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## **THE MORPHOLOGY AND DEVELOPMENT OF AORTICORENAL GANGLION (*GANGLION AORTICORENALE*) IN AMERICAN STAFFORDSHIRE TERRIER IN PERINATAL PERIOD**

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[ABSTRACT](#)  
[INTRODUCTION](#)  
[MATERIAL AND METHODS](#)  
[RESULTS](#)  
[DISCUSSION](#)  
[CONCLUSIONS](#)  
[REFERENCES](#)

### **ABSTRACT**

The investigation was made on 11 dogs (American Staffordshire Terrier), coming from two uteruses in perinatal period. The morphological analysis of aorticorenal ganglion was based on the morphometry and morphology of above-mentioned ganglion. The neural connections of the ganglion (afferent and efferent branches and nerves) were also described.

**Key words:** dogs, perinatal period, sympathetic system, aorticorenal ganglion

### **INTRODUCTION**

The accessible literature lacks of wider studies on the morphology and development of aorticorenal ganglion (*ganglion aorticorenale*) in dogs in perinatal period.

The morphologic analysis of aorticorenal ganglion in sheeps and pigs in perinatal period introduced Pospieszny [7, 8]. The morphology of above-mentioned ganglion and its function in neural kidney supply was described by Norvell [6], the innervations of kidneys and suprarenal glands in horse, pig and sheep postnatally, introduced Langenfeld [3].

Aorticorenal ganglion belongs to the binate celiac ganglion, which is the main constituent of celiac plexus, it was described in man by Marciniak, Ziółkowski [4]. The aorticorenal ganglion is binate and it usually lies above the renal artery, between this artery and the abdominal aorta, sometimes it is situated cranially from the renal artery. In some cases the aorticorenal ganglion can be doubled or tripled on one body side [2]. It was described in adult domestic animals.

The work is devoted to the morphological analysis of dog's aorticorenal ganglion in perinatal period. The investigations are very interesting because they refer to the aorticorenal ganglion, which is responsible for a lot of important functions in organism. Our work gives a detailed description of the ganglion, its location and neural connections.

## MATERIAL AND METHODS

The investigation was made on 11 fetuses, 5 males and 6 females, being the contents of two uteruses. The age of fetuses was assigned to the 62<sup>nd</sup> day of gestation. The age of fetuses was calculated by CRL – crown-rump length [1]. Whole material was fixed in 4% formalin solution. During the morphologic investigation 2-3% acetic acid solution and 70% ethanol solution were used in order to make the ganglion and nerves more visible. It allows to proper interpretation of the neuroanatomical events. The author used NAV [5] and NE [5] in the descriptive part of this work. The investigation was made using the magnifying glasses and stereoscopic microscope. The measurements were taken with an electronic slide-caliper to the last complete 0,1 mm. The work contains also photographs.

## RESULTS

### Location

The aorticorenal ganglion in investigated dogs from perinatal period occurred varied topography with regard to renal artery and abdominal aorta. Above-mentioned ganglion lies in four different places, as shown in [Fig.1](#):

- a. cranially, in front of the renal artery
- b. directly on the wall of the renal artery
- c. caudally, behind the renal artery
- d. nearby the outlet of renal artery from abdominal aorta

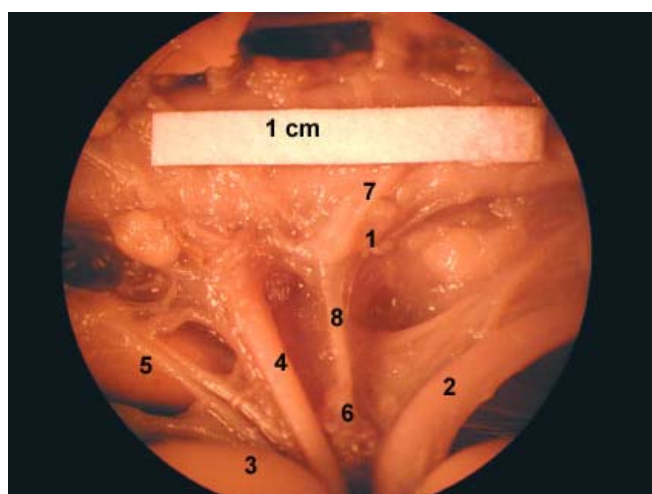
A. The mentioned ganglion lies on the right side in a half of its length in 2 females and 1 male. In 2 females and 1 male it was located on the right side, nearby the hilum of kidney.

B. It lies on the left in 1 female.

C. Aorticorenal ganglion lies on the right in a half of the artery. The same situation on the left occurs in 1 female.

D. It lies on the right side in 1 male.

**Fig.1. The aorticorenal ganglion (ganglion aorticorenale) of dogs (American Staffordshire Terrier) from perinatal period. Left side of investigated material.  
1- aorticorenal ganglion, 2-ureter, 3-kidney, 4-renal artery, 5-suprarenal gland, 6-renal plexus, 7-communicating branches, 8- renal branches**



The duplicated aorticorenal ganglion on both body sides occurred in 2 males and 1 female. In one female, the first ganglion was located on the left side behind the renal artery in a half of its length and the second lies in front of the renal artery, nearby the hilum of kidney. In the first male both the ganglions lie on the left side, below the wall of abdominal aorta. In the second male, the first ganglion was located behind the renal artery, in a half of its length and the second lies in front of the renal artery, nearby the hilum of kidney.

### Shape

The shape of investigated ganglion:

- e. elongated
- f. ovate

The aorticorenal ganglion was elongated on the right side in 4 males and 5 females, and on the left side in 4 females and 3 males. The ganglion take the shape of oval in other investigated fetuses.

### Morphometry

During the investigations following measurements were executed:

- a. length of the aorticorenal ganglion on both side of the body
- b. length from the aorticorenal ganglion to caudal extremity of the suprarenal gland on both side of the body ([Tab.3](#))

A. The averaged length of ganglion in the first and the second group was similar and equals:

I group – right side 0.34 mm; left side 0.276 mm; II group – right side 0.31 mm; left side 0.297 mm ([Tab.1](#)).

B. The longest section was in the first group on the left side and equals 3.878 mm, the shortest section was in the second group on the right side and equals 2.153 mm ([Tab.4](#)).

**Table 1. The morphometry of aorticorenal ganglion with regard to the length and weight of fetus**

Fetus					Length of the ganglion			
Uterus	Number	Sex	Length	Weight	Right	Left	Right average	Left average
I	1	F	180	403	0.32	0.25	0.34	0.276
	2	M	160	393	0.33	0.51		
	3	F	160	462	0.39	0.34		
	4	F	160	350	0.31	0.16		
	5	M	160	426	0.35	0.19 0.21		
II	6	F	160	329	0.23	0.34	0.311	0.293
	7	M	180	476	0.21	0.24 0.18		
	8	F	170	348	0.51	0.41		
	9	F	160	349	0.32	0.34		
	10	M	190	436	0.34	0.29 0.16		
	11	F	180	398	0.26	0.33		

**Table 2. The sceleototopy with regard to the lumbar vertebrae**

Uterus	Number	Sex	Left side	Right side
I	1	F	L <sub>1</sub>	L <sub>2</sub> – L <sub>3</sub>
	2	M	L <sub>1</sub> – L <sub>2</sub>	L <sub>1</sub> – L <sub>2</sub>
	3	F	L <sub>3</sub>	L <sub>3</sub>
	4	F	L <sub>1</sub> – L <sub>2</sub>	L <sub>1</sub> – L <sub>2</sub>
	5	M	L <sub>2</sub> – L <sub>3</sub>	L <sub>1</sub> – L <sub>2</sub>
II	6	F	L <sub>1</sub> – L <sub>2</sub>	L <sub>1</sub> – L <sub>2</sub>
	7	M	L <sub>1</sub> – L <sub>3</sub>	L <sub>2</sub> – L <sub>3</sub>
	8	F	L <sub>1</sub> – L <sub>3</sub>	L <sub>1</sub>
	9	F	L <sub>2</sub> – L <sub>3</sub>	L <sub>1</sub> – L <sub>2</sub>
	10	M	L <sub>2</sub> – L <sub>3</sub>	L <sub>1</sub> – L <sub>2</sub>
	11	F	L <sub>1</sub>	L <sub>1</sub> – L <sub>2</sub>

**Table 3. The length of section from the aorticorenal ganglion to the suprarenal gland caudal extremity**

Uterus	Number	Sex	Left side	Average	Right side	Average
I	1	F	2.06	3.878	2.07	2.624
	2	M	4.27		3.25	
	3	F	4.01		3.15	
	4	F	4.23		3.18	
	5	M	4.03 4.41		1.47	
II	6	F	2.11	3.017	3.11	2.153
	7	M	3.47 2.01		3.24	
	8	M	1.86		1.00	
	9	F	3.25		2.00	
	10	F	3.77 1.69		1.72	
	11	M	2.98		1.85	

**Table 4. The length of section from the aorticorenal ganglion to the suprarenal gland caudal extremity with regard to sex**

Number	Sex	Left side	Average	Right side	Average
2	M	4.27	3.29	2.07	2.624
5	M	4.03 4.41		3.25	
7	M	3.47 2.03		3.15	
8	M	1.86		3.18	
11	M	2.98		1.47	
1	F	2.06	3.017	3.11	2.153
3	F	4.01		3.24	
4	F	4.23		1.00	
6	F	2.11		2.00	
9	F	3.25		1.72	
10	F	3.77 1.69		1.85	

#### Neural connection

The aorticorenal ganglion joins the following nerves and neural branches:

1. greater splanchnic nerve (nervus splanchnicus major)
2. lumbar part of the sympathetic trunk (pars lumbalis truncus sympaticus)
3. lumbar splanchnic nerves (nervi lumbales splanchnici)
4. renal branches (rami renales)
5. renal plexus (plexus renalis)

The greater splanchnic nerve - branches from the thoracic ganglion Th<sub>5</sub> – Th<sub>13</sub> on both sides in investigated fetuses. The thoracic ganglia gives communicating branches (rami communicantes), which join each other and form the trunk of above-mentioned nerve. This situation refers to both sides of the body. After its formation, the greater splanchnic nerve goes through the aortic hiatus to the suprarenal gland's region. There, the major part of neural fibres reaches the caudal pole of suprarenal gland, the slender of neural fibres join the aorticorenal ganglion ([Tab.5](#)).

**Table 5. The location of major splanchnic nerve and the place of neural roots branching**

Uterus	Number	Sex	Location of nerve		Place of branching	
			Left side	Right side	Left side	Right side
I	1	F	Th <sub>13-7</sub>	Th <sub>13-6</sub>	Th <sub>11-10-9-8</sub>	Th <sub>10-9-8</sub>
	2	M	Th <sub>12-7</sub>	Th <sub>13-6</sub>	Th <sub>10-9-8-7</sub>	Th <sub>9-8-6</sub>
	3	F	Th <sub>11-9</sub>	Th <sub>10-7</sub>	Th <sub>11-10-9</sub>	Th <sub>10-8-7</sub>
	4	F	Th <sub>12-8</sub>	Th <sub>12-9</sub>	Th <sub>11-10-8</sub>	Th <sub>11-10-9</sub>
	5	M	Th <sub>11-5</sub>	Th <sub>11-9</sub>	Th <sub>10-9-8-5</sub>	Th <sub>11-10-9</sub>
II	6	F	Th <sub>11-8</sub>	Th <sub>10-6</sub>	Th <sub>10-9-8</sub>	Th <sub>10-8-6</sub>
	7	M	Th <sub>12-9</sub>	Th <sub>13-8</sub>	Th <sub>11-10-9</sub>	Th <sub>12-11-8</sub>
	8	M	Th <sub>13-8</sub>	Th <sub>9-5</sub>	Th <sub>10-9-8</sub>	Th <sub>9-8-6</sub>
	9	F	Th <sub>12-8</sub>	Th <sub>12-6</sub>	Th <sub>12-8</sub>	Th <sub>9-8-7</sub>
	10	F	Th <sub>12-6</sub>	Th <sub>10-5</sub>	Th <sub>10-9-6</sub>	Th <sub>8-6-5</sub>
	11	M	Th <sub>13-8</sub>	Th <sub>12-9</sub>	Th <sub>10-9-8</sub>	Th <sub>12-9</sub>

The lumbar part of sympathetic trunk – its lumbar ganglia (L<sub>1</sub> –L<sub>5</sub>) are well-developed, taking the shape of spindle, lying below the muscle psoas major and psoas minor (musculus psoas major et minor) on the right and the left side of the body. They give the lumbar splanchnic nerves in the amount of two on both sides, which are joining the renal plexus and the aorticorenal ganglion.

The lumbar splanchnic nerves – branch from three lumbar ganglia (L<sub>1</sub>, L<sub>2</sub>, L<sub>3</sub>) on the left and the right side and reach the aorticorenal ganglion. The first lumbar ganglion (L<sub>1</sub>) gives four branches, which penetrate into the renal plexus and the aorticorenal ganglion.

The renal branches – branching from the caudal extremity of aorticorenal ganglion. The longest branch goes to the hilum of kidney.

The renal plexus – accompany the renal artery, it is located near the hilum of kidney and around above-mentioned artery. The plexus is formed by branches from the celiac plexus, lumbar splanchnic nerves, the branches of lesser splanchnic nerve and branches from the aorticorenal ganglion.

### Sceletotopy

The location of aorticorenal ganglion is varied not only in males and females, but also on the right and left side of the body. It is caused by the varied location of above-mentioned ganglion with regard to the renal artery and abdominal aorta. In 1 female it lies on both sides on the level of L<sub>3</sub>. In 1 male on the level of L<sub>1</sub> no the right side. In 3 males and 4 females the ganglion lies on the level of L<sub>1</sub> – L<sub>2</sub>. In 1 male and 1 female it is located on the level of L<sub>2</sub> – L<sub>3</sub> on the right. The varied location of ganglion occurs also on the left side of the body. In 2 females and 2 males it lies on the level of L<sub>1</sub> – L<sub>2</sub>. In 1 male on the level of L<sub>1</sub> – L<sub>3</sub>. In 2 females and 1 male it lies on the level of L<sub>2</sub> – L<sub>3</sub>. In 1 male and 1 female it is located on the level of L<sub>1</sub> ([Tab.2](#)).

## DISCUSSION

The morphology of aorticorenal ganglion in perinatal period depends on the development of varied organs in fetus.

The location of ganglion changes in perinatal period from L<sub>1</sub> – L<sub>3</sub> in investigated dog's fetuses. It is caused not only by the location of ganglion with regard to the renal artery and abdominal aorta, but also by the location of abdominal organs with regards to each other. The location of aorticorenal ganglion in pigs from perinatal period is stable [7].

In our investigation we proofed the varied location of aorticorenal ganglion with regard to renal artery. Above-mentioned ganglion lies cranially or caudally from the renal artery, it lies also directly on the wall of abdominal aorta or nearby the output of renal artery from aorta. We observed two shapes of the ganglion: ovate and elongated. The same ganglion in pigs takes the shape of spindle, triangular or it was irregular [7].

The length of mentioned ganglion is much bigger on the right side both in males and females than on the left.

The aorticorenal ganglion joins the major splanchnic nerve, lesser splanchnic nerve, celiac ganglion and celiac plexus, lumbar splanchnic nerves, renal plexus and (by renal branches) kidney.

Our results can not be compared to the works introduced by Langenfeld and Norvell [3], because their investigations refer to adult animals.

### CONCLUSIONS

The investigations of aorticorenal ganglion morphology in dogs (American Staffordshire Terrier) from perinatal period allows to come to the conclusion that:

1. The sex of investigated fetuses does not depend on the location of aorticorenal ganglion.
2. It occurs four locations of the ganglion.
3. It occurs two shapes of above-mentioned ganglion.
4. It occurs varied location with regard to the lumbar vertebrae and the renal artery.
5. Varied ganglion length on both sides of the body.

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