, questions have been raised about the need for ICU admission. Few studies have been conducted. One study reported that only a few patients benefit from ICU care.36 One must recognize that these



patients are at high risk for complications. Within this population are those patients identified as being at particularly high risk because of characteristics already mentioned as representing a pre-existing comorbidity (e.g., HPT). Appropriate monitoring and care must be provided regardless of clinical setting selected.

### *Ongoing Nursing Assessment and Monitoring*

Frequent vital sign, neurological, and wound assessment should be conducted. Some physicians insert a Jackson-Pratt drain at the operative site to manage drainage. The purpose of the drain is to prevent development of a hematoma, which could compress the airway. If a venous graft is used, the donor site is also monitored. The physician sets the target parameters for maintenance of systolic and diastolic blood pressure, based on a reasonable baseline before surgery. Vasopressors or antihypertensives may be ordered to maintain the desired blood pressure levels.

Frequent monitoring of neurological signs is necessary to determine any neurological changes associated with cerebral ischemia or stroke. In addition, the cranial nerves, especially V, VII, IX, X, XI, and XII, are assessed for deficits (facial drooping, hoarseness, diminished/lost gag and/or swallowing reflexes, and weakness of the tongue). Note presence of a small unilateral pupil with flushing of the skin, which may suggest development of Horner's syndrome. In the immediate postoperative period, the head of the bed may be flat or elevated, depending on the preference of the physician. The patient is positioned off the operative site. A central venous line, peripheral IV line, urinary catheter, cardiac monitor, and oxygen therapy are usually used. After protection of the airway has been established, items may be added to the patient's diet.

Most patients are discharged from the hospital in a day or two with a prescription for lifetime aspirin therapy (325 mg/day), unless a contraindication is found. Patient education should include what to report immediately to the physician. This includes new onset of unilateral headache, neurological deficits, or seizure activity. The importance of maintaining good blood pressure control and monitoring of blood pressure is stressed. Other risk modification, with the assistance of the primary care provider, is also discussed.

## Other Cerebral Vascular Procedures

### *Carotid Stenting and Angioplasty*

Although carotid stenting and angioplasty are available, experience and understanding are limited about their potential use. Currently, their clinical applications are being explored and evaluated.37

### *Ventricular Shunts*

A ventricular shunt is used to treat hydrocephalus. It consists of a primary catheter, a

reservoir, a one-way valve, and a terminal catheter. It is implanted surgically to provide for drainage of excessive CSF from the brain to decrease or prevent increased ICP. The primary catheter is implanted into the lateral ventricle through a bur hole. An incision is made under the scalp, and the catheter is pulled through so that the reservoir rests on the mastoid bone. CSF flows from the catheter to the reservoir, in which the CSF collects. A one-way valve on the reservoir prevents CSF reflux. A special instrument is used to pull the terminal catheter under the skin to the terminal point, which is the subarachnoid space or another body cavity (peritoneum, vena cava). The terminal catheter is then secured into position. In the adult, the peritoneal cavity is often used. The shunt is left in place permanently unless it becomes dislodged, plugged, or infected. In these situations, the shunt would be removed surgically and replaced.

Depending on the type of shunt placed, the physician may write an order to pump the shunt a given number of times at prescribed intervals (e.g., 10 times every 6 hours). The purpose of pumping a shunt is to flush the system of exudate that could plug the small tubing. To pump the shunt, lightly palpate the mastoid process with the index and middle fingers until the reservoir is palpated. It will feel bouncy to the touch. Next, with the index or middle finger, compress and gently release the reservoir the prescribed number of times. Documentation and any changes in neurological function are recorded in the patient's chart.