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Original Contribution

ANATOMOTOPOGRAPHICAL AND MORPHOLOGICAL ANALYSIS OF NORMAL KIDNEYS OF RABBIT (ORYCTOLAGUS CUNICULUS)

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ABSTRACT

AIM: To determine some qualitative and quantitative characteristics of normal kidneys in rabbits and their use in diagnostics of kidney lesions in animals.

MATERIALS: We used 12 mature, clinically healthy, euthanized rabbits, 8 months of age from New Zealand White breed and weight between 2.8kg and 3.2kg.

METHODS: After applied laparotomy we studied the topography and the shape of the kidneys in the rabbits. The results were collected and recorded. There were also macroscopical linear measurements done after the organ's extirpiration. The obtained data was processed via variable statistical methods.

RESULTS: The right kidney was situated in the margins between 13th thoracic and 2nd lumbar vertebras and the left kidney was between the margins of 3rd and 5th lumbar vertebras. The lateral edges did not reach the sides of the abdominal walls. The pelvis of the left kidney was larger in length and smaller in width compare to the right organ. The width of the cortex and the medulla of the right kidney were greater than the left one. The width of the hilus of the right kidney was greater than the left.

CONCLUSION: The right kidney in rabbit is shorter and narrower and the left is longer, wider and dorsoventrally flattened. The right kidney is located craniomedially and dorsally compare to the left. Despite many authors, we used as bone landmarks only the bodies of the thoracic and lumbar vertebras.

Key words: kidney, cadaver anatomy, rabbit

INTRODUCTION

The kidneys in rabbit are single-partition (unipyramidal). They are localized retroperitoneally, as the right kidney is between the 11th and 12th intercostal space and the second lumbar vertebrae. The cranial pole reaches the liver under the last intercostal space and makes a mark on the caudal end of it. The caudal pole of the right kidney goes to the descending end of the duodenum. The left kidney is localized between the 2nd and 4th lumbar vertebras and remains ventrocaudally to the right one. Ventrally of the left kidney are situated arches of the jejunum and ventrocranially – the descending colon as well as the body of the pancreas. The left kidney touches the left abdominal wall (1, 2).

The rabbit kidneys are described in details from (3). The author presents these organs as relatively primitive in structure compare to the kidneys of the rest of the mammals. The right kidney is situated cranially to the left one. The kidneys are unipapillary and the evaginations of the fornix of the pelvis are large. The rabbit does not have superficial kidney veins, which prominate under the fibrous capsule, unlike the kidneys of the human, dog and the cat. The number of kidney glomerules in rabbits are increased after birth, compare to the rest of the mammal, where their number remains constant. In rabbit unlike the other mammals the urine is rich in calcium and magnesium

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compounds, due to the lower calcium reabsorption.

Many researchers (4) study the kidneys of the rabbit in relation to the development of some animals of unilateral and bilateral kidney agenesis.

Morphometric study of the kidneys in rabbit is done from (5, 6). The authors present comparative data for the weight, volume, craniocaudal, dorsoventral and mediolateral dimentions of the kidneys before and after formalin fixation.

The rabbit is good experimental model for research and reproducibility of results for kidney transplantations in human (7). The authors perform successful kidney transplantation in rabbit as they study the donors and the recipients.

Some authors (8) study morphometrically the kidneys in rats. The authors complete comparative analysis of weight, length, width of the left and the right kidneys in male and female rats and find sexual dimorphism.

In 2005 year (9) research anatomotopographically the kidneys in human and determine that the localization of the kidneys is not dependant on the level of separation of the relevant kidney artery from the abdominal aorta.

The incomplete literature for macroscopical anatomy of the kidneys in rabbit had motivated us to conduct the present study.

Our aim was to determine some qualitative and quantitative characteristics of the normal kidneys in rabbit to be able to utilize the results for diagnostics of kidney lesions in animals.

MATERIALS AND METHODS

Object

We looked at 12 mature, clinically healthy rabbits, 8 months of age from New Zealand White and weight between 2.8kg and 3.2kg. The animals were euthanized with 150 mg i. v. Thiopental® (thiopental sodium 1000 mg) Biochemie, Austria (10).

Anatomotopographic study

Right after the euthanasia of the animals was performed laparotomy. The topography and the shape of the left and the right kidney were studied. The results were documented with digital camera Canon Legria HF R16E (Canon Inc. Japan).

Macromorphometric study

Macroscopic linear measurements of the kidneys in rabbit were studied after extirpiration of the organs. For that purpose we used Standard Caliper – MITUTOYO D-2 (USA). The statistical analyses (descriptive statistics) were performed with statistical software (11).

Ethical protocol

The study was approved by the institutional committee of animal care. The experiments were made in strict compliance with European convention for vertebrate animals' protection, used for experimental and other scientific purposes (Starsbourg /16th May, 1986), European convention for companion animals' protection (Starsbourg /13th November, 1987) and animal protection's law in Republic of Bulgaria (section IV-Experiments with animals, art. 26, 27 and 28, received on 24th January 2008 and published in Government Gazette, № 13, 2008).

RESULTS

The cranial pole of the right kidney had reached the beginning of 13th thoracic vertebrae and had made impression on the caudal lobe of the liver. The caudal pole had reached the end of the 2nd lumbar vertebrae. The lateral edge did not touch the right abdominal wall. The right kidney remained to the middle of the length between the spine and the side abdominal wall **(Figure 1)**. The left kidney had been situated in the borders of the cranial end of 3rd lumbar vertebrae to cranial end of the 5th lumbar vertebras. The lateral edge did not reach the left abdominal wall. The left kidney was found laterally to the middle of the distance between the spine and the side abdominal wall **(Figure 2)**.

The shape of the two kidneys was typical kidney-bean, as the one of the right was more flattened in cranio-caudal direction (**Figure 3**). During the study of the middle cut of the kidney clearly were marked the different parts of the parenchyma (cortex, medulla, papilla and papilla) and the kidney pelvis (**Figure 4**). The kidneys of the rabbit were typical unipyramidal. The papilla had sharp arch end, which stood out toward the kidney hilus. The kidney pelvis was respectively concaved toward the free end of the papilla that formed two recesses (**Figure 4**).

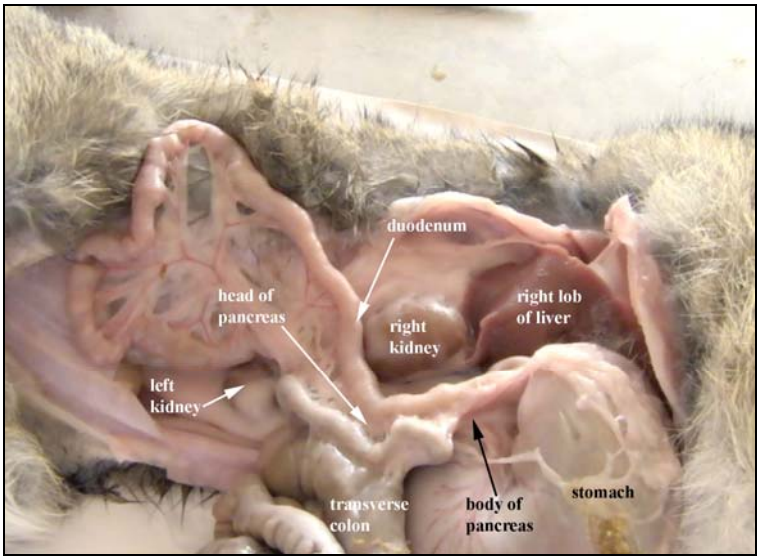

Figure 1. Anatomotopographical localization of the right kidney in rabbit.

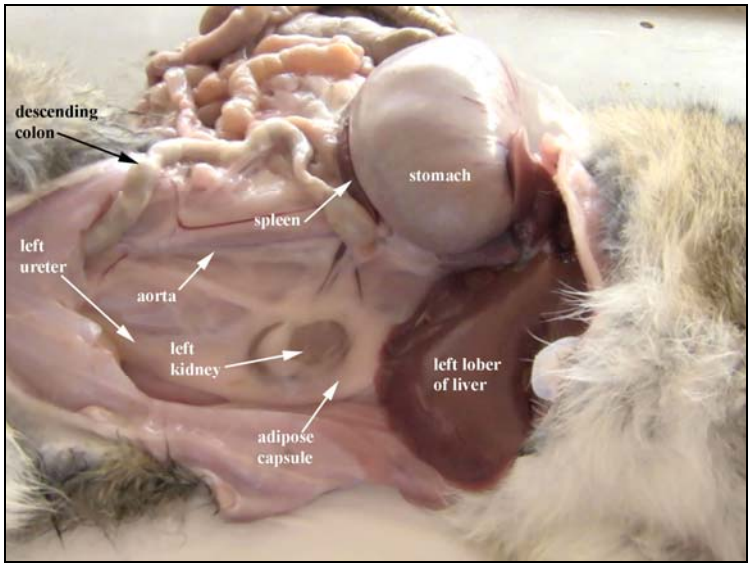

Figure 2. Anatomotopographical localization of the left kidney in rabbit.

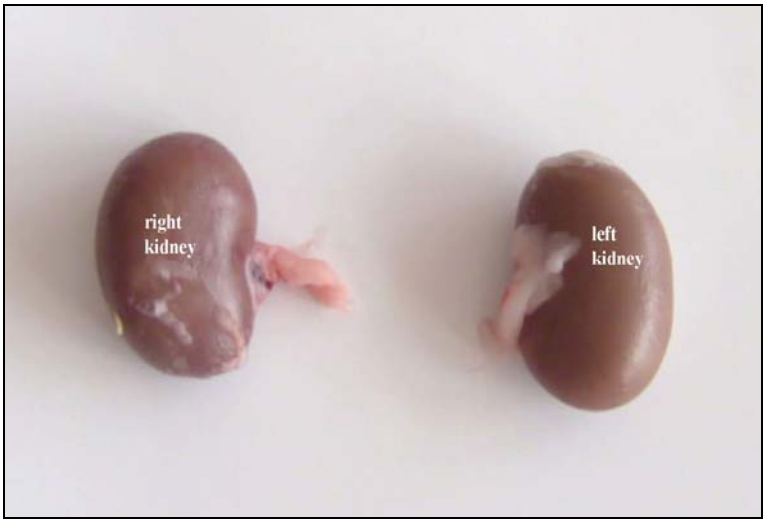

Figure 3. Shape of right and left kidney in rabbit.

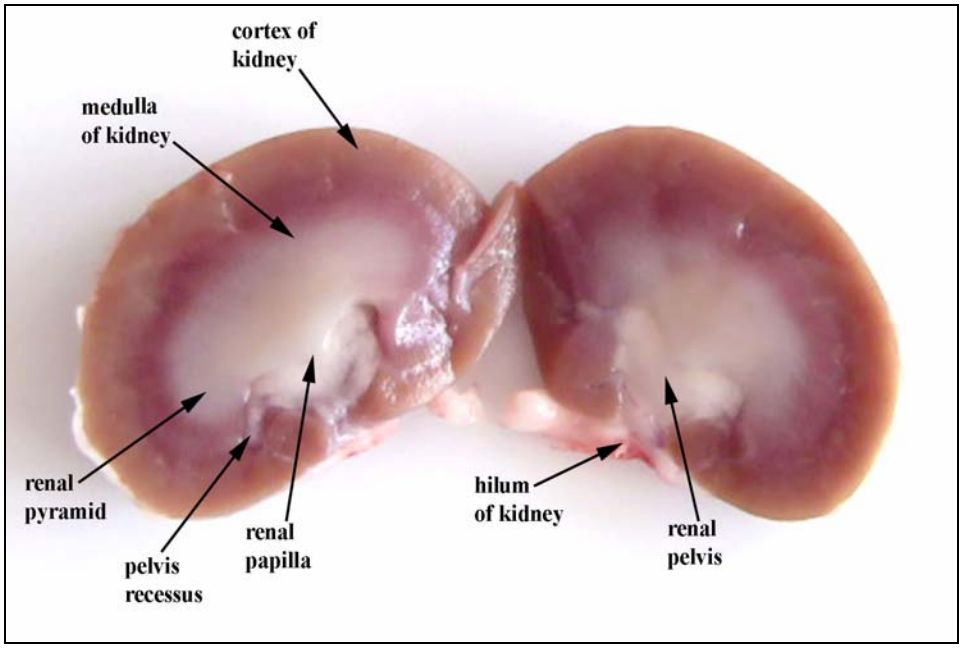

Figure 4. Middle cut surface of the kidney in rabbit.

Morphometric study showed that the left kidney is longer and wider (mediolateral size) compare to the right one. The dorsoventral size of the right kidney was greater compare to the left one (**Figure 5 and Table 1**). The pelvis of the left kidney had greater length and smaller width compare to the right. The width of the cortex and the medulla of the right kidney were with greater values than the left one. The width of the hilus of the right kidney was greater compare to the left one (**Figure 6 and Table 1**).

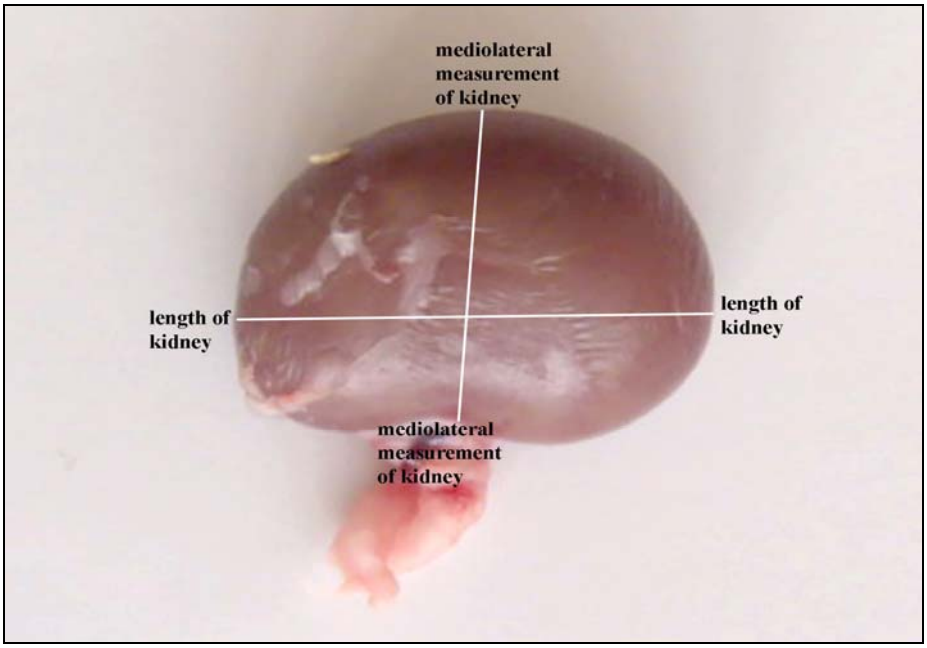

Figure 5. External parameters of the kidney in rabbit.

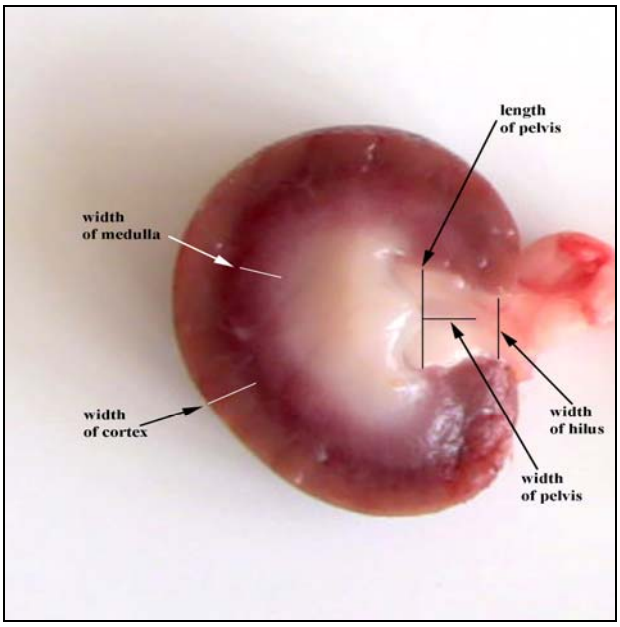

Figure 6. Internal parameters of kidney in rabbit.

Table 1. *Measured macroscopic parameters (in mm) of the normal kidneys of New Zealand white rabbit*

View of kidney	N	Parameters	Range	Minimum	Maximum	Mean	Standart Error	Standart Deviation
View of right kidney	12	Length of kidney	4	33	37	35.25	0.35	1.22
	12	Mediolateral measurement of kidney	3	24	27	25.5	0.29	1
	12	Dorsoventral measurement of kidney	3	16	19	17.75	0.3	1.06
	12	Length of pelvis	3	9	12	10.5	0.29	1
	12	Width of pelvis	2	9	11	9.92	0.23	0.79
	12	Width of cortex	2	5	7	4.92	0.19	0.67
	12	Width of medulla	2	4	6	4.5	0.18	0.62
	12	Width of hilus	3	4	7	5.58	0.23	0.79
View of left kidney	12	Length of kidney	2	38	40	38.83	0.21	0.72
	12	Mediolateral measurement of kidney	3	25	28	26.5	0.23	0.8
	12	Dorsoventral measurement of kidney	4	15	19	16.92	0.31	1.08
	12	Length of pelvis	3	13	16	14.17	0.27	0.94
	12	Width of pelvis	2	7	9	8.755	0.18	0.62
	12	Width of cortex	1	4	5	4.5	0.15	0.52
	12	Width of medulla	2	3	5	4	0.17	0.6
	12	Width of hilus	2	4	6	4.75	0.18	0.62

DISCUSSION AND CONCLUSION

From the obtained macromorphometric data we can conclude that the right kidney in rabbit is shorter, narrower and the left is longer, wider and dorsoventrally more flattened compare to the right one. The right kidney is positioned cranionmedially and dorsally compare to the left one.

The results from our study showed that the kidneys in rabbit are with asymmetric localization, as the left kidney is positioned caudolaterally to the right. The data confirms the

research from (1-3) regarding the topographical position of the kidneys in rabbit.

Unlike (1, 2), who determine the localization of the kidneys compare to the intercostal space and the bodies of the corresponding vertebras, we used as costal guide only the bodies of the thoracic and lumbar vertebras. The determined by us topographic localization of the right and the left kidney does not correspond with the results from (1, 2).

The studied from us kidneys in rabbits were unipyramidal, which corresponds with the data from (1-3). The kidneys laterally did not touch the abdominal walls, as the left was positioned more laterally compare to the right one. The data does not support the statements from (1-3), according to which the left kidney does touch the left abdominal wall.

The presence of the found by us recesses of the pelvis corresponds to the data from (3) for the morphology of the kidneys in the rabbit.

In comparison to the research by (4), which studies the kidneys in rabbits in relation to the growth of kidney abnormalities, we looked at some qualitative and quantitative parameters of the kidneys in healthy animals.

Unlike (5, 6), who show morphometric data of the kidneys before and after fixation, we give data of organs studied immediately after laparotomy and extirpiration.

In comparison to the results of (8) for the kidneys in rats, we did not conjunct our results for kidneys in rabbits with sexual dimorphism.

Despite the determined from (9), by whom the localization of the kidneys is not dependent of the level of separation of the appropriate kidney artery, we did not use the artery as vessel marker for the disposal of the kidneys in rabbits.

Just like the standpoint of (7), according to which the rabbit is good experimental model for research of kidney transplantation in humans we also claim that the rabbit is suitable biological model for clinicoanatomical study of the kidney lesions in animals.

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