Anatomical radiological features of abdominal aorta and some of its branches in the rabbit in the segment Th12-L3

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ABSTRACT

Ten sexually mature rabbits of New Zealand white breed were studied. Post mortal angiography of abdominal aorta was conducted. The results from post mortem angiography in ventrodorsal recumbency presented topography and anatomical location of abdominal aorta and some of its branches in the cranial and middle abdominal region. Celiac artery was visualized at the transition between Th13 and L1. Splenic artery belongs to the common gastrolienal trunk. Left gastric artery, gastroduodenal artery, common hepatic artery, proper hepatic artery arise from celiac artery as separate branches. Left and right hepatic arteries are branches of proper hepatic artery. The post mortem angiography of abdominal aorta and its branches in dorsoventral aspect in the segment between Th12-L3 gives information about topography, anatomical location and way of the abdominal aorta, celiac artery, right and left renal arteries. Left cranial abdominal artery is well defined vessel. In both projections (ventrodorsal and dorsoventral), the transition between Th13 and L1 is anatomical landmark for beginning of celiac artery.

Keywords: abdominal aorta, celiac artery, anatomy, radiology

Introduction

The rabbit liver is anatomical model to investigate hepatic arterial blood supply in humans. There is morphological similarity in hepatic arterial system in these biological species (Burgener and Gothlin, 1978).

Macroscopic features of the main abdominal vessels and their branches in New Zealand White rabbit have been investigated by some researchers (Abudi-Figueiredo et al., 2008). The authors carry out the study, due to lack of confirmatory data regarding their topology.

Rabbit celiac artery is divided into two trunks: hepatic artery is included together with gastroduodenal and right gastric artery in one trunk; there is another trunk common for splenic artery and left gastric artery (Ahasan et al., 2012).

Celiac artery in European rabbit is composed of common hepatic artery and common trunk. The last is divided into left gastric artery and splenic artery (Nowicki et al., 2010).

The topographic beginning of rabbit celiac artery in most cases is at the transition between Th13 and L1. Celiac artery is a branch of abdominal aorta (Abudi-Figueiredo et al., 2008)

There is celiac mesenteric trunk in humans, which includes celiac artery and superior mesenteric artery (Çiçekcibai et al., 2005).

Other authors (Nonent et al., 2001) find that celiac artery, superior mesenteric artery and inferior mesenteric artery form in humans celiac bimesenteric trunk.

According to Abudi-Figueiredo et al. (2008) there are two main branches of rabbit celiac artery: splenic l artery and left gastric artery. Rabbit hepatic artery arises from left gastric artery. The beginning of splenic artery from celiac artery presents the vessel as a single branch, when it penetrates the spleen it is divided into one to four branches. Splenic artery has also additional smaller branches (one to five) that are found on the visceral surface of stomach.

Seo et al. (2001) find in the rabbit two hepatic arteries: common hepatic artery and proper hepatic artery. There are four X-ray attenuated vessels which define the beginning and origin of proper hepatic artery - abdominal aorta, celiac trunk, common hepatic artery and cranial mesentery artery.

Cranial abdominal artery is a paired vessel. In most cases the left and right cranial abdominal artery arises from corresponding renal arteries. Topography of the right cranial abdominal artery is cranial to left cranial abdominal artery. Rarely the anatomical projection of both vessels coincides. It is possible both cranial abdominal arteries to arise from abdominal aorta's wall. Thus the topography of these arteries is cranial to renal arteries (Maženský et al., 2012).

Lack of appropriate literary data for anatomical features of celiac artery and some of its branches are motif to carry out the present *post mortem* anatomical radiological study. The obtained data could be applied as comparative anatomical base for morphological interpretation of the abdominal vessels in other biological specimens, including humans.

Materials and Methods

Objects: Ten sexually mature rabbits of New Zealand white breed were studied. The average carcass weight was from 1 to 1.5 kg. The cadavers were obtained from slaughterhouse for extraction production and meat processing of lagomorphs in compliance with the requirements of regulation (Regulation № 36 from March 23, 2006, published in Government Gazette № 35 from April 24, 2006) regarding hygiene and inspection at slaughter.

Subjects: The cadavers were studied, according to the following algorithm:

1. Anatomical study of the topography of the intra-and extra-thoracic part of abdominal aorta and its branches, following dissection in compliance with methods of the classic anatomy (Figure 1).

2. Cannulation of the abdominal aorta in the segment of Th12-L4.

3. Ligation of cranial mesenteric artery, celiac artery and abdominal aorta.

4. Preparation of concentrated X ray positive solution. The mixture contains DK-BAR-MILVE (90 g $BaSO_4$ and 8.37 g excipients) 30 g of natural gypsum and 100 ml water (Yonkova, 2014).

5. Injective function in the abdominal aorta with X-ray positive mixture.

6. Postmortal angiography of abdominal aorta. The study was performed with X-ray machine TUR 800 D-1 (Röntgenbelichtungsautomat – 20029), Dresden with digitizing camera- iQ-CR ACE, who is a CR reader to digitize X-ray imaging.

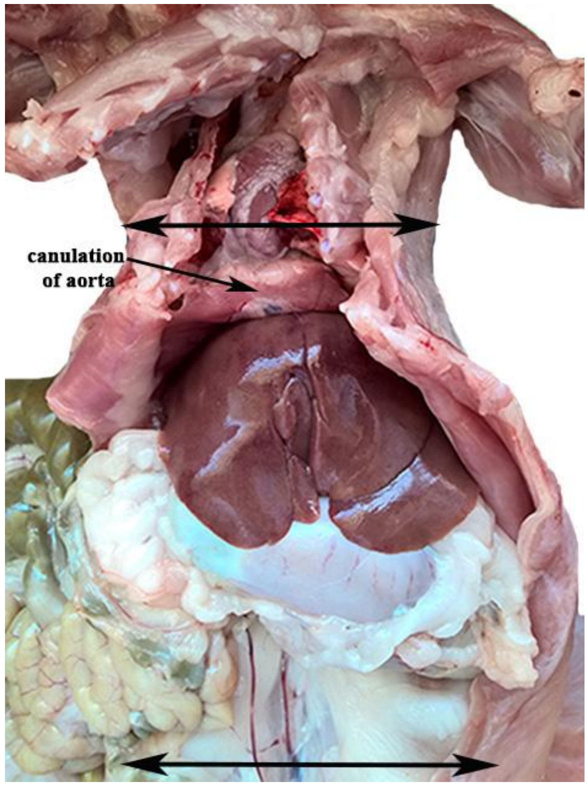

Figure 1: Anatomical algorithm to section parts of the trunk (in the segment from Th11 to L4) (arrows) and anatomical approach to cannulate abdominal aorta.

Results

The results from post mortem angiography in ventrodorsal recumbency present topography and anatomical location of abdominal aorta and some of its branches in the cranial and middle abdominal region. The anatomical image of the celiac artery is visualized in gray-whitish nuances and is located at the transition between Th13 and L1 with clearly defined lines and anatomical location of its main branches. Splenic artery belongs to the common gastrolienal trunk and it penetrates the splenic pulp, splitting into smaller branches. When reach the stomach splenic artery is split into smaller branches, which are well defined soft tissue norm attenuated findings compared to the visceral surface of the stomach. Left gastric artery is a branch of celiac artery. The vessel is hypperattenuated finding. It is close to lesser curvature of stomach. Gastroduodenal artery arises from celiac artery, close to abdominal aorta. Common hepatic artery is a separate branch of celiac artery. Soft tissue characters of proper hepatic artery and common hepatic artery are the same. Proper hepatic artery is a branch of celiac artery. Left and right hepatic arteries are branches of proper hepatic artery. Left hepatic artery is composed of right and left branches and the right hepatic artery gives branches to gall bladder and right lobe of liver. Left renal artery is a direct branch of abdominal aorta. It penetrates renal hilus and split into smaller branches (Figure 2).

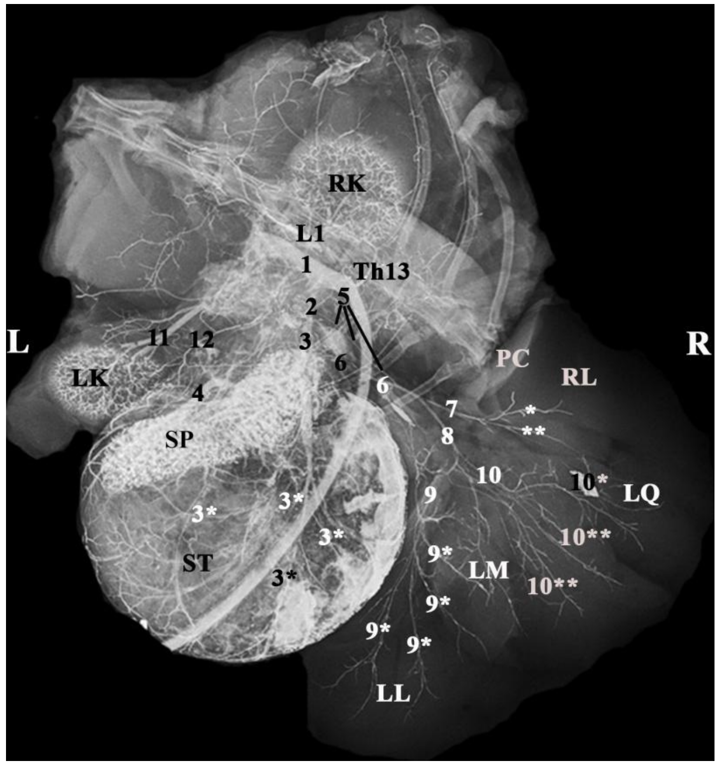

Figure 2: Post mortal radiological angiography of the abdominal aorta and its branches of the rabbit at ventrodorsal view. (Trunk has been cut and cadaveric segment between Th11 and L4 has been used). (1) abdominal aorta; (2) celiac artery; (3) splenic artery; (4) left gastric artery; (5) common hepatic artery; (6) proper hepatic artery; (7) right hepatic artery; (*) branch of right hepatic artery; (**) cystic artery (8) left hepatic artery; (9) lateral branch of left hepatic artery; (9*) subbranch of the lateral branch of left hepatic artery; (10) medial branch of left hepatic artery; (10*) subbranch of the medial branch of left hepatic artery in quadrate lobe; (10**) subbranch of the medial branch of left hepatic artery in left medial lobe of the liver; (11) left renal artery; (12) gastroduodenal artery; (LL) left lateral lobe of liver; (LM) left medial lobe of liver; (LQ) quadrate lobe; (RL) right lobe of liver; (PC) caudate process; (ST) stomach; (SP) spleen; (LK) left kidney; (RK) right kidney.

The *post mortem* angiography of abdominal aorta and its branches in dorsoventral aspect in the segment between Th12-L3 gives information about topography anatomical location and way of the abdominal aorta, celiac artery, right and left renal arteries. When the cadaver segment is positioned in dorsoventral recumbency, transition between Th13 and L1 is visualized. This anatomical structure is used as bone landmark, which defines the beginning of celiac artery. Celiac artery is X-ray positive finding, close to dorsolateral surface of L1. Because of overlap of adjacent structures, the end segments of the left and right renal arteries are visualized, immediately upon encroachment into hilus renalis. Left cranial abdominal artery is well defined vessel together with X-ray positive branches of lumbar arteries. The topography of the vessel is cranial to the left renal artery. Because of overlap of the soft tissues, the beginning of left cranial abdominal artery and right cranial abdominal artery itself are not observed (Figure 3).

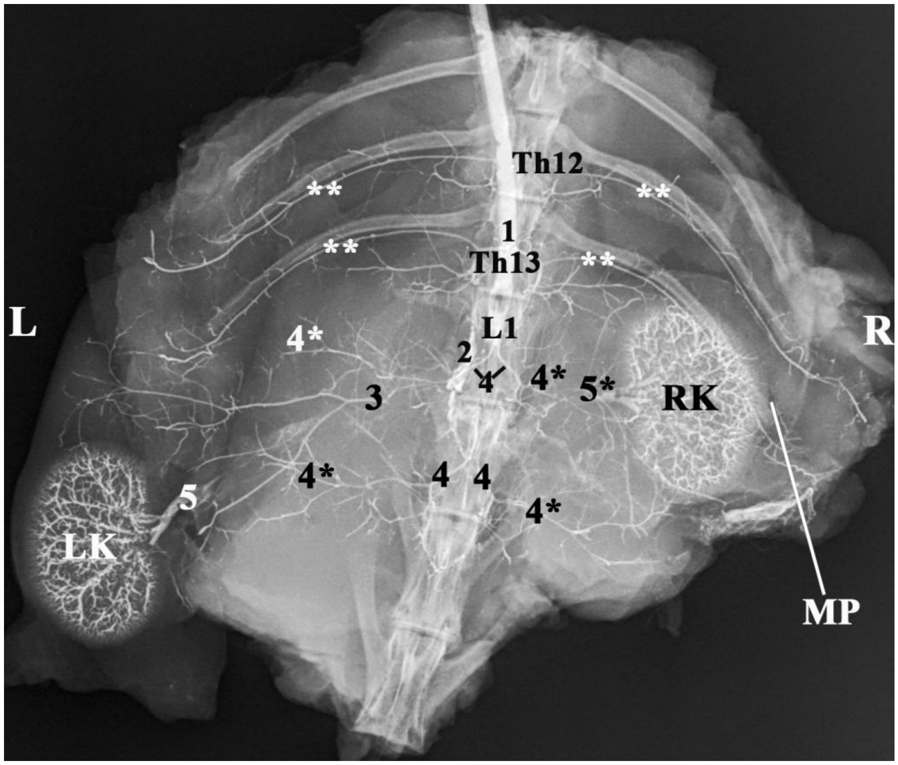

Figure 3: Post mortal radiological angiography of the abdominal aorta and its branches of the rabbit at dorsoventral view. (Trunk has been cut and cadaveric segment between Th11 and L4 has been used). (1) abdominal aorta; (2) celiac artery; (3) left cranial abdominal artery; (4) lumbal arteries; (5) left renal artery (5*) right renal artery; (**) intercostal arteries; (MP) Morison pouch; (LK) left kidney; (RK) right kidney.

Discussion

Data of the present anatomical study motivate us to present results that the rabbit is a suitable model for anatomical investigation of the abdominal vessels in humans and some domestic mammamls. This fact corresponds to the study of Burgener and Gothlin (1978), which concerns the same biological species.

The results of the present morphological study confirm and add described by Ahasan et al. (2012) macroscopic features of the celiac artery and its branches (splenic artery and left gastric artery belong to common gastrolienal trunc).

Common hepatic artery is a separate branch of the celiac artery, contrary to described by Ahasan et al. (2012) second arterial trunk, which is common for hepatic artery, gastroduodenal artery and right gastric artery.

The obtained anatomical data for celiac artery in New Zealand rabbit correspond to the published results by Nowicki et al. (2010) for the topographic features of the celiac artery and its two branches in european rabbit. Common hepatic artery is a separate, sharply distinguished branch of celiac artery. Left gastric artery and splenic artery begin from celiac artery and form common trunk.

Contrary to Nowicki et al. (2010) who find two separate branches of celiac artery in european rabbit, the obtained by us anatomical angiographic data demonstrate also gastroduodenal artery, except described by Nowicki et al. (2010) common hepatic artery, left gastric artery and splenic artery, connected in a common trunk.

Our results for localization and totpography of celiac artery toward the bone spinal segement (Th13-L1) correspond to data of Abudi-Figueiredo et al. (2008) that transition between Th13 and L1 is anatomical landmark, which defines topography of the beginning of celaic artery.

In comparison to described in humans by Çiçekcibai et al. (2005) celaic mesenterial trunk, celiac artery in the white New Zealand rabbits is a separate branch of the abdominal aorta, which possesses the following radiologically visible branches: splenic artery, left gastric artery, gastroduodenal artery and common hepatic artery.

Contrary to data of Nonent et al. (2001) for celiac bimesenteric trunk in humans (composed of celiac artery, superior mesenteric artery and inferior mesenteric artery), we find that celiac artery is a separate branch of the abdominal aorta and it does not form commun vascular trunk with cranial and caudal mesenteric arteries.

Contrary to data of Abudi-Figueiredo et al. (2008) that rabbit celiac artery has two main branches-splenic artery and left gastric artery we find the following: splenic artery, left gastric artery, gastroduodenal artery and common hepatic artery are branches of celiac artery. Except common hepatic artery there is another vessel which participates in arterial blood supply of the rabbit liver lobes - proper hepatic artery. It is a branch of celiac artery.

The results of the present anatomical radiological study for topographic features of splenic artery, which interprete that artery belongs to the common gastrolienal trunk and penetrates the splenic pulp, and its anatomical contact with visceral surface of the stomach (splenic artery has smaller branches which are sharply distinguished and normoattenuated findings, compared to stomach) correspond to data of Abudi-Figueiredo et al. (2008) for the same artery in domestic rabbit.

Proper hepatic artery arises from celiac artery, compared to published variations in its origin by Seo et al. (2001) (abdominal aorta, celiac trunc, common hepatic artery, cranial mesenteric artery).

In accordance with Maženský et al. (2012) who describe cranial abdominal artery in the rabbit we also find by this radiological anatomical method left cranial abdominal artery. Due to overlapping of soft tissues at dorsoventral recumbency of the studied object, right cranial abdominal artery is not visualized. Found by us cranial localization of the left cranial abdominal artery to the left renal artery motivates us to assume that this vessel is a direct branch of the abdominal aorta. This fact add the attitude of Maženský et al. (2012) that cranial abdominal artery arises from abdominal aorta and in the same time differs to published by the same author that cranial abdominal artery is a branch of the renal artery.

Conclusion

The results from the anatomical radiological study for abdominal aorta and its branches in the segment Th12-L3 provides information on macroscopic anatomical features of intra- and extrathoracic part of abdominal aorta, celiac artery, renal artries and some branches as cranial abdominal artery. The obtained data are descriptive, complete and confirm described by some authors for these vessels in the rabbit. Data from the present study are for: anatomical localiaztion of celiac artery in the segment Th13-L1; common gastrolienal trunk, which includes left gastric artery and splenic artery; topography of splenic artery toward vicseral surface of the stomach; anatomical localiaztion of left gastric artery and gastroduodenal artery; two hepatic arteries, which are branches of celiac artrey and anatomy of cranial abdominal artery. These facts motivate us to assume: by postmortal radiological study with X-ray positive mixture, that contains $BaSO_4$, can obtain detailed anatomical and imaging anatomical data for the way, topography and anatomical localization of abdominal aorta and its branches.

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