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RESEARCH ARTICLE

Double Renal Artery in Baladi Rabbit

Reda Abd Allah Mohamed

Department of Anatomy and Embryology, Faculty of Veterinary Medicine, Beni Suef University, Beni Suef 62512, Egypt

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***Corresponding Author**
Reda Abd Allah Mohamed
kkidareda@yahoo.com

ABSTRACT

The aim of this study was to describe the variation of the renal arteries in Baladi rabbit which are of importance in the experimental field. Research was carried out on 10 Baladi Rabbits. The arterial system was injected manually with gum milk latex colored red with carmine through the ascending aorta. Careful gross dissection of the abdominal aorta and renal arteries was performed after embedding in 10% formalin solution for 2-3 days. In 90% of the cases, each rabbit kidney was supplied by a corresponding single renal artery that arose from each side of the abdominal aorta. While in 10% of the cases, it was observed that the left renal artery was doubled; left renal and accessory left renal arteries. The accessory left renal artery is smaller than the main left renal artery and it originated from the abdominal aorta slightly caudal to the origin of the main artery.

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INTRODUCTION

Rabbits have been used as urologic models in many studies, such as histotripsy (Styn *et al*., 2010), magnetic resonance imaging (Choo *et al*., 1997) radiofrequency ablation (Miao *et al*., 2001), lithotripsy (Fernandez *et al*., 2009) and partial nephrectomy (Tyritzis *et al*., 2007). Kidneys are paired structures located in the abdominal cavity. The kidneys of domestic animals are typically supplied by a pair of renal arteries from either side of the abdominal aorta (Dyce *et al*., 2002). In a study using dogs Sajjarengpong and Adirektaworn (2006) stated that double renal arteries could be found in both sexes, but only on the left side. Multiple renal arteries to each kidney were also found in some other species: man, cat, guinea pig (Shively, 1978) and mink (Wiland and Indykiewicz, 1999). Such variations in the renal arteries have surgical and radiological importance (Saritha *et al*., 2013). Thus the aim of this study was to describe the variations of the renal arteries as a first experimental study in Baladi rabbit to bring awareness to clinicians during removal, translocation or transplantation of the kidneys.

MATERIALS AND METHODS

The present investigation was carried out on a total of 10 adult apparently healthy Baladi rabbit of both sexes. The animals were collected from several farms at Beni-Suef Governorate. The rabbits were used immediately after slaughtering. Thorough washing was done with normal saline solution via the abdominal aorta. The arterial system was injected manually with gum milk latex colored red with carmine through ascending aorta while the right atrium of heart was opened in order to lower the pressure in the vessels to ensure good injection. A longitudinal incision was made in the midventral line of the abdominal wall starting from the xiphoid cartilage of the sternum till the anus. Careful gross dissection of the abdominal aorta and renal arteries was performed after embedding in 10% formalin solution 2-3 days, with help of a magnifying lens whenever needed. The nomenclature employed in this study was in accordance with that of the Nomina Anatomica Veterinaria (2005) and Gupta *et al*. (2011).

RESULTS

Normally and in 90% of the cases, each rabbit kidney has only a single renal artery arising from each side of the abdominal aorta and entered it via its hilum. The right renal artery (Fig. 5/1) emerged from the abdominal aorta at the level of the cranial aspect of the 2nd lumbar vertebra slightly cranial to the left renal artery. The left renal artery (Figs. 1, 2/2) was seen arising from the abdominal aorta at the level of the 2nd lumbar vertebra nearly 1.5 cm far from the origin of the cranial mesenteric artery caudally and about 0.5cm caudal to the origin of the right renal artery. The left renal artery was longer than the right renal artery.

In one case, there was an accessory left renal artery (Figs. 1,2/3) that arose from the abdominal aorta at the level of the 3rd lumbar vertebra and entered the kidney via its hilum. It was smaller than the main left renal artery. The distance between the origins of the accessory left renal and left renal arteries was 1.3 cm with the accessory one being caudal. Each of the right renal artery and the main left renal artery gave off cranial abdominal artery (Figs. 1/4, 1/6, 2/4) while, no extra branching was seen on the accessory left renal artery. The right kidney showed no vascular changes. The right and left kidneys of the rabbit did not show any gross abnormalities.

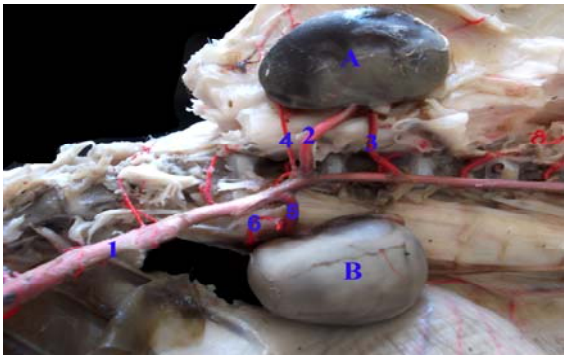

Fig 1: A photomicrograph of the internal viscera of the renal region of Baladi rabbit showing the duplication of the left renal artery; 1: Abdominal aorta; 2: Left renal artery; 3: Accessory left renal artery; 4: Cranial abdominal artery; 5: Right renal artery; 6: Cranial abdominal artery; A: Left Kidney; B: Right kidney

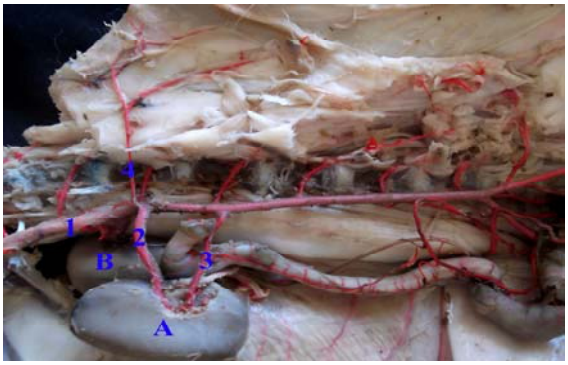

Fig. 2: A photomicrograph of the internal viscera of the renal region of Baladi rabbit showing the duplication of the left renal artery (The left kidney is reflected to the right side); 1: Abdominal aorta; 2: Left renal artery; 3: Accessory left renal artery; 4: Cranial abdominal artery; A: Left Kidney; B: Right kidney.

DISCUSSION

The current study showed that the renal arteries observed in this study originated from each side of the abdominal aorta, the finding which was in agreement with that described by Nickel *et al*. (1981) and Aksoy *et al*., (2004) in Tuj sheep. While, Ghoshal (1975) determined that their origins to be from the ventral surface of the aorta in ruminants.

The study under investigation showed that the left renal artery was longer than the right renal artery, confirming observations of Maženský *et al*. (2012) in New Zealand White rabbits, Aksoy and Ozudogru (2003) in Van cat, Ozudorgu and Ozdemir (2005) in wolf, Nickel *et al* (1979) in cattle. While Sajjarengpong and Adirektaworn (2006) in dog, Ozdemir *et al*. (2009) in Kangal dog, Aksoy *et al*., (2004) in Tuj sheep and Nickel *et al* (1979) in horse, Paryani (2012) in one humped camel mentioned that the right renal artery was longer than the left one.

In this study, the incidence of double renal arteries was in 10% of the Baladi rabbits and they were only on the left side, which simulated that reported in 10% New Zealand White rabbits (Maženský *et al*., 2012), 2.63% in European rabbit (Nowicki *et al*., 2010), in a three old male cadaver cat (Pestana *et al*. 2011), one case in goat (Abidu-Figueiredo *et al*., 2009 and Olopade *et al*., 2010), 9.72% in dogs (Sajjarengpong and Adirektaworn, 2006) and 20.7% in mink (Wiland and Indykiewicz, 1999). While, Christensen (1952), Reis and Tepe (1956), Shively (1978) and Wiland and Indykiewicz (1999) found double renal arteries on the both sides, although they reported that the incidence of double renal arteries was more on the left side than on the right side. Gupta *et al*. (2011) stated that in 1.7% of humans there are three accessory renal arteries that are found on left side.

In the present work, the accessory left renal artery was smaller than the left renal artery, as shown by Olopade *et al*. (2010) in Nigerian goat.

In agreement with that recorded by Sajjarengpong and Adirektaworn (2006) in dogs, the present study stated that the double right renal artery in the rabbit was not present. While, Maženský *et al*. (2012) in New Zealand White rabbits stated that in one case, the accessory renal artery was recorded in the right kidney. Moreover Aksoy and Ozudogru (2003) in 16% of Van cats stated that there are two right renal arteries, the right dorsal and right ventral renal arteries arise from the ventral aspect of the abdominal aorta. Wiland and Indykiewicz (1999) in 20.0% of dogs and Kurtul *et al*. (2002) in a cadaver of the German shepherd dogs stated that right renal artery is doubled. Gupta *et al*. (2011) stated that in 1.7% of humans there are two accessory renal arteries are present on right side. Loukas *et al*. (2005) in a male human cadaver reported that there are three renal arteries observed on the right side, the authors added that on the right side, one accessory renal artery originated as a common trunk with the inferior mesenteric artery.

The obtained results were parallel to those described by Maženský *et al*. (2012) in New Zealand White rabbits and Nowicki *et al*. (2010) in European rabbit who mentioned that the cranial abdominal was a paired artery originating from right and left renal arteries.

Morphological variations observed here could have been linked to embryonic development (Noden and de Lahunta, 1985 as well as Sajjarengpong and Adirektaworn 2006) and we hypothesize that the presence of double renal arteries may be due to two events during development. Firstly, the lateral aortic branch does not degenerate and the renal artery develops from the lateral aortic branch. In the fetus, multiple lateral branches supply the mesonephros and as the mesonephros degenerates, the lateral aortic branch also degenerates. Secondly, the double renal arteries come from dorsal and

ventral branches which arise directly from abdominal aorta of double renal arteries. During embryonic development, the dorsal, lateral and ventral branches arise from the aorta. The renal artery develops from the lateral branch that is paired.

Conclusion

The presence of accessory renal arteries is an important anatomical feature which the surgeons should be aware of to avoid damage of these arteries during removal or translocation of the kidney and to evaluate the donor kidneys for possible renal transplantation, renovascular reconstruction and uroradiological procedures.

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