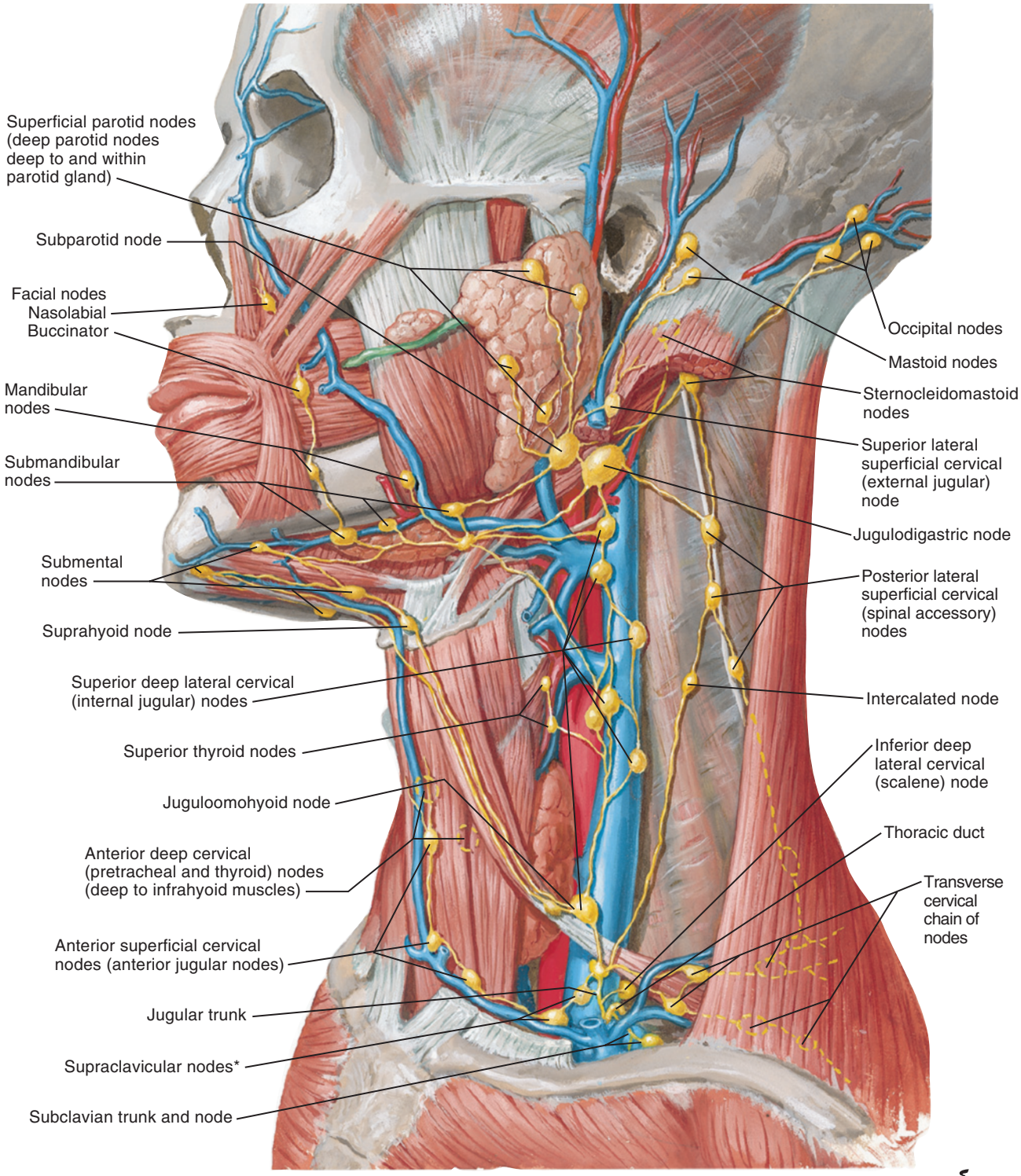

*The supraclavicular group of nodes (also known as the lower deep cervical group), especially on the left, are also sometimes referred to as the signal or sentinel lymph nodes of Virchow or Troisier, especially when sufficiently enlarged and palpable. These nodes (or a single node) are so termed because they may be the first recognized presumptive evidence of malignant disease in the viscera.

Figure 8.1 Lymphatic anatomy of the head and neck region. (Reprinted from Netter Anatomy Illustration Collection. ©Elsevier Inc. All Rights Reserved.)

nodes. This point is important to note when harvesting a supraclavicular lymph node flap where these structures may be encountered. One might ask, "What would happen if the thoracic duct were ligated?" It is interesting to note that ligation of the thoracic duct is the treatment of choice for refractory chylothorax complicating esophagectomy or other thoracic intervention, yet lymphedema is typically not observed following this procedure.[6,7] There has only been one report in the literature of lymphedema from the chest to the toes following thoracic duct ligation for idiopathic chylothorax.[8] However, it is unclear whether or not there was a component of preexisting primary lymphedema.

Detailed lymphatic anatomy and drainage of the upper and lower limbs is still an area of continued exploration. However, both cadaveric dissections and indocyanine green lymphangiography (IGL) are providing a more complete picture of the lymphatic system. In the extremities there is a horizontal latticework of lymphatic capillaries in the dermis that drain into "pre-collectors," which dive deep and empty into superficial lymphatic "collectors" located in the subcutaneous layer.[9–11] These collectors are easily visualized on IGL and are long vessels mostly along the medial limb, which empty into the local lymph node basin. There are also less numerous lymphatic vessels that are located deep to the deep muscle fascia that travel alongside arteries. The existence of connections between the superficial and deep lymphatic system is still the subject of further investigation.[10,12] The interaction between the superficial and deep system is a matter of great interest and affects our conceptual framework regarding the role of lymphovenous bypass.[13–16]

In the lower limb there are lymphatic vessels that travel along the lesser saphenous vein in the posterior leg, which enter the popliteal nodes, but the majority of lymphatic vessels gather around the vicinity of the greater saphenous vein. These collectors continue up the medial thigh, where they encounter one or two sentinel lymph nodes located deep, along the femoral vessels typically several centimeters below the groin crease (Fig. 8.2).[17] These lymph nodes also receive efferent lymphatic vessels from superolaterally oriented lymph nodes that drain the lower abdomen and hips, as well as medially from the superficial layers of the genitalia. Lymphatic traffic then continues medially (medial to the superficial inferior epigastric vein) and deep, along the iliac vessels and ultimately into the thoracic duct. One question previously posed by Tourani and colleagues, was How deep are the superficial collectors?[12] In the medial thigh, where the greater saphenous vein is located deep to the superficial fascial system (analogous to Scarpa's fascia), the lymphatic collectors were found both superficial and deep to this fascia. This may suggest that even superficial excision of fat in the medial thigh could potentially compromise lymphatic drainage although this has not been formally studied.

Lymphatic drainage of the upper extremity follows a similar motif: most of the superficial lymphatic flow follows the course of the superficial veins and is ultimately funneled into a single large sentinel lymph node in the axilla (Fig. 8.3).[9,18] Lymphatic drainage then proceeds more proximally into several other smaller lymph nodes. Based on intraoperative study using reverse lymphatic mapping, lymph nodes draining the upper limb are consistently located high in the axilla in proximity to the axillary vein, deep to the pectoralis major muscle, and can also contribute to drainage of the chest.[19] These critical lymph nodes can be supplied by the thoracodorsal artery, lateral thoracic artery, or direct branches from the axillary artery (Fig. 12.2). Alternate lymphatic pathways also exist in the upper limb as lymphatics along the cephalic vein can bypass the axillary nodes and pass through the supraclavicular lymph nodes. An interesting cadaveric study by Suami et al., of a patient who underwent axillary node dissection without clinical lymphedema, illustrates some key differences in normal and abnormal lymphatic drainage.[10] On the affected side, there were incompetent lymphatic valves in the pre-collectors with dermal reflux, and hypertrophy of epitrochlear nodes around the elbow. The superficial lymphatics were obliterated above the elbow but there was a connection between the superficial and deep system that allowed drainage to a few remaining axillary nodes. These detailed anatomic studies and reports are steadily accumulating into a critical body of knowledge for further refinement of lymphatic techniques in the future.

PATHOPHYSIOLOGY

Lymphedema has traditionally been thought of as swelling resulting from lymphatic obstruction, but we have come a long way from this concept. Lymphedema most commonly has a delayed presentation following lymphadenectomy, and exhibits behavior of a proliferative disease, as opposed to a simple surgically induced obstruction to lymphatic flow. While the initial insult to the lymphatic system does cause lymphatic impairment and edema, an immune response may ensue, leading not only to destruction of lymphatic vessels but also fat hypertrophy and fibrosis.[20–27] Central to understanding the progression of lymphedema is the concept that an initially fluid-filled limb progresses into a fibrofatty limb that directly affects surgical decision making and managing patient expectations. This cascade of events is also the subject of investigation into medical therapies that may blunt or reverse this process and could potentially be used as adjuvant therapies to surgery in the future.[21,23]

INDICATIONS FOR LYMPHATIC SURGERY

Awareness of the spectrum of disease in lymphedema from a fluid-dominant limb to a fibrofatty-dominant limb is important in selecting an appropriate operation for the individual patient. There are two general types of surgery for lymphedema: debulking and physiologic procedures. Debulking techniques do not treat the underlying cause of lymphedema, but are aimed solely at reducing limb volume, essentially treating the fat hypertrophy component of lymphedema. On the other hand, physiologic procedures such as lymphovenous anastomosis (LVA) or vascularized lymph node transfer (VLNT) are aimed at addressing the underlying lymphatic disease process. While these modalities have been effective at reducing the fluid component of lymphedema, the effect on fat hypertrophy has yet to be determined. It also seems that the very best candidates for physiologic procedures are thin patients that have earlier