

advanced distally. The proximal part of the great saphenous vein is secured to the wire and retrieved, i.e., stripped, via the calf incision. Stripping of the great saphenous vein below the knee and stripping of the small saphenous vein usually are not performed because of the respective risks of saphenous and sural nerve injury. Complications of great saphenous vein ligation and stripping include deep vein thrombosis, bleeding, hematoma, infection, and nerve injury. Recurrent varicose veins occur in up to 50% patients by 5 years, due to technical failures, deep venous insufficiency, and incompetent perforating veins.

Stab phlebectomy is another surgical treatment for of varicose veins. A small incision is made alongside the varicose vein, and it is avulsed by means of a forceps or hook. This procedure may be performed in conjunction with saphenous vein ligation and stripping or thermal ablation. Subfascial endoscopic perforator surgery (SEPS) uses endoscopy to identify and occlude incompetent perforating veins. It also may be performed along with other ablative procedures.

Endovascular interventions, surgical bypass, and reconstruction of the valves of the deep veins are performed when feasible to treat patients with advanced chronic venous insufficiency who have not responded to other therapies. Catheter-based interventions, usually involving placement of endovenous stents, may be considered to treat some patients with chronic occlusions of the iliac veins. Technical success rates exceed 85% in most series, and long-term patency is achieved in approximately 75% of these patients. Iliocaval bypass, femoroiliac venous bypass, and femorofemoral crossover venous bypass are procedures used occasionally to treat iliofemoral vein occlusion; saphenopopliteal vein bypass can be used to treat chronic femoropopliteal vein obstruction. Long-term patency rates for venous bypass procedures generally exceed 60% and are associated with improvement in symptoms. Surgical reconstruction of the valves of the deep veins and valve transfer procedures are used to treat valvular incompetence. Valvuloplasty involves tightening the valve by commissural apposition. With valve transfer procedures, a segment of vein with a competent valve, such as a brachial or axillary vein, or adjacent saphenous or deep femoral vein, is inserted as an interposition graft in the incompetent vein. Both valvuloplasty and vein transfer operations result in ulcer healing in the majority of patients, although success rates are somewhat better with valvuloplasty.

**Lymphedema** Lymphedema is a chronic condition caused by impaired transport of lymph and characterized by swelling of one or more limbs and occasionally the trunk and genitalia. Fluid accumulates in interstitial tissues when there is an imbalance between lymph production and lymph absorption, a process governed in large part by Starling forces. Deficiency, reflux, or obstruction of lymph vessels perturbs the ability of the lymphatic system to reabsorb proteins that had been filtered by blood vessels, and the tissue osmotic load promotes interstitial accumulation of water. Persistent lymphedema leads to inflammatory and immune responses characterized by infiltration of mononuclear cells, fibroblasts, and adipocytes, leading to adipose and collagen deposition in the skin and subcutaneous tissues.

**Lymphatic Anatomy** Lymphatic capillaries are blind-ended tubes formed by a single layer of endothelial cells. The absent or widely fenestrated basement membrane of lymphatic capillaries allows access to interstitial proteins and particles. Lymphatic capillaries merge to form microlymphatic precollector vessels, which contain few smooth muscle cells. The precollector vessels drain into collecting lymphatic vessels, which comprise endothelial cells, a basement membrane, smooth muscle, and bileaflet valves. The collecting lymphatic vessels in term merge to form larger lymphatic conduits. Analogous to venous anatomy, there are superficial and deep lymphatic vessels in the legs, which communicate at the popliteal and inguinal lymph nodes. Pelvic lymphatic vessels drain into the thoracic duct, which ascends from the abdomen to the thorax and connects with the left brachiocephalic

vein. Lymph is propelled centrally by the phasic contractile activity of lymphatic smooth muscle and facilitated by the contractions of contiguous skeletal muscle. The presence of lymphatic valves ensures unidirectional flow.

**Etiology** Lymphedema may be categorized as primary or secondary (Table 303-2). The prevalence of primary lymphedema is approximately 1.15 per 100,000 persons less than 20 years of age. Females are affected more frequently than males. Primary lymphedema may be caused by agenesis, hypoplasia, hyperplasia, or obstruction of the lymphatic vessels. There are three clinical subtypes: congenital lymphedema, which appears shortly after birth; lymphedema praecox, which has its onset at the time of puberty; and lymphedema tarda, which usually begins after age 35. Familial forms of congenital lymphedema (Milroy's disease) and lymphedema praecox (Meige's disease) may be inherited in an autosomal dominant manner with variable penetrance; autosomal or sex-linked recessive forms are less common. Mutations in genes expressing vascular endothelial growth factor receptor 3 (VEGFR3), which is a determinant of lymphangiogenesis, have been described in patients with Milroy's disease. A mutation on chromosome 15q is associated with the cholestasis-lymphedema syndrome. A mutation in the *FOXC2* gene, which encodes a transcription factor

**TABLE 303-2 CAUSES OF LYMPHEDEMA**

Primary
Sporadic (no identified cause)
Genetic disorders
Milroy's disease
Meige's disease
Lymphedema-distichiasis syndrome
Cholestasis-lymphedema
Hypotrichosis-lymphedema-telangiectasia
Turner's syndrome
Klinefelter's syndrome
Trisomy 13, 18, or 21
Noonan's syndrome
Klippel-Trénaunay syndrome
Parkes-Weber syndrome
Hennekam's syndrome
Yellow nail syndrome
Intestinal lymphangiectasia syndrome
Lymphangiomyomatosis
Neurofibromatosis type 1
Secondary
Infection
Bacterial lymphangitis ( <i>Streptococcus pyogenes</i> , <i>Staphylococcus aureus</i> )
Lymphogranuloma venereum ( <i>Chlamydia trachomatis</i> )
Filariasis ( <i>Wucheria bancrofti</i> , <i>Brugia malayi</i> , <i>B. timori</i> )
Tuberculosis
Neoplastic infiltration of lymph nodes
Lymphoma
Prostate
Others
Surgery or irradiation of axillary or inguinal lymph nodes for treatment of cancer
Iatrogenic
Lymphatic division (during peripheral bypass surgery, varicose vein surgery, or harvesting of saphenous veins)
Miscellaneous
Contact dermatitis
Rheumatoid arthritis
Pregnancy
Factitious