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DEPARTMENT TOPOGRAPHIC ANATOMY
AND OPERATIVE SURGERY

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CLINICAL ANATOMY OF THE NECK REGION

Methodical recommendations for students

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CLINICAL ANATOMY OF THE NECK

The upper limit of the neck (*cefalocervical limit*) is a conventional line that crosses the lower jaw (basis of mandible) and its angle, the bottom of the external auditory canal, the apex of mastoid process (*procesuus mastoideus*) and superior nuchal line (linea nuchae superior) to the external occipital protuberance (*occipitalis external protuberance*).

The lower limit between the neck and thorax (*cervicotoracic limit*) is represented in the anterior by upper edge of sternal manumbrium (*manumbrium sternum*), sternoclavicular joint and clavicle (collarbone) and in the posterior by a conventional line that connects the two acromio-clavicular joints (*articulatio sternoclavicularis*) and the top of spinous process (*processus spinosus*) of the seventh cervical vertebra.

Tracing a frontal plane through the transversal processes of the cervical region is obtained a conventional division of the neck into 2 compartments: anterior (neck itself) - containing cervical bodies (*larynx, trachea, pharynx, esophagus, thyroid and parathyroid glands*) and posterior, which is represented by muscle and cervical vertebrae. Such a division has an anatomical substrate, because the deep fascia of the neck sends in frontal plane some connective tissue septa, linking the deep fascia and transverse processes of the cervical vertebrae.

Landmarks and projections in anterior part of the neck

Throughout its trajectory can be palpated the lower jaw, angle of the jaw, collarbone, sternum jugular notch (corresponding intervertebral cartilage Th2-3), scapular acromial apophysis. The first rib can be palpated in supraclavicular fossa. Much simpler is to determine the first rib in position when muscles of this region are relaxed, when the head is turned toward the question and the shoulder is close to the neck.

On transversal veretebral process of the VI cervical vertebrae (middle front edges of sternocleidomastoidian m.) can be determined a tuber - carotid tubercle (*tuberculum caroticum*). Common carotid artery can be compressed by this tuber in case of bleeding. Edges of sternocleido-mastoid m., hyoid bone and thyroid cartilage, and between them - thyrohyoid membrane can be palpated also. The arch of the cricoid cartilage is projected at the level of VI-th cervical vertebrae.

In small supraclavicular fossa – between the sternal and clavicular feet of sternocleidomastoid m., under prevertebral fascia, phrenic nerve

passes. Here can be determined a painful point in case of phrenic neuralgia. In great supraclavicular fossa we can palpate the brachial plexus and subclavian artery, which can be compressed to the first rib.

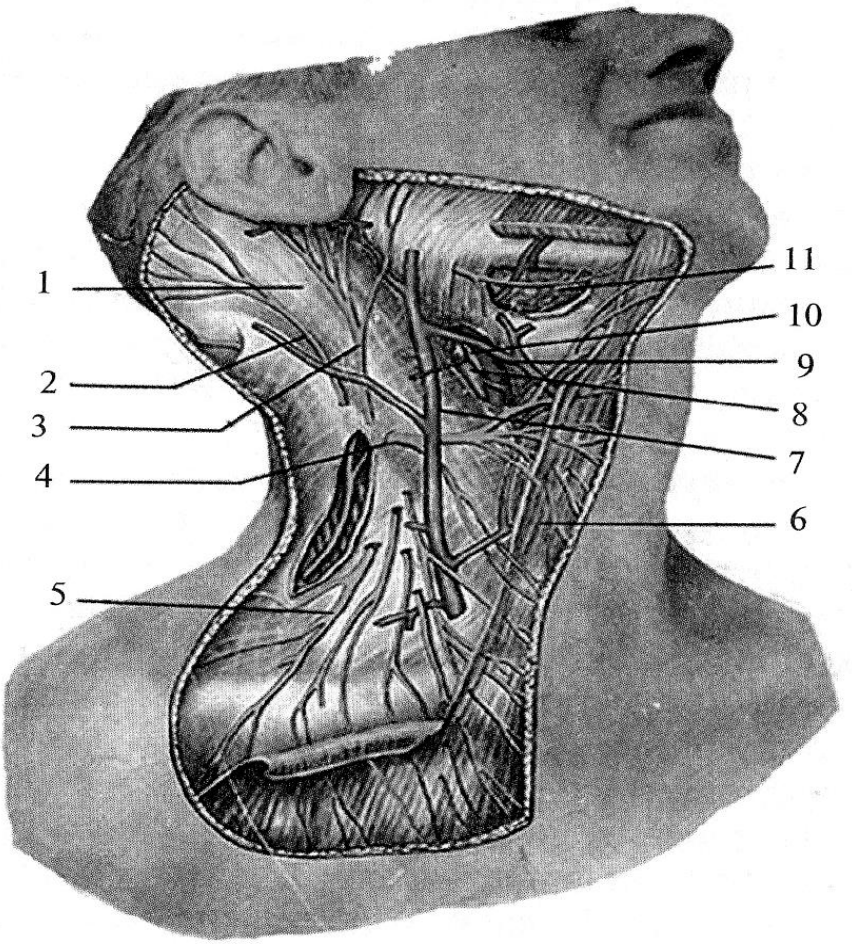
Thyroid cartilage is joined with cricoid cartilage by cricothyroid membrane (synonym – *lig. conicum*) − where conicotomy is performed in extreme cases.

Sternocleidomastoid muscle (*m. sternocleidomastoideus*) is obliquely intersected by the external jugular vein, which has a trajectory from the angle of the jaw to the middle of the clavicle. At the middle of the posterior edge of the sternocleidomastoid m. are emerging and projecting out cervical plexus cutaneous branches, as well as accessory nerve.

Projection line of the common carotid artery (*a. carotis communis*) is determined when the head is returned to the opposite side, as follows: proximal point is situated at midway between mastoid process (*processus mastoideus*) and angle of the jaw (identical for both sides), distal point is located on the right sternoclavicular joint on the right side and the left corresponds to the space between the sternal and the clavicular feet of sternocleidomastoid m..

Subclavicular artery is projected at the level of midlle of clavicle, when artery passes from supraclavicular fossa to subclavicular fossa, and after that into axillary cavity.

Pirogov's jugular venous angle (confluens of internal jugular with the subclavian veins) is projected in angle formed by the posterior edge of sternocleidomastoid m. and the clavicle. The apex of the lungs is projected in supraclavicular fossa.



Projections and superficial anatomical landmarks formations in the neck. Superficial veins and nerves. 1 – superficial lamina of own neck fascia; 2 – small occipital n.; 3 – greater auricular n.; 4 – transverse n. of the neck; 5 – supraclavicular nn; 6 – platisma m.; 7 – external jugular v.; 8 – internal jugular v.; 9 – common carotid a.; 10 – sternocleidomastoid m.

TOPOGRAPHIC DIVISIONS IN THE CERVICAL REGION

The neck is conventionally divided into a several of regions the boundaries of which can be seen on the surface of the skin. A sagittal plane drawn through the middle of the cervical vertebrae divides cervical region into 2 parts: right and left (*regio coli dextra et sinister*). Each of them contains properly sternocleidomastoid region and two large triangles: lateral and medial.

Medial triangle is bounded by the lower jaw, the front edge of the sternocleidomastoid muscle and anterior midline of the neck. A transverse plane passing along the upper edge of the body and large horns of the hyoid bone divides the medial triangle of the neck in two regions: over- and infrahyoid. In medial triangle can be distinguished smaller triangles.

I. **In suprahyoid region** we can distinguish:

- Submental triangle – bounded by both bellies of digastric muscle and the body of the hyoid bone;
- Submandibular triangle - bounded by the lower edge of the mandible body and anterior and posterior bellies of digastric muscle (corresponds to the location of submandibular gland).

II. **In infrahyoid region** we can distinguish:

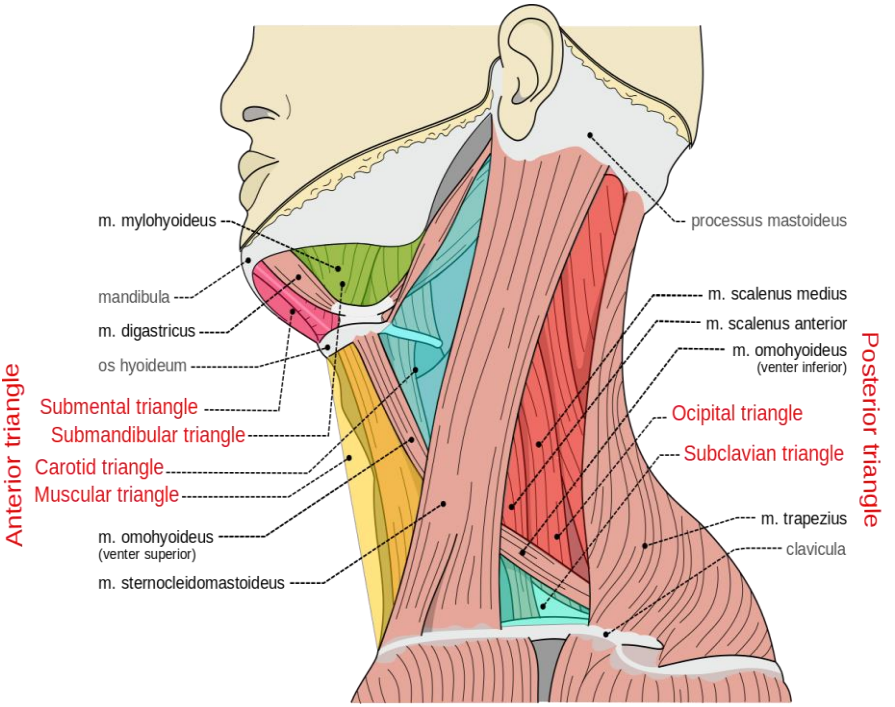
- Carotid triangle - bounded by the posterior belly of digastric muscle, superior belly of omohyoid muscle and anterior margin of sternocleidomastoid m. (corresponds to the location of the carotid artery);
- Omotraheal triangle - bordered by superior belly of omohyoid m., anterior edge of sternocleidomastoid muscle and the midline of the neck.

Sternocleidomastoidian region is located and corresponds to the respective muscle.

Lateral triangle of the neck is located between the posterior edge of the sternocleidomastoid muscle, anterior edge of trapezius muscle and superior edge of the clavicle. We distinguish two triangles:

Omotrapezoid triangle is bounded by the anterior edge of trapezius muscle, posterior edge of sternocleidomastoid m. and lower belly of omohyoid m.;

Omoclavicular triangle which has the following limits: upper edge of the clavicle, the lower belly of omohyoid muscle and the posterior edge of the sternocleidomastoid muscle.



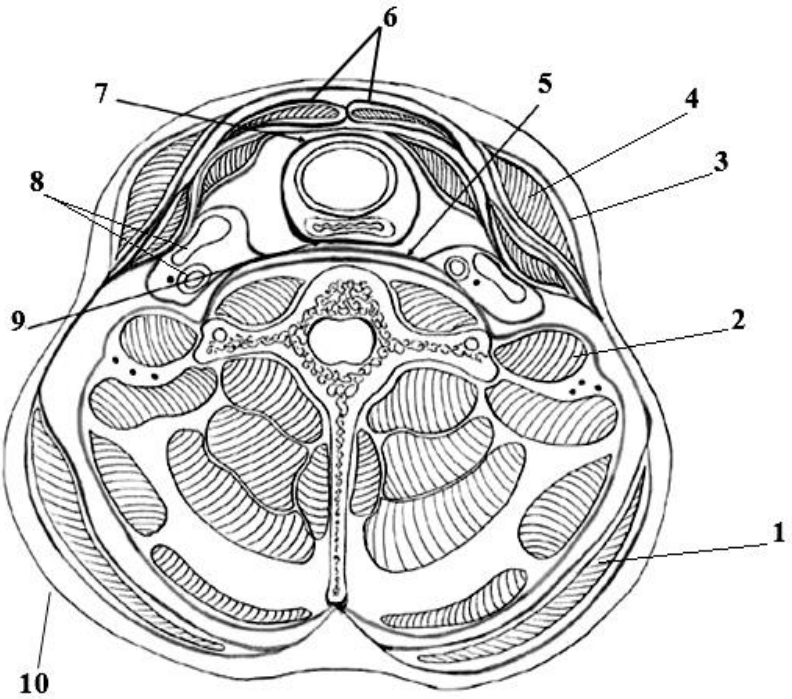
Topographic divisions in the neck.

CERVICAL FASCIAE

Quite complex topographic relations between the neck organs can be more easily understood and memorized if their study begins by describing fascial flakes, which are the connective skeleton of the neck.

Due to an unordered sheaths distributions in the cervical region, describing their encounters some obstacles, which is why this issue is treated differently in scientific sources.

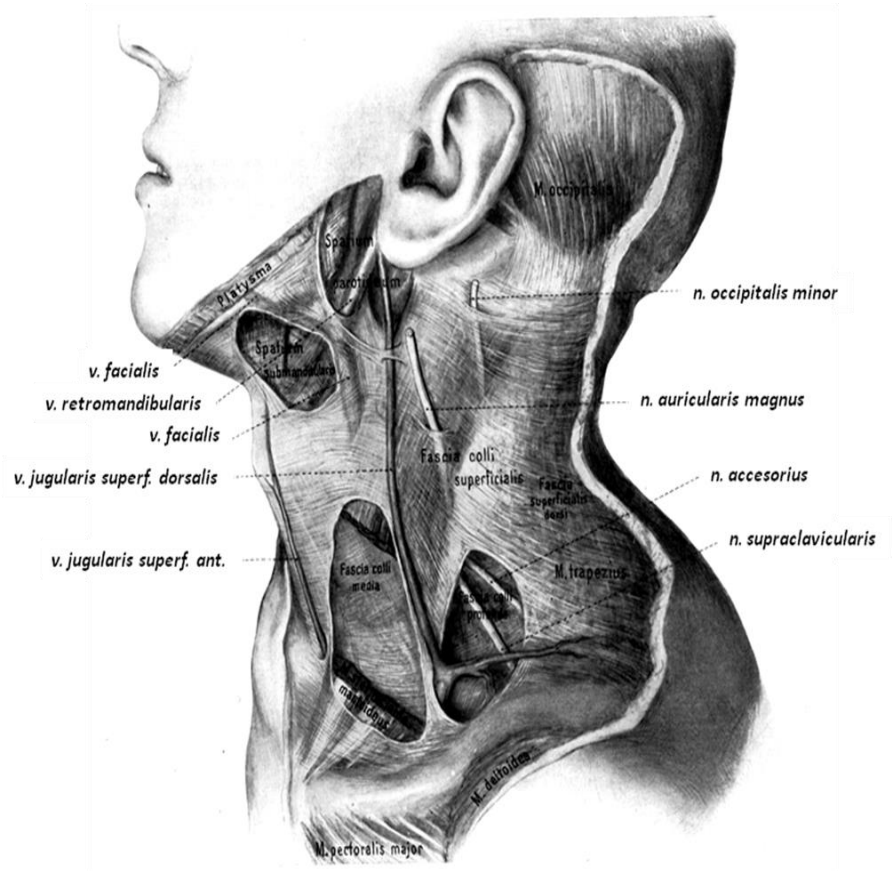
According to N. V. Shevkunenko 's concept is distinguished five neck fascias. 2 of which proper: *lamina profunda fasciae colli propriae, fasciae endocervicalis* and three improper: *fascia superficialis, lamina superficialis fasciae colli propriae, fasciae prevertebralis*.



Schematic representation of the neck fascia on the cross-section. 1 – trapezius m.; 2 – scalene mm.; 3 – superficial lamina of own neck fascia (fascia II); 4 – sternocleidomastoid m.; 5 - prevertebral fascia (fascia V); 6 – deep lamina of own cervical fascia; 7, 9 - endocervical fascia

(fascia IV), 8 - medial neurovascular bundle of the neck; 10 - superficial fascia.

I. Superficial fascia (*fascia superficialis*) – surrounds the cervical region, is situated deeper than subcutaneous fat, it forms a sheath for platisma muscle.



Superficial fascia aspect

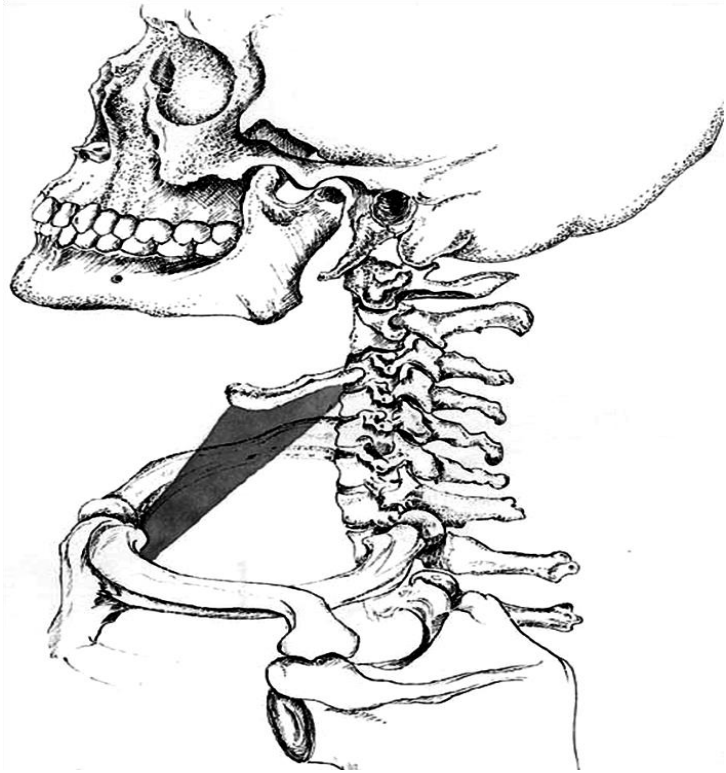
II. Superficial lamina of own cervical fascia (*lamina superficialis fasciae colli propriae*) – starts from the spinous processes of the cervical vertebrae, forms sheaths for trapezius m. in posterior, and for sternocleidomastoid muscle in anterior, and also submandibular gland capsule. The lower it is inserted on the anterior upper sternal manubrium and clavicles, and the higher the lower jaw, mastoid apophyses, superior nuchal line. It sends in frontal plane connective tissue septa to the

transverse processes of the cervical vertebrae, dividing in this way the cervical region in the anterior and posterior compartements. On the face the second neck fascia extends in parotidomaseteric fascia, forming parotid gland capsule, and covers the masseter muscle.

Dimensional graphical representation of the topography of superficial lamina of own cervical fascia. Circular path, proximal and distal insertion lines of the fascia is well defined.

III. Deep lamina of own cervical fascia (deep lamina fasciae colli propriae, omoclavicular aponeurozis or Riche's aponeurozis) - fascia or omoclavicular aponeurozis is located in the depth of the anterior region of the neck muscles, forming sheath for pretraheal group of muscles (thyrohyoid, sternohyoid, sternotyroid, omohyoid). Omoclavicular fascia has a trapezoid form and inserts on the hyoid higher, lower - on the posterior edge of the sternum and clavicles, and laterally is limited by omohyoid m..

On anterior midline the fascia II accretes with fascia III, forming the white line of the neck up to body of the hyoid bone.

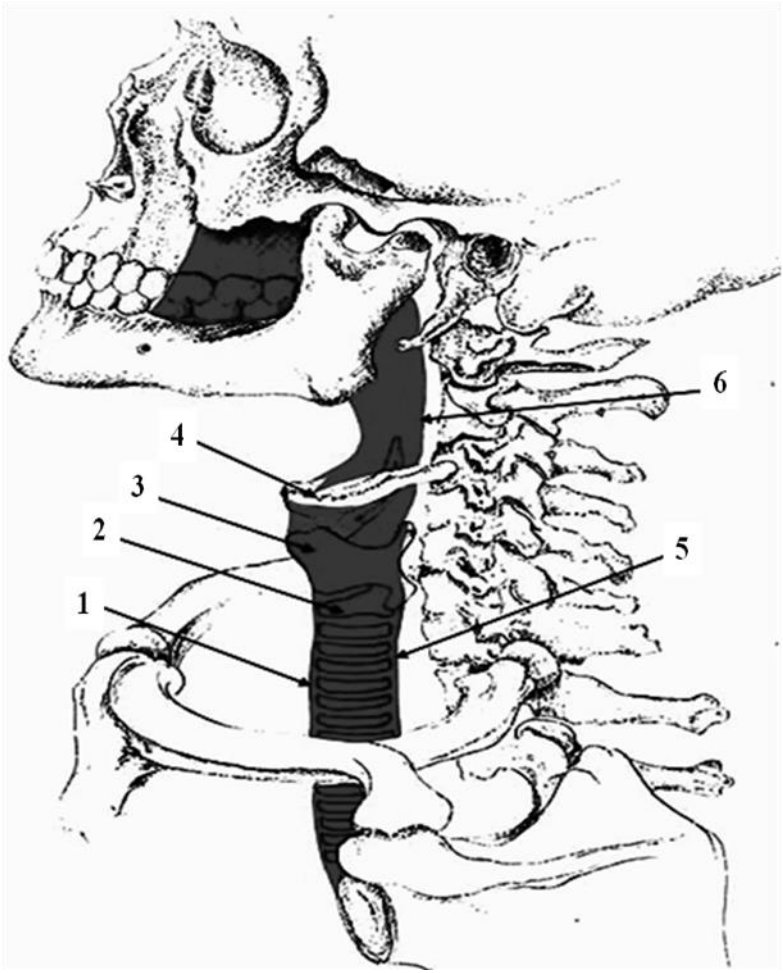


Graphical and dimensional representation of topography of deep lamina of own cervical fascia.

IV. Endocervical fascia (fasciae endocervicalis) consists of:

- Visceral lamina – surrounding the cervical organs (larynx, pharynx, thyroid gland, trachea and esophagus);
- Parietal lamina – that covers inside surface of neck's "cavity", forming a sheath for medial cervical neurovascular package, consisting of common carotid artery (a. carotis communis), internal jugular vein (v. jugularis interna) and vagus nerve (vagus n.). Inside of sheath, septa of connective tissue separate each element from each other.

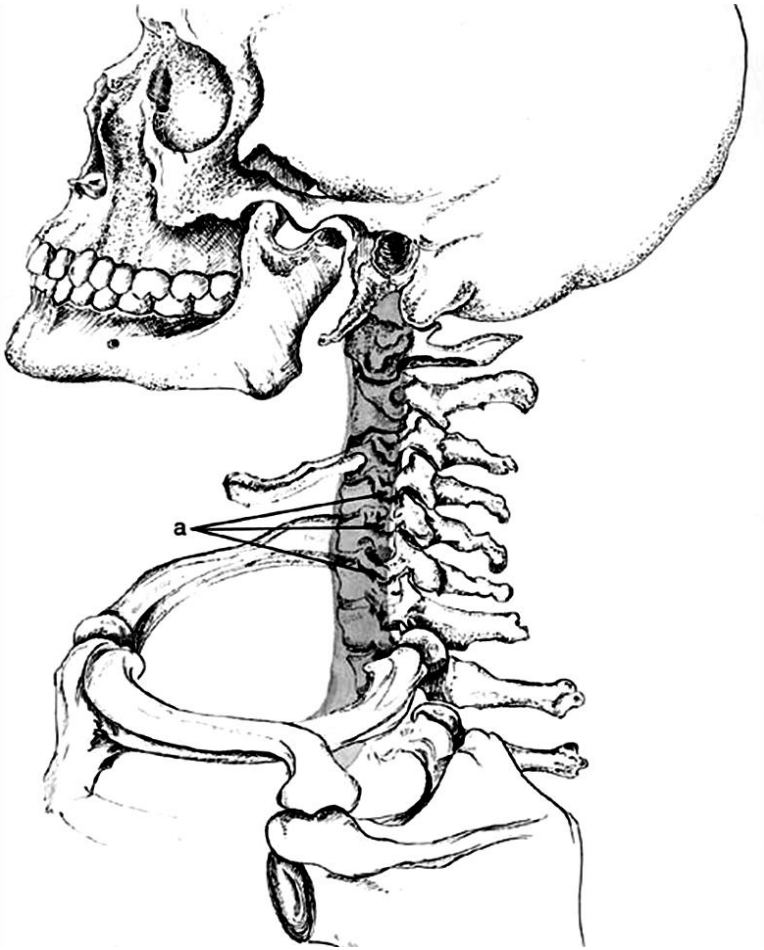
Parietal lamina retrosternally continues into visceral lamina, describing a curvature with convexity facing the distal direction, which is penetrated by several nervous and lymphatic elements. At this level previsceral cellular fat space communicates directly with the space from anterior mediastinum.



Dimensional and graphic representation of topography of endocervical fascia. It is well defined spatial positioning fascial cylinder, starting from the base of the skull and hyoid bone, descending into the mediastinum. 1 – the trachea; 2 – cricoid cartilage; 3 – thyroid cartilage; 4 – hyoid bone; 5 – retrofaringeal space; 6 – posterior mediastinum.

5. Prevertebral fascia (fasciae prevertebralis) covers the cervical sympathetic chain and form sheaths for long muscles of the head and neck, scalene muscles, subclavian vein (in the antescalen space), subclavian artery and the brachial plexus (localized in the interscalen space). Superior fascia begins at the occipital bone (tuberculum pharingeum) and lower down in posterior mediastinum, tapering up to 3-4 thoracic vertebrae. Phrenic nerve (*n. phrenicus*) passes in the thickness of prevertebral fascia, while cervical sympathetic ganglia (*ganglia cervicalia truncus simpaticus*) are located on the fascia V.

Superficial veins adventitia is fixed, in the cervical region, by cervical fascial tabs. This prevents their collapse during inspiration. The situation with negative pressure in the veins, and in case of injury in this region, this mechanism can cause the appearance of air embolism.



Dimensional and graphic representation of topography of prevertebral fascia. It is well defined spatial positioning of the fascia in frontal plane, anterior of cervical vertebral bodies, with the starting level of the base of the skull with the lower trajectory toward the chest cavity.

CELLULAR SPACES OF THE NECK

(Demarcation, extension, content)

1. Interaponevrotic suprasternal-supraclavicular space is located between the cervical fascia II and III, based on the clavicles and sternal manubrium. This space is lined with lax cellular tissue and extends higher up midway between the sternum and the hyoid bone. It has a triangular shape and extends to the posterior side of sternocleidomastoid m. These goes directly into the retrosternocleidomastoid check bag area (Gruber) located posterior to the sternocleidomastoid muscle. In this way the bag is closed at this level.

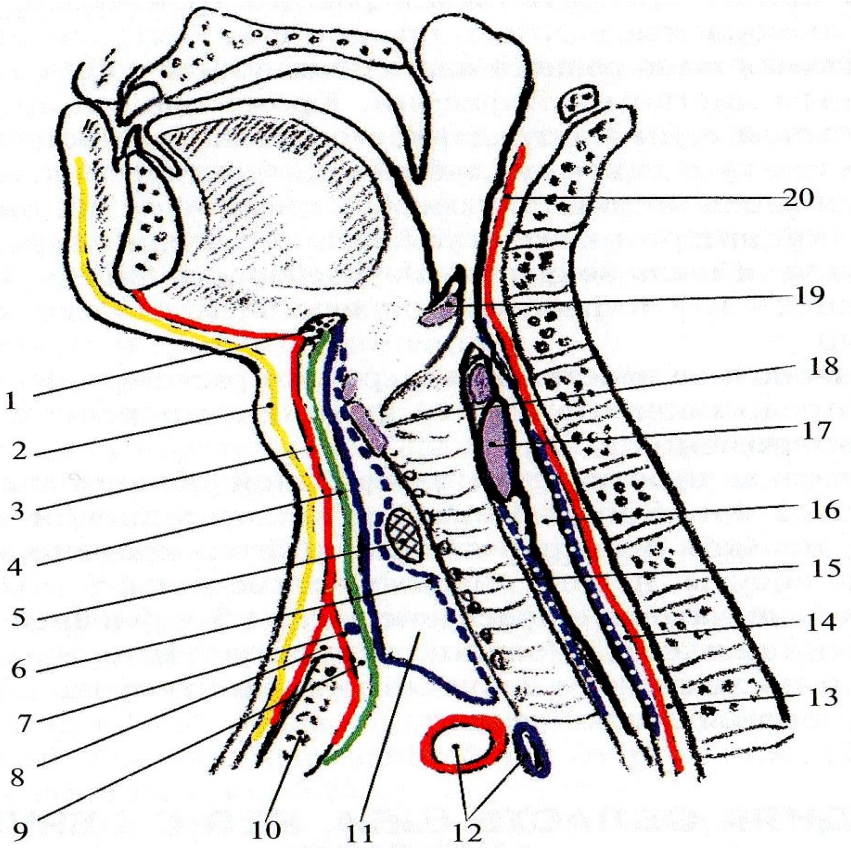
Contains: lymph nodes and jugular venous arch (which makes anastomosis between the veins from the left with the right side). In the presence of pus in this space (secondary to manumbrium sternal osteomyelitis) an inflammatory "collar" appears, limited in inferior by clavicle and sternum.

2. Previsceral space. It is located between the parietal and visceral lamina endocervical fascia. It extends from the hyoid bone to the jugular notch of the sternum. The portion corresponding to the trachea – **pretraheal space**.

Contains: pretraheal lymph nodes, impar thyroid venous plexus, upper pole of the thymus, inferior thyroid artery, brachiocephalic trunk (rare variant), sinister brachiocephalic vein (conditioning), recurrent laryngeal nn. (conditioning), thyroid ima a.. Last in 12% of cases originated from brachiocephalic trunk or the arch of the aorta and irrigates thyroid isthmus.

This space communicates directly with the anterior mediastinum, so in the presence of pus, it descends into the mediastinum, passing through a septum (perforated by many blood and lymphatic vessels), which is formed as a result of the passage of the parietal blade in the visceral one of endocervical fascia, at sternal manubrium.

In performing the tracheostomy, in the case where the diameter of the tracheostomic cannula is smaller than the diameter of the hole made in the trachea, air can cause both the anterior mediastinum and subcutaneous emphysema. This complication can be avoided by suturing the visceral blade of fascia endocervical to skin.



Schematic summary reprezentation of the cervical fascia and some of the cellular spaces of the neck in sagital section. 1 – hyoid bone; 2 – superficial fascia; 3 – superficial lamina of own cervical fascia; 4 – deep lamina of own cervical fascia; 5 – parietal lamina of endocervical fascia; 6 – visceral lamina of endocervical fascia; 7 – arch of jugular vein; 8 – interaponevrotic suprasternal space; 9 – suprasternal space; 10 – sternal manubrium; 11 – previsceral space; 12 – brachiocephalic a. and v.; 13 – prevertebral space; 14 – retrovisceral space; 15 – the trachea; 16 – the esophagus; 17 – cricoid cartilage; 18 – vocal chords; 19 – epiglottis; 20 – prevertebral fascia.

3. Retrovisceral space (retropharyngeal the top). It is located between endocervical fascia and prevertebral fascia.

Contains: Lymph and retrofaringean venous plexus. Superior extends in retrofaringean space (so to the base of the skull), and lower in

the posterior mediastinum. In the presence of infection in this space and retrofaringean or periesofagian phlegmons (resulting lesions of the esophagus by penetrating foreign body) pus can run down the posterior mediastinum.

4. Submandibular space (hiomandibular bag). This is well izolated space between laminas of the second fascia. But communicates in anterior direction, on the path of submandibular gland duct with the cell adipose tissue spaces of the floor of the mouth, and on the path of facial a. and v. with the sheath's space of medial neurovascular bundle of the neck.

Contains: submandibular salivary gland, lymph nodes (subfascial and in the thickness of the gland), facial vein and artery (*a., v. facialis*), being separated from one to another by the posterior lobe of the gland.

5. Neurovascular space (*spatium vasonervorum*). This space is formed by the parietal lamina of endocervical fascia.

Contains: carotid a., internal jugular v., vagus n., lymph nodes and extends higher up the base of the skull and enters in the distal direction in the anterior mediastinum.

6. Sternocleidomastoid space (*spatium sternocleidomastoideus*). It is limited by the sheath of sternocleidomastoid m. This space can be affected in case of purulent myositis or Bezold mastoiditis (secondary mastoiditis, the infectious processes in the middle ear with pus erupts in sheath of sternocleidomastoid m. or under the cervical muscles, which inserts the mastoid process).

7. Prevertebral space (or deep cervical). It is located between the cervical vertebrae and prevertebral fascia (5th neck vertebrae, lower reaches to III-rd thoracic vertebra.

Contains: long muscles of the head and neck, sympathetic trunk (or can be in the thickness of prevertebral fascia).

8. Antescalen space (*spatium antescalenum*). Bounded back – by anterior scalene m., anterior-medial – by sternohyoid and sternotyroid mm., anterior-lateral – by sternocleidomastoid m..

Contains: internal jugular vein bulb, subclavian v. and junction of these two veins – jugular venous angle (Pirogov), phrenic n., superficial and ascendent cervical aa., suprascapular and transverse cervical aa.,

terminal branches of thoracic duct (in the left) and right lymphatic duct (in the right).

Conventionally this space can be divided into two parts:

- The lower compartment of antescalen space − where the subclavian vein (*v. suclavia*) intersects horizontally anterior scalene muscle, joins with the internal jugular vein, forming jugular venous angle. In this venous angle flows also external jugular v., in the left − thoracic duct and in the right – right lymphatic duct;

- The upper compartment of antescalen space − contains several formations: the early portion of. the common carotid a. (*a. carotis communis*), vagus n., (*n. vagus*), internal jugular v. bulb (*bulbus v. jugularis interna*).

In this space, on the anterior surface of scalene anterior m. phrenic nerve descends vertically downward in/ or deeper than prevertebral fascia.

9. Interscalen space (spatium interscalenum) is located between the anterior and medial scalene muscles where following structures are located: the second segment of the subclavian artery and brachial neural plexus, surrounded by cellular tissue and prevertebral fascia, the latter forming a lodge (a sheath) for these formations. Subclavian artery lies in the angle formed by lateral edge of the anterior scalene muscle and I-st rib.

10. Scalenotraheovertebral triangle (*trigonum scalenovertebrale*) is shaped like a triangular prism with the base to the dome of the pleura, and the top to the transversal process of the VI-th cervical vertebra. Space is limited by the anterior scalene muscle, the dome of the pleura and longus coli muscle.

Contains:

- jugular venous angle (Pirogov) in the right, the internal jugular v. and the incipient portion of brachiocephalic v. in the left;
- common carotid a.;
- vagus n., phrenic n. and recurrent laryngeal n.
- the antescalen portion of the subclavian artery and its ramifications - vertebral a., tireocervical trunk, internal thoracic a..

Tireocervical trunk gives: superior thyroid a., ascending cervical a., superficial cervical a. and transverse scapular a.;

- lymph nodes, middle, intermediate and inferior sympathetic ganglia;
- end portion of the thoracic duct (from left) and right lymphatic duct (from right).

11. Superficial space of the lateral triangle of the neck. Located between cervical the second and the third fascia of the neck.

Contains: lymph nodes, cervical superficial a., suprascapular a., accessor n.. On the path of suprascapular artery this space communicates with the cellular adipose tissue spaces of the scapular region.

12. Deep space of the lateral triangle of the neck. Located deeper than prevertebral fascia.

Contains: lateral cervical neurovascular bundle (subclavian a. and n., brachial neural plexus), cervical transversal a., lymph nodes. This space communicates on the path of vessels and nerves with axillary cavity.

13. Parapharyngeal space. This space extends from the skull base, lateral of the pharynx and has two compartments separated by stilofaringian fascia:

Anterior parapharyngeal compartment is accompanied by:

- Parapharyngeal lobe of the parotid gland - laterally.
- palatine tonsil - medially.

Posterior parapharyngeal compartment contains:

- internal carotid artery.
- internal jugular vein.
- nerves - vagus, glossopharyngeal, accessor.
- lymph nodes.

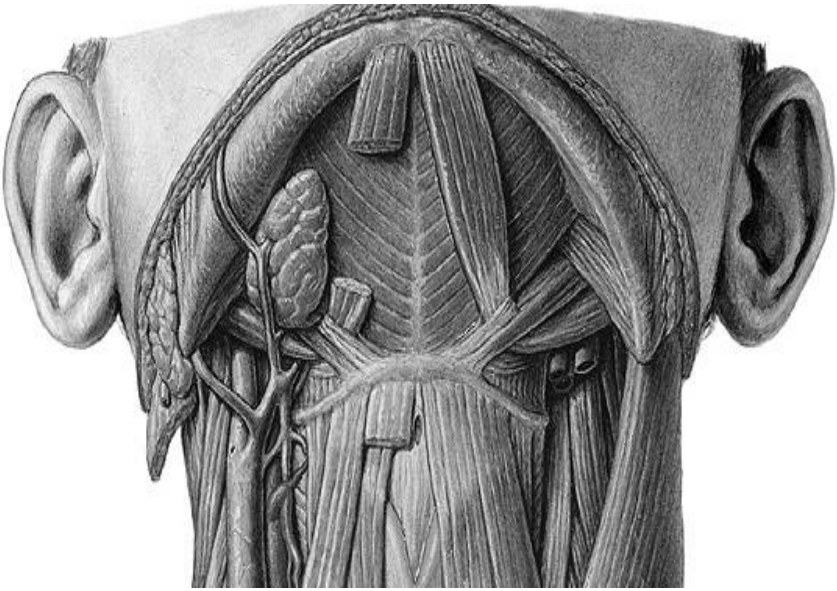
SUPRAHIOIDIAN REGION

Suprahioidian compartment has following limits:

- superior – line drawn by the lower jaw to mastoid process;
- inferior – line through the body of the hyoid bone and it's large horns;
- lateral – the front edges of the sternocleidomastoid muscles.

The suprahioidian compartment includes three smaller regions:

- submental – odd;
- submandibular – pear.



Suprahyoid region's topography (surface layers). 1 – stilohyoid m.; 2 – anterior and posterior bellies of the digastric m.; 3 – external jugular v.; 4 – external and internal carotid aa.; 5 – sternocleidomastoid m.; 6 – milohyoid m.; 7 – submandibular gland; 8 – parotid gland; 9 – pretraheal mm.

Submental triangle

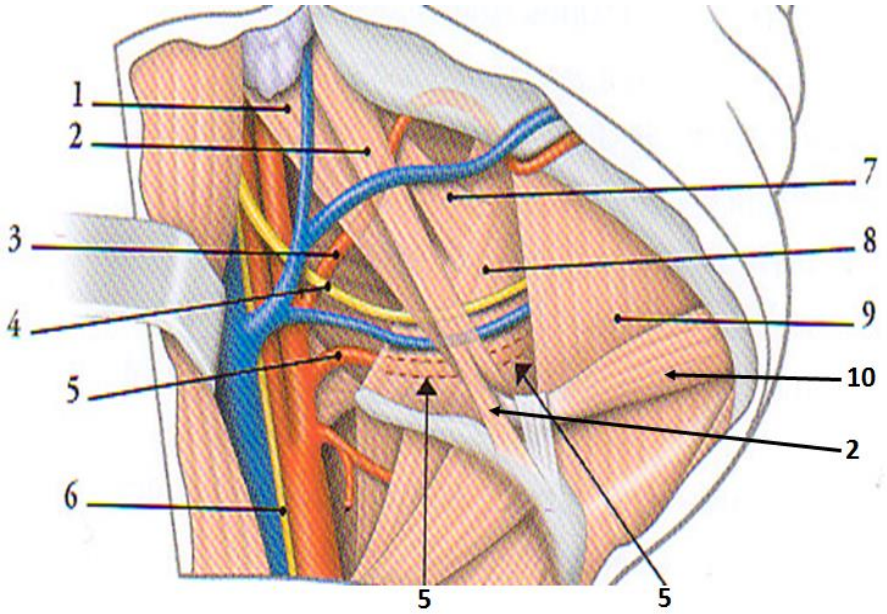
In submental triangle of the neck, under fascia, few lymph nodes are located. Muscles, situated deeper than fascia are arranged in several layers:

- anterior bellies of digastric mm.;
- milohyoid m.;

- geniohyoid m.;
- geniogloss m.;
- the last layer is the mucosa of the oral cavity vestibule.

Submandibular triangle

Submandibular triangle is bounded by the lower jaw and anterior and posterior bellies of digastric muscle.



Topography of submandibular triangle. 1 – posterior belly of digastric m.; 2 – stilohyoid m.; 3 – facial a.; 4 – hypoglossal n.; 5 – lingual a.; 6 – vagus n; 7 – geniohyoid m.; 8 – hyoglosus m.; 9 – milohyoid m.; 10 – anterior belly of digastric muscle.

Layers:

1. The skin, mostly covered with hairs in men and is well intergrow with platisma m.;

2. Subcutaneous adipose tissue, is well developed in children and obese people;

3. Superficial fascia with platisma muscle. Between the deep wall of the sheath of platisma m. and the second fascia, alongside the lower edge of the mandible pass: the marginal mandibular branch and cervical branch innervating platisma m. as branches of the facial nerve. Also cutaneus coli

n. passes and penetrates platisma m. and finally it is situated in the subcutaneous layer.

4. Fascia II (lamina superficialis fasciae colli propriae) forms sheath for submandibular gland and at the border of the mandible angle and the front edge of sternocleidomastoidian m. thickens, bounding a capsule of submandibular gland from a capsule of parotid gland. Superficial lamina of submandibular gland's sheath, covering the outer surface of the gland, inserts of the lower margin of the jaw, while the deep lamina covers the inner surface of the gland is inserted to milohioid line of the jaw, located above. Thus upper outer surface of the gland is in direct contact with the internal surface of the mandible (fovea submaxillaris). In this way bone's purulent destructive processes, with odontogenic origin, can affect submandibular gland. Lower capsule is fixed at the hyoid bone. Fascia surrounds gland freely, without sending septa in depth of the gland. Between submandibular gland and it's capsule is a layer of cellular tissue. The capsule is well isolated, especially near where the blades are fixed with hyoid bone, just in anterior direction, through the crack, between the hyoglos and milohyoid muscles on submandibular gland secretory duct path, this space communicates with floor's adipose cell tissue space of the oral cavity. Also here is situated the lymph nodes, which may also be in the depth of the gland. The lower lip cancer metastasis may affect these nodes, in this case is indicated not only the removal of the submandibular lymph nodes, but also of the submandibular gland, if necessary even bilaterally.

5. Submandibular gland has two extensions, one in the posterior, which lies under the angle of the jaw and another in anterior, which can enter the same intermuscular fissure with its excretory duct.

6. The posterior lobe of the submandibular gland separates facial artery by vein (*a. et v. facialis*), so vein is more superficially but artery is deeper (on inner surface of gland). On the path of these two anatomical elements, relatively closed space, the lodge of submandibular gland can communicate with the sheath's space of medial neurovascular bundle of the neck.

7. Submandibular gland duct passing between milohioid mm.and hioglos m. enters into correlation with other important anatomical structures. More superior in that cracks lingual n. (*n. lingualis*) penetrates and lower hypoglossal n. and lingual vein (*n. hipoglossus, v. lingualis*).

8. The floor of submandibular triangle consists of milohyoid m., hyoglos m., digastric m. and stilohyoid m.. Between milohyoid m. and hyoglos m. following structures pass: submandibular gland duct, hypoglossal n., lingual v. and lingual n..

The right and left milohyoid are joined on the anterior median line, thereby forming a suture (raphe) it is quadrangular and form the mouth diaphragm.

Lingual artery is located deeper than hyogloss m. into Pirogov's triangle, which is bordered: in superior by – hypoglossal n., in inferior - by tendineal centre of digastric m., in anterior – by free edge of milohyoid m., and hyoglos m. constitutes the floor of this triangle. In case of severe trauma, accompanied by lingual injuries (breaking or tearing tongue), is indicated artery ligation in limits of Pirogov triangle or at its origin from the external carotid artery (*a. carotis externa*). Given the fact that the right and left lingual artery are connected by a plurality of anastomoses, in addition to this, in the vascularization of the tongue participate and other sources. Unilateral ligation of lingual artery may be insufficient for an adequate hemostasis. Currently, sometimes proceeds from the external carotid artery ligation.

In the top of the submandibular triangle, on external surface of hyoglos m. lingual n. passes (*n. lingualis*), which then enters in the fissure between milohyoid m. and hyoglos m., then between hyoglos m. and genioglos m.. This nerve participates in innervation of the mucosa of the mouth and tongue.

Infrahioidian compartement

Limits:

Superior – a horizontal line passing through hyoid bone and its large horns.

Inferior – notch of the sternum, clavicles.

Lateral – the front edges of the sternocleidomastoid muscle.

Carotid triangle

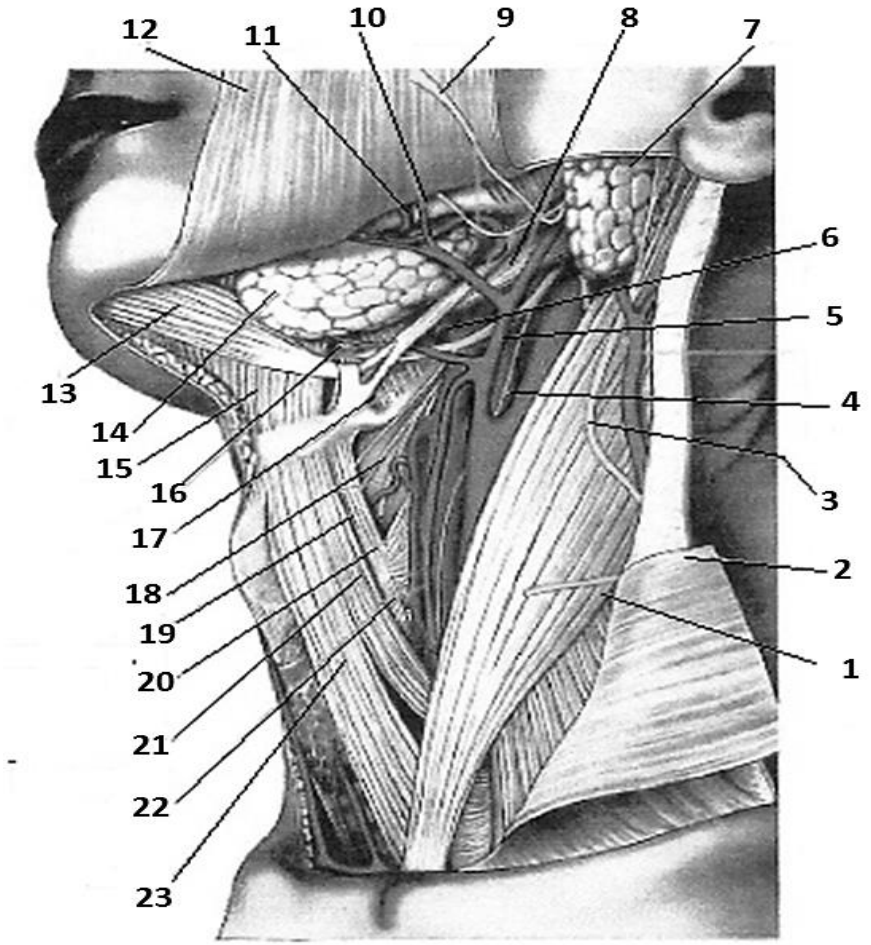
It is bordered by posterior belly of digastric muscle, superior belly of omohyoid m. and anterior edge of sternocleidomastoid muscle.

Layers:

1. The skin;
2. Subcutaneous fat tissue;
3. Superficial fascia with platysma m.

Cervical branch of the facial nerve, the transverse cervical nerve from neck's plexus and anterior jugular vein pass under superficial fascia.

4. Superficial lamina of own neck fascia.



Topography of the carotid triangle. 1 – sternocleidomastoid m.; 2, 12 – superficial cervical fascia with platisma m.; 3 – great auricular n.; 4 – the upper branch of the cervical loop; 5 – facial vein; 6 – facial artery; 7 – parotid gland; 8 – posterior belly of digastric m.; 9 – marginal mandibular branch of facial n.; 10 – facial vein; 11 – facial artery; 13 – anterior belly of digastric m.; 14 – submandibular gland; 15 – milohyoid m.; 16 – lingual vein; 17 – hyoglos m.; 18 – internal laryngeal nerve; 19 – tireohyoid m.; 20 – external laryngeal nerve; 21 – superior belly of omohyoid m; 22 – superior thyroid artery; 23 – sternohyoid muscle.

5. Parietal lamina of endocervical fascia, that forms a sheath for the main medial neurovascular bundle of the neck consisting of: common

carotid artery located medially, internal jugular vein located laterally, and vagus nerve posterior and between them.

Projection line of the common carotid artery – bisector of angle between sternocleidomastoid muscle and omohyoid muscle. Cervical loop is located on the sheath of neurovascular bundle of the neck, formed of two roots: top (from hypoglossal nerve) and lower (from the cervical plexus). Cervical loop gives branches to the pretraheal group of muscles situated below the hyoid bone.

Hypoglossal nerve (*n. hipoglossi*), situated lower than posterior belly of digastric muscle, has a trajectory as a curve with convexity distal oriented, intersects internal and external carotid arteries and their branches, being superficial and passes in submandibular triangle between digastric m. and stilohyoid m.

At the upper edge of the thyroid cartilage common carotid artery is divided into: external and internal carotid arteries (*a. carotis interna et externa*).

Hallmarks between internal and external carotid arteries:

a. the external carotid artery is located medially and more anterior than internal carotid artery, which is located more laterally and posterior;
b. the internal carotid artery in the cervical region does not give the branches but internal carotid artery gives;
c. the initial portion of internal carotid artery is dilated (sinus caroticus).
d. the application of hemostatic forceps on the external carotid artery the pulse disappears on facial and superficial temporal arteries (sign subjective / objective / true / authentic).

External carotid artery branches:

From its anterior part start:

- superior thyroid artery (*a. thiroideae superior*), from which the superior laryngeal artery starts;
- lingual artery (*a. lingualis*) passes between medial constrictor of the larynx muscle and hyoglos muscle and penetrates in the thickness of the tongue;

- facial artery (*a. facialis*), bypassing the posterior belly of digastric muscle penetrates in submandibular triangle and it is placed on the floor, surrounding the lower jaw and extends to the face.

From the posterior surface of the external carotid artery start:

- ascending pharyngeal artery;
- posterior auricular arteries and stilomastoid branches;
- occipital artery;
- branches to sternocleidomastoid muscle.

Slightly higher than place of emergence of the superior thyroid a. from external carotid a., the last is intersected by the facial vein. Frequently, upper, lingual and thyroid veins are joined by a big number of interconnection veins, forming a venous plexus, which covers the initial part of external carotid a. in limits of superior angle of the carotid triangle.

Deeper external and internal carotid arteries superior laryngeal nerve (*n. laringeus superior*) (from vagus n) passes obliquely. It divides deeper than these vessels in the external branch (for pharyngeal constrictor inferior m.) and internal branch, which extends in anterior direction. Internal branch along with superior laryngeal artery (superior thyroid artery branch) penetrates the thyrohyoid membrane a little bit inferior to large horns and distributes in the mucosa of the larynx. External branch from, laryngeal superior nerve, with another branch of vagus n. form depressant heart nerve (*n. depressor cordis*, Tion's nerve), which together with the heart branches from vagus n., being on the lateral wall of the trachea, making connections with cervical sympathetic trunk branches, participate in forming cardiac nervous plexus.

Reflexogen carotid area is located at the bifurcation of the common carotid artery. Structurally it consists of several parts, which plays a large role in regulating the cardiovascular system activity:

- carotid glomus *(glomus caroticus*) - neural ganglion riches in chemoreceptors;
- carotid sinus (*sinus caroticus*) - a slight expansion of the initial portion of the internal carotid artery, are located where the artery intima contains baroreceptors,
- branches from glossopharyngeal n., vagus n. and sympathetic trunks.

Excitation of this area causes a drop in blood pressure.

Sympathetic trunk locates in thickness of prevertebrale fascia deeper than medial neurovascular bundle of the neck and is located mainly on the long muscles of the head and neck.

Superior cervical ganglion of the sympathetic trunk is located on the prevertebral fascia, medial to the vagus nerve at the level of spinous and transverse processes of the cervical vertebrae II-III. It gives carotid nerve branches, which together with internal carotid artery enters into the cranial cavity.

Medial cervical ganglion is located at the level of cervical vertebra VI.

Intermediate cervical ganglion – level VII cervical vertebra and is located on the anterior surface of vertebral artery. From these ganglia most branches to the heart start, which in its path communicate with nervous branches from vagus nerve.

Lower cervical ganglion usually it unites with the first thoracic ganglion, forming the stellate ganglion. This ganglion is located on the long neck muscle, in scalenovertebral triangle. Scheletotopic it is at the level of the spinous and transverse processes of the VII-th cervical vertebrae and the head of the first rib.

Sympathetic cervical ganglions are connected with cervical nerves by interconnecting branches. From each node emerge branches to the heart and cervical organs.

Omotraheal triangle region

It is bounded by omohioid and sternocleidomastoid muscles and anterior cervical midline.

Layers:

1. skin.
2. subcutaneous adipose tissue.
3. superficial fascia with platisma muscle.
4. Superficial lamina of own fascia of the neck, which accrete with omoclavicular fascia and form on cervical midline the white line of the neck.
5. Omoclavicular fascia makes sheaths for sternohyoid, sternothyroid, thyrohyoid, omohyoid muscles.

Deeper than layers what were listed are vital cervical organs.

Larynx

Superoanterior limit is the radix of the tongue that rises in epiglottis.

Posterior limit – the apex of arytenoid cartilage.
Lateral limits – arytenoepiglotic plicae.

All these parties delimit – entrance to the larynx (*aditus laringis*).

The lower limit is the cricoid cartilage, which can be palpated at the cervical vertebra VI. Between cricoid cartilage and thyroid cartilage is the cricothyroid membrane (*lig. conicum*), where conicotomy is performed, and between thyroid cartilage and hyoid bone – thyrohyoid membrane.

Sintopy – in anterior is the pretraheal group of muscles, laterally are lobes of thyroid gland.

Cartilaginous skeleton of the larynx is dressed by muscles and make possible cartilages mobility, adapting them to different physiological needs. They are: cricothyroid m., posterior and lateral cricoarytenoid mm., transverse and oblique arytenoid mm., thyroarytenoid m., thyroepiglotic m., aryepiglotic m..

Larynx cavity

1. laryngeal vestibule: from the epiglottis to the vestibular fold.
2. interventricular region: between vestibular fold and fold between vocal chords.
3. infraglotic cavity.

Vestibular folds delimiting rhyme vestibules, voice ligaments below them – rhyme glotidis between them are larynx ventricules.

Innervation of the larynx is ensured by the vagus nerve innervating the airway below the epiglottis. From this nerve start:

- superior laryngeal nerve, with its two branches: external – motor and internal - sensory, innervating segment from the epiglottis to the vocal cords;
- recurrent laryngeal nerve a (branch of the vagus nerve) - innervates the lower part of the vocal cords and trachea through inferior laryngeal nerve as a terminal branch. All laryngeal muscles are innervated by the recurrent laryngeal nerve, except cricothyroid muscle – is innervated by the superior laryngeal nerve (external branch).

Bilateral superior laryngeal nerve paralysis diminishes a phonation easyly, but respiratory act is not disturbed. In acute conditions or situations, when superior laryngeal nerve is intact, bilateral recurrent laryngeal nerve paralysis leads to respiratory act disturbance because the cricothyroid muscle, that is innervated by the superior laryngeal nerve is under tension and antagonist muscles are paralyzed. In chronic conditions with recurrent laryngeal nerve paralysis, respiratory disorders rarely meet, because they include compensatory mechanisms.

The pharynx

The pharynx extends from the base of the skull to the cervical vertebrae VI. Lateral to nazo- and bucopharinx is parapharyngeal space (described above). Long muscles of the neck and cervical vertebrae, covered by prevertebral fascia, are posteriorly to the laryngeal part of the pharynx. Posterior pharyngeal wall is covered by a visceral lamina of endocervical fascia and is separated from the prevertebral fascia by retropharyngeal space, which is separated by a connective tissue membrane in the right and left compartments. The larynx is anteriorly, laterally – upper lobes of the thyroid gland and the common carotid aa..

Vascularization:

- Branches of ascending pharyngeal aa.;
- Ascendent palatine a.;
- Descendent palatine a.;
- Superior and inferior thyroid aa..
- Innervation:
- Branches of the vagus n.;
- Glossopharyngeal n.;
- Sympathetic trunks.

Esophagus

The esophagus has a length of about 25 cm and three narrowings on its path: the cervical, thoracic and abdominal.

- The first narrowing (physiological stricture) is in the initial portion of the esophagus;
- Second narrowing – at the level of the bifurcation of the trachea;
- Third narrowing – at the level of crossing by the diaphragm.

Scheletotopic beginning of the esophagus corresponds to VII-th cervical vertebra, the cervical portion length is 4-5 cm. Cricoid cartilage, and trachea are anteriorly. Cervical esophagus deviates to the left of the midline. Between esophagus and the trachea is formed a tracheoesophageal groove, where is located – left recurrent laringeal n.. Right nerve is located posteriorly to the trachea, adhering to the outside of the esophagus. Retroesophagian space is limited by fascia IV and V, and it extends higher in retropharyngeal space and lower – in the lax cellular space of the posterior mediastinum.

Vascularization is assured by esophageal branches from inferior thyroid artery. Innervation - the recurrent laryngeal nerve and sympathetic trunk branches.

Thyroid

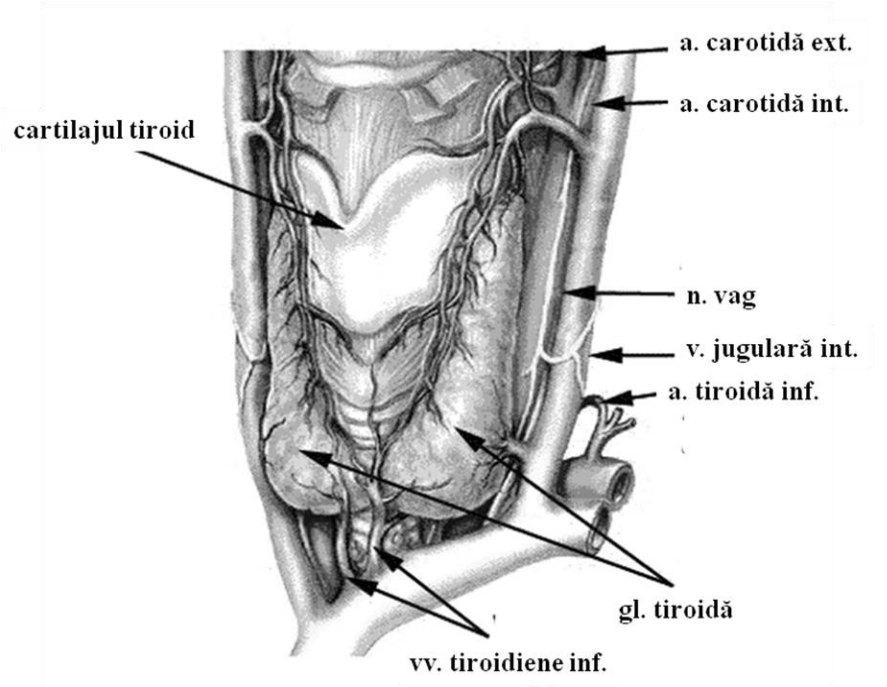
It is composed of two lobes and isthmus and its capsule is originating from the visceral lamina of endocervical fascia. This capsule gives some connective tissue septa that divide the gland into lobules. Parathyroid glands are outside of thyroid gland capsule. Endocervical fascia at this level gives some thicker fibers, which have properties as a ligament and pass from the gland to other organs (median and lateral ligaments). Thyroid gland isthmus is located above the trachea (corresponds to the tracheal rings 2-4). The sides adhere to the trachea, larynx, pharynx, esophagus and cover a medial circumference of the common carotid aa. Recurrent laryngeal n. adhere to gland in the posterior. From the anterior thyroid gland is covered by sternohyoid, sternothyroid and omohyoid mm.

Vascularization: superior and inferior thyroid aa. and rarely – *a. thyreoidea ima*. Thyroid arteries form two systems: intraorganic (from the account of thyroid arteries) and extraorganic (from the account of arteries of neighboring organs). The veins form plexus on the isthmus and laterally.

Innervation: branches from sympathetic trunks and laryngeal nerves.

Parathyroid glands

Even formations (two upper and two lower), located on the posterior surface of the thyroid lobes between the capsule and endocervical fascia



Thyroid gland topography. Anterior vew.

Sternocleidomastoidian region

Sternocleidomastoid region corresponds with sternocleidomastoid muscle which reaches superiorly mastoid process and inferiorly – jugular notch and collarbones.

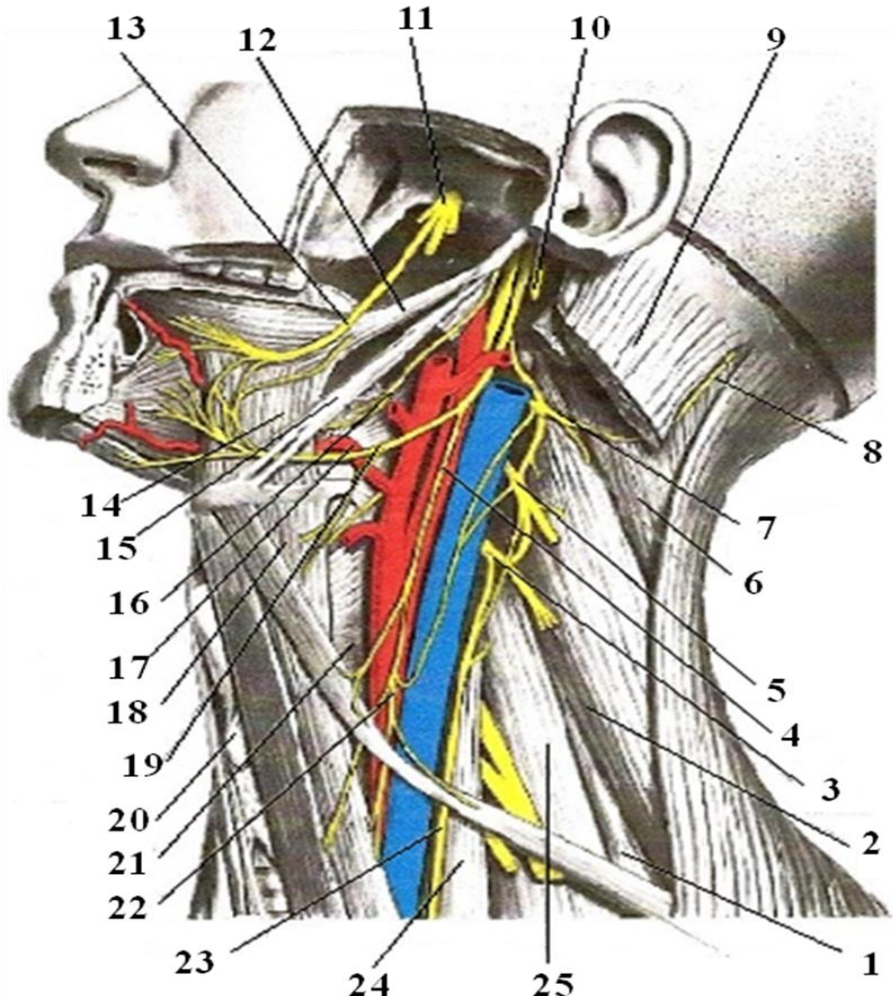
Stratigraphy:

1. skin;
2. subcutaneous adipose tissue;
3. superficial fascia, which forms a sheath for platisma muscle.

Between fascia I (superficial) and II (own) are arranged external jugular vein, superficial lymph nodes, cutaneous nerves of cervical plexus (large auricular n., transversal neck n., small occipital n., supraclavicular nn.).

External jugular vein projection: a line connecting angle of the jaw with the angle between the back edge of the sternocleidomastoid muscle and the clavicle. External jugular vein, in the lower third of the neck, penetrates the second and the third fascia of the neck and flows into the

subclavian vein. External jugular vein (*v. jugularis externa*) is formed from two roots: the posterior auricular vein and retromandibular vein.



Topography of the sternocleidomastoid region. 1 – scalene posterior m.; 2 – levator scapulae m.; 3 – the IV-th cervical ventral branch; 4 – the upper branch of the cervical loop; 5 – the III-rd cervical ventral branch; 6 – splenius capitis m.; 7 – the II-nd cervical ventral branch; 8 – occipital small n.; 9 – sternocleidomastoid m.; 10 – accessor n.; 11 – mandibular n; 12 – digastric m.; 13 – lingual n.; 14 – hyoglos m.; 15 – stilohyoid m.; 16 – glossopharyngeal n.; 17 – lingual a.; 18 – thyrohyoid m.; 19 – hypoglossal n.; 20 – cricoid cartilage; 21 – constrictor inferior m; 22 - cervical loop; 23 – phrenic n.; 24 – scalene anterior m.; 25 – medial scalene m.

Superficial nerves listed above become superficial in the middle of the posterior edge of sternocleidomastoid m., then branch off in different directions.

4. Superficial lamina of own fascia of the neck forms a sheath for sternocleidomastoid m., which has its origins in two feet from the sternum and clavicle and secured to the mastoid process. This muscle is innervated by branches from accessor n., passing 1.5 cm above the exit place of the superficial branches of cervical plexus, which is under the second fascia II, in a adipose tissue cell space, on the levator scapula m., passing towards *m. trapezius*.

5. Omoclavicular fascia is present only in the lower third, it extends laterally up to omohyoid m..

Under sternocleidomastoid muscle, mainly cervical neurovascular bundle lies in its fascial sheath, made by parietal lamina of endocervical fascia, which in anterior accrete to own and omoclavicular fascias and in the posterior with prevertebral fascia.

Common carotid artery is on prevertebral fascia, corresponding with spinous and transverse processes of the cervical vertebrae tubers and prevertebral mm.. The most prominent is the tuber of the VI-th transversal process (*tuberculum caroticum*), corresponding to the mid edge of the sternocleidomastoid m. or cricoid cartilage. In case of lesion of the artery or its branches above this place, the common carotid artery can be compressed digitally to this tuber to obtain temporary hemostasis, sliding your fingers between the neck's organs and the anterior edge of the sternocleidomastoid m.

6. **Prevertebral fascia**. Under prevertebral fascia long muscles of the head and neck are located medially and anterior and medial scalene muscles laterally. Also here, is the cervical plexus and sympathetic trunk.

Cervical plexus is made by anterior branches from first four cervical nerves. This plex gives two types of branches:

- muscular branches – participating in the formation of deep cervical plexus;
- cutneous branches – forming superficial cervical plexus.

The deep branches are motor branches. Phrenic nerve consists of fibers from C3, C4 and C5. He descends on the anterior surface of the

scalene muscle, then it descends down in the anterior mediastinum crossing diaphragm with its phrenicoabdominal branches.

Cutaneous branches are sensitive and are divided into two groups:

- the first group formed three nerves:
  - ✓ small occipital n.;
  - ✓ great auricular n.;
  - ✓ transversal coli n..
- the second group consists of three groups of branches:
  - ✓ suprasternal nn;
  - ✓ supraclavicular nn;
  - ✓ supraacromial nn *(nn. supraclavculares mediales, intermedii and laterales).*

Sympathetic trunk, after Ageenko, in the cervical region, consists of four nodes: superior, medium, intermediate and inferior. The superior and inferior nodes are permanent, while the intermediate and inferior in 1/3 cases may be missing.

Superior cervical ganglion is located on long head m. (*m. longus capitis*) on transversal processes of the cervical C2-C3.

Medium cervical ganglion is located on long m. of the neck and is close to the curvature described by superior thyroid a. Scheletotopic is located at the level of transversal process of C VI.

Intermediate cervical ganglion is located on the anterior or antero-medial surface of the vertebral a. at midway between its origin and the place where this artery enters into the channel formed by the spinous and transverse processes of the cervical vertebra (VII). Characteristic for this ganglion is that it generates two branches, which include subclavian artery and unite him with inferior ganglion, forming subclavian loop.

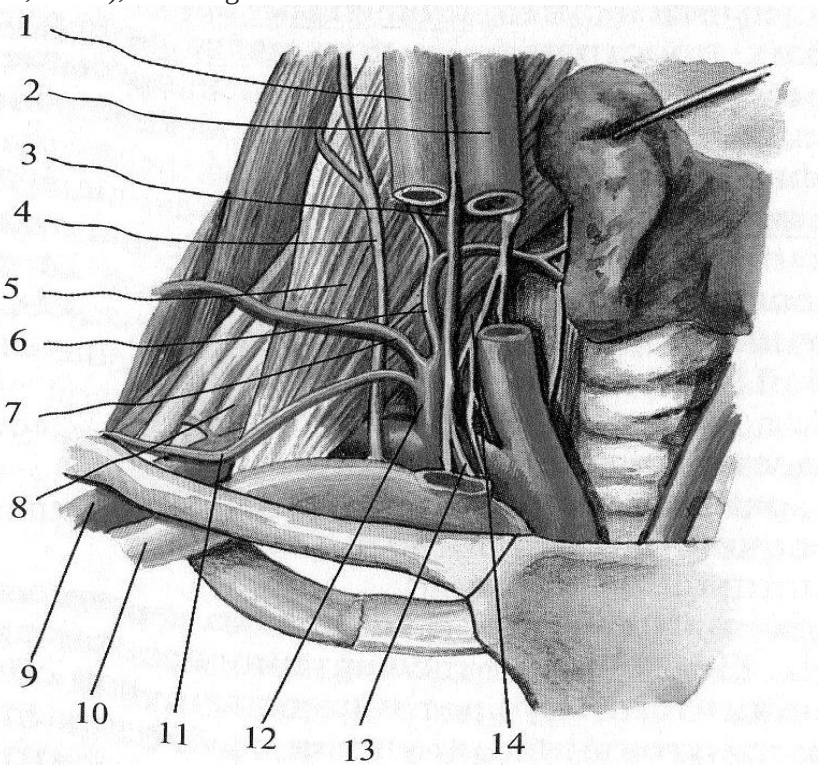
Lower cervical ganglion joins usually with the first thoracic ganglion, forming the stellate ganglion (*ganglion stellatum*). It is located in the scalenovertebral triangle, located on the vertebra C VII and head of the first rib, close to the origin place of the vertebral a. from subclavian a. With anterior-inferior surface comes into contact with the pleura dome. From pleura start up two fine ligament: ligg. pleurocostale et pleurovertebrale separating subclavian and vertebral arteries from this ganglion. On its posterior surface is in contact with the arterial costocervical trunk.

From each of these ganglion a lot of branches start to the cervical organs, to the heart and also communicating branches to vagus n.

The cervical sympathetic trunk participates in innervation of the smooth muscles of the eyeball (*m. dilator pupillae*), eyelids (*mm. tarsales*) and orbit (*m. orbitalis*). As a result of damage to the cervical sympathetic trunk (as a result of compression of tumor, trauma, cervical spine disorders) may occur following signs: miosis, blefarospazm and enophtalmia.

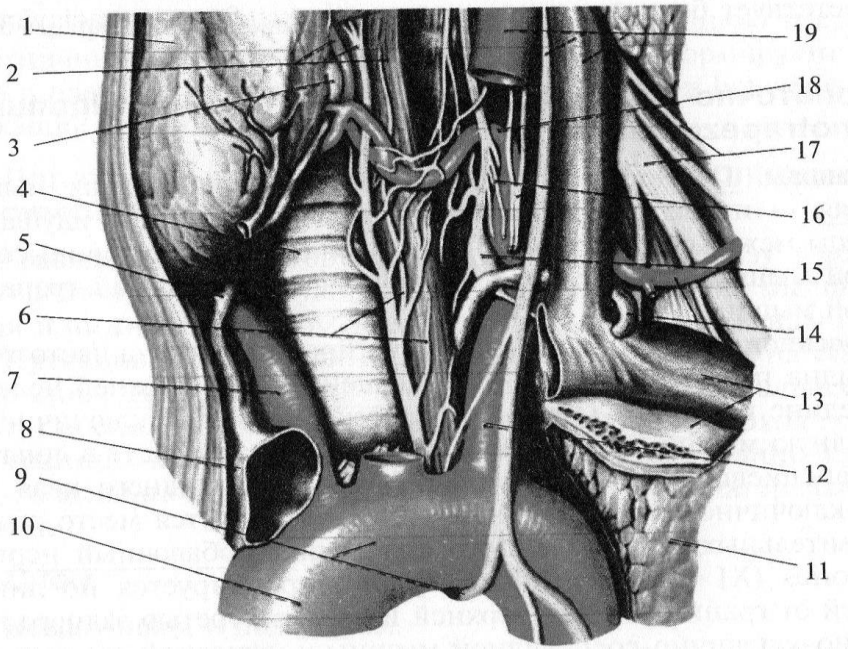
The same triad of symptoms may occur in the thoracic sympathetic trunk compression by aortic aneurysm or a mediastinal tumor.

Most cardiac branches are starting from medium and intermediate nodes. Cardiac sympathetic branches form a plurality of interconnections with cardiac branches of the vagus n, in result superficial and deep aorto-cardiac plexus appear. Along the medial edge of the common carotid artery and its sheath superior branch of deprersory cordis n. passes (*n. depressor cordis*, Tione), from vagus n.



Subclavian artery topography in the scalenovertebral triangle. 1 – internal jugular v.; 2 – the common carotid a.; 3 – vagus n.; 4 – phrenic n.;

5 – anterior scalene m.; 6 – superior thyroid a.; 7 – transverse cervical a.; 8 – brachial plexus; 9 – subclavicular a.; 10 – subclavian a.; 11 – suprascapular a.; 12 – thyreocervical trunk; 13 – recurrent laryngeal n.; 14 – vertebral a.



Topography of the thoracic duct. 1 – thyroid gland (left lobe); 2 – inferior laryngeal a., recurrent laryngeal n. and esophagus; 3 – lower left parotid gland; 4 – trachea; 5 – thyroid ima v.; 6 – esophageal branches of the recurrent laryngeal n.; 7 – the brachiocephalic trunk; 8 – brachiocephalic v.; 9 – aortic arch and left recurrent laryngeal n.; 10 – ascending aorta; 11 – the left lung; 12 – the left subclavian a.; 13 – subclavian v. and the first rib; 14 – thoracic duct; 15 – stellate ganglion; 16 – cervical cardiac nerve branches; 17 – neural brachial plexus; 18 – superior thyroid a.; 19 – the common carotid a., vagus n. and the internal jugular v.

Thoracic duct passes from posterior mediastinum on the left side of the neck between esophagus and the initial portion of subclavian a. At the level of VII-th cervical vertebra thoracic duct describes a curvature, which is located in the scalenovertebral triangle, and placed on the dome of the pleura, passing anterior to the subclavian artery, stellate ganglion, vertebral a. and v. Neurovascular package consists of the common carotid a., internal jugular v., vagus n. is located more anterior than the thoracic duct,

and phrenic n. stay more posterior. Terminal portion of the thoracic duct empties into the left venous angle – through one or more trunks.

The medial cervical ganglion (*ganglion cervical medium*) locates at the apex of the scalenovertebral triangle, and the inferior (*ganglion cervicothoracicum, stellatum*) is located at the level of origin of the vertebral artery from subclavian artery.

D. A. Zhdanov says that phrenic n. frequently passes posteriorly of curvature of thoracic duct. Therefore thoracic duct may be injured during interventions performed on left phrenic n., or vice versa during interventions performed on cervical thoracic duct can be injured phrenic n.

Lateral triangle of the neck

It has the following borders:

anteriorly – the back edge of sternocleidomastoid m;
posteriorly – the front edge of the trapezius m.;
inferior – collarbone.

Stratigraphy:

1. thin skin is thin and mobile;
2. subcutaneous adipose tissue;
3. Fascia I (superficial) - in the anterior-inferior part with platisma m. Between the first fascia (superficial) and the second (own) are located superficial structures (veins and nerves): external jugular vein, which descends on the posterior margin of sternocleidomastoid m, supraclavicular nn., oriented down to the collarbone. In the middle of posterior edge of sternocleidomastoid m. in the same layer, small occipital, large ear, transverse cervical nn. appear.
4. Fascia II (superficial lamina of own fascia) - is present within this triangle just as one slide.
5. Fascia III(omoclavicular fascia) – is present only within the omoclavicular triangle. – Deeper fascia III in this triangle is an area of lax cellular tissue, the supraclavicular lymph nodes are located, adhering to the fascia V (prevertebral). Deeper than fascia V is located lateral neurovascular bundle of the neck (suclavian a., subclavian v., plexus brahialis). Within the triangle omotrapezoid deeper fascia II (own) follows fascia V (prevertebrală). Between these two fascias also is an area of tissue cell lax, through which accessor n. (which comes under the posterior edge of sternocleidomastoid, slightly higher than mid of this muscle and curves downward and posterior under trapezius m.

Right subclavian artery originates from the brachiocephalic trunk and the left from the arch of the aorta. Acording to its topography subclavian artery is divided into three portions:

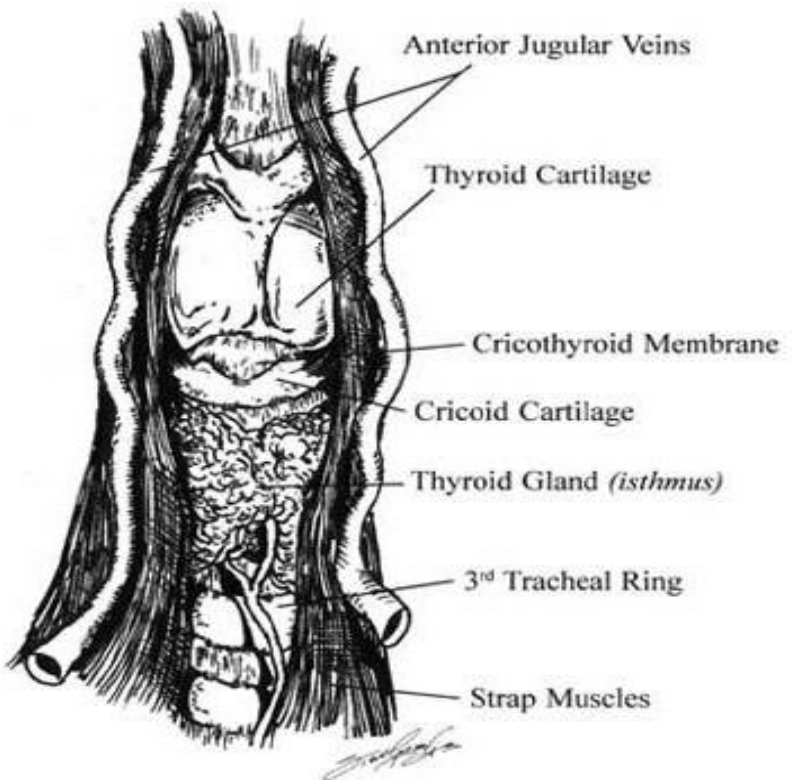
- *prescalenic portion* (within the scalenovertebral triangle), from it following branches start:
  - ✓ vertebral a.,
  - ✓ internal thoracic a.,
  - ✓ thyreocervical trunk;
- *scalene portion* corresponding with interscalen space. It gives:
  - ✓ costocervical trunk that branches in supreme intercostal artery and deep cervical artery. Subclavian artery, being in interscalen space, can be compressed by the first rib in case of temporary hemostasis
- *postscalenic portion* generating:
  - ✓ transverse artery of the neck.

Congenital malformation

Congenital torticollis, is a condition in which the chin is directed towards one of the shoulders, while the head is tilted toward the other shoulder. Congenital torticollis occurs when sternocleidomastoid m., responsible for neck extension, is shorter. Frequently, the head is tilted to the right, while his chin to the left, indicating that right sternocleidomastoid m. is affected and as a result, head mobility is reduced. It can also be present in the muscle knot. It is considered that muscle can be stretched or torn during birth, leading to scarring and shorten the muscle. Some cases of congenital torticollis is produced by damage to the upper cervical spine. Torticollis may appear later during life, but it will be an acquired torticollis. Congenital torticollis is treated by exercises designed to stretch the neck muscle. If the child's condition does not improve in 2-3 months is indicated a surgery for muscle elongation.

Tracheostomy

Tracheostomy is an operative procedure that creates a surgical airway in the cervical trachea. It is most often performed in patients who have had difficulty weaning off a ventilator, followed by those who have suffered trauma or a catastrophic neurologic insult. Infectious and neoplastic processes are less common in diseases that require a surgical airway.



Anterior anatomy of the larinx and trachea

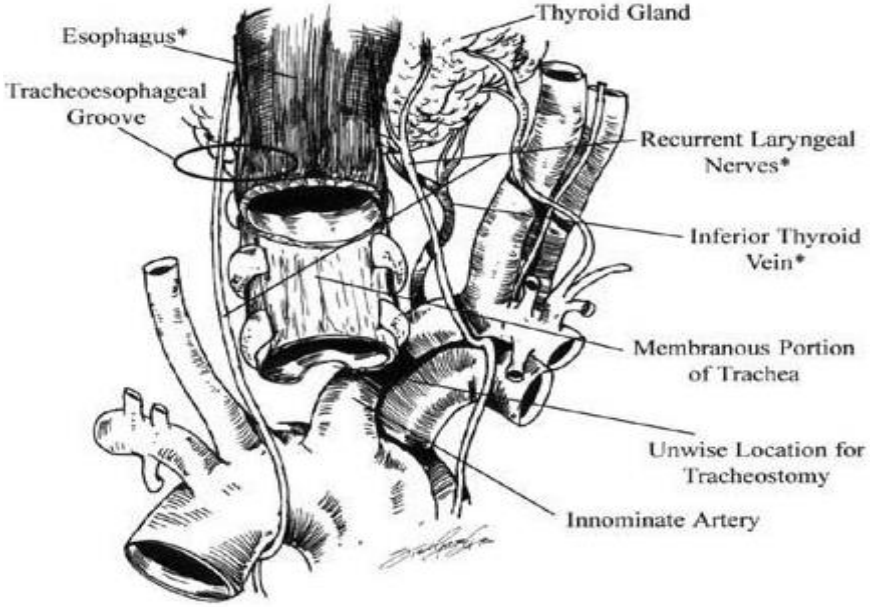
Indications

The advent of the antibiotic era and advances in anesthesia have made tracheostomy a commonly performed elective procedure. Important to note, however, is that there are situations when tracheostomy is quite urgent or emergent. This typically involves patient who is immediate need of a surgical airway because of impending airway obstruction.

General indications include the following:

- congenital anomaly (eg: laryngeal hypoplasia, vascular web)
- upper airway foreign body that cannot be dislodged with heimlich and basic cardiac life support maneuvers
- supraglottic or glottic pathologic condition (eg: infection, neoplasm, bilateral vocal cord paralysis)
- neck trauma that results in severe injury to the thyroid or cricoid cartilages, hyoid bone, or great vessels

- subcutaneous emphysema
- facial fractures that may lead to upper airway obstruction (eg, comminuted fractures of the mid face and mandible)
- upper airway edema from trauma, burns, infection, or anaphylaxis
- prophylaxis (as in preparation for extensive head and neck procedures and the convalescent period)
- severe sleep apnea not amendable to continuous positive airway pressure devices or other less invasive surgery



Posterior view of peritracheal structures

Contraindications

No absolute contraindications exist for tracheostomy. A strong relative contraindication to discrete surgical access to the airway is the anticipation that the blockage is a laryngeal carcinoma.

Types of Tracheostomy Tubes

A tracheostomy (trach) tube is a curved tube that is inserted into a tracheostomy stoma (the hole made in the neck and windpipe (Trachea)). There are different types of tracheostomy tubes that vary in certain features for different purposes. These are manufactured by different companies. However, a specific type of tracheostomy tube will be the same no matter which company manufactures them. A commonly used tracheostomy tube

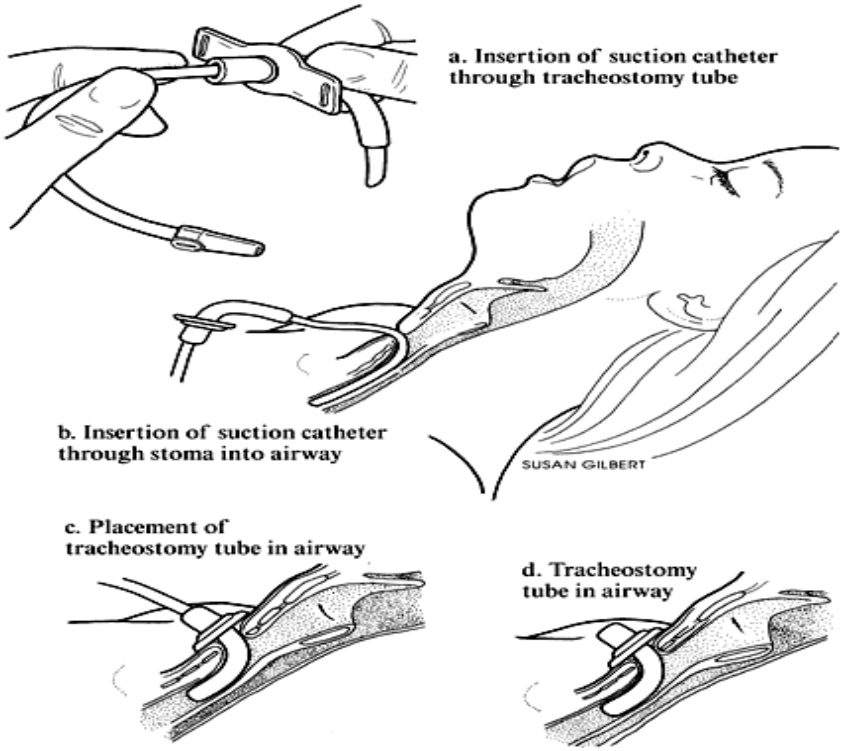
consists of three parts: outer cannula with flange (neck plate), inner cannula, and an obturator. The outer cannula is the outer tube that holds the tracheostomy open. A neck plate extends from the sides of the outer tube and has holes to attach cloth ties or velcro strap around the neck. The inner cannula fits inside the outer cannula. It has a lock to keep it from being coughed out, and it is removed for cleaning. The obturator is used to insert a tracheostomy tube. It fits inside the tube to provide a smooth surface that guides the tracheostomy tube when it is being inserted.

Tracheostomy tubes

Parts of the tracheostomic cannula

Surgical tracheostomy

- the patient is supine with head extension and under general anaesthesia.
- a 2 inched (5 cm)vertical midline incision on the skin is made, from the upper border of the cricoid cartilage to the sternal notch (heavy bleeding may occur due to the anastomosing veins located here in the superficial fascia).
- the incision of the deep fascia is continued in the midline opening the 2 sternohyoid muscles.
- then, the endocervical fascia is incised transversely under the cricoid cartilage to expose the rings of the trachea.
- divide the thyroid isthmus if needed.
- the trachea is then disected by a small incision placed between the 2nd and 3rd or 3rd and 4th., removing the anterior portion of tracheal ring.
- the pacient may cough violently due to entry of blood into the airway at this point.
- tracheostomy tube is inserted.



Tracheostomy tube plasement

Percutaneous tracheostomy

- percutaneous placement of a tracheostomy is performed using guide wires and dilators.
- guidewire is placed between the first and second tracheal ring.
- gradually, the hole size is increased using dilators of varying sizes which are passed over the guide wire.
- this can be performed blindly in experienced hands but often is aided by the use of a bronchoscope.

There are various other methods also available, both for surgical and for percutaneous dilatational tracheostomy.

Postoperative management:

- constant supervision;
- a well-ventilated warm room;
- for cuffed tube: to release regularly the inflated pressure to reduce the ischemic necrosis of the tracheal wall;
- for metal tube: to remove, clean, sterilize and replace the inner part as often as it becomes blocked;
- aspiration of the secretions by soft moist catheter;
- phisiotherapy.

Advantages:

- Reduction of the anatomical dead space by aproximately 50%;
- Reduction of the work of breathing;
- Increased level of alveolar ventilation;
- Decreased level of sedation needed;
- Patient's ability to talk and eat even if the tube is in place.

Disadvantages:

- Formation of thick mucus which is able to block the tube;
- Loss of ciliated cells causing the mucociliary stream to be arrested;
- Aspiration of secretions.

Complications:

Immediate

- Haemorrhage – eg, from thyroid isthmus.
- Hypoxia.
- Trauma to recurrent laryngeal nerve.

- Damage to the oesophagus.
- Pneumothorax.
- Infection.
- Subcutaneous emphysema.

Early

- Tube obstruction or displacement.
- False passage formation.
- Pooling of secretions, leading to aspiration and lower respiratory tract infection (LRTI).
- Aspiration.
- Bleeding from the tracheostomy site.
- Infection.

Late

- Airway obstruction with aspiration.
- Damage to larynx - eg, stenosis.
- Tracheal stenosis.
- Tracheomalacia.
- Aspiration and pneumonia.
- Fistula formation - eg, tracheo-cutaneous or tracheo-oesophageal.

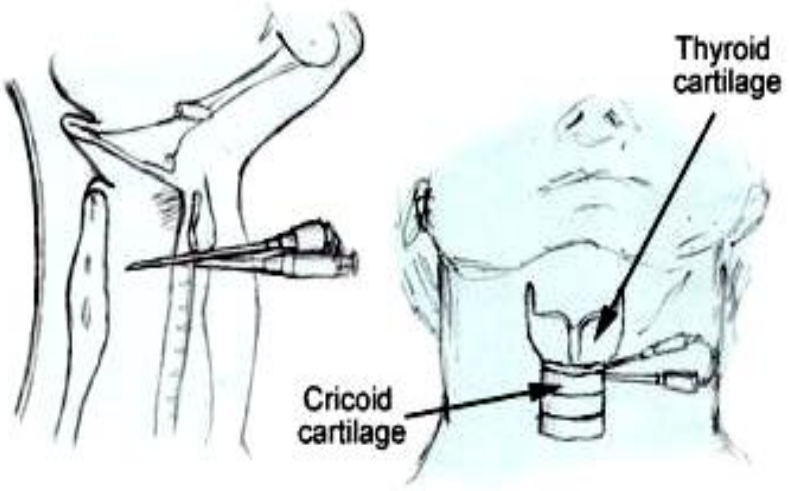
Classification:

- Upper – is an opening of trachea above the isthmus of thyroid gland;
- Middle – is an openning of trachea at the level of isthmus after its transection;
- Lower – is an oppening of trachea below the isthmus of thyroid gland.

Cricothyrotomy

A **cricothyrotomy (also called crike**, **thyrocricotomy**, **cricothyroidotomy**, **inferior laryngotomy**, **intercricothyrotomy**, **coniotomy** or **emergency airway puncture**) is an incision made through the skin and cricothyroid membrane to establish a patent airway during certain life-threatening situations, such as airway obstruction by a foreign body, angioedema, or massive facial trauma. Cricothyrotomy is nearly always performed as a last resort in cases where orotracheal and nasotracheal intubation are impossible or contraindicated. Cricothyrotomy is easier and quicker to perform than tracheotomy, does not require manipulation of the cervical spine, and is associated with fewer complications. However, while cricothyrotomy may be life-saving in

extreme circumstances, this technique is only intended to be a temporizing measure until a definitive airway can be established.



Some general indications for this procedure include:

- Inability to intubate
- Inability to ventilate
- Severe traumatic injury that prevents oral or nasal tracheal intubation

Contraindications:

- Inability to identify landmarks (cricothyroid membrane)
- Underlying anatomical abnormality such as a tumor or severe goiter
- Tracheal transection
- Acute laryngeal disease due to infection or trauma
- Small children under 10 years old (a 12–14 gauge catheter over the needle may be safer)

The procedure was first described in 1805 by Félix Vicq-d'Azyr, a French surgeon and anatomist. A cricothyrotomy is generally performed by making a vertical incision on the skin of the neck just below the laryngeal prominence (Adam's apple), then making another transverse incision in the cricothyroid membrane which lies deep to this point. A tracheostomy tube or endotracheal tube with a 6 or 7 mm internal diameter is then inserted, the cuff is inflated, and the tube is secured. Confirmation

of placement is assessed by bilateral ausculation of the lungs and observation of the rise and fall of the chest.

Needle cricothyrotomy

A *needle cricothyrotomy* is similar, but instead of making a scalpel incision, a large over-the-needle catheter is inserted (12- to 14-gauge). This is considerably simpler, particularly if using specially designed kits. This technique provides very limited airflow. The delivery of oxygen to the lungs through an over-the-needle catheter inserted through the skin into the trachea using a high pressure gas source is considered a form of conventional ventilation called percutaneous transtracheal ventilation (PTV).

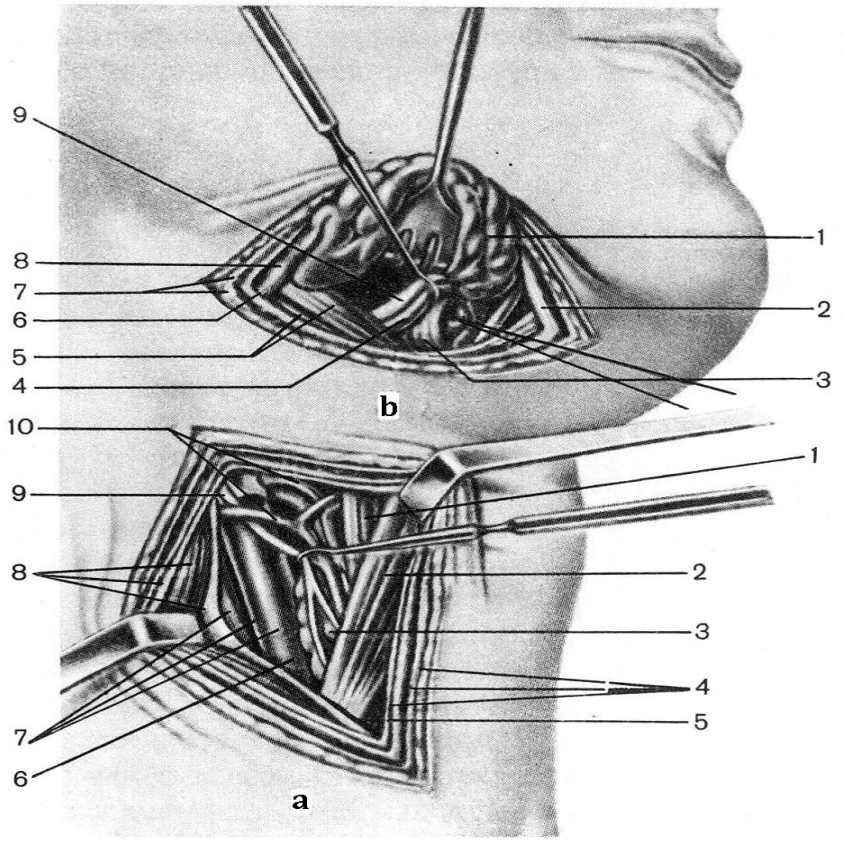
Surgical approach to common carotid artery

The common carotid arteries differ in position, and relations at their origin. The right carotid artery arises from innominate artery, behind the right sterno-clavicular articulation; the left – from the highest part of the arch of the aorta. The left carotid artery is therefore longer. Both arteries ascend obliquely outward from the arch of aorta to the head. Roots, directions and position of right and left carotid arteries are different, but in the neck, the two common carotid arteries resemble each other so closely, that one description will apply to both. All nuances of the anatomy we will demonstrate on example of the right carotid artery. The common carotid artery is contained in a sheath, derived from the endocervical fascia, which also encloses the internal jugular vein and vagus nerve. The IJV is lying on the outer (lateral) side of the artery, and Vagus nerve between the artery and vein, posteriorly to both of them. The common carotid artery is a long vessel without any branches previous to its bifurcation. During the bifurcation the common carotid artery creates two major branches: external and internal carotid arteries. The ECA gives off eight (8) branches and we can indicate that are most important from surgical technology point. They are:

- superior thyroid artery
- lingual artery
- facial artery (External Maxillary artery)

Those are anterior branches and superior thyroid artery is the first one. We have to remember that superior thyroid artery together with internal and external carotid arteries have to be controlled (looped or clamped) during the surgery. The internal carotid artery (ICA) that rises from bifurcation of the common carotid artery is going upward and posteriorly from ECA. It supplies the anterior part of the brain and the eye.

ICA enters the canal in the temporal bone and forms multiple branches inside the skull. The cervical (neck) portion of the ICA gives off NO branches. Another important nerve structure that has to be recognized and preserved during surgery is Hypoglossal nerve (which brings supply to tongue‘s muscles). Others segments of surgical anatomy of this region we will talk about during surgery discussion.



Denudation of common carotid (a) and lingual (b) arteries. **A)** 1 – thyrohyoid; 2 – upper belly of omohyoid m.; 3 – thyroid gland; 4 – superficial fascia with platisma m.; 5 – superficial lamina of own cervical fascia; 6 – neurovascular bundle sheath, 7 – common carotid arteri, internal jugular vein and vagus n.; 8 – sternocleidomastoid m.; 9 – upper radix of the cervical loop, superior thyroid artery.

B) 1 – submandibular gland; 2 – superficial lamina of own cervical fascia; 3 – hyoglos m; 4 – lingual artery; 5 – posterior belly of digastric m.; 6 – facial a; 7 – superficial fascia with platisma m.; 8 – retromandibular vein; 9 – hipoglosal n.; 10 – lingual artery.

The patient is positioned with the neck extended and the head turned away from the side of the surgery. The incision is made along the anterior border of the sternocleidomastoid muscle from superior edge of thyroid cartilage and down for 5–6cm. Using electrocautery, the surgeon cauterizes superficial vessels and incises the platysma muscle in the line of the incision. Common carotid artery is gently mobilized. As we have mentioned above, common carotid artery, vagus nerve and internal jugular vein have common sheath, which has to be opened prior to artery dissection.

Ligating of common carotid artery (CCA) and external carotid artery (ECA)

Indications:

- Wounds;
- Aneurysm;
- Tumors of facial region;
- Resection of mandibula.

Technique of CCA ligating – arteria is devided from surrounding tissue and two ligatures are applied on it at a distance of 1-1,5cm from the bifurcation. Blood supply restores by anastomoses between:

- Right and left ECA (*aa. facialis, occipitalis*);
- ECA and a. subclavia (*a. thyroidea superior et inferior*);
- ECA ECA and internal carotid artery (ICA) (*rami of a. ophtalmica*);
- Right and left ICA and a. subclavia (circle of Willis).

Technique of ECA ligating – it is necessary to ligate artery after place of giving a. thyroidea superior. Blood supply restore by anastomoses between:

- Right and left ACA;
- ECA and a. subclavia;
- ECA and ICA.

Denudation and lingual artery ligation

Indications. It is indicated in plagues of the tongue, rupture of the tongue and for preliminary hemostasis in case of removal of cancer.

The patient position. Head thrown back and turned on the opposite side of where it occurs.

Technique. 4cm incision in the mid of distance between large horn of the hyoid bone and the lower jaw, with 1cm below and parallel to it. Cut

the skin, subcutaneous adipose cellular tissue, superficial fascia with platisma muscle. Cut submadibulare gland capsule from the second fascia of the neck in such a way as not to damage the facial vein. After gland moving up can be seen lingual triangle. Within this triangle it is penetrated bluntly between the fibers of hyoglos muscle, where is located the lingual artery and it can be ligated.

Ligating of lingual artery within the lingual triangle (Pirogov) presents technical difficulties. Therefore lingual artery ligating, currently can be performed at the origin of this artery from the external carotid artery in carotid triangle.

Vagosympathetic block according with Visnevsky

Indications: closed and open pneumothorax.

Principle: Nn. Phrenicus, vagus and sympathicus are blocked with novocain to prevent shock in case of pneumothorax.

Technique: the patient's head is turned to the other side. Sternocleidomastoid muscle is moved to the medial side and needle is introduced at the posterior margin of muscle above the external jugular vein (at the level of hyoid bone). Then needle is moved to the vertebral column. Then it is pulled back from the vertebral column at a distance of 0.5 cm and 40-50 ml of 0.25% solution of novocain is introduced.

Criteria of successful block are hyperaemia of a face on the side of block and Claude- Bernard-Horner syndrome – ptosis, miosis, endophtalm.

Acces to the oesophagus

Indications: bullet of other wounds of the oesophagus, swallowing of the foreign body into the oesophagus; diverticulum.

Procedures:

- The patient is placed in the supine position. A pillow is placed under the shoulder. The head is turned to the right side. The operative intervention is done on the left side of the neck.
- General anesthesia or local anesthesia is administered. The surgeon must avoid anesthesia of the recurrent laryngeal nerve. This procedure is performed under the control of the patient's voice.
- Dissection of skin, subcutaneous tissue, platysma muscle and superficial fascia is made along the anterior margin of the left sternocleidomastoid muscle from mastoid process to the superior margin of the thyroid cartilage. Then, the anterior covering of the sternocleidomastoid muscle is opened and retracted laterally.

- The deep wall of the sheath of sternocleidomastoid muscle and common sheath of the neurovascular bundle are dissected carefully: the common carotid artery, internal jugular vein and vagus nerve are retracted laterally.

A dissection is made between the anterior and posterior bellies of the omohyoid muscle on the superior border of the dissected tissue. The sternohyoid muscle, sternothyoid muscle, lateral lobe of thyroid gland and trachea are retracted. Then, the oesophagus which lies between trachea and vertebra is exposed.

The soft tissue in front of the oesophagus is cleared with a blunt hook. The left inferior thyroid artery is ligated and dissected if necessary. 2 ligature handles are applied to the oesophagus: the oesophagus is opened longitudinally until the mucous membrane. The mucous membrane is held with a clamp and dissected with a scalpel. The wall of the oesophagus is dissected above the foreign body. The unaffected wall is dissected if the wall of the oesophagus above the foreign body is severely damaged. The foreign body is extracted by fingers or instrument through the opening.

The edges of the wound are retracted and processed. Interrupted catgut sutures are made through all layers of the oesophagus. Then, gauzes and gloves of the surgeon are changed. External interrupted silk sutures are applied to the muscular and adventitious layers.

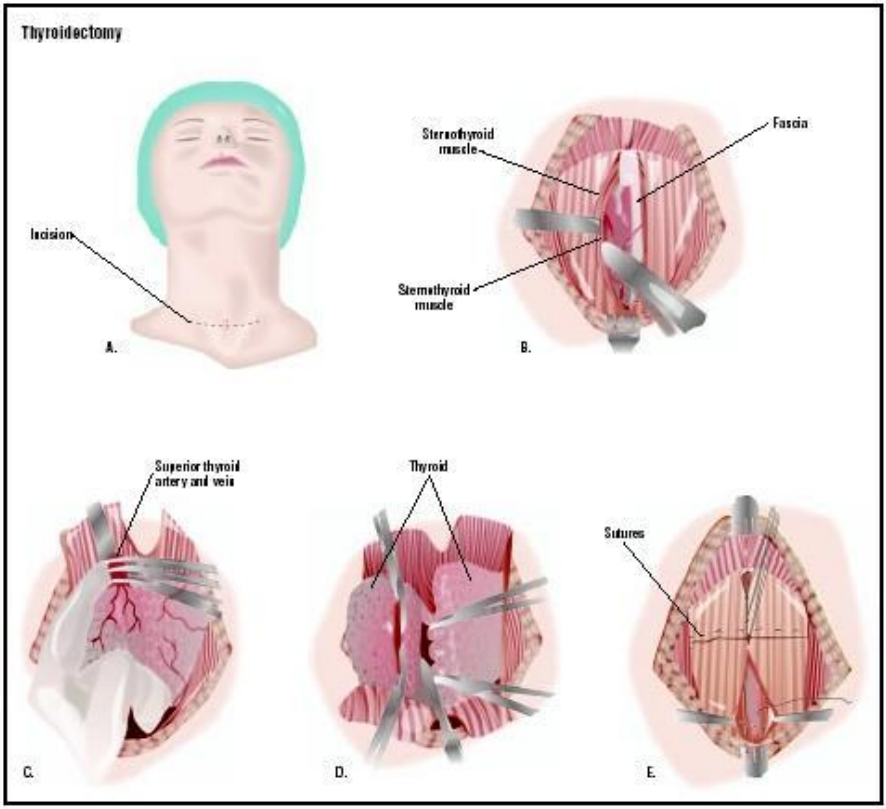
Interrupted catgutsutures are applied to the anterior and posterior walls of the muscular coverings of the sternocleidomastoid muscle while the silk sutures are applied to the skin.

An oesophageal fistulais made in purulent inflammation of the perioesophageal tissue. A draining tube is inserted into the perioesophageal tissue. A nasogastric tube is inserted through the nose for feeding of the patient. A fistula of the stomach (gastrostomy) is made in several situations.

Strumectomy: indications, classification, technique, complications.

Definition

Thyroidectomy is a surgical procedure in which all or part of the thyroid gland is removed. The thyroid gland is located in the forward (anterior) part of the neck just under the skin and in front of the Adam's apple. The thyroid is one of the body's endocrine glands, which means that it secretes its products inside the body, into the blood or lymph. The thyroid produces several hormones that have two primary functions: they increase the synthesis of proteins in most of the body's tissues, and they raise the level of the body's oxygen consumption.



Strumectomy

Technique of subtotal subfascial resection of thyroid gland *according with Nicolaev*

- Transversal collar-shaped incition is carried out between sternocleidomastoid muscles at 2-3 cm above the jugular incisures. Skin, SCT and fascias are cut.
- Acording with the volume of goiter infrahyoid muscles may be cut or move away with blunt retractors.
- Novocain is introduced under the parietal lamina of the 4th fascia. It will make moving out of gland capsule easier.
- Parietal lamina is cut, and then isthmus of gland is cut too.
- One of the gland lobes moving to the wound. It is divided from the fascial capsule. Gland tissue is removed and posterior part remains (part which locates closely to trachea). It prevents from mistaken removing of parathyroid glands and damaging of recurrent laryngeal nerve.

- Arrest of the bleeding carries out well. Capsule is sutured. Operative wound is washed with Novocain to remove toxic colloid with hormones of the gland.
- Other lobe is removed by the same way.
- Wound is sutured. Drainage is applied for a one day.

Complications:

- Bleeding;
- Thyreotoxic crisis – it takes place if colloid with the gland hormones trapped into the blood;
- Damage of recurrent laryngeal nerves – hoarseness of a voice in case of nerve damage at one side and aphonia in case of nerve damage at the both sides;
- There may be asphyxia in case of huge goiter, which causes the atrophy of tracheal cartilages;
- Myxedema takes place in case of excessive removing of gland tissue;
- Tetany takes place in case of removing parathyroid glands.