

Chapter 84: Surgical Anatomy

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Surgeons doing head and neck surgery must first master the surgical anatomy and technique of doing neck dissection. Neck dissection is either the classic en bloc neck dissection described in 1906 by George Crile, Sr, or the modified neck dissection made popular by Dr Richard Jesse (Jesse, 1978) at M. D. Anderson Hospital in Houston, Texas, and Dr Ettore Bocca (Bocca and Pignataro, 1987) of Milan, Italy, and is the basic operation for the accomplished head and neck surgeon with a complete practice of head and neck surgery dealing with primary tumors of the oral cavity, oropharynx, hypopharynx, larynx, thyroid, upper jaw, and salivary glands, and with tumors arising from the skin of the head and neck area.

Neck dissection is actually a surgical dissection of the anterior and lateral neck done for the purpose of removing tumor and cervical lymph-bearing tissues. A rational plan for surgery for cancer of the cervical lymphatics is based on a thorough understanding and application of the detailed anatomy of the cervical lymphatic system, the deep cervical fasciae, and the relation of these to the muscles and neurovascular structures of the anterior and lateral neck.

The sternocleidomastoid muscle divides the cervical region into two designated triangles - anterior and lateral (Fig. 84-1). The anterior triangle is bordered by the anterior margin of the sternocleidomastoid muscle and by the inferior margin of the mandible, and the anterior neck is divided into two bilateral halves by the vertical midline from the mental symphysis to the suprasternal notch. The lateral triangle is bordered by the anterior margin of the trapezius muscle, by the posterior border of the sternocleidomastoid muscle, and by the middle third of the clavicle. The part of the neck covered by the trapezius muscle in continuity with the posterior cervicooccipital region is the posterior neck.

The anterior neck contains the cervical parts of the aerodigestive tract: larynx and trachea, hypopharynx and esophagus, thyroid and parathyroid glands, carotid sheath and the large neurovascular structures contained therein, and suprahyoid and infrahyoid strap muscles, as well as a host of associated neurovascular and lymphatic structures (Fig. 84-2). The anterior neck extends cranially to the mandibular margin and caudally to the chest of the thoracic inlet. The inferior margin of the mandible along with the digastric stylohyoid-mylohyoid muscle complex, outlines the submandibular area (submandibular triangle). The submandibular area contains the submandibular gland, associated fasciae, lymphatic structures, parts of the anterior facial vein and facial artery, and the marginal mandibular branch of the facial nerve. It is also the area from which anatomic and surgical access can be gained to the floor of the mouth.

The position of the most lateral of the infrahyoid muscles, the omohyoid muscle, demarcates (1) the upper part of the anterior neck known as the carotid triangle, where the carotid sheath structures are relatively superficial in their location, and (2) the lower and anterior part of the neck known as the muscular triangle, which contains the infrahyoid muscle strap muscles, the aerodigestive tract, and the thyroid gland complex.

The lateral neck, or the lateral triangle of the neck, is often referred to as the posterior triangle and is bounded by the borders of the sternocleidomastoid muscle and trapezius muscle and the middle third of the clavicle (see Fig. 84-2). The area of the lateral neck takes on the geometric form of a triangle. The contents of this triangle include fibrofatty lymphatic-containing tissue, cranial nerve XI, the superficial and cutaneous components of the cervical nerve plexus, and a host of small vascular bundles, the presence of which at surgery has in the past led to the description of this surgical area as "bloody gulch". The presence of the lower muscle belly of the omohyoid muscle in the triangle just above the clavicle demarcates a small subclavian triangle in the lateral neck, carrying with it important surgical implications, since in the depth of the subclavian triangle are found the cervical and thoracic outflow of nerves and vessels into the axilla - the brachial plexus from the interscalene muscle interval and the subclavian vessels arching over the first rib from the thorax to the axilla.

Cervical Lymphatics

The cervical lymphatic system is divided into superficial and deep chains (Fig. 84-3). Superficial lymphatics perforate the first layer of cervical fascia to empty into the deep cervical lymphatic chain. Although the lymph nodes of the superficial group are frequently involved by metastasis, especially during the late stages of cancer, the superficial lymph nodes are nevertheless of little significance from a practical standpoint of surgical treatment. The reason is that if superficial lymphatics are involved with cancer they cannot be removed without resection of large areas of skin.

The deep cervical lymphatics are important, since they receive lymph from the mucous membranes lining the mouth, pharynx, larynx, and major salivary and thyroid glands, as well as the skin of the head and neck. The deep cervical lymphatics accompany the internal jugular vein and their branches or lie within the major salivary glands. Of the anterior group of these cervical lymphatics the most important are the subdigastric or superior jugular nodes, which, with the middle and inferior nodes, extend along the wall of the internal jugular vein to its entry into the subclavian vein. From the standpoint of applied surgical anatomy, it is important to recognize no higher than the posterior belly of the digastric muscle and no lower than the clavicle. Lindberg and Jesse, in a monumental paper in 1972, showed that, without question, the most common areas of involvement of the cervical lymphatic chain are the subdigastric or junctional nodes of Fisch. The definitive upper and lower limits of the deep jugular chain are important for the head and neck surgeon in neck dissection, whether it be en bloc or modified, since between these two levels it is possible to section the internal jugular vein and remove it, together with the accompanying lymphatics, as described by George Crile and practiced by Hayes Martin (1951) and John Conley (1970), or to carefully dissect the lymphatics from the anteroposterior lateral aspects of the internal jugular vein with preservation of the vein, as described by Richard Jesse (1978) and by Ettore Bocca and O. Pignataro (1987). Again, the most important nodes of the deep jugular chain are the subdigastric group that lie in close proximity to the superoanterior part of the accessory nerve and are the most difficult part of the deep jugular dissection.

Lymph nodes of the lateral triangle of the neck are designated as upper, middle, and inferior cervical nodes and, by some anatomists and surgeons, as the spinal accessory group of the cervical lymphatic system. This group of lymphatics begins beneath the upper part of the sternocleidomastoid muscle and extends downward and backward, following the course

of the spinal accessory nerve. From a practical standpoint of metastasis, the lateral cervical lymphatic chain receives drainage mainly from the nasopharynx, but in its upper portion it communicates with the subdigastric nodes of the deep internal jugular vein. Inferiorly, the lateral cervical chain turns forward into what is called the supraclavicular group of nodes to join the internal jugular chain of lymphatics at the root of the neck. Conley's description of neck dissection (Conley, 1970), which is an en bloc procedure, is the technique used by most head and neck surgeons today and taught by most program directors, since it begins at the anterior border of the trapezius muscle and is carried in a medial and anterior direction, removing the group of nodes in the lateral triangle of the neck. Conservative modification of the classic en bloc dissection ablates all of the important lymph-bearing tissue in the lateral neck that is removed in the radical operation, but with the important feature of preservation of the spinal accessory nerve.

In the submandibular area, there are three groups of nodes: preglandular, interglandular; and the prevascular and retrovascular nodes that, in general, drain the mucous membrane of the lower lip, cheeks, alveolar region, floor of mouth, and anterior tongue and then empty into the deep jugular chain. Preglandular submandibular nodes lie on the anterior part of the submandibular salivary gland. Interglandular submandibular nodes lie within the submandibular salivary gland and drain the floor of the mouth and the midportion of the anterior tongue. Prevascular and retrovascular nodes lie just anterior and posterior to the facial artery and facial vein at the lower edge of the mandible. This group of nodes is often first involved by metastatic cancer from an oral cavity lesion.

The lower parotid nodes are situated in the lower pole of the parotid gland and may be involved secondary to the preauricular parotid nodes in cancer of the parotid salivary gland, or they may be involved in cancer of the upper lip. In carrying out the technique of neck dissection, whether it be radical dissection or modified, the tail of the parotid salivary gland is removed with the inferior parotid lymph nodes in this area.

Cervical lymph nodes in the anterior neck, except for those bordering on being microscopic and situated along the aerodigestive tract or in association with the thyroid gland, are located along the internal jugular vein from the level of the posterior belly of the digastric muscle to the root of the neck where the internal jugular vein joins the subclavian vein. Those that are most cranial in their position are deep at the level of the posterior belly of the digastric muscle and drain the deep face and anterior neck. One of these nodes commonly is referred to as the jugulodigastric node, emphasized so often because it is the first echelon and drains the posterior faucial region, including the tonsil.

Middle jugular nodes are located in the neck to the level of where the omohyoid muscle crosses the carotid sheath and drain the middle parts of the aerodigestive tract in the neck and the thyroid gland. Inferior nodes are found along the internal jugular vein from the level of the omohyoid to the root of the neck where the jugular vein joins the subclavian vein. These nodes drain from the thyroid and the lower cervical parts of the aerodigestive tract, that is, the trachea and esophagus. The lowest of the jugular nodes are confluent with the medial extent of the transverse cervical nodes of the lateral neck and usually constitute what are referred to as the prescalene nodal masses, which are so importantly located at the interface between the body regions: low neck, apex of the axilla, and thoracic outlet. The nodes of the jugular group are found in the loose connective tissue of the carotid sheath and lie anterior,

lateral, and posterior to the internal jugular vein in the sheath. The possibility of lymphatic efferents from the nodes low in the neck communicating with lymph nodes in the superior mediastinum is a very real and serious concern to the head and neck surgeon.

Efferent lymphatic vessels in the cervical region on the right and left sides communicate with the great veins. On the left side a large lymph vessel, the thoracic duct, receives lymphatic tributaries from the neck and is a major lymphatic vessel from the mediastinum and the abdomen. The thoracic duct enters the jugulosubclavian venous junction on the left side at the root of the neck. From the mediastinum, the course of this vessel describes an upward and left lateral arch behind the carotid sheath, receives lymphatic tributaries from the neck, and enters the venous junction in the angle between the left internal jugular veins and subclavian veins. Injury to this vessel in any surgery performed on the left side of the neck should be carefully avoided in order to prevent a chylous fistula. No singular or large lymph vessel is found on the right side of the root of the neck. Rather, multiple lymph vessels are seen, although one vessel may be identified and termed the *right lymphatic duct*. Such vessels on the right, single or multiple, will join the subclavian venous junction, as described, on the left side.

The cervical lymph nodes contained within the anterior and lateral triangles of the neck are, without exception, contained in the loose connective tissues associated with the neurovascular structures, muscles, and their fasciae. The nodes have a close relationship with these fasciae. They are never directly related to or intimate with the vessels or muscles covered by them. Invasion of the muscles and vessels by metastatic cancer of the lymph nodes may occur only by direct invasion after the capsule of the lymph node has been effaced. The classical radical neck dissection of Crile, which is an en bloc removal of the lymphatic system of the neck, requires resection of all structures contained in the anterior and lateral triangles of the neck, which would mean removal of a number of important structures whose only relationship with the lymphatic system is that of proximity. A thorough modified neck dissection may be satisfactorily carried out when the fasciae of the muscles and vessels are carefully stripped away and the fatty lymphatic tissue removed en bloc after the essential structures have been identified and preserved.

Cervical Fasciae

The fasciae and fascial planes of the head and neck were described in detail in the 1930s by Collier and Yglesius (1937) and by Grodinsky and Holyoke (1938; Fig. 84-4). The fasciae were described as being within the boundaries of fascial envelopes about muscles, around cervical viscera, or around vascular structures, and as loose areolar tissue spaces between the fasciae or fascial planes.

Fasciae and fascial planes are important to the surgeon, since these represent the basis or recognizing tissue planes and carrying out a proper dissection of the neck.

The superficial fascia of the anterior and lateral neck contains the platysma muscle. A plane can be developed superficial to the platysma muscle, or a skin flap can be raised to include the platysma muscle in it. Invasion of this plane by disease may require extensive removal of the subcutaneous layers.

Deep to the superficial layer of the deep cervical fascia lies a discrete fascial lamina, the superficial layer of the deep cervical fascia, which invests all structures in the neck, much like a collar. This fascia attaches dorsally to the cervical spine and extends cranially to the occiput, mastoid, and inferior margin of the mandible and, attaching to the mandible, invests the submandibular gland and provides a distinct fascial compartment for the gland. Attached to the bone elsewhere, the superficial layer of the deep cervical fascia attaches to the hyoid bone, to the clavicle, and to the manubrium of the sternum. As it relates to the sternocleidomastoid muscle and trapezius muscle, this fascia assumes a bilaminar character as it invests each muscle in turn. In the suprasternal region the fascia also is bilaminar, and, by the attachment of it to the anterior and posterior surfaces of the sternum, there is created an interfascial space, the suprasternal space of Burns, through which anastomotic superficial vessels cross the midline of the neck. Elsewhere, the fascia is a single lamina, as in the region of the anterior cervical triangle and across the ventral midline and covering the lateral triangle between the borders of the sternocleidomastoid and trapezius muscles. Superiorly, the fascia also splits to invest the parotid gland, to create a compartment for the parotid and the many structures located in that gland: facial nerve, terminal branches of the external carotid artery, retromandibular vein, and lymphatic structures.

In the deep surface of the superficial layer of the deep cervical fasciae, the extensions of connective tissue contribute to the formation of an investment of the carotid artery, internal jugular vein, and carotid artery and vagus nerve, known as the carotid sheath. Multiple laminae of deep cervical fascia invest the suprahyoid and infrahyoid strap muscles and can be identified as thin muscle fascial laminae. The deepest of these laminae are associated with the thyrohyoid muscle, the thyroid gland, and trachea; in fact, they invest the cervical parts of the airway and are referred to as the pretracheal fascia or the middle layer of the deep cervical fascia. Lateral extension from the pretracheal fascia also contribute to the formation of the carotid sheath. Within the carotid sheath are separate individual sheaths for each of its main constituents, namely, the carotid artery, internal jugular vein, and vagus nerve. The carotid sheath is continuous with the laminae of the neighbouring fasciae: that of the pharyngeal wall, that of the prevertebral muscles, that of the prevertebral fascia, that of the infrahyoid muscles, and that of the sternocleidomastoid muscle. Areolar connective tissue external to the carotid sheath contains lymph nodes on the anterior, lateral, and posterior aspects of the carotid sheath. On the posterior aspect of the carotid sheath but more fully incorporated in the fascia of the prevertebral muscle bundle lies the cervical part of the sympathetic trunk.

The deepest cervical fascia invests the prevertebral muscles and is aptly termed *prevertebral fascia*, because it extends from the base of the skull to the tubercles of the transverse processes of all cervical vertebrae and is continuous along the ventral surface of the vertebral column into the posterior mediastinum. It is recognized as the fascia of, and investment for, the splenius capitis; levator scapulae; anterior, middle, and posterior scalene muscles; and the longus colli and capitis muscles; as well as for important nerve structures. The cervical and brachial nerve plexus and the sympathetic trunk are invested by the prevertebral fascia, which forms the floor of the lateral triangle of the neck. As an extension of the fascia of the scalene muscles, the prevertebral fascia envelops the brachial plexus and is continuous in investment of the nerves and subclavian vessels into the axilla as the infundibulum for the axillary sheath.

Intrafascial or subfascial lymphatics or nodes have not been described in the prevertebral fascia, which leads one to question the need to include this fascia lamina when doing a lymph node dissection of the neck. The consequences of elevating prevertebral fascia in doing a neck dissection, beyond merely increasing the devastation wrought by the surgical exercise, can be severe. If this fascia is raised, there is risk of involving what lies deep in the fascia, notably the cervical and brachial plexus, the sympathetic trunk, and the phrenic nerve. The cervical plexus emerges from between the scalene muscle bundles. The brachial plexus emerges from the interscalene interval between anterior and middle scalene muscles, as does the subclavian artery at the level of the first rib, and together these neurovascular structures descend into the axilla. The phrenic nerve crosses obliquely on the anterior surface of the anterior scalene muscle from lateral to medial and lies deep to the prevertebral fascia. It originates from C3, C4, and C5 and descends into the mediastinum to supply the diaphragm. Consequently, in the lateral region of the neck, between the superficial layer of the deep cervical fascia or investing fascia forming a roof, and the prevertebral fascia forming a floor, the contents of the lateral triangle are contained within a substantial but variable amount of fibrofatty and loose connective tissue. The contents are neurovascular structures, including the spinal accessory nerve, peripheral branch of the cervical nerve plexus, and numerous small arteries and veins and the lymphatic structures. If the surgical procedure denudes prevertebral muscles or their investing fasciae, the nerves that lie deep to the prevertebral fascia are put at risk, and it is better to consider avoiding these structures and thereby obviate loss of shoulder function because of injury to the brachial plexus, loss of diaphragmatic respiratory function because of section of the phrenic nerve, or sympathetic disturbances in the head, neck, and upper limb because of injury to the sympathetic trunk. Surgically, an adequate cleavage plane can easily be developed superficial to the prevertebral fascia.

Sternocleidomastoid Muscle and Spinal Accessory Nerve

The sternocleidomastoid muscle is attached cranially to the lateral surface of the mastoid process of the temporal bone and to the lateral part of the superior nuchal line of the occipital bone. Caudally, it divides into sternal and clavicular heads to attach on the sternum and the clavicle (Fig. 84-5). It is invested by the superficial layer of deep cervical fascia and splits into two laminae to cover the superficial and deep surfaces of this muscle. At the anterior margin of the sternocleidomastoid muscle, thickened fascia attaches to the fascia at the angle of the mandible, thereby creating the angular band that is called Charpy's band. The presence of this band can make surgery to open the interval between the sternocleidomastoid muscle and the angle of the mandible and the parotid gland more difficult, and the band should be sectioned.

Crossing the outer surface of the sternocleidomastoid muscle in its upper half is the external jugular vein, marking out its course from the angle of the mandible to the midpoint of the posterior margin of the sternocleidomastoid muscle. Within one finger-breadth cranial to and parallel to the vein, the great auricular nerve crosses the outer surface of the sternocleidomastoid muscle from Erb's point (the midpoint along the posterior margin of the sternocleidomastoid muscle) coursing to cutaneous distribution in the region of the auricle and over the parotid gland. From Erb's point, one or more other nerves derived from the cervical plexus also cross the outer surface of the sternocleidomastoid muscle and distribute to cutaneous areas of the anterior neck and submental region. These are the anterior cutaneous nerves of the neck.

The spinal accessory nerve enters or lies deep to the sternocleidomastoid muscle and somewhat parallels the more superficial course of the external jugular vein. The accessory nerve divides within or deep to the sternocleidomastoid muscle to supply it and to continue through the lateral neck to distribute to the trapezius muscle. Cranial nerve XI has rootlets of origin from the brainstem (bulbar fibers) and from the cervical cord (spinal fibers) originating from the cord as low as C5 or C6. The spinal outlets contribute to a nerve that rises along the spinal cord to enter the cranium at the foramen magnum and to be joined in the posterior fossa by the bulbar fibers. The combined fibers exit from the cranium by way of the jugular foramen, and the accessory nerve crosses ventral to the internal jugular vein deep to the posterior belly of the digastric muscle. Fibers of bulbar origin join the vagus in the jugular foramen and distribute to the pharyngeal-laryngeal muscles. Fibers of spinal origin distribute to the girdle muscles, or example, sternocleidomastoid and trapezius.

The spinal accessory nerve can be identified entering the deep surface of the sternocleidomastoid muscle 4 cm or more below the mastoid process. It can be located at Erb's point just superior to where the great auricular nerve surfaces from the deep neck. The spinal accessory nerve can also be located readily in the lateral neck at the point where it disappears on the deep surface of the trapezius muscle, roughly two finger-breadths superior to the clavicle at the anterior margin of the trapezius muscle. The usual course of the spinal accessory nerve passes through the sternocleidomastoid muscle, although occasionally it may lie deep to the muscle, in which case care must be exercised to isolate the nerve in clearing the area of connective tissue and lymphatic tissue when doing a modified neck dissection.

The blood supply to the sternocleidomastoid muscle is extensive. Multiple vascular bundles are given to the muscle on its deep surface along its length from cranial to thoracic attachments: branches from the occipital artery; from the posterior auricular artery; from the superior thyroid artery; from superficial and transverse cervical arteries; and from the transverse scapular artery. Functionally, the sternocleidomastoid muscle acts in elevation of the thoracic cage and shoulder girdle, or, with fixation of the limb, will act in lateral flexion of the head to the shoulder on the same side and rotate the head to direct the chin upward to the opposite side. The trapezius muscle is one of several muscles that elevate the shoulder girdle and retract the girdle dorsally. It assists the sternocleidomastoid muscle in rotation of the head and in lateral flexion of the neck.

Internal Jugular Vein

From the skull base in the jugular foramen to the root of the neck, with the subclavian vein, the internal jugular vein receives venous tributaries from the parotid, from the floor of the mouth, from the occipital region, and from thyroid areas (Fig. 84-6). Each tributary may need to be contained by ligature and the removal of the internal jugular vein in radical or modified neck dissection procedures. At the skull base, the spinal accessory nerve courses in front of the internal jugular vein at the level of the transverse process of the first cervical vertebra. Related to this area in the anterior neck, lymph nodes associated with the spinal accessory nerve and those of the superior jugular group lie in the loose connective tissue and are known as the junctional lymph nodes of Fisch. These are first- or second-echelon nodes draining primary tumor sites high in the aerodigestive tract. Nodal tissue can also be found on the anterior, lateral, and posterior aspects of the connective tissue sheath of the internal jugular vein. It is the connective tissue of this space, which is located posterolateral to the

carotid sheath, that is closely associated with the internal jugular vein and is removed en bloc in the classic radical neck dissection, or the vein is preserved in the modified or conservation procedure.

Carotid Arteries and Hypoglossal Nerve

In the anterior triangle of the neck in the carotid sheath, the common carotid artery divides at the upper border of the thyroid cartilage, just below the level of the tip of the hyoid bone, into the external and internal branches (Fig. 84-7). The internal carotid artery typically takes a straight and unbranched course to the skull base to its entrance into the carotid canal and the petrous bone. In 15% of cases, the internal carotid artery can vary from normal, be somewhat redundant, and take on the form of being frankly kinked or coiled at some point from the bifurcation to the skull base.

The superior thyroid artery arises from the external carotid artery close to the bifurcation and usually below the level of the greater cornu of the hyoid bone. The lingual artery, like the superior thyroid artery, arises from the anterior surface of the external carotid artery from just below the level of the digastric, at about the level of the body of the hyoid bone, and courses forward deep to the muscle to appear in an inferior part of the digastric triangle. For the surgeon who does free jejunal graft for replacement of the cervical esophagus with microvascular anastomosis of the superior mesenteric vessels to branches of the external carotid artery, the lingual artery is the best vessel for this operation. The ascending pharyngeal artery arises not from the infradigastric portion of the external carotid but from the posterior medial surface of the vessel; hence it is not usually seen in a neck dissection. Just below or under cover of the posterior belly of the digastric, the facial or external maxillary artery arises from the anterior surface of the external carotid artery, while the occipital artery arises from its posterior surface. The branches of the external carotid artery, which course posteriorly, regularly cross the internal jugular vein superficially. These branches include the sternocleidomastoid branch, the occipital artery, and sometimes the posterior auricular artery. The ventral branches of the external carotid artery distribute to the thyroid (superior thyroid artery), facial regions (external maxillary artery), tongue and tonsil (lingual artery), deep face and nose (internal maxillary artery), and superficial scalp (superficial temporal artery). Dorsally directed branches of the external carotid artery pass, as mentioned above, superficially across the internal jugular vein and go to occipital and auricular areas (occipital and posterior auricular arteries) or are muscular branches to the sternocleidomastoid muscle, branching either directly from the external carotid artery or as branches of the occipital, posterior auricular, or superior thyroid artery. These arteries may need to be secured in the course of neck surgery. As mentioned above, the ascending pharyngeal artery arises in the bifurcation of the common carotid artery and from that point courses straight to the occipital skull base as a major contributor of vascular supply of the pharyngeal wall, including the tonsil, and to the cranial dura in the posterior cranial fossa. This artery does not become visible during the usual course of neck dissection.

The hypoglossal nerve (XII) typically emerges between the internal carotid artery and the internal jugular vein to descend in the lateral groove between them, to a point not far above the carotid bifurcation. It then gives off the superior root of the ansa cervicalis (the descendans hypoglossi of the ansa hypoglossi) and curves forward across the lateral surfaces of both internal and external carotid vessels. In this course it usually passes downward until

just lateral to the origin of the occipital artery and then turns forward, being held at the turn by the sternocleidomastoid branch of the occipital artery so that it hooks around these vessels before it runs forward above the hyoid bone. Before giving off the root of the ansa it receives fibers from the first and second cervical nerves, many of which go into the ansa. Cranial nerve XII passes forward deep to the stylohyoid muscle and to the posterior belly of the digastric and enters the posterior part of the submandibular or digastric triangle, where it comes to lie on the lateral surface of the hyoglossus muscle, under the cover of the submandibular gland. Here it is accompanied by the largest tributary of the lingual vein, the vena comitans nerve hypoglossi. It passes forward on the hyoglossus and disappears between the posterior border of the mylohyoid muscle: here beneath the tongue it curves forward and upward on the lateral surface of the genioglossus muscle, anastomoses with the lingual nerve, and enters the musculature of the tongue. After giving off the root of the ansa cervicalis at about the level of its forward turn, the hypoglossal nerve gives twigs to the thyrohyoid and geniohyoid muscles, which in turn are usually believed to contain only cervical nerve fibers, and branches to the external muscles of the tongue before ending in the intrinsic muscles. Nerve XII is the motor nerve to tongue muscles and provides for all the motor supply to the tongue, with the exception of the palatoglossus muscle supplied by the vagal complex.

Infrahyoid Strap Muscles

Ranging from cranial attachments on the hyoid bone and thyroid ala to more caudal attachments on the sternum and scapula are muscles of the anterior neck lying anterior and lateral to the thyroid gland and referred to as the infrahyoid strap muscles (Fig. 84-8). They are described as accessory muscles of respiration. Functionally, they are a part of a longitudinal motor complex that ranges in attachment from the base of the tongue to the superior mediastinum and regulates the luminal dimension of the laryngeal part of the airway in respiration. Thus the sternothyroid and sternohyoid muscles are described as being involved in increasing the dimension of the glottic segment of the airway in inspiration.

The omohyoid muscle, the most lateral of the infrahyoid muscle group, is, like the digastric, a two-bellied muscle. Its superior belly is attached to the hyoid bone, and its inferior belly is attached to the superior margin of the scapula just posterior to the lesser scapular notch. The two bellies are joined together by a tendon located deep to the sternocleidomastoid muscle and having fascial continuity with the fasciae of the overlying sternocleidomastoid muscle and clavicle and the underlying carotid sheath. The omohyoid muscle becomes somewhat of a surgical landmark, for the carotid sheath lies deep to the superior belly in the anterior neck. The brachial plexus and subclavian vessels lie deep to the inferior belly of the omohyoid in the lower part of the lateral neck just above the clavicle.

The ansa cervicalis, draped across the carotid sheath, is the nerve supply to the infrahyoid strap muscles and is at risk in any surgical procedure done in the anterior neck. At worst, some degree of inspiratory disturbance of respiratory function could be anticipated, but it is transitory in nature, following interruption of these nerves. Only the external jugular vein lies superficial to the posterior belly of the omohyoid in the lateral neck. All important neurovascular structures lie deep to the muscle belly.

Digastric, Stylohyoid, and Mylohyoid Muscles

The key to understanding the continuity of anatomy or in planning surgical procedures in the upper neck is the digastric-stylohyoid-mylohyoid muscle complex (Fig. 84-9). The digastric muscle is attached to the deep surface of the mastoid in the digastric groove as a posterior muscle belly, is attached to the lesser cornu of the hyoid bone as a tendon slip, and is attached to the deep surface of the mandible in the mental region as an anterior muscle belly. Associated with the tendinous attachment of the digastric to the hyoid bone is the stylohyoid muscle, which splits into two muscle bundles to permit the digastric tendon to pass between them. The posterior bellies of the digastric and the stylohyoid have become landmarks that are junctional in position between the head and neck. Certain anatomic axioms can apply to the surgical anatomy of this area:

1. All major structures coursing between the head and neck do so by passing deep to the digastric-stylohyoid complex. This includes the hypoglossal and vagus nerves, the carotid arteries, and the internal jugular vein. Only the marginal mandibular branch of the facial nerve, the anterior facial vein, and the posterior facial vein lie superficial to the digastric-stylohyoid complex. The usual relationship of the marginal mandibular branch of the facial nerve to the anterior facial vein is that the nerve lies superficial to the vein. Advantage can be taken of this anatomic relationship in doing a dissection of the submandibular area by ligating the vein and elevating it along with the marginal mandibular nerve cranially and over the mandible to protect the nerve against injury. If one does not do this technique, there is risk of injury to this nerve and consequent facial disfigurement owing to loss of depressor functions of the lower lip and corner of the mouth.

2. The facial nerve emerges from the stylomastoid foramen of the temporal bone and, before entering the parotid compartment, is located briefly in loose connective tissue. This occurs just above the anterior margin of the posterior belly of the digastric muscle and inferior to the tip of the mastoid process.

An important surgical landmark in the upper cervical region in the subdigastric area, more posteriorly, is the transverse process of the first cervical vertebra. The transverse process is of large size, projecting directly laterally from the lateral mass of the atlas, and serves for the attachments of muscles that assist in rotating the head. The transverse process can easily be palpated anteriorly inferiorly to the mastoid process deep in the subdigastric cervical region and is in constant relation to the internal jugular vein and spinal accessory nerve and the internal carotid artery, which lie directly in front of this prominent bony process.

The suprahyoid muscles lying between the hyoid bone and the body of the mandible constitute a muscular framework of the floor of the mouth referred to as the oral diaphragm. This includes the anterior belly of the digastric muscle, the mylohyoid muscle, and the geniohyoid muscle, arranged from superficial to deep in the suprahyoid area. Each is a masticator muscle, a jaw depressor by function, since each attaches to the mandible. Collectively they contribute to the muscular support of the floor of the mouth and provide the tension needed, much like a springboard, to allow the backward thrust of the tongue in the oral cavity in the first phase of swallowing. The mylohyoid muscle is a sheet of muscle contributing to the floor of the mouth. It is attached to the mylohyoid line on the inner surface of the mandible bilaterally and to the hyoid bone and to the muscle of the opposite side

by way of a midline muscular raphe. The deep part of the submandibular gland and duct enters the floor of the mouth by passing around the posterior free margin of the mylohyoid muscle. Hence the deep part of the submandibular gland and the sublingual gland lies in the loose connective tissue superior to the mylohyoid muscle. Also found in the loose connective tissue is the submandibular duct and the lingual and hypoglossal nerves.

The nerve to the anterior belly of the digastric and mylohyoid muscles, the mylohyoid branch of the trigeminal nerve, is quite superficially placed in the suprahyoid region between the two muscles and can be injured or interrupted in doing a dissection in the area of the submandibular compartment. The risk of injury to this nerve involves loss of muscular support of the floor of the mouth and reduced tongue thrust in the first phase of swallowing.

Summary

A rational plan for surgery of this area is based on a correct and thorough understanding of the anatomy of the neurovascular and muscular structures, cervical lymphatics, and cervical fasciae of the anterior and lateral neck. As mentioned in the beginning of this chapter, the head and neck surgeon must master (1) the surgical anatomy of the neck to carry out the practice of surgery in this area and (2) the surgical procedures that most young surgeons are taught today, namely, en bloc radical neck dissection or modified neck dissection. Whether one practices the en bloc or a more conservative or modified neck dissection, thorough knowledge of the anatomy of the head and neck is essential.