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MORPHOLOGY AND DEVELOPMENT OF DEPRESSIVE NERVE (*nervus depressor*) OF PIG AT PRENATAL STAGE

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ABSTRACT

The research was conducted on 117 pig fetuses from 12 uteri. The pigs came from 5-7th, 10-11th and 12-13th week of pregnancy. Morphological analysis of the depressive nerve and biomechanics of the nerve were described. The initial form of depressive nerve, characteristic for the first weeks of prenatal stage is usually a built from single elements. The origin of fetus from the same horns of uteri and their sex have no important influence on the morphology and the development of the nerve in their prenatal stage.

Key words: pig, prenatal period, depressive nerve

INTRODUCTION

The research on the development of autonomous nervous system has an important, cognitive value for morphology, physiology, pathology and clinical research. It results both, from the role the autonomic nervous system plays in the maintenance of the correct function of all system organs and in pathogenesis of separate disease entity. Its importance is also connected with the morphological complex structure of the system, including the vagus nerve.

Thanks to the latest achievment in neurophysiology, it was established that the elements of the vegetative nervous system, which are situated circumferentialy, such as the aortic plexus, splanchnic nerves, the sinus and cervical sinus nerves as well as the left and the right depressive nerve, are in close connection with central blood preasure regulating systems (cerebral cortex, hipothalamus, medulla oblongata, spinal cord).

The depressive nerve works as a compensatory (buffer) nerve creating an important mechanism of arterial blood preasure regulation and inflow of blood to the cerebrum. This nerve is a part of the baroreceptive sphere placed in the wall of the aortic arch and in the heart muscle [6].

In mature specimen the nerve is a thin nerve branch spreading out independently from the laryngeal cranial nerve [5].

Up to now there has been no morphological description concerning the depressive nerve of pig's fetuses prenatal period refering to one family.

The nerve and other parts of the vagus nerve of sheep and pigs were described by Pospieszny [13,14,15]. Nitschke [11] and Nickel [10] described the morphological structure of the nerve of mature specimens including pigs. Kreiner [7] established that the depressive nerve directly comes from the cranial laryngeal nerve, which is the nervous branch spreading out from distal ganglion of vagus nerve. However, this ganglion is built from two kinds of cells which are connected with the bronchial nerve structure. Ganglion distale doesn't develop from crista neuralis but from ectodermal cells which fall in here in an early prenatal stage and change into ganglion cells. They are placodes- the remains of some kind of sense organs- probably used to control water flow through gills.

MATERIAL AND METHODS

The research was conducted on 117 pig fetuses from 12 uteri. The material came from one breeding centre, where the zootechnical and veterinary conditions were identical. The material was geneticaly homogeneous.

During the research the cross-section of population method was used [1]. NAV and NEV were used [9]. The authors tried to describe the exact age of specimen and the age of the sets. The age was marked according to Marrable [8]. The material was preserved in 1-2% formaldehyde solution. During research 0,5-1,0% ethamoic acid solution and 70% ethanol solution were used. During preparation stereoscopic microscope was used (10x-125x). The topographic anathomy methods such as skeletotopia, holotopia and syntopia were applied. Attention was paid to biomechanics of development. Morphometry of the distal vagal ganglion and its derivatives was done.

RESULTS

The development of depressive nerve in prenatal period of pigs is very well connected with the development of distal ganglion of vagus nerve and its derivatives such as the cranial laryngeal nerve and the depressive nerve.

The distal ganglion of vagus nerve is distinguished by great dynamics of development caused mainly by changes in the development in the pharyngolaryngeal region and the base of skull region. In fetuses from 5th to 7th week of pregnancy, the ganglion is situated between the cranial base of skull and the mandible and its coronoid process. During the development of the region and the vagus nerve, there is a translocation of the ganglion in the caudal direction. As a result of the translocation, during the 14-17th week of pregnancy, the ganglion takes position below the angle of mandible and the position remains unchanged till delivery.

The length of the ganglion of the pig in the prenatal stadium varies from 1.1mm for the youngest fetuses, 2.6mm for fetuses from the 10-11th week of pregnancy, to 4.4mm for the oldest ones.

The cranial laryngeal nerve is the important part of the vagus nerve, from which the depressive nerve spreads out or not. Although, in the fetuses from the 5th-7th week of pregnancy, in the cephalic and cervical part of the vagus nerve, it is difficult to establish the exact place, from which the aortal nerve spreads out from the cranial laryngeal nerve, you may observe the initial point, from which the nerve spreads out - on the left side of the preparations. During this stage of development, distal ganglion of the vagus nerve and the cranial cervical ganglion are situated close to each other and on the same level. Cranial laryngeal nerve is distinguished by a weak topographical stabilization related to the place of its spreading out from the mentioned ganglion. In fact it spreads out at the whole length of the ganglion in examined specimens. In other words, during this stage (5th to

7th week of pregnancy) there is no clear accentuation of the place at which the depressive nerve spreads out from the cranial laryngeal nerve. At the stage of 10th to 11th week of pregnancy, the place, where the depressive nerve spreads out from the cranial laryngeal nerve is clearly visible. At this age, the depressive nerve is parallel or situated in some distance from the cranial laryngeal nerve. At the begining, it goes to the lateral edge of the distal ganglion of vagus nerve and then to the caudal pole of the ganglion and it goes into the a weak connection with the vagal trunk by the connective tissue. On the left side the specimens it spreads out in a very clear way and goes much below the caudal pole of the ganglion to the main mass of the vagus nerve making connection with it.

At the 12th to 13th week of the prenatal stage, the way that the depressive nerve spreads out from the ganglion, is consolidated. At this stage of development, the depressive nerve on the left side of the specimens, morphologically is very well developed - usually single, rarely double. It's covered with a sheath of the connective tissue and in this form it reaches the cranial thoracic aperture (apertura thoracis cranialis). On the right side of the specimens, there is no clear morphological accentuation of the place, where the depressive nerve spreads out from the cranial laryngeal nerve (Fig.1). In a few cases it is clearly visible. From this fact, we can assume, that when the place where the depressive nerve spreads out from the cranial laryngeal nerve is not obvious, the depressive nerve must be in the main mass of the vagus nerve or in cardiac branches of the vagus nerve. When the depressor nerve comes from the cervic part to the thoracic cage, on the left side of the specimens at the 5th-6th week of the prenatal stage (allometria), the nerve spreads out from the main mass of the vagus nerve almost at the level of the aortic arch (Fig.2). During the 10th to11th week, its separation from the maternal trunk moves towards cranium, so that in specimens from the 12th -13th week it appears at the cranial thoracic aperture (apertura thoracis cranialis). At the first stage of development the deprssive nerve is a single nerve, than it is characterized by having 2 to 4 branches, which spread out along the aortic arch, come to the arteriosus ligament and the base of heart, providing it (Fig.2). On the right side of the specimens, it is difficult to observe, where the nerve spreads out and how it reaches the base of heart. The nerve may be a part of heart branches of the vagal nerve or it may be a component of the main mass of the vagal nerve.

Fig. 1. The capital and cervical part of the aortic nerve (n.depressor) in pig from the 10th week of prenatal period. Left side of investigated material.
1 - vagus nerve, 2 - distal ganglion of vagus nerve, 3 - cranial laryngeal nerve, 4 - depressor nerve, 5 - sympathetic trunk

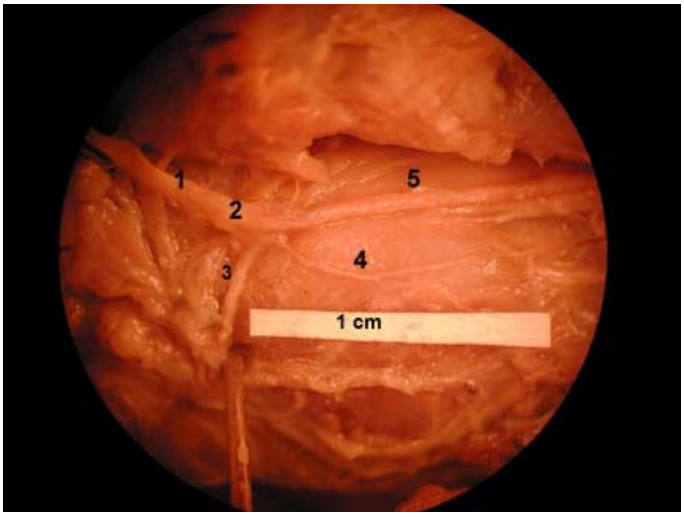
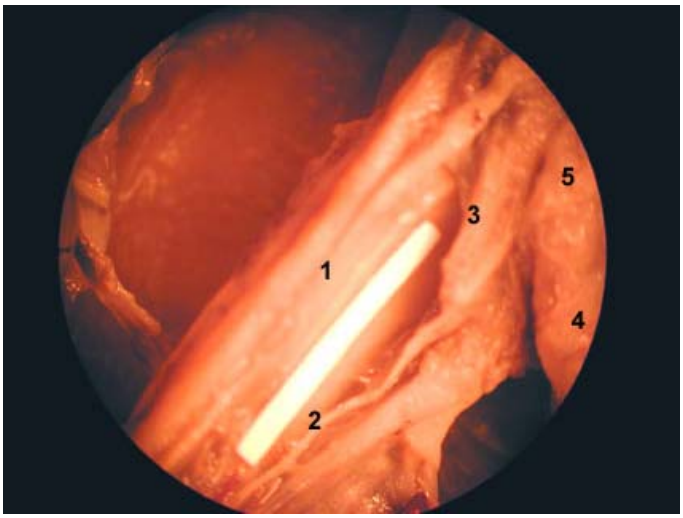


Fig. 2. The thoracic part of the aortic nerve in pig from the 10th weeik of prenatal period. 1 cm. Left side of investigated material.
1 – vagus nerve, 2 – depressor nerve, 3 – aoric arch, 4 – pulmonary trunk, 5 – arterial duct



Biomechanics of the aortal nerve of the pig in the prenatal stage

The biomechanic phenomena, that happens in the n. depressor during prenatal stage are mainly connected with dynamic changes of the development of the pharyngo-laryngeal region and the region of heart. There is an intensive embryonic and prenatal induction related to the development of the nerve. Due to the changes, the cranial cervical ganglion ascends towards the cranial region and at the same time the distal ganglion of vagus nerve descends towards the caudal region. As a result of induction, angular values of the separation of the cranial laryngeal nerve and, in consequence, the values of separation of the depressive nerve from the distale ganglion of vagus nerve, change.

During the 5th -6th week of pregnancy this value is 35-45 degrees; during the 10th-11th week - 50-60 degrees and in the 12th-13th week - 80-95 degrees. The morphological and biomechanic situation in the region of heart is more stabilized. The separation of the depressive nerve on the left side is gradual and gentle. On the right side it is difficult to diagnose and to establish.

DISCUSSION

The development, morphology and biomechanics of the depressive nerve is connected with changes in the region of head, but mainly with the development and descending of the heart. Our research shows that it is well developed on the left side of the specimens, while on the right side of the specimens it can be placed in the main mass of vagal nerve or in its cardiac branches.During the examined stage, at its final course it provides the aortic arch, the base of heart and the arteriosus ligament.

When analysing available literature, it must be stressed, that in terminal phase of prenatal period, the examined nerve has simillar structure to the nerve of mature specimens [10,11,12] Cytological examinations of localization of depressive nerves centres in the medulla oblongata of sheep by Flieger and co-authors [4,5] proved that, the left and the right depressive nerves are separate.

When analysing the development of depressive nerve we took into consideration - biomechanics of development, the embryonic and prenatal induction and the tissue impedance [2,3]. These methods clearly show changes in the development of nerves and their surroundings.

CONCLUSIONS

1. The depressive nerve in prenatal stage characterize by the great dynamics of development, which are related with changes in the organs of head and changes in the region of heart.
2. The separation of the left depressive nerve from the cranial laryngeal nerve distincts even at the early stage of development. The right depressive nerve rarely appear as a separate morphological unit.
3. The initial form of depressive nerve, characteristic for the first weeks of prenatal stage is usually a built from single elements.
4. The origin of fetuses from the same horns of uteri and their sex have no important influence on the morphology and the development of the nerve in their prenatal stage.

REFERENCES

1. Bożiłow W., Sawicki K., 1980: Metody badań zmienności cech anatomicznych człowieka podczas rozwoju prenatalnego i okołoporodowego. [The Methods of Investgations of the Human's Anatomical Variability Features during a Prenatal and Perinatal Period]. Monografia. Academia Medica Wratislaviensis Wrocław [in Polish].
2. Drzazga A., Pospieszna J., 2001: Prenatal changes in the dielectric properties of selected animal tissues. Folia Morphologica, vol.60, no.2 : 122.
3. Drzazga A., Pospieszna J., In vitro dielectric properties of the porpoise skin from 10^{-4} Hz to 10^{4}. Morphological days in Ceske Budejovice. 31.01.02 – 1.02.2002, 131-133.
4. Flieger S., 1971: Ośrodki nerwowe nerwu krtaniowego przedniego i tylnego oraz ich udział w unerwieniu krtani. [The Nervous Centres of the cranial and caudal laryngeal nerve and their share in Innervation of the larynx]. Pol. Arch. Wet., 3:467-474 [in Polish].
5. Flieger S., Welento J., Eustachiewicz R., 1977: Eksperymentalne badania nad lokalizacją ośrodków serca u owcy. [The Experimental Investigations of the Localisation of the Sheep's Heard Centre]. Med. Wet., 12:744-748 [in Polish].
6. Ganong W.G., 1994; Fizjologia. [Physiology]. Wydawnictwo Lekarskie. PZWL Warszawa [in Polish].
7. Kreiner J., 1970: Biologia mózgu. [The Biology of the Brain]. PWN Warszawa [in Polish].
8. Marrable A., 1971: The embryonic pig. A chronological account. Pitman Medical, London.
9. Nomina Anatomica Veterinaria (NAV), Nomina Embryologica Veterinaria (NEV) 1994.
10. Nickel R., Schummer A., Seiferle E., 1975: Lehrbuch der Anatomie der Haustiere.Band IV.
11. Nitsche Th., 1973: Zur makroskopischen Anatomie der Gehrinnenerven des Hausschweines. 4 teil. Die Nn. Encephalici IX-XI. Anat. Histol. Embrol., 2:354-384.
12. Perman E., 1924: Anatomische Untersuchungenuber die Herznerven bei den hoheren Saugetieren und beim Menschen. Ztsch. F. Anat. U. Entwicklsch., 71:383-457.
13. Pospieszny N., 1979: Morphologie und Topographie des Brustteiles des nervus vagus beim Schaf in der prenatalen Periode. Zool. Pol., 2:195-225.
14. Pospieszny N., 1984: Das Verhaltnis des Nervus accessorius zum Ganglion distale nervi vagi beim Schaf in der prenatal Periode. Anat. Anz., 157:127-135.
15. Pospieszny N., 1993: Morphology and development of the extracranial part vagus nerve of the pig during the fetal period. Zeszyty Naukowe Akademii Rolniczej we Wrocławiu. Rozprawa Habilitacyjna nr 122. Wrocław, 1-72.

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