

## Some macrometric anatomical parameters of the adrenal glands in the New Zealand white rabbit

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### ABSTRACT

The anatomical features of the rabbit adrenal glands have been investigated in some aspects, either via classic anatomical methods and routine histology, either using imaging modalities in our previous experiments. The present study is focused for obtaining data, concerning the objective values of three macrometric indices – lateromedial, craniocaudal and dorsoventral diameters. We used the cadavers of thirty-four 8-month old (sexually mature) healthy white New Zealand rabbits weighing 2.8-3.2 kg. We reached the abdominal cavity after median incision. The both kidneys were kept in abdominal cavity with a view to find more easily the location of the right and left adrenal glands. The material was documented using a digital camera. The craniocaudal, dorsoventral and lateromedial diameters have been measured using a digital caliper, as the obtained values were accurate to the second sign. Descriptive analysis of the results using Statistica 8 - StatSoft DELL was performed. The lateromedial diameter of the right adrenal gland was  $5.1 \text{ mm} \pm 1.0$ , craniocaudal diameter was  $9.3 \text{ mm} \pm 1.2$  and the dorsoventral diameter -  $5.0 \text{ mm} \pm 0.8$ . For the left adrenal gland were measured the following values - the lateromedial diameter was  $6.5 \text{ mm} \pm 1.2$ , the craniocaudal diameter was  $10.2 \text{ mm} \pm 1.4$  and the dorsoventral diameter was  $6.3 \text{ mm} \pm 0.9$ . Our results showed that the studied parameters of the left gland were with higher values compared to the right gland. The results from the conducted anatomical study deepens the knowledge for the macroscopic features of the rabbit adrenal glands.

## INTRODUCTION

The contemporary investigations in Human Medicine include rabbits as an animal model to study the mechanisms of many human diseases, the medical treatment of neoplasms, orthopedic approaches and surgery technics (1).

The rabbit adrenal glands are used as a model for laboratory experiments. The stress in the rabbit is many time predominant and it is connected to the normal condition of the rabbit glands. Many researchers conduct adrenalectomy in rabbits to investigate the function of the adrenal gland as a model in humans. It is known that there are variations, regarding the arterial blood supply of the rabbit glands (2).

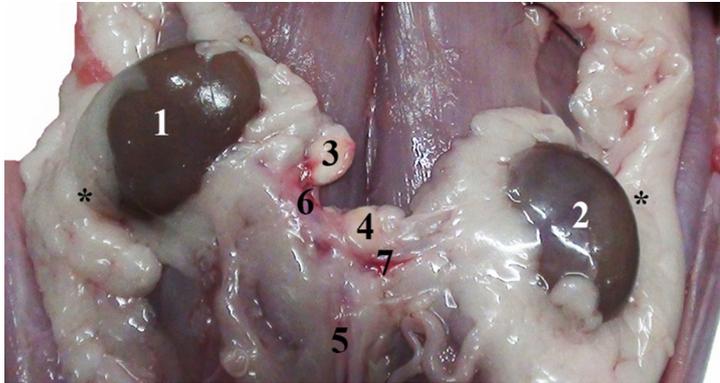
Even more, the rabbit is introduced as a pet. The modern veterinary medicine considers the rabbits as predisposed animals for adrenal glands diseases. The knowledge of the normal ultrasonographic measurements of the glands are important as a base for diagnosis of adrenocortical disease, adrenal tumor or testosterone pathologies. The adrenal neoplasia and hyperplasia are related to hypertestosteronism (3, 4).

The right adrenal gland in the rabbit is ellipsoid and situated craniomedially to the right kidney and more cranial to the left gland. In the same time, it is dorsolaterally orientated to the caudal vena cava. The left gland is oval and situated laterally to the abdominal aorta. The right gland is closer to the right kidney, while the left gland is in a distance to the left kidney (5, 6). The adrenal glands in the cat are situated cranially to the right and respectively the left kidney. Their lateromedial diameter in ultrasound studies varies from 0.29–0.53 cm (7).

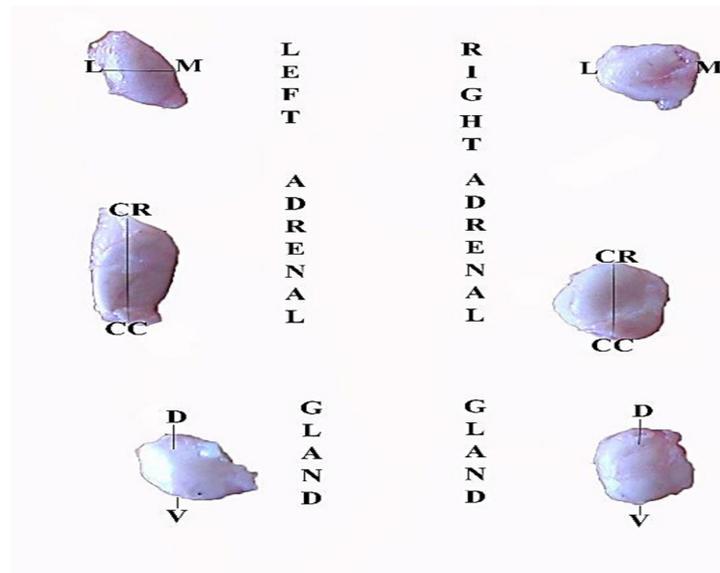
In many studies, the ultrasonographic method is used as an anatomical method to study the dorsoventral diameter (width) of the canine adrenal glands from different breeds. This parameter is more precise, compared to the length of the gland and it is constant to the body size (9). According to some authors (8), the normal width of the left adrenal gland in the small dog breeds is  $4.32 \pm 1.00 \text{ mm}$ , and that of the right adrenal width is  $4.21 \pm 1.1 \text{ mm}$ . Both parameters are with close values. The normal adrenal width in small breeds is constant to the body weight.

The literary data which focus on the macrometric measurements of the glands in the rabbit are scarce. The

normal anatomical parameters of the glands are reported mainly using ultrasound. The dissection is performed only to investigate the topography and closeness of the glands (10). The aim of this study to investigate macrometric anatomical parameters of the adrenal glands in the New Zealand white rabbit.



**Figure 1.** Gross Anatomy of the rabbit abdomen. Both kidneys are kept in the abdominal cavity. (1) right kidney; (2) left kidney; (3) right adrenal gland; (4) left adrenal gland; (5) caudal vena cava; (6) right renal artery; (7) left renal artery; (\*) adipose capsule.



**Figure 2.** Anatomic presenting of the studied parameters in the rabbit adrenal glands. LM - lateromedial diameter; CR, CC – craniocaudal diameter; DV - dorsoventral diameter

## MATERIAL and METHODS

### Anatomical algorithm

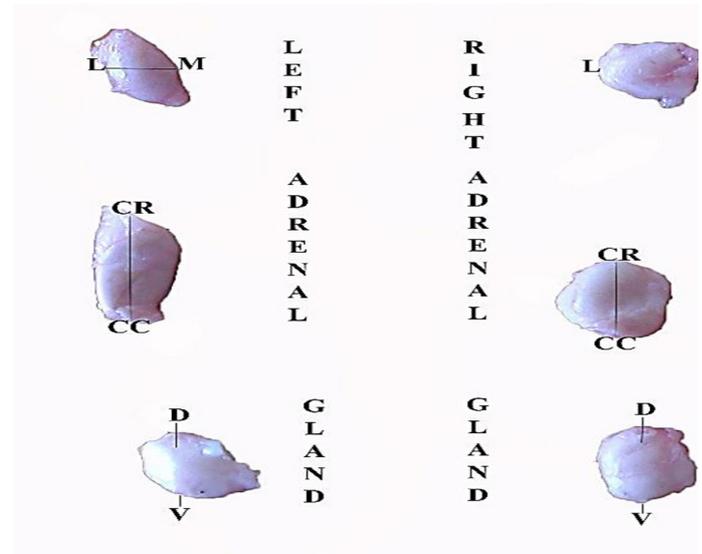
We used the cadavers of thirty-four (seventeen males and seventeen females) 8-month old (sexually mature) healthy white New Zealand rabbits weighing 2.8-3.2 kg. The rabbits euthanised under general anaesthetics 4 mg/kg of xylazine (Xylapan, Chassot, 20 mg/ml) and 50 mg/kg of ketamine (Narketan 10, Chassot, 100 mg/ml). We reached the abdominal cavity after median incision. For better orientation the abdominal organs were eviscerated. The both kidneys were kept in abdominal cavity with a view to find more easily the

location of the right and left adrenal glands. The material was documented using a digital camera (Figure 1).

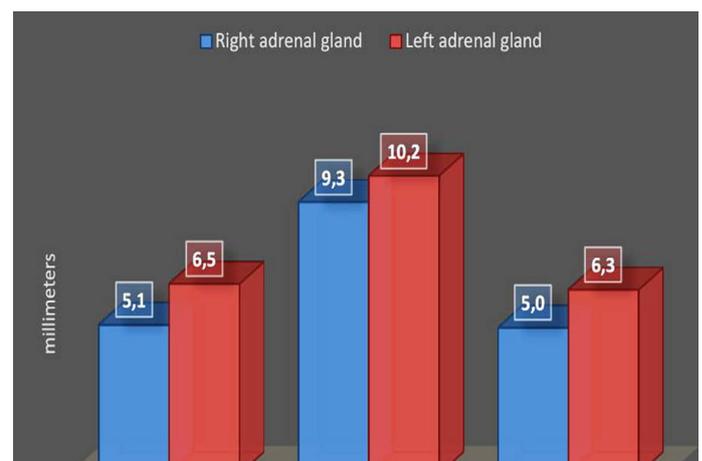
The craniocaudal (CR, CC), dorsoventral (DV) and lateromedial (LM) diameters have been measured using a digital caliper, as the obtained values were accurate to the second sign (Figure 1 and Figure 2).

### Statistical analysis

Descriptive analysis of the results using Statistica 8 - StatSoft DELL was performed. Correlations were calculated between some anatomical diameters of adrenal gland and body weight.



**Figure 3.** Graphic presenting of the studied parameters in the rabbit adrenal glands. LM - lateromedial diameter; CR, CC – craniocaudal diameter; DV - dorsoventral diameter.



**Figure 4.** Macrometric anatomical parameters of the adrenal glands in the New Zealand white rabbit

## RESULTS

LM diameter of the right adrenal gland was 5.1 mm  $\pm$  1.0 (Figure 4). This parameter was consistent to the body weight

( $P > 0.05$ ) and age ( $P > 0.05$ ) of the animals. LM diameter of the left adrenal gland was  $6.5 \text{ mm} \pm 1.2$ . This parameter was consistent to the body weight ( $P > 0.05$ ) and age ( $P > 0.05$ ) of the animals. This parameter, measured in the left adrenal gland was greater than that of the right gland.

CR, CC diameter of the right gland was  $9.3 \text{ mm} \pm 1.2$ . There was a correlation between adrenal gland CR, CC diameter and the values of the body weight. CR, CC diameter of the left adrenal gland was  $10.2 \text{ mm} \pm 1.4$ . There was a correlation between adrenal gland CR, CC diameter and the values of the body weight.

DV diameter of the right adrenal gland was  $5.0 \text{ mm} \pm 0.8$ . The values of this parameter are similar to the values of DV diameter. There was a correlation between adrenal gland DV diameter and the values of the body weight. DV diameter of the left adrenal gland was  $6.3 \text{ mm} \pm 0.9$ . The values of this parameter are similar to the values of DM diameter. There was a correlation between adrenal gland DV diameter and the values of the body weight.

## DISCUSSION

The obtained data present the macrometric anatomical parameters of the rabbit adrenal glands. Thus we assume that the results could be used for contemporary investigations in the Human Medicine, because the rabbits are used as animal models (1).

We have conducted the present study in order to obtain objective anatomical data for the macrometric parameter of the rabbit adrenal glands. Our theory deepens the knowledge, because it gives objective information for the variation of LM, CR, CC and DV diameters of the studied organs. This information could be used as model for laboratory experiments to investigate the function of the adrenal gland in humans (2).

Our data will be applicable as anatomical base to study the LM diameter, CR, CC diameter and DV diameter of the rabbit adrenal glands, because this animal species is considered as a pet wand at the same time is predisposed for adrenal glands diseases. Our attitude correspond to the data for the importance of the knowledge for the normal measurements of the glands (3,4).

In our investigation, we used the published data (5, 6) for the anatomical peculiarities and topography of the studied organs in the rabbit for better orientation. This study is a continuation of the previous study for the rabbit glands (6) and deepens the knowledge for these glands, because it is focused on the macrometric parameters.

Our algorithm is anatomical and includes the only dissection. We obtained values for the LM diameter of the right and left adrenal glands in sexually mature and clinically healthy animals, separated in two equal groups, regarding the gender. We resume that these anatomical data could be used as a base to study the imaging anatomical specifics of these glands.

Our approach differs from that applied in the cats (7) and dogs (9) to study the adrenal glands, because we include as a

method only the dissection. In the same time, we claim that there is a correlation between adrenal gland DV diameter and the values of the body weight. Our theory corresponds to the thesis for this index of the adrenal glands in the dog (9).

The LM and DV diameters of the rabbit of the right and left adrenal glands were with close values. On the other side CR, CC diameter in the both glands are with greater values than LM and DV diameters. The studied parameters of the left gland were with higher values compared to the right gland. According to us, there is a correlation between the values of the adrenal glands' diameters and the values of the body weight. Our attitude corresponds to the theory of some authors (8) for the adrenal glands in the small dog breeds.

## CONCLUSION

Our results showed that the studied parameters of the left adrenal gland are with higher values compared to the right gland. The data from the conducted anatomical study deepens the knowledge for the macroscopic features of the rabbit adrenal glands. Considering the fact that, these organs in the rabbit are used as model when study the peculiarities of the human glands we propose the given macrometric data to be applied as a morphological base.

## DECLARATIONS

### Ethics Approval

This study was approved by animal ethics committee of the Trakia University (No: 51/2012, No: 59/2013), Bulgaria.

### Conflict of Interest

The authors declare that they have no competing interests.

### Author Contribution

Idea, concept and design: K Stamatova-Yovcheva, R Dimitrov

Data collection and analysis: K Stamatova-Yovcheva, R Dimitrov,

ÖG Dilek, D Yovchev

Drafting of the manuscript: K Stamatova-Yovcheva

Critical review: R Dimitrov, ÖG Dilek, D Yovchev

### Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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