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Anatomo-Topographic Features of the Adrenal Gas in Various Animals

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ABSTRACT

This article presents a review of the literature data on the anatomical and topographic features of the adrenal glands of various animals.

Relevance. The adrenal glands are small paired endocrine glands [2,8,13]. The location of the adrenal glands can be different:

I. Holotopia. The adrenal glands are located in the lumbar region, in the retroperitoneal space, in the thickness of the perirenal tissue [2,4,5,8,12,13].

II. Skeletotopia. Lyashchenko D.N., Lyashchenko S.N.[6] when studying the topography of the adrenal glands, it was determined that the right adrenal gland can be located at the level from the middle of the intervertebral fissure ThX-XI to the lower edge of the body LI, the left adrenal gland is determined at the level from the lower edge of ThX to the upper edge of the body LII. Most often, the right and left adrenal glands are projected to the level of the middle of the ThXII body. Each adrenal gland is located at the level of the 11th and 12th intercostal spaces [13]. In some animals, the adrenal glands can be located asymmetrically, relative to the spinal column [8]. Fedotov D.N. [10] Having studied the species specificity of the anatomical and topographic features of the adrenal glands in piglets, taking into account holotopy, skeletotopy and syntopy, he determined that the adrenal glands are located at the level of I - II lumbar vertebrae - in newborns, the last thoracic - I lumbar vertebrae - in suckling pigs and weaners (the right one is slightly lower than the left).

III. syntopia

The adrenal glands are located above the upper pole of each respective kidney

[2,4,5,12,13]. Sergeev A.A., Choporova N.V.[8] when studying the adrenal glands of domestic animals, it was found that in some animals the adrenal glands are located asymmetrically relative to the spinal column, in cattle the adrenal glands are located in front of the kidneys, in the horse it is near the inner edge of the kidneys, in the pig they are located on the inside of the anterior end of the kidneys. The right adrenal gland is located above the left [6,10,14].

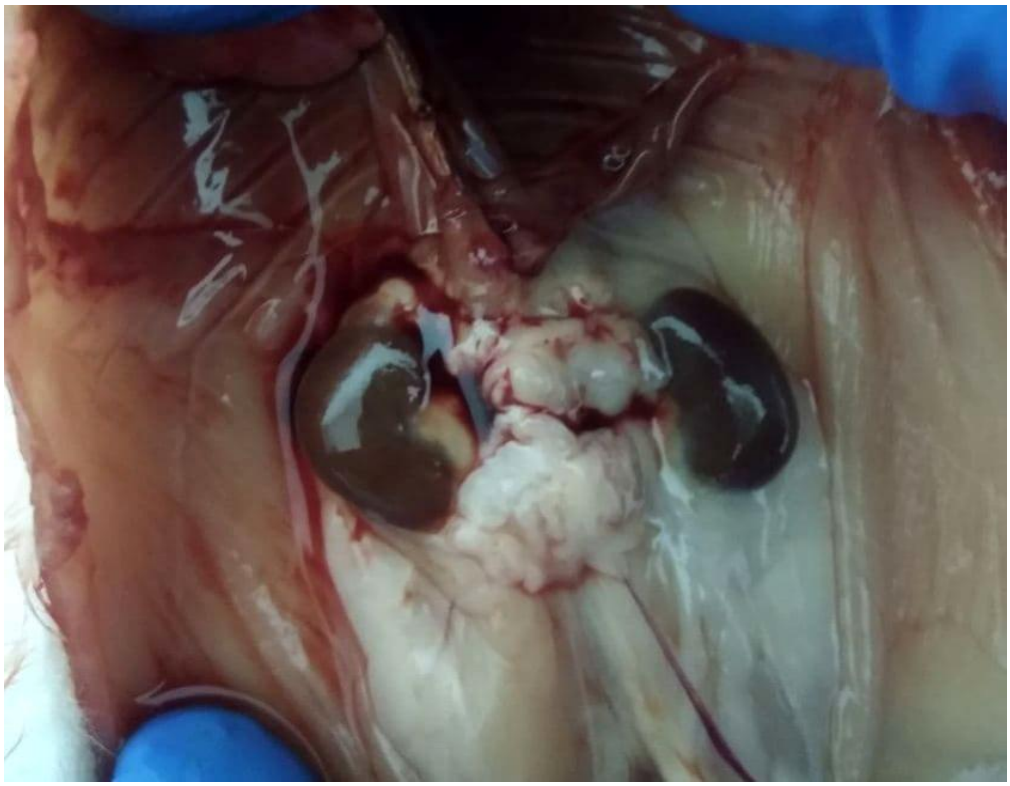

Figure 1. Topography of the adrenal glands of white outbred rats 3 months of age. Photo of an autopsied animal after removal of the liver, spleen, pancreas and gastrointestinal tract

Fedotov D.N.[10] having studied the syntopy (topographic relation of the organ to neighboring anatomical structures) of the adrenal glands of newborn piglets, suckling piglets and weaned piglets, he concluded that the formation of the endocrine functions of the adrenal glands in the early stages of postnatal ontogenesis of piglets, when the processes of shaping and growth of the developing organism deserve special attention are carried out with great intensity and lead to serious transformations. In newborn piglets, the adrenal gland lies medially on the kidney, its cranial end does not reach the cranial pole of the kidney by 4–6 mm. The organ lies on the renal vein. The left adrenal gland is completely covered by the pancreas, but the caudal end of the adrenal gland is bordered by the spleen and the greater curvature of the stomach. The right adrenal gland is in close contact with the kidney. Covered by the right lateral lobe and the caudate process of the liver;

- in suckling piglets, the adrenal gland is located medio-cranially on the kidney. The caudal part of the organ is covered by the left lobe of the pancreas. The adrenal gland is in contact with the renal vein. The right adrenal gland covers the entire cranial pole of the kidney and is covered by the right lateral lobe of the liver;

- in weaned piglets, the adrenal gland lies on the cranial pole of the kidney (3 mm from its caudal end of the adrenal gland to the renal vein). The left organ is in contact with the spleen and the greater curvature of the stomach. The pancreas does not cover it. The kidney has a fatty capsule, which is a fatty perinephric body. The right adrenal gland lies on the renal vein, not in

contact with the kidney. The adrenal glands of adult mammals are located at the inner sides of the anterior ends of the kidneys [5]. The adrenal glands are located close to critical vessels and organs. The right adrenal gland is located just below the liver, behind the inferior vena cava and anterior to the diaphragm. The left adrenal gland is located medial to the spleen, superior to the splenic artery and vein, lateral to the abdominal aorta and anterior to the diaphragm [13]. Saadi A. et al. in their studies determined that the location of the right adrenal gland in front of the right crus of the diaphragm occurs in 85%, in 15% of cases the right adrenal gland was located between the right crus of the diaphragm and the psoas muscle. The left adrenal gland in 40% of cases is located directly in front of the left crus of the diaphragm, in 60% of cases between the left crus of the diaphragm and the psoas muscle. In cattle, the right adrenal gland lies near the vena cava and joins the liver, while the left adrenal gland lies next to the aorta [8]. In appearance, the adrenal glands are most often described as pyramids flattened from front to back [2,12,13,]. The right adrenal gland looks like a triangle with rounded corners, and the left one resembles a crescent [2,12,13,]. According to the description by R Megha et al. [13], the right adrenal gland has a pyramidal shape, while the left adrenal gland has a crescentic shape. Bandyreva L.A. [5] in the study of the glands of various mammals describes the shape of the adrenal glands depending on the type of mammals, the adrenal glands can be of various shapes, round-oval in sika deer, sheep and cattle, heart-shaped and triangular in deer and goats. Sergeev A.A., Choporova N.V. [8], while studying the adrenal glands of domestic animals, came to the conclusion that in some animals the adrenal glands have the same bean-shaped shape as the kidneys. The adrenal glands of a pig, a horse are flat, oblong in shape. In cattle, the shape of the right adrenal gland is triangular with a large depression at the base, resembling the shape of a sickle or heart, the shape of the left adrenal gland is elongated, horseshoe-shaped with a curved end, which resembles a hook. The adrenal glands of piglets are oval-elongated, in weaners they begin to acquire a lanceolate shape, the cross section of the glands is triangular in shape [10]. The appearance of the adrenal gland depends on many factors, such as the topographic and anatomical location, the connection of the gland with nearby organs, and large main vessels. The adrenal glands are in close contact with the kidneys, stomach, spleen, liver, pancreas. In the immediate vicinity of the gland there are such large vessels as the abdominal aorta, inferior vena cava, renal vessels (Sapin M.R., Milyukov V.E., Dolgov E.N., Bogdanov A.V. [2]). The adrenal glands are located close to critical vessels and organs [13]. Sapin M.R., Milyukov V.E., Dolgov E.N., Bogdanov A.V. [2] when describing modern ideas about the structure of the human adrenal glands, they determined that the weight of each adrenal gland in a person is finally established by the age of 20 and, on average, is 4-7 g. Each gland weighs an average of 5 g [13]

Mitani F. et al. [11], studying the functional zonality of the rat adrenal cortex, note that the total weight of the adrenal glands is about 10–15 g in humans and 40–60 mg in rats. Islamov Sh.E., Makhmatmuradova N.N., Normakhmatov I.Z. [3] argue that the relative weight of the adrenal glands in intact rats is 0.13 ± 0.0026 mg per 100 g of animal body weight. P Nagarajan, R Gudde, R Srinivasan [12] also note that rat kidneys weigh about 40–60 mg. The weight of the adrenal glands in cattle is 5-20 g, in a horse 5-41 g, in a pig, the average weight of the adrenal glands is 4 g [8] . The consistency of the adrenal glands is quite dense [2,5,8]. The glands are externally covered with a fibrous capsule [2,3,5,8]. According to R Megha, CJ Wehrle, S Kashyap, SW Leslie [13], a thick capsule consisting of connective tissue surrounds the entire adrenal gland. The thickness of the capsule is directly dependent on the age of the animal, the capsule in the organ of young individuals is thin, due to which the strands of cells are visible,

and the thickening of the adrenal capsule is observed in mature animals [7]. The glands have a smooth surface [2,5,8]. The adrenal gland has three surfaces: anterior, posterior, and inferior. The lower surface is also called the renal, or the base of the adrenal gland. The anterior and posterior surfaces are connected by the superior and medial margins [2]. On the anterior surface of the gland there is a well-defined, horizontal groove, which forms the gate of the adrenal gland. The length of the adrenal gland in humans is on average 4-6 cm, width - up to 2-5 cm and thickness - 0.2-2.0 cm, while the size of the right adrenal gland is slightly smaller than the left one [2,13] Megha R., Wehrle C.J., Kashyap S., Leslie S.W. [13], studying the size of the adrenal glands, concluded that the size of the adrenal glands at birth is approximately one third of 1/3 of the size of the kidney, in adults they are only 1/30 of the size of the kidney. The dimensions of the adrenal glands are 50 mm high, 30 mm wide and 10 mm thick. The size of the adrenal glands ranges from 2-3 cm in small ruminants, to 5-8 cm in large ruminants. In cattle, the length of the adrenal gland is 2.5-3 cm, thickness 1-1.5 cm. 4-9 cm, width 2-4 cm. Pig adrenal glands are on average about 4 cm long [8]. Sapin M.R. et al., [2] studying modern ideas about the structure of the human adrenal glands, came to the conclusion that the adrenal glands have a yellowish color. Nagarajan P., Gudde R., Srinivasan R [12], in their work note the adrenal glands as small light pink nodules.

In cattle, the color of the adrenal glands may be red with a bronze tint, in the horse, the color of the adrenal glands is red-brown [8]

When studying the morphology of the endocrine system organs in nutria Luppova, I.M., Kurishko O.M., Fedotov D.N. [7] found that the color of the adrenal glands depended on the age of the animals. The color of the adrenal glands in young animals can be light yellow, yellow, yellow with a creamy tint, beige, later, due to the thickening of the adrenal gland capsule in mature animals, the gland acquires a gray-yellow color with a brownish-yellow tint. The adrenal glands of newborn piglets are maroon-brown in color, in other periods of development of piglets they become brown [10]. The color of the adrenal glands on the cut is yellow on the outside and darker in the central part of the gland [7,13].

The adrenal cortex tends to be thicker and therefore more yellow in color. The adrenal medulla is more reddish-brown in color [13]. Bondyreva L.A., Luppova I.M. describe the color of the layers of the adrenal gland in a section, the cortical, outer, lying on the periphery, has a lighter color and the medulla, located in the central part of the gland, is darker. Sapin M.R. et al. pointed out that macroscopically, on a transverse section of the human adrenal glands, at the border of two layers of the cortical and medulla, one can sometimes notice a dark-colored strip - an intermediate layer, called Virchow's layer, which is a connective tissue layer and often interrupted.

The adrenal glands produce various vital hormones, which requires a good blood supply, so the adrenal glands are extremely well vascularized. The blood supply to the gland is carried out due to the penetration of the upper, middle and lower adrenal arteries into the adrenal gland. According to Wright N, Burns B.[16] The three main sources of blood supply to the adrenal glands are:

The superior adrenal arteries, which are small branches from the inferior phrenic artery.

1. The middle adrenal artery arises directly from the abdominal aorta.

2. The inferior adrenal artery departs from the renal artery on both sides

Megha R., Wehrle C.J., Kashyap S., Leslie S.W.[13] note that there are many variations in the origin of the adrenal arteries. The superior adrenal artery may originate from: abdominal

aorta, celiac trunk, intercostal artery (rare). Middle adrenal artery from the inferior phrenic, renal, superior mesenteric artery or from the celiac trunk. The inferior adrenal arteries may originate from the abdominal aorta and from the inferior phrenic artery. Kigata T., Shibata H. studied the anatomical variants of the arterial blood supply to the adrenal glands of rats by introducing colored latex into the arteries. and concluded that the number of adrenal arteries varies on the right - from 4 to 12, on the left - from 3 to 11, and the total number is from 9 to 20 (average 14). There are no gender differences in the nature of vascularization; individual variations are common in rats. Venous drainage from the adrenal glands depends on the side of the gland [13,17] Siebert M, Robert Y, Didier R, Minster A, M'sallaoui W, Bellier A, Chaffanjon PC. [17] described anatomical variations in the venous outflow from the adrenal glands. The left adrenal gland is anatomically further away from the inferior vena cava, so the left adrenal vein flows into the left renal vein. The right adrenal vein is located much closer to the inferior vena cava and flows directly into this large vessel. There are reports of venous connections between the left adrenal and left pudendal veins, as well as the inferior phrenic vein. Double left adrenal veins are also common.

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