

Deep Structures of the Neck

Competencies: AN-35.3, 35.5, 35.6, 35.9

Objectives

- Briefly describe the formation, branches and distribution of cervical plexus
- Describe the cervical part of the sympathetic chain and their clinical relevance
- Locate the parts of the superficial and deep cervical lymph nodes and to discuss the areas/structures draining into them
- Describe the parts, branches and distribution of the subclavian artery
- Describe the boundaries and contents of the scalenovertbral triangle
- Describe the course and branches of the vertebral artery in the neck

CERVICAL PLEXUS

The cervical plexus of nerves are formed by the ventral rami of the upper four cervical nerves. They are present posterior to the prevertebral fascia and in front of the scalenus medius and levator scapulae muscles. The branches of the cervical plexus include both cutaneous and motor branches.

Cutaneous branches: They pierce the prevertebral fascia and appear in the posterior triangle of the neck at the posterior border of the sternocleidomastoid muscle (just above the midpoint of the posterior border of the sternocleidomastoid muscle).

1.Lesser occipital nerve: It hooks around the spinal part of the accessory nerve and then ascends along the posterior border of the sternocleidomastoid muscle. It supplies the skin of the posterior quadrant of the scalp and the pinna of the ear.

2.Great auricular nerve: It emerges from the posterior border of the sternocleidomastoid muscle, then

crosses the muscle obliquely. It supplies skin over the parotid region, angle of the mandible, pinna and lobule of the ear.

3.Transverse cutaneous nerve of the neck: It crosses the sternocleidomastoid muscle horizontally to proceed in medial direction. It supplies skin over the anterior triangle.

4.Supraclavicular nerve (C3 and C4): After emerging from the posterior border of the sternocleidomastoid muscle, it descends in the lower part of the roof of the posterior triangle. It then pierces the deep fascia above the clavicle to become superficial. It divides into medial, intermediate and lateral branches. It supplies skin of the front of the chest up to the level of sternal angle and second rib. It also supplies skin of the upper and posterior part of the shoulder. The phrenic nerve also has the root value C3, C4 and C5. This explain the referred pain over the shoulder in case of phrenic nerve involvement (pleurisy, diaphragm irritation, peritonitis).

Muscular branches: They supply scalene muscles, levator scapulae, rectus capitis lateralis and anterior, longus capitis and longus colli. Through phrenic nerve it supplies the diaphragm and through ansa cervicalis, they supply extrinsic muscles f the neck (Fig.73.1).

CERVICAL SYMPATHETIC CHAIN

The right and left sympathetic chains extend from the base of the skull to the first coccygeal vertebra. Each chain is paravertebral in position and consists of about 22 ganglia. In front of the coccyx, the right and left sympathetic chains are connected by a median

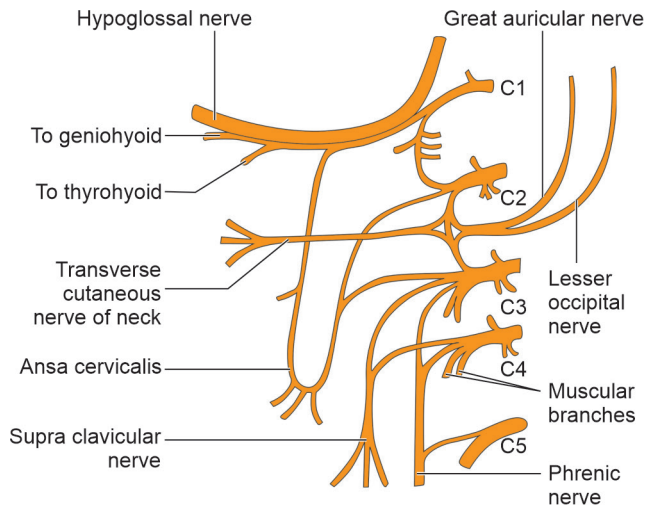


Fig. 73.1: A schematic representation of the cervical plexus

ganglion called 'ganglion impar'. The cervical part of the chain presents 3, the thoracic 11, the lumbar 4 and sacral 4 ganglia.

Initially the number of ganglia corresponds with the number of spinal nerves. Later upper 4 cervical ganglia fuse to form superior cervical sympathetic ganglion; the 5th and 6th fuse to form middle and 7th and 8th fuse to form inferior cervical ganglion.

The cervical part of the sympathetic chain is present posterior to the carotid sheath. The ganglia do not receive preganglionic communicantes (white rami)

from cervical spinal nerves but give postganglionic communicantes (grey rami) to cervical spinal nerves. This is because the cervical part of the spinal cord does not have lateral horn cells to provide sympathetic outflow. Hence the preganglionic sympathetic fibres to all the head and neck structures arise from the lateral horn cells of the upper two (or three) thoracic segments of the spinal cord.

The preganglionic sympathetic fibres from the lateral horns of the upper two thoracic segments of spinal cord enter the upper two thoracic sympathetic ganglia and then ascend in the cervical part of the chain. Branches arising from these ganglia (post ganglionic fibres) form plexus around arteries and also join cervical spinal nerves (through grey rami communicantes) to reach the target structures. It also communicates with hypoglossal nerve.

Superior Cervical Sympathetic Ganglion

- It is the largest of all the three cervical ganglia and is about 2 cm long.
- It is placed opposite to C2 and C3 vertebrae.
- It is related in front to the internal carotid artery; hence an aneurysm of this artery can compress the ganglion. The ganglion is placed in front of the longus colli muscle.

Branches (All these are having post ganglionic sympathetic fibres)

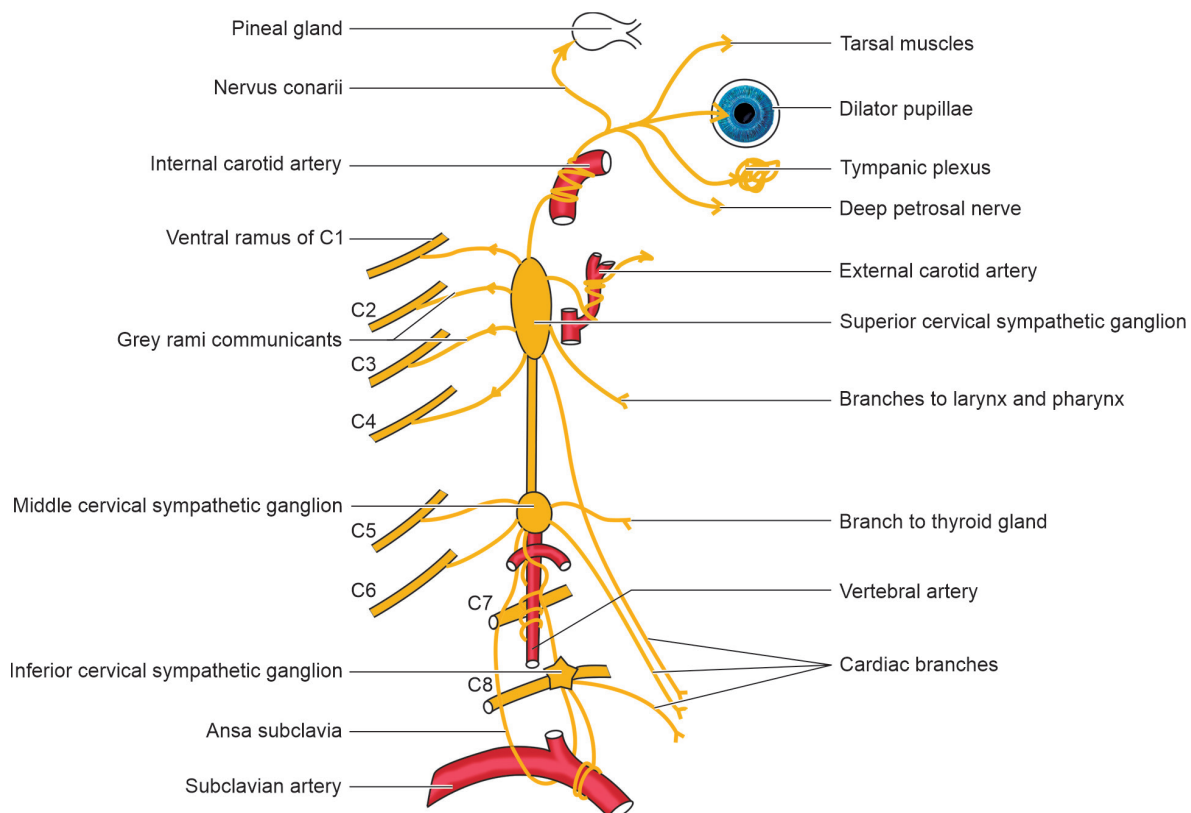


Fig. 73.2: A schematic illustration showing cervical sympathetic chain and its branches

1. It forms a plexus around the internal carotid artery. From this plexus following branches are given off (Fig.73.2):

- a. **Deep petrosal nerve:** It joins with the greater petrosal nerve (branch from the facial nerve) at the foramen lacerum to form the 'nerve of the pterygoid canal'. The nerve of the pterygoid canal ends in the pterygopalatine ganglion. The sympathetic fibres without relaying in the ganglion are distributed through branches of the ganglion.
 - b. **Plexus around the terminal branches of the internal carotid artery (anterior cerebral, middle cerebral)** provide sympathetic fibres to cerebral blood vessels. Plexus around the ophthalmic artery enter the globe of the eye through ciliary ganglion (without relaying) and supplies dilator pupillae and tarsal muscles.
 - c. **Nervus Conarii** passes through endothelial lining of the straight sinus (in the tentorium cerebelli) and supplies pineal gland.
 - d. **Carotico-tympanic nerves** enter the middle ear and contribute to the tympanic plexus along with glossopharyngeal nerves.
 - e. **Communicating branches to the trigeminal ganglion.**
2. Plexus around the external carotid artery and its branches facial artery, maxillary artery and middle meningeal arteries.
 3. **Cardiac branches:** They convey postganglionic sympathetic fibres (efferent) to the heart through cardiac plexus. The cardiac branches from the left ganglion reach superficial cardiac plexus, while from the right side will reach deep cardiac plexus. The superior cervical sympathetic ganglion does not receive any pain (afferent) fibres from the heart.
 4. Branches are given to carotid body and sinus, vagus hypoglossal and glossopharyngeal nerves.
 5. Grey rami communicantes to upper 4 cervical spinal nerves.

Middle Cervical Sympathetic Ganglion

It is located opposite the C6 vertebra, between the loop of the inferior thyroid artery and common carotid artery (Fig.73.2).

Branches

- a. Cardiac branches join the deep cardiac plexus to provide postganglionic sympathetic fibres to the heart. They also bring afferent (pain) fibres from the heart.
- b. Plexus around the inferior thyroid artery.
- c. Grey rami communicantes to 5th and 6th cervical spinal nerves.

Inferior Cervical Sympathetic Ganglion

- It is located between the transverse process of the C7 vertebra and the neck of the first rib.

- Anteriorly it is related to first part of the subclavian artery, carotid sheath, thoracic duct (on left side), cervical pleura.
- Sometimes the inferior ganglion joins with the first thoracic ganglion to form 'stellate ganglion'.

Branches:

- a. Cardiac branches to the heart through deep cardiac plexus. They provide postganglionic sympathetic fibres to the heart. They also bring afferent (pain) fibres from the heart.
- b. Plexus around the vertebral and subclavian arteries.
- c. Grey rami communicantes to 7th and 8th cervical spinal nerves. The grey rami communicantes joining the 8th cervical nerves carry postganglionic fibres to the upper limb (Fig.73.2).



Clinical Notes

Horner's syndrome: A lesion affecting the preganglionic fibres from T1 and T2 segments of the spinal cord cause Horner's syndrome. The site of injury could be ventral ramus of 1st thoracic nerve or upper thoracic sympathetic ganglion or any of the three cervical sympathetic ganglia. An aneurysm of internal carotid or common carotid artery, thyroid enlargement, presence of cervical rib, tumors affecting the apex of the lung, lymph node enlargement can cause Horner's syndrome. It is manifested by:

1. **Miosis:** Constriction of the pupil (dilator pupillae supplied by the sympathetic fibres is affected, hence unopposed action of the parasympathetic fibres through oculomotor nerve to sphincter pupillae constricts the pupil)
2. **Ptoxis:** Drooping of the upper eyelid due to paralysis of superior tarsal muscle (pseudoptosis).
3. **Enophthalmos:** Retraction of the eyeball into the orbit due to paralysis of the orbitalis muscle that spans the inferior orbital fissure, supplied by sympathetic fibres.
4. **Anhidrosis:** Loss of sweating on the face and head on the affected side.

Stellate Ganglion Block

Stellate ganglion provides sympathetic efferents to the upper extremities, head, neck, and heart. In case of intractable angina pectoris, cardiac pain can be suppressed by anesthetic infiltration around the ganglion or sometimes surgical removal of bilateral stellate ganglion. Hence knowledge about the relations of this ganglia is important during such procedures. The nerve block is also indicated in pain syndromes (complex regional pain syndrome, Phantom limb pain, Herpes zoster) and vascular insufficiency (Raynaud's syndrome).

Relations of Stellate Ganglion

Anterior: The structures anterior to the ganglion include the skin and subcutaneous tissue, the sternocleidomastoid and the carotid sheath. The dome of the lung lies anterior and inferior to the ganglion.

Medial: The prevertebral fascia, vertebral body of C7, oesophagus and thoracic duct lie medially (on left side).

Posterior: Structures posterior to the ganglion include the longus colli muscle, anterior scalene muscle, vertebral artery, brachial plexus sheath and neck of the first rib.

Although the ganglion lies at the level of the C7 vertebral body, the needle is inserted at the level of C6 to avoid piercing the pleura. The carotid tubercle (a tubercle on the transverse process of the sixth cervical vertebra) is palpated lateral to the cricoid cartilage. After retracting the carotid sheath laterally, the needle is directed onto the tubercle, and then redirected medially and inferiorly toward the body of C6.

CASE 1

An elderly man presented with a developing aneurysm of the right internal carotid artery, as revealed by a bruit heard over the vessel during a routine physical examination. Radiologic examination revealed that the arterial dilatation was located about 4 cm inferior to the base of the skull at the level of the second cervical vertebra. Since the patient was asymptomatic with regard to the aneurysm, the physician decided that, rather than subjecting him to surgery right now, he would follow up the possible progression of the condition at regular intervals. During his next appointment three months later, the doctor observed a slight miosis, ptosis, anhidrosis, and vasodilation of the peripheral arteries (thus causing a flushing of the skin), all symptoms occurring on the right side of the face. Another appointment was set for one month then, at which time the patient demonstrated a progression of the major symptoms described above. In addition, the following secondary symptoms were manifested at this time: an illusion of slight enophthalmos, ocular hypotony, slight facial hemi atrophy (diminished muscular tone on the right side of the face; slight tissue wasting), transitory increases in facial temperature on the right side and increased secretion of tears from the right eye. The physician, recognizing these symptoms were secondary as a result of the aneurysm, scheduled the patient for surgery. An aneurysmectomy (surgical removal of the sac) was performed, the patient recovered quickly, and the symptoms of

the disorder diminished gradually over a period of several weeks and finally disappeared altogether.

1. What structure was compressed by the aneurysm? Attempt to account for the major symptoms (miosis, ptosis, anhidrosis, vasodilation) on the basis of this compression.
2. What are the origin and course of the fibers contained within the compressed structure?
3. What other ways can you think of that this structure or related components might become injured?
4. How do you account for the disappearance of symptoms after the surgical repair or correction of the aneurysm?

CASE 2

A 46-year-old man who had undergone right-sided pneumonectomy for carcinoma of the bronchus was seen by his thoracic surgeon as a follow-up after the surgery. The patient said that he was fit and was gaining some weight. He noticed that a week past, his right upper eyelid tended to droop slightly when he was tired at the end of the day. After a careful physical examination, the surgeon noticed that in addition to the ptosis of the right eye, the patient's right pupil was constricted and his face was slightly flushed on the right side. Further examination revealed that the skin on the right side of the face appeared to be warmer and drier than normal. Palpation of the deep cervical lymph nodes revealed a large hard fixed node just above the right clavicle. The surgeon made the diagnosis of a right-sided Horner's syndrome which happened as a result of tumour metastasis of the right sympathetic cervical trunk.

1. How would you explain the right ptosis and pupillary constriction in this case?
2. How would you explain the flushing of the right side of the face and why is it warmer?

DEEP CERVICAL LYMPH NODES

The cervical lymph nodes are classified into superficial and deep groups. Lymph from the superficial nodes drains into a deep group and finally drains into the jugular trunk. The left jugular trunk joins the terminal part of the thoracic duct, while the right jugular trunk opens at the junction between the right internal jugular vein and right subclavian vein.

There are about 300 lymph nodes present in the head and neck region. Enlargement of these lymph nodes are common in infections, tuberculosis or sometime by direct infiltration from the cancerous source.

The superficial nodes include submandibular, submental, superficial parotid, deep parotid, occipital,

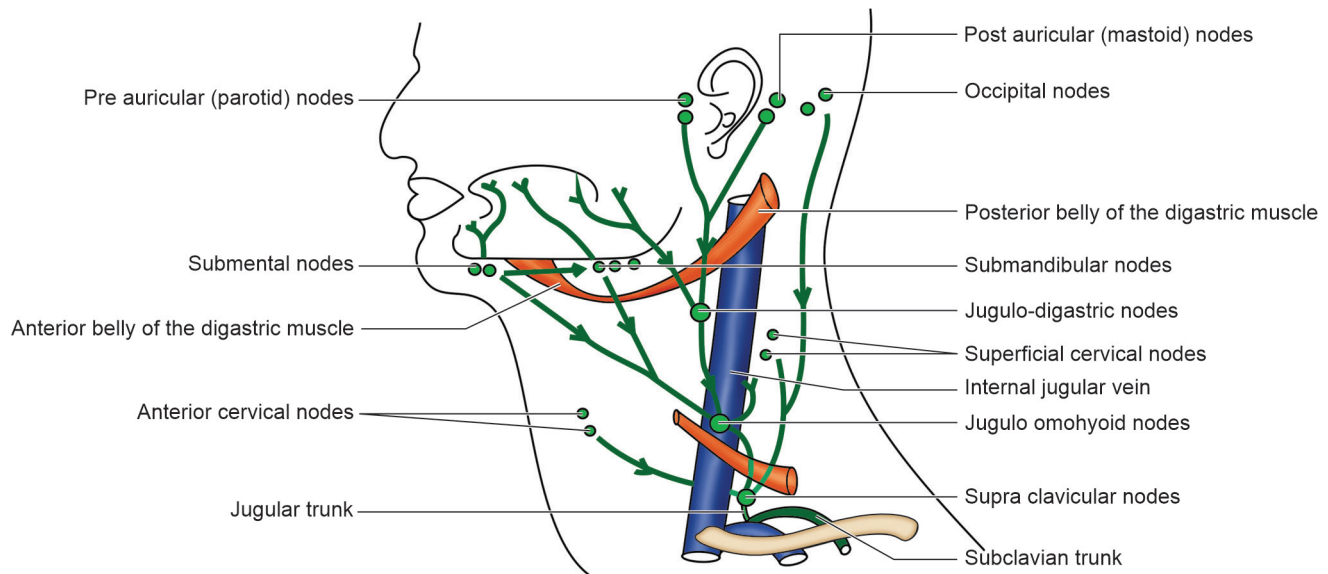


Fig. 73.3: A schematic illustration showing location of major lymph nodes of the head and the neck

superficial cervical and retro auricular nodes. They are discussed at the appropriate region.

The deep cervical groups of lymph nodes are placed along the internal jugular vein deep to the sternomastoid muscle (Fig.73.3). They are further classified into upper and lower groups. The upper group consists of 'jugulo-digastric nodes' and the lower group consists of 'jugulo-omohyoid nodes'.

Jugulo-Digastric Nodes

They are placed below the posterior belly of the digastric, behind the common facial vein and in front of the internal jugular vein. The group receives lymph mainly from palatine tonsil, pharynx, oral cavity, face and posterior third of the tongue. The efferent vessels arising from them drain into the lower group of deep cervical lymph nodes. Jugulo-digastric nodes are often referred to as lymph nodes of tonsil.

Jugulo-Omohyoid Nodes

This group is placed along the internal jugular vein, just above the intermediate tendon of the omohyoid muscle. They receive lymph directly from the tongue and also through submental, submandibular and jugulo-digastric nodes. Jugulo-omohyoid nodes are often referred to as lymph nodes of the tongue.

Supraclavicular Nodes

They are placed along the subclavian vessels in the lower part of the posterior triangle. Some of the lower group of the deep cervical lymph nodes are also placed in front of the scalenus anterior muscle. In cases of carcinoma of the stomach, colon, testis, there is a possibility of retrograde spread through the thoracic duct and thus involving the supraclavicular nodes. The enlargement of left supraclavicular nodes in these conditions is called 'Virchow's nodes'.

Retropharyngeal Nodes

These nodes are located in the retropharyngeal space (posterior to constrictor muscles of the pharynx and in front of the prevertebral fascia). They receive lymph from oropharynx, nasopharynx, auditory tube, nasal cavity, paranasal sinuses and cervical vertebral column. These nodes are enlarged in tuberculosis of the vertebrae. Abscess formation from these lymph nodes can cause retropharyngeal abscess, which can extend downwards into the thorax. The efferent from these nodes drain into lower deep cervical nodes.

Prelaryngeal, Pretracheal, Para Tracheal Lymph Nodes

These nodes drain the larynx, trachea and thyroid gland. The efferent from these nodes drain into lower deep cervical nodes.

The lymph nodes are palpated from proximal (superficial group) to distal (deep group) nodes. In case of an enlarged lymph node, the area draining into it must be examined for inflammation or diseases.

Clinical Notes

Block dissection of neck: In case of carcinoma of the certain structures in the neck and secondary infiltration of these nodes it requires surgical removal of them. All the cervical lymph nodes are removed to prevent metastasis. Sometimes it is necessary to sacrifice, internal jugular vein, external jugular vein, sternomastoid muscle and spinal accessory nerve. At present a modified radical neck dissection is also suggested, which involves excision of all lymph nodes with preservation of one or more non-lymphatic structures like spinal accessory nerve, internal jugular vein and sternomastoid muscle.

In radical neck dissection, all the lymph nodes and lymphatic vessels are removed between the platysma and the deep cervical fascia. The area involves mandible superiorly, the lateral border of the strap muscles medially, the anterior border of the trapezius posteriorly and the clavicle inferiorly. The following structures are preserved: the carotid artery, the vagus, phrenic and hypoglossal nerves and the cervical sympathetic chain. The spinal accessory nerve is usually sacrificed which may produce a shoulder drop.

CASE 3

A 45-year-old man was referred to a surgeon because of a pigmented skin lesion in the right temporal region. A diagnosis of malignant melanoma had been made. The surgeon explained to the patient the seriousness of the condition. Although there were no secondary metastases in the regional lymph nodes, it was decided to perform a block dissection of the lymph nodes on the right side of the neck and remove the internal jugular vein on that side as well.

1. Which group of lymph nodes receive the lymph from the skin of the right temporal region?
2. Why is it necessary to remove the internal jugular vein when performing a block dissection of the deep cervical lymph nodes?
3. Which important nerves are related to the deep cervical lymph nodes and may have to be sacrificed in a block dissection of the neck?

SUBCLAVIAN ARTERY

Origin: On the right side it arises from the brachiocephalic trunk and on the left side it arises as a direct branch from the arch of aorta.

Course: Each artery arches laterally in the root of the neck, in front of the apex of the lungs and cervical pleura. It passes over the superior surface of the first rib. At the outer border of the first rib the artery continues as an axillary artery.

Parts: The subclavian artery is divided into three parts by scalenus anterior muscle. The portion of the artery medial to the muscle is the first part, the portion behind the artery is the second part and distal (lateral) to the muscle is the third part.

First Part

It extends from the sternoclavicular joint to the medial margin of the scalenus anterior muscle.

Relations

Anteriorly: Vagus with its cardiac branches, cervical cardiac branches of the sympathetic chain, ansa subclavia, union of internal jugular vein with subclavian vein to form right brachiocephalic vein, (thoracic duct and phrenic nerve on the left side), sternohyoid, sternothyroid and sternocleidomastoid muscles.

Posteriorly: Apex of the lung covered by cervical pleura, suprapleural membrane, inferior cervical sympathetic ganglion (Fig.73.4A).

The right recurrent laryngeal nerve hooks the undersurface of the first part of the right subclavian artery.

Branches from the first part: The subclavian artery gives many branches in the neck which supplies neck, upper limb and through its vertebral branch it supplies spinal cord and the brain (Fig.73.4B).

1. Vertebral artery
2. Internal thoracic artery (explained in the thorax)
3. **Thyrocervical trunk:** This arterial trunk soon divides into three branches - the inferior thyroid

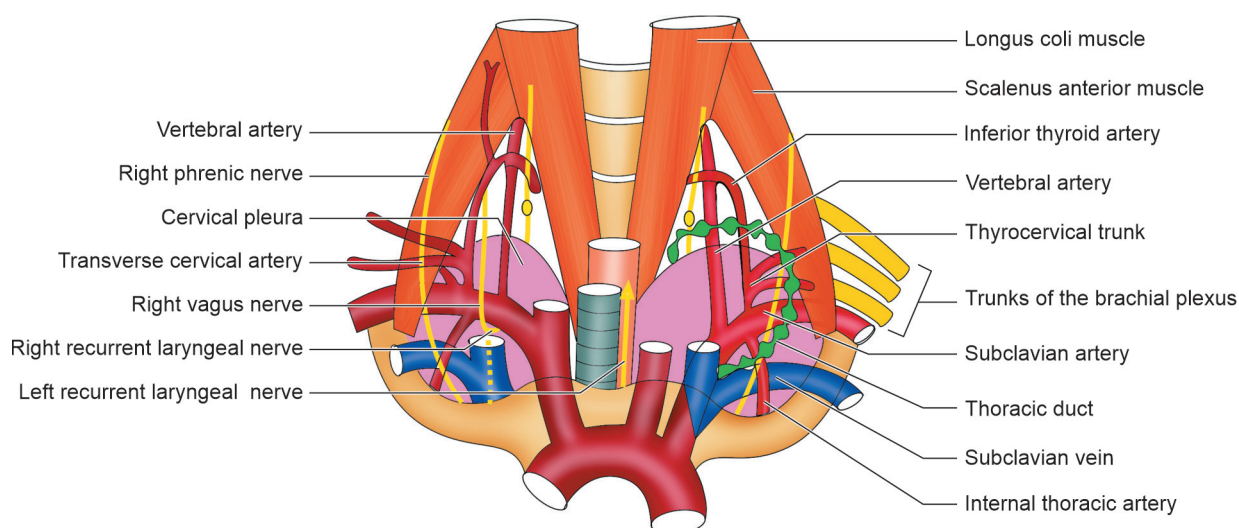


Fig. 73.4A: A schematic illustration showing major relations and branches of the subclavian arteries (anterior view)

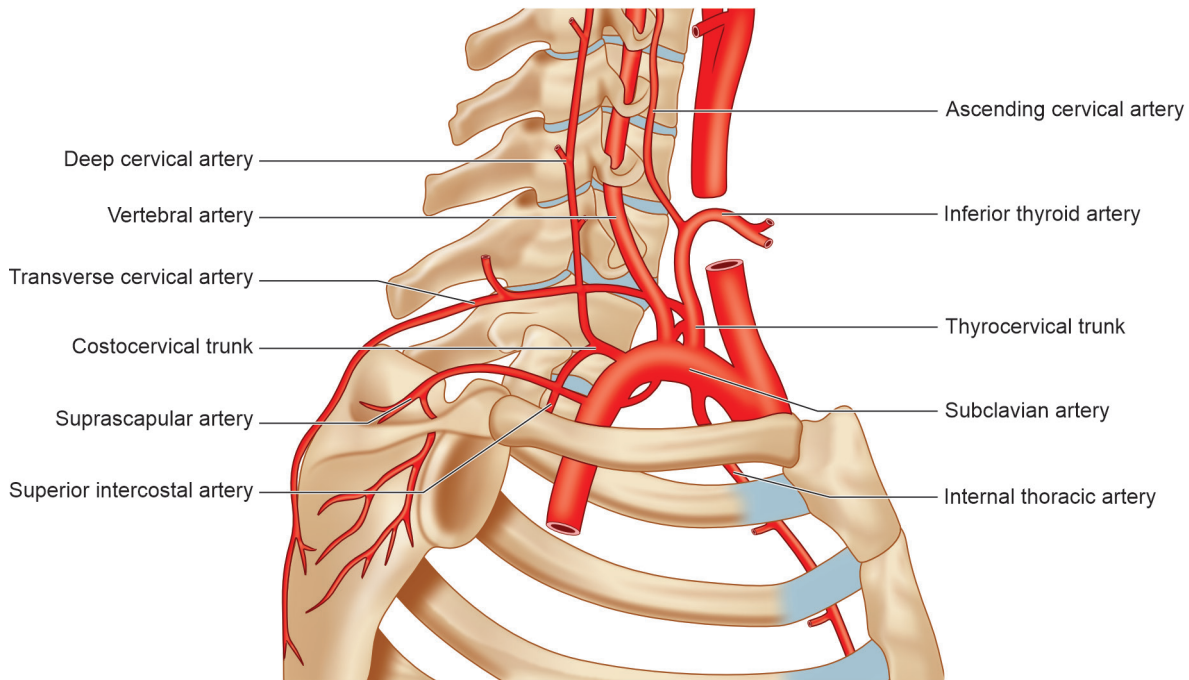


Fig. 73.4B: A schematic illustration showing branches of the right subclavian artery (lateral view)

artery, supra scapular artery and superficial cervical artery (transverse cervical artery).

a) Inferior thyroid artery: It forms a loop and passes medially towards the base of the thyroid gland. It passes behind the carotid sheath and in front of the vertebral artery. On the left side it is crossed in front by the thoracic duct. Close to the lower pole of the thyroid gland the artery is related to recurrent laryngeal nerve. Apart from giving ascending and descending branches to the thyroid gland, it also gives branches like—ascending cervical, inferior laryngeal, tracheal, oesophageal arteries. The ascending cervical ascends along the transverse processes of the cervical vertebrae along with the phrenic nerve. It gives branches to the spinal cord.

b) Superficial cervical (or Transverse cervical artery): It passes laterally in front of the scalenus anterior muscle to appear in the posterior triangle. Here the artery passes laterally superficial to the trunk of the brachial plexus. It passes deep to the trapezius muscle.

c) Supra scapular artery: It passes below the transverse cervical artery. It also crosses superficial to the scalenus anterior to appear in the posterior triangle. Here the artery crosses superficial to the third part of the subclavian artery and trunks of the brachial plexus. It passes beneath the clavicle and subclavius muscle to appear in the supraspinous fossa. It descends into infraspinous fossa through a spinoglenoid notch. At the back of the scapula, it anastomoses with branches of circumflex scapular

and dorsal scapular arteries (connecting the first part of the subclavian artery with the third part of the axillary artery).

Second Part

It is deep to the scalenus anterior muscle.

Relations

Anterior: Scalenus anterior, phrenic nerve on the right side, subclavian vein and sternomastoid muscle.

Posterior: Apex of the lung covered by cervical pleura, suprapleural membrane, lower trunk of the brachial plexus and scalenus medius muscle.

Superior: Upper and middle trunk of the brachial plexus.

Branches: It gives **costocervical trunk**. It crosses the apex of the lung and at the neck of the rib it divides into superior intercostal and deep cervical arteries.

1. Superior intercostal artery: It descends in front of the neck of the upper two ribs. It gives posterior intercostal arteries to the first and second intercostal spaces.

2. Deep cervical artery: It ascends between the transverse process of the C7 vertebra and the neck of the first rib. It ascends deep to the semispinalis capitis and supplies deep muscles.

Third part

- It is distal (lateral) to the scalenus anterior muscle appears in the posterior triangle.
- It appears in the posterior triangle in the interval between the scalenus anterior and scalenus medius muscles.

- It is the most superficial part of the subclavian artery.
- The artery can be approached lateral to the posterior border of the sternomastoid muscle.
- It can be compressed against the first rib with the shoulder depressed.

Relations

Anteriorly: Nerve to subclavius, external jugular vein, subclavian vein.

Posteriorly: Lung and pleura, lower trunks of the brachial plexus (postero-inferiorly).

Inferiorly: Superior surface of the first rib.

Superiorly: Upper and middle trunk of the brachial plexus.

Branches: It gives dorsal scapular artery.

Dorsal scapular artery: It also appears in the posterior triangle. It passes deep to the levator scapulae, and then descends along the medial margin of the scapula deep to the rhomboideus muscles.

In one third of the individuals, the superficial cervical and dorsal scapular arteries arise from a common trunk called 'transverse cervical' artery. Its superficial branch represents superficial cervical and deep branch represents dorsal scapular artery (Fig.73.4B).

Vertebral Artery

The vertebral artery is the major artery supplying the contents of the posterior cranial fossa including brainstem, cerebellum, and occipital lobes of the cerebrum. The course, branches and distribution of the artery in the cranial cavity is explained in the chapter 89.

Origin: Each vertebral artery is a branch from the first part of the subclavian artery.

Course: The course of the vertebral artery is very long and has been divided into four parts.

First part: It extends from its origin to the foramen transversarium of sixth cervical vertebra.

This part of the artery traverses the 'scaleno-vertebral triangle'. It is related to inferior thyroid artery and is crossed by the thoracic duct anteriorly on the left side. The stellate ganglion, seventh and eighth cervical spinal nerves are posterior to the artery.

Second part: It ascends through foramina in the transverse processes of upper six cervical vertebrae. It is surrounded by vertebral venous plexus and sympathetic fibres derived from stellate ganglion. At the foramen transversarium of the second cervical vertebra (axis), the vertebral artery takes a wide curve to turn laterally and upward to reach the foramen transversarium of the atlas. This will ensure that the artery is not compressed when the head is laterally flexed and also helps in reducing the arterial pressure in the cranial cavity (Fig.73.5A and B).

Branches: The spinal branches enter the vertebral canal through intervertebral foramina and supply contents of the vertebral canal. They supply spinal cord through anterior and posterior spinal arteries. The radicular branches of these spinal arteries supply the nerve roots.

Third part: It is located in the suboccipital triangle. The artery grooves the posterior arch of the atlas and enters the cranial cavity through foramen magnum. The dorsal ramus of the first cervical nerve (suboccipital nerve) emerges beneath the artery.

Fourth part: The vertebral artery pierces the duramater and enters the cranial cavity through foramen magnum. It ascends in front of the medulla

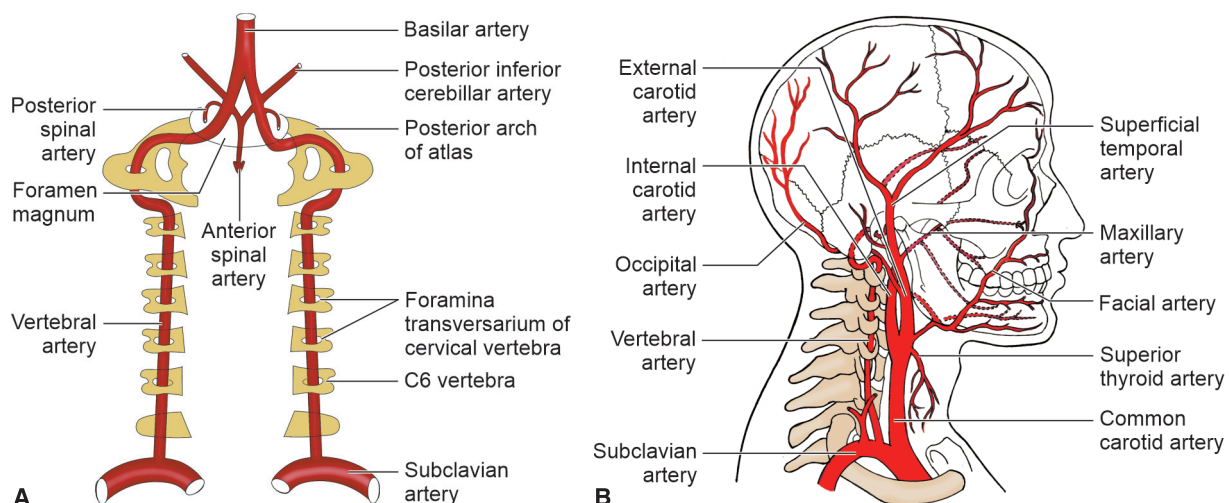


Fig. 73.5: A: A schematic illustration showing right and left vertebral arteries; B: A schematic illustration showing major arteries of the head and the neck

oblongata (along the rootlets of the hypoglossal nerve). At the upper part of the medulla oblongata (pontomedullary junction), the right and left vertebral arteries join to form the basilar artery.

Clinical Notes

Subclavian steal syndrome: An atherosclerotic plaque can cause stenosis (narrowing) of the subclavian artery near its origin from the arch of the aorta or from brachiocephalic trunk. Such stenosis will reduce the arterial blood supply to the upper limb on the affected side. In such case the blood in the vertebral artery on the normal (opposite) side is shunted where the right and left vertebral arteries join.

The blood flow in the vertebral artery on the affected side is reversed so that it will be able to fill the subclavian artery beyond the stenosis. This can cause shortage of blood supply to the brainstem especially during times of increased demand of blood supply to the upper limb (for example during exercise) on the affected side. The syndrome presents symptoms of pain, tingling and low blood pressure in the upper limb of the affected side and also medullary symptoms like giddiness and fainting.

DEEP MUSCLES OF THE NECK

The deep muscles of the back are paravertebral and prevertebral muscles. The para vertebral muscles include scalenus anterior, scalenus medius, scalenus posterior, scalenus minimus. The para vertebral muscles include longus colli, longus capitis, rectus capitis anterior and lateralis. These muscles are anteriorly covered by prevertebral fascia. The attachment, nerve supply and actions are summarized in Table 73.1 and Fig.73.6

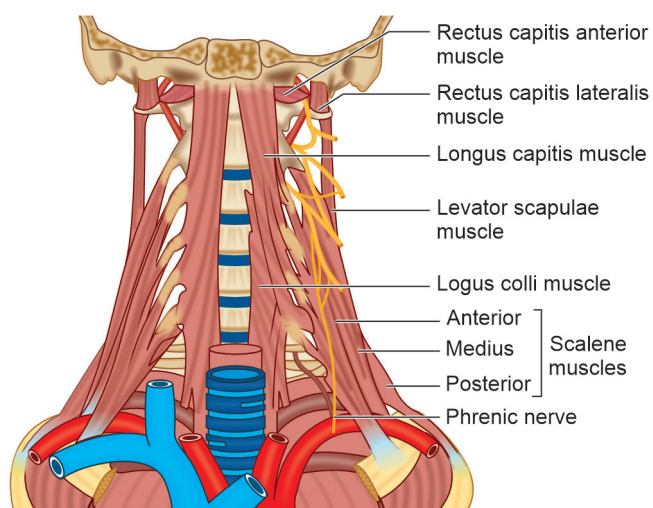


Fig. 73.6: Deep muscles of the neck (anterior view)

Relations of the Scalenus Anterior

Anteriorly: Phrenic nerve, Prevertebral fascia, branches of the thyrocervical trunk (with transverse cervical artery) in the lower part, thoracic duct (on the left side only), carotid sheath with its content, clavicle with subclavius muscle and sternocleidomastoid muscle.

Posteriorly: Second part of the subclavian artery, roots of the brachial plexus, scalenus medius muscle, cervical pleura and apex of the lung in the lower part.

Clinical Notes

Scalenus anterior syndrome: Hypertrophy of the muscle can compress the subclavian artery and brachial plexus. The symptoms are similar to cervical rib syndrome.

Scalenus Minimus

It is rudimentary and represented by suprapleural membrane.

Origin: Lower border of the transverse process of the C7 vertebra.

Insertion: Inner margin of the 1st rib (some of its fibres continue with suprapleural membrane (Sibson's fascia)).

Scaleno-vertebral triangle

This triangle is located at the root of the neck with some structures which are of clinical significance.

Boundaries

Medially: Longus colli

Laterally: Scalenus anterior muscle

Base: First part of the subclavian artery

Apex: Meeting point between the longus colli and scalenus anterior at the level of transverse process of C6 vertebra

Contents

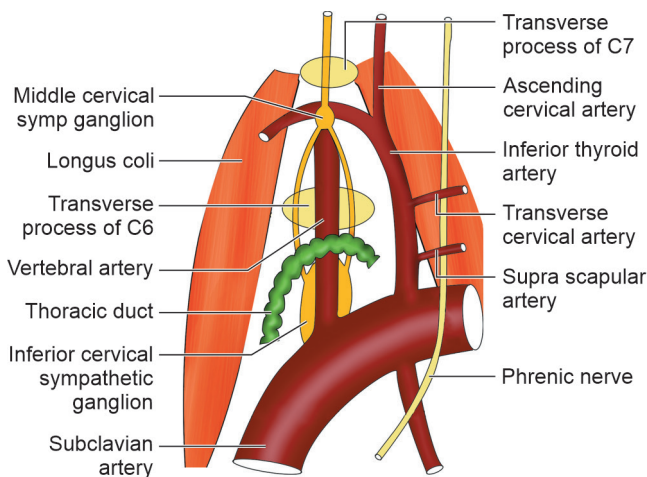
1. First part of the vertebral artery and accompanying vein (Fig.73.7).
2. Cervical part of the sympathetic chain with middle and inferior ganglia.
3. Inferior thyroid artery
4. Thoracic duct on the left side
5. Transverse process of C7 vertebra
6. Ansa subclavia-a nerve loop connecting middle and inferior cervical sympathetic ganglia, which loops around the first part of the subclavian artery.

Prevertebral Muscles

The following muscles lie in front of the cervical vertebral bodies. They are all covered anteriorly

Table 73.1: Attachment and actions of deep muscles of the neck

Name of the muscle and its origin	Insertion	Nerve supply	Action
Scalenus anterior Anterior tubercle of the transverse processes of the 3rd to 6th cervical vertebrae	Scalene tubercle on the inner border of the first rib and also to ridge on the upper surface of the first rib between subclavian vein in front and the subclavian artery behind	Ventral rami of C4, C5 and C6 spinal nerves	It elevates the first rib and is an accessory muscle of inspiration. Acting from below, bilateral action of the muscle can flex the cervical part of the vertebral column
Scalenus medius Posterior tubercles of the transverse processes of C2 to C7 vertebrae	Upper surface of the 1st rib behind the groove for the subclavian artery	C3 to C8 spinal nerves	Elevates the rib (accessory muscles of inspiration) and bends the neck to its own side (lateral flexion)
Scalenus posterior Posterior tubercles of the transverse processes of C4, C5 and C6 vertebrae	Outer surface of the 2nd rib	C6, C7 and C8 spinal nerves	Elevates the 2nd rib and bends the neck to its own side

**Fig. 73.7:** A schematic illustration showing boundaries and contents of the scaleno-vertebral triangle

by prevertebral fascia, and they form the posterior boundary of the retropharyngeal space. The attachments, nerve supply and actions of the prevertebral muscles are summarized in Table 73.2 and Fig.73.6.

Solutions to the clinical case studies

Case 1

1. The superior cervical sympathetic ganglion was compressed by the aneurysm.

Miosis is the constriction of the pupil due to paralysis of dilator pupillae which is supplied by sympathetic fibres.

Ptos is drooping of the upper eyelid due to involvement of superior tarsal muscle.

Anhidrosis is referring to loss of sweating on the face, due to involvement of sympathetic fibres that supply sweat glands.

Vasodilation of the peripheral arteries is due to involvement of the smooth muscle of peripheral blood vessels. The relaxation of arteriolar smooth muscle (vasodilation) resulting in redness of the face and increased temperature. Some of the secondary symptoms of his syndrome are more difficult to explain by a direct relationship to sympathetic denervation. The four main symptoms, however, are quite adequate in diagnosing Horner syndrome and are the ones that should be stressed to the beginning student.

2. The sympathetic fibres to the head area (smooth muscles of the blood vessels, sweat glands, smooth muscles of the eyelid and dilator pupillae muscle) are derived from T1 and T2 segments of the spinal cord. The preganglionic fibres reach the upper two thoracic sympathetic ganglia through ventral roots of the spinal nerve (first and second thoracic spinal nerves) and white ramus communicantes. After traversing the sympathetic ganglia (without relaying), they (the preganglionic fibres) ascend in the sympathetic chain to reach the cervical part of the sympathetic chain. After synapsing in the neurons of the cervical sympathetic ganglia, the postganglionic fibres are distributed either by joining the cervical spinal nerves (through grey rami communicantes) or by forming plexus around the arteries.
3. An aneurysm of common carotid and internal carotid arteries, thyroid enlargement, presence of cervical rib, tumors affecting the apex of the lung, lymph node enlargement can cause Horner's syndrome.

Table 73.2: Attachments, nerve supply and actions of prevertebral muscles

Name of the Muscle and its origin	Insertion	Nerve supply	Actions
Longus colli Upper oblique part : Anterior tubercle of transverse process of vertebrae C3 and C4 Middle vertical part : Bodies of the C4 to T3 vertebrae Lower oblique part : Bodies of vertebrae T1 and T2	Tubercle of anterior arch of atlas Anterior surface of bodies of vertebrae C2 to C7 Anterior tubercle of transverse process of C5 and C6 vertebrae	Ventral rami of C2 to C6	It flexes the cervical vertebral column, and the lower oblique part rotates the neck to the opposite side
Longus capitis Anterior tubercles of the transverse processes of the C3 to C6 vertebrae	Inferior surface of the basilar part of the occipital bone on either side of the pharyngeal tubercle	Ventral rami of C2 to C6	It flexes the head
Rectus capitis anterior Anterior surface of the lateral mass of the atlas	Inferior surface of the basilar part of the occipital bone in front of the occipital condyle	A nerve loop formed by the ventral ramus of C1 and C2	It flexes the head at the atlanto occipital joint
Rectus capitis lateralis Upper surface of the transverse process of the atlas	Jugular process of the occipital bone	Ventral ramus of C1 and C2	It bends the head to the same side

- Disappearance of the symptoms after surgery is due to withdrawal of compressing pressure on the ganglion.

Case 2

- Refer the earlier case
- Refer the earlier case

Case 3

- The lymph from the temporal region drains into the parotid group of lymph nodes. The efferent lymph from these nodes drains into the deep cervical lymph nodes, which are embedded in the carotid sheath and the tunica adventitia of the internal jugular vein.
- To ensure that all the deep cervical nodes are removed, it is therefore necessary to remove the internal jugular vein on that side.
- The spinal part of the accessory nerve and the hypoglossal nerves are carefully preserved in block dissections of the neck. However, if they are involved in secondary cancerous growth, they are sacrificed.

- A man has metastatic carcinoma and enlarged deep cervical lymph nodes. One of his symptoms is a hoarse voice, barely heard above a whisper. Subsequently he succumbs to the death and at autopsy it is found that one of the enlarged nodes has put pressure on a nerve in the tracheoesophageal groove. Presumably this was the reason for the hoarse voice. Which nerve was involved?

- External laryngeal nerve
- Internal laryngeal nerve
- Pharyngeal branch of the vagus nerve
- Recurrent laryngeal nerve

- A 34-year-old man who is a professional weightlifter comes to his physician complaining of recent weakness in his left arm and frequent tingling in his hand and fingers during exercise sessions which subsides with rest. He is diagnosed as having vascular insufficiency due to scalenus anticus syndrome and as a remedy it is decided to transect the anterior scalene muscle where it inserts on the first rib. During surgery, which structure in contact with the anterior surface of the muscle must the surgeon be careful of sparing?

- Sympathetic chain
- Vagus nerve
- Phrenic nerve
- Lower trunk of the brachial plexus

- A 62-year-old man with a previous history of right carotid endarterectomy, comes to his physician complaining of light-headache and dizziness whenever he uses his right hand vigorously. He is diagnosed as having subclavian steal syndrome due to an atherosclerotic plaque at the point where his right

MCQs

- A patient with Raynaud's disease undergoes a stellate ganglion block. Which of the following is the most likely to be the ipsilateral effect of this procedure?
 - Pallid face
 - Profuse facial sweating
 - Ptosis
 - Pupillary dilation

- subclavian artery branches from the brachiocephalic trunk. The cerebral insufficiency is the result of blood being stolen from which artery?
- External carotid
 - Internal carotid
 - Middle cerebral
 - Vertebral
5. A post graduate medical student attempts to insert a central venous catheter into the heart by a subclavicular approach to the subclavian vein. Following this attempt, it is noted that the patient has difficulty in breathing. What nervous structure lying immediately deep to the subclavian vein, as it crosses the scalenus anterior muscle, might have been injured?
- External laryngeal nerve
 - Phrenic nerve
 - Recurrent laryngeal nerve
 - Sympathetic trunk
6. Which structure lies immediately anterior to the right anterior scalene muscle at its costal attachment?
- Subclavian artery
 - Subclavian vein
 - Thoracic duct
 - Thyrocervical trunk
7. A person develops a primary tumor of the thyroid gland and, among other symptoms, drooping of the eyelid and constriction of the pupil on the right side of the eye is noted. What nerve fibers have been interrupted by the tumor?
- The cervical sympathetic chain
 - Postganglionic sympathetic
 - Preganglionic parasympathetic
 - Postganglionic parasympathetic
8. While doing a deep cervical lymph node dissection on the left side anterior to the scalenus anterior muscle, which of these structures is least likely to be encountered?
- Upper trunk of the brachial plexus
 - Subclavian vein
 - Phrenic nerve
 - Cervical part of the thoracic duct
9. The middle cervical sympathetic ganglion, recurrent laryngeal nerve, and parathyroid glands are all closely related with which blood vessel?
- Inferior thyroid vein
 - Inferior thyroid artery
 - Superior thyroid artery
 - Superior thyroid vein
10. During surgical procedures in the neck, structures within the carotid sheath can be retracted (pulled aside) as a unit. Which of the following structures is not enclosed in the carotid sheath?
- Vagus nerve
 - Common carotid artery
 - Cervical sympathetic trunk
 - Internal jugular vein
11. In an automobile accident, a rider sustains a severe neck injury at the C6 level. In addition to crushing of the spinal cord, the left transverse process of the C6 vertebra is fractured. What artery is endangered?
- Common carotid
 - Vertebral
 - Inferior thyroid
 - Internal carotid
12. You have a patient with a drooping right eyelid. You suspect Horner's syndrome. Which one of the following signs on the right side would confirm this diagnosis?
- Constricted pupil
 - Dry eye (lack of tears)
 - Exophthalmos
 - Sweaty face
13. A young child falls with a sucker stick in his mouth and it hits the back of his pharynx. He later presents with both ptosis, pupillary miosis. Which of the following structures was most likely injured which would explain these findings?
- Superior cervical ganglia
 - Arch of the aorta
 - Esophagus
 - Oculomotor nerve
14. A 32-year old patient presents with paresthesia on the medial side of one hand and forearm accompanied by a diminution of the radial pulse. He undergoes surgery to relieve the compression causing these symptoms. During the procedure the anterior scalene muscle is incised. Which of the following nerves is most in danger or injury during this procedure?
- Recurrent laryngeal nerve
 - Phrenic nerve
 - Superior laryngeal nerve
 - Vagus nerve

ANSWERS TO MCQs

1. C	2. D	3. C	4. D	5. B
6. B	7. A	8. A	9. B	10. C
11. B	12. A	13. A	14. B	

JUST BEFORE THE EXAM

Sympathetic ganglia	Location	Branches and Distribution
Superior cervical sympathetic ganglion	In front of C2 and C3 vertebrae, behind internal carotid artery	Plexus around the internal carotid artery supplies lacrimal gland, dilator pupillae muscle, superior tarsal muscle, heart, pineal gland, smooth muscles in the wall of the anterior and middle cerebral arteries
Middle cervical sympathetic ganglion	In front of C6 vertebra	Cardiac branches supply heart
Inferior cervical sympathetic ganglion	Between the transverse process of the C7 vertebra and neck of the first rib	Cardiac branches supply heart Sympathetic fibres to the upper limb

Horner's syndrome → Injury to cervical part of the sympathetic chain (cervical rib, tumour affecting apex of the lung, thyroid gland enlargement, enlargement of the deep cervical lymph nodes and aneurysm of the internal carotid artery). Manifested by Miosis (constriction of the pupil) + Ptosis (drooping of the upper eyelid) + Enophthalmos (retraction of the eye + Anhidrosis (loss of sweating in the face).

Deep cervical lymph nodes → Located along the internal jugular vein, which includes Jugulodigastric and Jugulo-omohyoid nodes.

Subclavian artery → Branch from the arch of the aorta on the left side and from the brachiocephalic trunk on the right side. It continues as an axillary artery beyond the outer border of the first rib. The scalenus anterior muscle divides the artery into 3 parts (medial to the muscle is first part, deep to the muscle is second part and lateral to the muscle is third part).

