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Inhaber: Marina Kisiliuk

Tel.: + 49 51519191533

Fax.: + 49 5151 919 2560

Email: info@dwherold.de

Internet: www.dwherold.de

Chefredakteur/Editor-in-chief:

Marina Kisiliuk

Korrektur:

O. Champela

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aprokharau@gmail.com

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wlad_cor@mail.ru

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algiv@rambler.ru

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makae@bsmu.by

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n.kanunnikova@grsu.by

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Giedrius.Vanagas@lsmuni.lt

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Armuntas.Baginskas@lsmuni.lt

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Ais.shahlol@sebhau.edu.ly

Edmundas Kadusevicius, MD, PharmD, PhD, Prof.
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Edmundas.Kadusevicius@lsmuni.lt

Ivo Grabchev, Prof., PhD.
Chemistry, Bulgaria
i.grabchev@chem.uni-sofia.bg
grabchev@mail.bg

Mariyana Ivanova Lyubenova, Prof., PhD.
Ecology, Bulgaria
ryann@abv.bg
ryana_1@yahoo.com

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tmarinova@yahoo.com

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Biology. Bulgaria
evgueni_ananiev@yahoo.com

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Biology, Bulgaria
mitovplamen@gmail.com

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Physiology, Bulgaria
arny87@yahoo.co.uk

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Ecology, Bulgaria
anivel@abv.bg

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osdemir@cu.edu.tr

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Indijharnaray@gmail.com

Marián Halás doc. RNDr, Ph.D.
Human geography, Czech
marian.halas@upol.cz

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Biology, Turkey
payfer@cu.edu.tr

Tusharkanti Ghosh Prof.
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tusharkantighosh53@yahoo.in

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khuda1949@mail.ru

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djtjohnson@earthlink.net

Satanovsky Leon MD/PhD.
Perio-odontologie, Israel
satleonid@gmail.com

Lists of references are given according to the Vancouver style

**Kryvetskyi V.V.,
Narsiya V.I.,
Kryvetskyi I.V.**

M.G.Turkevych Department of Human Anatomy, Higher State Educational Establishment of Ukraine "Bukovinian State Medical University", Chernivtsi, Ukraine, vitusik_cv@rambler.ru

BLOOD SUPPLY OF THE CERVICAL REGION OF THE VERTEBRAL COLUMN DURING THE FETAL PERIOD AND IN NEWBORNS

Abstract. *The peculiarities of the blood supply of the cervical region of the vertebral column of 35 human fetuses, 30 newborns have been studied by means of morphological methods of investigation. The development of the blood vessels of the cervical region of vertebral column in health and also individual divergences during different age periods, the peculiarities of the blood supply of the parts of the vertebra as well as intervascular anastomoses along the vertebral collumn have been studied.*

Key words: *vertebral column, blood supply, ontogeneis, human.*

Introduction. The treatment of patients with compression syndromes is an urgent task of modern medicine. According to the WHO, 2/3 of the population suffers from radicular and joint pain of varying degrees of severity, leading to temporary and partial disability. Back pain is one of the main causes of economic losses in manufacturing [2, 3, 5, 6, 8, 9]. The results of the study conducted in the USA showed an increase in the total cost of diagnosis, treatment, and disability compensation to workers due to this pathology has increased from 15.6 billion dollars in 1997 to 28 billion dollars in 2000, that can makes this disease one of the most cost-effective [7, 10].

The normal development of the bone as an organ is in full compliance with the blood supply and the load. Variations in blood supply, load change will inevitably affect the structure and shape of the organ. [3] These relationships are defined by the following rules: the increase of the support load without an adequate increase of blood supply does not increase the bone mass; the increase of the support load accompanied by the increase of blood supply increases the bone mass; th decrease of the support load with sufficient blood supply promotes the bone resorption; preservance of the original support with reduced blood supply reduces osteogenesis; an equable reduce of the load and blood supply reduces the osteogenesis.

The dependence of bone structure and shape on an adequate blood supply and load made it possible to change the shape of the organ.

It is known that skeletal development is closely related to the circulatory system. The bone is not only a solid supporting substance but also a determined combination of special cellular elements of the blood-forming and blood-circulating system. The topicality of the task is determined by the need to find solutions to complex Orthopedic problem - a bloodless treatment of patients with spinal curvatures.

We believe that changing of the spinal shape can occur for various reasons, but surely one of the possible factors is the inadequacy between blood supply and the load. It also leads to changes in the shape of the spine, which results in scoliosis.

To investigate the problems of changing the shape of the spine, we examined its blood supply within norm.

Although the blood vessels of the spine were studied by many authors (KA Yudin, 1950; GA Ilizarov, 1981 et al.), but in the prenatal and neonatal ontogenesis such studies have not been fully conducted that makes the study urgent [1].

Objective: to examine the development and formation, as well as individual differences in the structure of blood vessels in normal spine and explore the symmetry and asymmetry of extra- and intraosseous vascular bed, the anatomical features of blood supply of the parts of the vertebra, and intervascular Materials and methods. The study was conducted on 35 human fetuses and 30 newborns. The research of vertebral arteries consisted of several stages: 1. The study of injected extraorganic arteries by anatomical dissection and radiography. 2. The study of

intraorganic arteries by making macroscopic samples, followed by X-ray in frontal, sagittal and horizontal planes. 3. The study of the spatial distribution of arteries in the vertebrae by enlightenment. A minimum was chosen as a contrast substance which aids in getting a clear X-ray image. However, unlike other authors, we used a water suspension of minium, by the method of B.V. Ognev.

Results and their discussion. As the study of cervical arteries revealed the sources of blood supply of the cervical vertebrae in newborns include vertebral artery, ascending and deep cervical arteries, thyro-cervical trunk, inferior thyroid, superior intercostal, subclavian, external carotid and intercostal arteries, that arise from the thoracic aorta. In fetuses an ascending pharyngeal artery and transverse colli artery should be added to this list, excluding the external carotid artery. The number of sources of blood supply of cervical part of vertebral column in fetuses ranges from 3 to 6, usually 4, and in newborns - from 4 to 8, usually 4 (68% of cases). The differences in the number of sources of arterial blood supply according to sex were not found. Vertebral, ascending and deep cervical, intercostal and ascending pharyngeal arteries form branches to supply cervical vertebrae equally on the right and left, others (thyro-cervical trunk, inferior thyroid and subclavian arteries) supply the cervical vertebrae unequally from both sides. Transverse cervical artery and external carotid artery give branches only to one corresponding side.

Vertebral artery (8 newborns' specimens) originates from the right and left side of the subclavian artery. In two specimens it starts left rising from the ascending part of the aortic arch and right subclavian artery. The caliber of right and left vertebral arteries in 20 specimens was identical, in 7 - different. The trunk of vertebral artery was relatively straight in 21 out of 30 cases, in 9 it was tortuous: on both sides in 5 cases and 4 on one side. Different levels and penetration of the vertebral artery in the openings of the transverse processes of the vertebrae; in 28 preparations the artery entered the transverse opening of VI vertebra, and in two cases some peculiarities were found: in one specimen it entered the transverse opening of V vertebra on rightside and leftside of VI one, in other case it entered the transverse opening of IV vertebra rightside and leftside of IIIrd.

The study of 35 cervical vertebrae of fetuses

shows that vertebral artery arises from the subclavian. The right and left arteries in all cases were of the same caliber. In 10 cases a winding vertebral artery was seen, and in 25 - straight. In 30 cases the artery entered the opening of the transverse process of the VI vertebra, in 5 cases - VII.

The ascending cervical artery always arises from the thyro-cervical trunk. Its branches came towards vertebrae in 100%. The caliber of the right and left arteries was identical in 28 newborn's specimens and in 2 it was different. The diameter of arteries in fetuses was the same. In 3 out of 30 specimens of vertebrae in infants and in 4 fetuses the ascending cervical artery was tortuous.

In newborns the beginning of ascending cervical artery was observed at the level of VI and VII vertebrae (25 and 5 specimens respectively), and in fetuses on the same level (28 and 7 specimens). Branches of the 1st and 2nd orders enter the intervertebral foramina of III-IV, IV-V and V-VI vertebrae and openings between II-III and V-VI vertebrae in newborns. In fetuses they often arise between the openings of III-IV and Vth vertebrae, seldom - between II-III and V-VI vertebrae; in newborns they supply Vth vertebrae with blood and sometimes - IV, VI vertebrae. The blood supply of II, III and VII vertebrae is rare. In fetuses above named arteries often direct towards III-IV vertebrae and in some cases towards I-IInd.

Deep cervical artery arose from costo-cervical trunk. Its branches came to the cervical vertebrae in 100%. The beginning of artery was not always at the same vertebrae' level. Thus, in 64% of cases it arose from costo-cervical trunk on the level of VII vertebra, and in 10% on the level of thoracic vertebra. In 26% of cases it begins on the level of VII cervical on the right, and I thoracic vertebra on the left. Deep cervical artery gives off branches on the level of different cervical vertebrae, in one specimen it reached atlas, in 9% - II vertebra in 41% - III in 37% - IV and in 10% - VII vertebra. In two cadavers of fetuses the right deep cervical artery reached the level of VI vertebra, and the left one - II vertebra. The branches of 1st and 2nd order from this artery enter the intervertebral openings: between V and VI vertebrae (in 14 cases), between VI and VII (61) and VII and cervical and thoracic vertebrae (6 cases). The most common was the approach to the outer surface of the vertebral arches and spinous processes of III-VII and rarely - I-II vertebrae.

The thyro-cervical trunk blood supplied the vertebrae in 34 cases (9 newborns and 25 fetuses specimens). At the level of VII vertebra a branch arose from it and reaches V or VI vertebrae, then goes down to I-II thoracic vertebrae. I gives rise to branches of the 2-3rd order. In 17 specimens they were facing each other, in 14 cases towards two and in 3 towards three vertebrae. Its branches reach the outer surface of the antero-external surface of V-VII cervical vertebrae.

The inferior thyroid artery supplies II to IV lower cervical vertebrae in 35 specimens, including 5 newborn's and 30 fetuses' adavers. Its branches directed the vertebrae from on right side in 15 cases, on the left side in 8 and on both sides in 12 specimens. The artery gives branches to the front surface of bodies of III-VII vertebrae.

The superior intercostal artery supplies VII vertebra in 16 specimens (5 newborns and 11 fetuses). Its branches (2 to 6) approach the VII cervical vertebra on both sides.

The subclavian artery supplies the cervical vertebrae in 9 cases (3 newborns and 6 fetuses' specimens).

Its branches come to the body of VII cervical vertebra from one side (right) in 6 cases from two sides in 6 cases.

The branches of the first intercostal artery are involved in blood supply of VII cervical vertebra (2 cases).

The transverse cervical artery gives branches to V-VII vertebrae (4 fetus' specimens). From the right transverse cervical artery one or two branches penetrate the intervertebral foramen of VI-VII vertebrae.

The ascending pharyngeal artery supplies vertebrae of fetuses (5 specimens). From both arteries the branches go to the front surface of atlas and to odontoid process of axis.

The external carotid artery gives branches to two vertebrae: the posterior arch of the atlas and to transverse processes of V vertebra.

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Thus the above described arteries are differently involved in the blood supply of the cervical spine. Obviously the various sources of blood supply of the cervical spine are possible in newborns and fetuses.

In newborns the vertebral, ascending and deep cervical arteries are permanent, others (thyro-cervical trunk, inferior thyroid artery, superior intercostal arteries) supply vertebrae mainly in fetuses, and only a few of them were seen in newborns. The subclavian and the first intercostal arteries and external carotid arteries supply cervical vertebrae in newborns only in rare cases. The ascending pharyngeal artery and transverse cervical artery were seen mainly in fetuses.

Conclusions. 1. Such sources of blood supply as thyro-cervical trunk, inferior thyroid, superior intercostal and first intercostal arteries tend to change with the body growth which leads to sharp limitation of their participation in the blood supply of cervical vertebrae. These arteries can be attributed to non-permanent additional sources of blood supply.

2. The number of permanent and non-permanent sources of the blood supply of vertebrae is different: for cervical vertebrae 3 to 6 in infants, and from 4 to 8 in fetuses.

3. The constant sources of blood supply (vertebral, ascending and deep cervical arteries) supply 1 to 7 cervical vertebrae, additionally - thyro-cervical trunk, inferior thyroid artery and superior intercostal, subclavian, first intercostal, ascending pharyngeal and transverse cervical

arteries supply with blood 1 to 4 cervical vertebrae.

4. There are more branches of 1st-2nd order, which rise towards the cervical vertebrae from permanent sources than those from additional; the latter, in turn, are more numerous in fetuses than in infants.

Prospects for further research. In future research the development and formation of blood supply of the thoracic spine during the prenatal and early neonatal periods of human ontogenesis and its features are planned to be studied.

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