

BOGOMOLETS NATIONAL MEDICAL UNIVERSITY  
DEPARTMENT OF HUMAN ANATOMY

## Guidelines

<i>Academic discipline</i>	HUMAN ANATOMY
<i>Module №</i>	2
<i>Content module №</i>	15
<i>Topic of the lesson</i>	Internal carotid artery. Subclavian artery.
<i>Course</i>	1
<i>The number of hours</i>	3

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## **1. The relevance of the topic**

Pathology of the internal carotid and the subclavian artery reflected firstly on the blood supply and functioning of the brain. In the presence of any systemic disease (atherosclerosis, aorto arteritis, vascular complications of tuberculosis and syphilis, fibromuscular dysplasia, etc) the lumen of these vessels narrowing that causes one of the most common diseases, cerebral ischemia (stroke). So, having knowledge about the anatomy of these vessels is provide importance to determine the precise localization of the inflammation and further treatment of these diseases.

### **2. Specific objectives:**

1. Define the beginning and demonstrate the course of the internal carotid artery.
2. Determine and demonstrate parts of the internal carotid artery.
3. Determine and demonstrate branches of the internal carotid artery.
4. Determine and demonstrate topography of the left and right subclavian arteries.
5. Determine three parts of subclavian artery, demonstrate branches of each of it and areas, which they carries blood to.

### **3. Basic level of knowledge.**

1. Demonstrate structural features of cervical vertebrae and chest.
2. Demonstrate the anatomical structures of the external and internal basis of the cranium.
3. Demonstrate muscles of the head, neck, chest, diaphragm and rectus abdominal muscle.
4. Demonstrate parts of the brain.
5. Demonstrate structure of the eye.
6. Demonstrate the location of the internal ear.
7. Demonstrate internal organs of the neck and thoracic cavity.
8. Demonstrate aortic arch and its branches.

## **4. Task for independent during preparation to practical classes**

### **4.1. Theoretical questions for the lesson:**

1. Where does the internal carotid artery is branching from common carotid artery?
2. Describe flexures which are formed by the internal carotid artery.
3. Name branch of the ophthalmic artery, which carries blood to the dura matter encephali.
4. What are the branches that the ophthalmic artery gives to the nasal cavity?
5. Name branches, which the internal carotid artery gives to the brain.
6. Name the arteries that form the arterial circle of the brain.
7. Name the topographic parts of the subclavian artery.
8. Name branches, which the vertebral artery gives to the spinal cord.
9. Name branches of the subclavian artery, which take part in blood supplying of the spinal cord.

## 4.2. The list of practical skills:

- Aortic arch
- common carotid artery
- The bifurcation of the common carotid artery
- Parts of the internal carotid artery
- Ophthalmic artery
- Anterior cerebral artery
- Middle cerebral artery
- Posterior communicating artery
- Vertebral artery
- The main artery
- Posterior cerebral artery
- The arterial circle of the brain
- Branches of the subclavian artery

### The content of the topic

The internal carotid arteries (ICA) originate at the bifurcation of the left and right common carotid arteries, at the level of the fourth cervical vertebrae (C4).

They move superiorly within the carotid sheath, and enter the brain via the carotid canal of the temporal bone. They do not supply any branches to the face or neck.

Once in the cranial cavity, the internal carotids pass anteriorly through the cavernous sinus. Distal to the cavernous sinus, each ICA gives rise to:

- Ophthalmic artery – Supplies the structures of the orbit.
- Posterior communicating artery – Acts as an anastomotic ‘connecting vessel’ in the Circle of Willis (see ‘Circle of Willis’ below).
- Anterior cerebral artery – Supplies part of the cerebrum.

The internal carotids then continue as the middle cerebral artery, which supplies the lateral portions of the cerebrum.

### Vertebral Arteries

The right vertebral artery. Superiorly, it converges with the left vertebral artery to form the basilar artery

The right and left vertebral arteries arise from the subclavian arteries, medial to the anterior scalene muscle. They then ascend up the posterior side of the neck, through holes in the transverse processes of the cervical vertebrae, known as foramen transversarium.

The vertebral arteries enter the cranial cavity via the foramen magnum. Within the cranial vault, some branches are given off:

- Meningeal branch – supplies the falx cerebelli, a sheet of dura mater.
- Anterior and posterior spinal arteries – supplies the spinal cord, spanning its entire length.
- Posterior inferior cerebellar artery – supplies the cerebellum.

After this, the two vertebral arteries converge to form the basilar artery. Several

branches from the basilar artery originate here, and go onto supply the cerebellum and pons. The basilar artery terminates by bifurcating into the posterior cerebral arteries.

### Arterial Circle of Willis

The terminal branches of the vertebral and internal carotid arteries all anastomose to form a circular blood vessel, called the Circle of Willis.

There are three main (paired) constituents of the Circle of Willis:

- Anterior cerebral arteries: These are terminal branches of the internal carotids.
- Internal carotid arteries: Present immediately proximal to the origin of the middle cerebral arteries.
- Posterior cerebral arteries: These are terminal branches of the vertebral arteries.

To complete the circle, two 'connecting vessels' are also present:

- Anterior communicating artery: This artery connects the two anterior cerebral arteries.
- Posterior communicating artery: A branch of the internal carotid, this artery connects.

There are three cerebral arteries; anterior, middle and posterior. They each supply a different portion of the cerebrum.

The anterior cerebral arteries supply the anteromedial portion of the cerebrum. The middle cerebral arteries are situated laterally, supplying the majority of the lateral part of the brain. The posterior cerebral arteries supply both the medial and lateral parts of the posterior cerebrum.

The spinal cord is primarily supplied by three longitudinal arteries, as it descends from the brainstem to the conus medullaris. These are:

- Anterior spinal artery– formed from branches of the vertebral arteries, travelling in the anterior median fissure. Gives rise to the sulcal arteries, which enter the spinal cord.
- Two posterior spinal arteries– originate from the vertebral artery or the posteroinferior cerebellar artery, anastomosing with one another in the pia mater.

However, below the cervical level supply from these longitudinal arteries is insufficient. There is support via anastomosis with the segmental medullary and radicular arteries.

The anterior and posterior segmental medullary arteries are derived from spinal branches of a number of arteries, before entering the vertebral canal through the intervertebral foramina.

The great anterior segmental artery of Adamkiewicz reinforces circulation to the inferior 2/3 of the spinal cord, and is found on the left in the majority of individuals.

The radicular arteries supply (and follow the path of) the anterior and posterior nerve roots. Some radicular arteries may also contribute to supplying the spinal cord.

From its origin, the subclavian artery travels laterally, passing between anterior and middle scalene muscles, with the anterior scalene (scalenus anterior) on its anterior

side and the middle scalene (scalenus medius) on its posterior. This is in contrast to the subclavian vein, which travels anterior to the scalenus anterior. As the subclavian artery crosses the lateral border of the first rib, it becomes the axillary artery.

On the right side the subclavian artery arises from the brachiocephalic (innominate) artery behind the right sternoclavicular articulation; on the left side it springs from the arch of the aorta. The two vessels, therefore, in the first part of their course, differ in length, direction, and relation with neighboring structures.

In order to facilitate the description, each subclavian artery is divided into three parts:

- The first portion extends from the origin of the vessel to the medial border of the Scalenus anterior.
- The second lies behind this muscle.
- The third extends from the lateral margin of the muscle to the outer border of the first rib, where it becomes the axillary artery.

The first portions of the two vessels require separate descriptions; the second and third parts of the two arteries are practically alike.

#### First part

##### Right subclavian artery

The first part of the right subclavian artery arises from the brachiocephalic trunk, behind the upper part of the right sternoclavicular articulation, and passes upward and lateralward to the medial margin of the Scalenus anterior. It ascends a little above the clavicle, the extent to which it does so varying in different cases.

It is covered, in front, by the integument, superficial fascia, the Platysma (platysma) muscle, deep fascia, the clavicular origin of the Sternocleidomastoideus (sternocleidomastoid) muscle, the Sternohyoideus (sternohyoid) muscle, and the Sternothyroideus (sternothyroid) muscle, and another layer of the deep fascia. It is crossed by the internal jugular vein and the vertebral vein, by the vagus nerve and the cardiac branches of the vagus and sympathetic, and by the subclavian loop of the sympathetic trunk which forms a ring around the vessel. The anterior jugular vein is directed laterally in front of the artery, but is separated from it by the Sternohyoideus and Sternothyroideus. Below and behind the artery is the pleura, which separates it from the apex of the lung; behind is the sympathetic trunk, the Longus collic and the first thoracic vertebra (T1). The right recurrent nerve winds around the lower and back part of the vessel.

##### Left subclavian artery

The first part of the left subclavian artery arises from the arch of the aorta, behind the left common carotid, and at the level of the fourth thoracic vertebra; it ascends in the superior mediastinal cavity to the root of the neck and then arches lateralward to the medial border of the Scalenus anterior.

It is in relation, in front, with the vagus, cardiac, and phrenic nerves, which lie parallel with it, the left common carotid artery, left internal jugular and vertebral veins, and the commencement of the left innominate vein, and is covered by the Sternothyroideus, Sternohyoideus, and Sternocleidomastoideus; behind, it is in relation with the esophagus, thoracic duct, left recurrent laryngeal nerve, inferior cervical ganglion of the sympathetic trunk, and Longus collic; higher up, however, the esophagus and thoracic duct lie to its right side; the latter ultimately arching over the vessel to join the

angle of union between the subclavian and internal jugular veins. Medial to it are the esophagus, trachea, thoracic duct, and left recurrent laryngeal nerve; lateral to it, the left pleura and lung.

#### Second part

The second portion of the subclavian artery lies behind the Scalenus anterior (anterior scalene) muscle; it is very short, and forms the highest part of the arch described by the vessel.

It is covered, in front, by the skin, the superficial fascia, the Platysma muscle, the deep cervical fascia, the Sternocleidomastoideus, and Scalenus anterior. On the right side of the neck the phrenic nerve is separated from the second part of the artery by the Scalenus anterior, while on the left side it crosses the first part of the artery close to the medial (middle) edge of the muscle. Behind the vessel are the pleura and the Scalenus medius (medial, or middle, scalene) muscle; above, the brachial plexus of nerves; below, the pleura. The subclavian vein lies below and in front of the artery, separated from it by the Scalenus anterior.

#### Third part

The third portion of the subclavian artery runs downward and lateralward from the lateral margin of the Scalenus anterior to the outer border of the first rib, where it becomes the axillary artery. This is the most superficial portion of the vessel, and is contained in the subclavian triangle.

It is covered, in front, by the skin, the superficial fascia, the Platysma, the supraclavicular nerves, and the deep cervical fascia. The external jugular vein crosses its medial part and receives the transverse scapular, transverse cervical, and anterior jugular veins, which frequently form a plexus in front of the artery. Behind the veins, the nerve to the Subclavius descends in front of the artery. The terminal part of the artery lies behind the clavicle and the Subclavius and is crossed by the transverse scapular vessels. The subclavian vein is in front of and at a slightly lower level than the artery. Behind, it lies on the lowest trunk of the brachial plexus, which intervenes between it and the Scalenus medius. Above and to its lateral side are the upper trunks of the brachial plexus and the Omohyoideus. Below, it rests on the upper surface of the first rib.

The subclavian arteries vary in their origin, their course, and the height to which they rise in the neck.

The origin of the right subclavian from the innominate takes place, in some cases, above the sternoclavicular articulation, and occasionally, but less frequently, below that joint. The artery may arise as a separate trunk from the arch of the aorta, and in such cases it may be either the first, second, third, or even the last branch derived from that vessel; in the majority, however, it is the first or last, rarely the second or third. When it is the first branch, it occupies the ordinary position of the innominate artery; when the second or third, it gains its usual position by passing behind the right carotid; and when the last branch, it arises from the left extremity of the arch, and passes obliquely toward the right side, usually behind the trachea, esophagus, and right carotid, sometimes between the esophagus and trachea, to the upper border of the first

rib, whence it follows its ordinary course. In very rare instances, this vessel arises from the thoracic aorta, as low down as the fourth thoracic vertebra. Occasionally, it perforates the Scalenus anterior; more rarely it passes in front of that muscle. Sometimes the subclavian vein passes with the artery behind the Scalenus anterior. The artery may ascend as high as 4 cm. above the clavicle, or any intermediate point between this and the upper border of the bone, the right subclavian usually ascending higher than the left.

The left subclavian is occasionally joined at its origin with the left

The left subclavian artery is more deeply placed than the right in the first part of its course, and, as a rule, does not reach quite as high a level in the neck. The posterior border of the Sternocleidomastoideus corresponds pretty closely to the lateral border of the Scalenus anterior, so that the third portion of the artery, the part most accessible for operation, lies immediately lateral to the posterior border of the Sternocleidomastoideus.

Some authors describe the subclavian artery as arising from the 7th intersegmental artery.

## LITERATURE

### Base:

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2. Sviridov, O. I. Human Anatomy / Sviridov O. I. – Kyiv: High school, 2000.

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3. Netter F. Atlas of human anatomy / F. Netter; [transl. from eng. A. A. Tsegelsky]; ed. by U.B. Tchaikovsky. – Lviv: Nautilus, 2004.
4. International anatomical nomenclature. Ukrainian standard / edited by I. I. Bobryk, V. G. Koveshnikov. - Kiev: Health, 2001.

## Tests

1. The patient, 17 years old, during tonsilectomy had a very heavy bleeding. What vessel was damaged during surgery?
  - A. The internal carotid artery.
  - B. The ascending Palatine artery.
  - C. The maxillary artery.
  - D. The descending Palatine artery.
  - E. The external carotid artery.

2. Patient, 45 years, complains of dizziness, satst during circulation, violation of coordination of movements. The examination established that the patient has degenerative disc disease of the cervical spine and compressed the vessel, passes through the transverse holes of the cervical vertebrae. What is a vessel?

- A. a.subclavia.
- B.a.vertebralis.
- C. a.carotis externa.
- D.a.carotis interna.
- E. a.occipitalis.

3. In a child 3 years, at a purulent inflammation of the middle ear involved in the pathological process artery that is bordered by a front wall of the tympanic cavity. What is the vessel involved in the pathological process?

- A.A.carotis externa.
- B.A.auricularis posterior.
- C. A.meningea media.
- D.A.carotis interna.
- E. A.temporalis superficialis.

4. Boy, 12 years old, for medical reasons made the removal zagrudinna cancer. While bandaged the blood vessels supplying the this gland. From which vessels depart branches to zagrudinna gland?

- A.Tr.thyrocervicalis.
- B.A.thoracica interna.
- C. A.vertebralis.
- D.Tr.costocervicalis.
- E. Aorta thoracica.

5. Dental surgeon at the woman, 24 years of age, was diagnosed with purulent inflammation of the sphenoid sinus. Done everything possible to prevent the engagement of the artery, which lies in pecurity sinus, and thus avoid the fatal blow. What is the artery?

- A. A.supraorbitalis.
- B. A.carotis externa.
- C. A.opthalmica.
- D. A.carotis interna.
- E. A.infraorbitalis.

6. The victim, 27 years old, with a cut wound of the skin of the frontal region taken to the emergency room. To stop bleeding the doctor bandaged the vessel that supplies this area. What is the vessel tied up?

- A. A.angularis.
- B. A.infraorbitalis.
- C. A.supraorbitalis.
- D. A.facialis.
- E. A.temporalis superficialis.



7. Patient, 75 years old, the doctor detected a complete loss of language due to hemorrhage in the region of the left inferior frontal gyrus. In the pool which of the cerebral arteries was bleeding?

- A. A.cerebri anterior.
- 8. A.cerebri media.
- C. A.cerebri posterior.
- D. A.communicans anterior.
- E. A.communicans posterior.

8. A sick woman, 55 years old, due to a hemorrhagic stroke in the area of sulcus calcarinus completely lost vision. Which of the cerebral arteries is most likely bad?

- A. A.cerebri anterior.
- B. A.cerebri media.
- C. A.cerebri posterior.
- D. A.vertebralis
- E. A.communicans posterior.

9. Patient, 55 years old, complains of pain in the upper eyelid, supraorbital region and forehead. The examination revealed: swelling of the upper eyelid and Oceanco tissue, inflammation of the frontal sinus. After the examination, the doctor diagnosed a thrombosis of the a.ophthalmica. Branch which vital artery is a. ophthalmica?

- A. A.subclavia.
- B. A.vertebralis.
- C. A.carotis externa.
- D. A.carotis interna.
- E. A.maxillaris.

10. The patient, 32 years old, complains of headache in the frontal region of the head and frequent bleeding from the nose. X-ray revealed inflammation of the frontal sinus. Which the vessel struck?

- A. A.ophthalmica.
- B. A.facialis.
- C. A.sphenopalatina.
- D. A.meningea anterior.
- E. Aa.nasales posteriores.