



## Research article

# Gross investigation and histological structure of abdominal aorta in local rabbits (*Oryctylagus conniculus*)

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(Received 19/8/2017, Accepted 22/11/2017)

## Abstract

*In the current study, fifteen rabbits from both sex have been used to identify the anatomical and histological structure of abdominal aorta. Ten rabbits used for anatomical study. The celiac artery was a first branch of abdominal aorta (A.A.) and then followed by cranial mesenteric artery, right and left renal arteries, lumber artery, caudal mesenteric artery and finally it's give off two common iliac trunk. The splenic artery was the larger branch of celiac artery and the cranial mesenteric artery was the greater branches of A.A. of rabbits. The lumber branches was very clear and a raised from the ventral aspect of A.A. There were numerous of jujenal arteries arises from cranial mesenteric artery and the testicular or ovarian arteries sometime originated above or below caudal mesenteric artery. Five rabbits used for histological study of the abdominal aorta of three regions at the (celiac artery. renal artery. and common iliac artery). The abdominal aorta were consist of three layers from internal to external tunica intima, T. media and T. adventitia. The intima consist of single layer of endothelial cells and it's the thinnest layer while T. media composed of numerous elastic laminae in circular arrangement and it's the thickest layer finally T. adventitia was the outermost layer consist of smooth muscle fibers, collagen fibers, few elastic fibers, and vasa vasorum. The aim of this study to exposure the normal appearance of abdominal aorta by used the using corrosion cast & latex techniques and histological studies.*

**Key words:** Abdominal aorta, Celiac artery, Common iliac trunk, *Oryctylagus conniculus*

## Introduction

Rabbit was a model animal used in the laboratory for medical experiments. The aorta is the major elastic artery of circulatory system and the arteries originated from it supply all tissues and organs of the body (1&2). Aortic artery divided into four branches according to the regions ascending aorta, aortic arch, thoracic aorta and abdominal aorta. The abdominal aorta (AA) was the major blood vessel in the abdominal cavity that convey oxygenated blood from thoracic cavity into the organs of the abdomen and lower limb (3,4,5,6,7,8,9 and10). The first branch of the abdominal aorta was celiac trunk which (separated into

the hepatic artery, splenic artery and left gastric artery), behind it descends cranial mesenteric artery, and several branches arising from it jujenal artery, middle colic, pancreatic-duodenal and ileocecolic artery and then it gave renal arteries (right and left), gonadal artery (ovaries and testicular), lumber, inferior mesenteric artery and the last branch common iliac that supply lower limb and pelvis (11&12). Histologically the wall of the abdominal aorta is consist of three layers. The tunica intima is relatively thick and lined by a single layer of endothelial cells beneath it subendothelial layer. The tunica media was thickest layer consist of numerous elastic



laminae in a circular and oblique arrangement while the tunica adventitia was relatively thin contain bundles of collagen fibers and few elastic fibers (13&14).

## Materials & Methods

### Ethical approval

The Animal Ethical Committee of Veterinary Medicine College, University of Al-Qadisiyah, Iraq, has approved the present study under permission No: 468

Fifteen adult local rabbits, aged 6-12 months and 1.5-2 Kg used for gross investigation and histological studies of the A.A. (Five rabbits for cast technique, five rabbits latex technique and the last five used for histological study). All animal were anesthetic by using ketamine 50mg/Kg and xylazine 10mg/Kg & exsanguinated. The rabbits were positioned dorso-ventrally for dissection thoracic cage by longitudinal incision. A cannula was inserted into left ventricle to injected normal saline 0.9% into the left ventricle to remove any blood

clotting may be found in the blood vessels. For the cast technique the cold acrylic were used to study A.A. and it's major branches originated from it 5 mg of resin self-curing powder and 15 ml of self-polymerizing liquid mixture together and then injected into the vascular system via the left ventricle by using syringe. After 24 hours from injection the specimens transferred to 25% KOH path for two weeks to maceration tissues (15, 16). For colored latex 5 ml of latex mixed with ammonium and red carmine stain injected into the left ventricle by syringe after 24 hours the arteries arises from A.A. were dissected carefully (17). For histological study the specimen of A.A. were taken and fixed in 10% formalin, and made routine tissue processing and staining by Hematoxylin and Eosin stain for general histological features and Verhoff stain for elastic fiber (18). Measurement the diameter of A.A. and thickness of each layer using coulometer.

## Results

Abdominal aorta is the fourth & larger segment of the aorta Figure (1) when it's enter the abdominal cavity after passing through the diaphragm, the first branch which celiac artery the mean diameter of the abdominal aorta at this branch was ( $48.70 \pm 6.86$ )  $\mu\text{m}$  was ends by the common iliac arteries which diameter of it ( $14 \pm 10.82$ )  $\mu\text{m}$ . The celiac artery was first main branch of the abdominal aorta was origin from the ventral aspect after 1cm from starting between 12-13 thoracic vertebrae to supply stomach, liver, spleen and duodenum. It gave common trunk for the splenic and left gastric arteries and a common trunk for hepatic, gastroduodenal and right gastric arteries Figure (2, 3A). Caudally to the celiac artery descends it gave cranial mesenteric artery; It was the largest branches of the abdominal aorta artery. It gave origin to pancreatic-duodenal, middle colic, jejunal and ileocecolic arteries Figure (3, 4). The

renal arteries origin after cranial mesenteric artery Figure (2) there was a variable distance between (right and left) renal arteries except in one carcasses they originated at the same level. The cranial abdominal arteries (right and left) arises directly in most carcasses from abdominal aorta except in single case originated from renal\_arteries after that caudal mesenteric artery arise from abdominal aorta Figure (2). The testicular or ovarian arteries Figure (1) originated in most cases above caudal mesenteric artery, but in one carcass they descended below caudal mesenteric artery, Also several branches of lumber arteries originated from the abdominal aorta Figure (4). The terminal portion of the abdominal artery in lumber region divided into two symmetrically common iliac arteries and each of them gave external and internal iliac arteries and the right and left profound iliac circumflex arteries originated from external



iliac arteries at the same level with internal iliac artery Figure (5). Histologically the wall of the abdominal aorta examined at three levels (celiac artery, renal artery and iliac artery). It was composed of three tunica (T). T. intima at three levels was consist of single layer of endothelial cells resting on basal lamina and beneath it subendothelial layer consist of loose connective tissue the thickness of intima at the level of celiac artery, renal artery and lumber regions were (2±2.06, 1.6± 1.41, 1.4± 1.54)µm respectively Table (1). T. media was the thickest layer. It was composed of series elastic laminae they arranged concentrically with circular orientation Figures (6, 7). Between them there was smooth muscle cells, reticular fiber and thickness of this layer at three region were (15±16.74,

10.6±11.84, 8.4± 9.73) µm respectively Table (1). The T. adventitia was the outer layer relatively thin. It consist of bundles of collagen fibers and between them elastic fibers, smooth muscle cells and vasa vasorum. Thickness of this layers were less than T. media at three region (6.8±7.59, 6.6±7.34, 4.2±4.63) µm respectively, so we observed the thickest T. intima, T. media, T. adventitia of the wall of A.A at the celiac artery, similarly we remarked a variable in the diameter and thickness of the wall of A.A at three regions (celiac artery, renal artery & iliac artery). The largest diameter of A.A. showed at celiac artery (48.70±6.86) µm Table (1) and the (thickest wall of A.A. also documented at this portion was (23±20.73) µm.

Table (1): Measurements of the thickness of the wall, thickness of *T. intima*, *T. media* and *T. adventitia* and diameter of abdominal aorta in local breed rabbits

Variable M±SE(µm)	AA at the celiac artery descend	AA at the renal artery descend	AA at the iliac artery descend
Thickness of the A.A. wall.	23±20.73	18.8±15.21	14±10.82
T. intima	2±2.06	1.6±1.41	1.4±1.54
T. media	15±16.74	10.6±11.84	8.4±9.73
T. adventitia	6.8±7.59	6.6±7.34	4.2±4.63
Diameter of A.A.	48.70±6.86	36.8±4.82	25.4±3.35

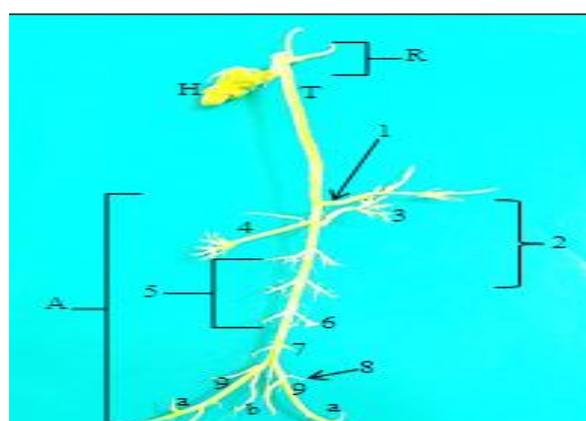
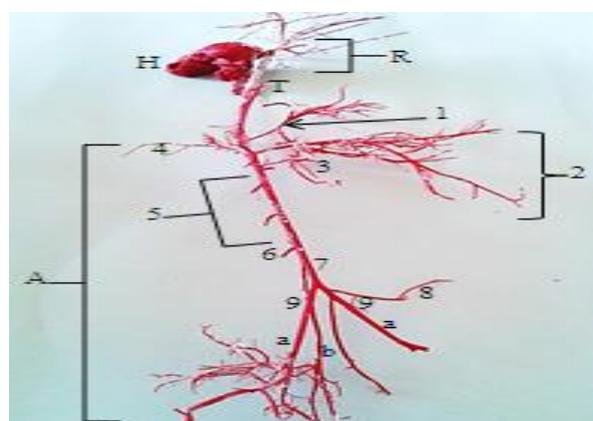


Figure (1): The cast of the abdominal aorta in local breed rabbits showing:- (H) heart (R) aortic arch (T) thoracic aorta (A) abdominal aorta (1) celiac artery (2) cranial mesenteric artery (3) left renal artery (4) right renal artery (5) limber arteries (6) testicular artery (7) caudal mesenteric artery (8) profound iliac circumflex artery (9) common iliac arteries (a) right and left external iliac (b) right and left internal iliac artery.

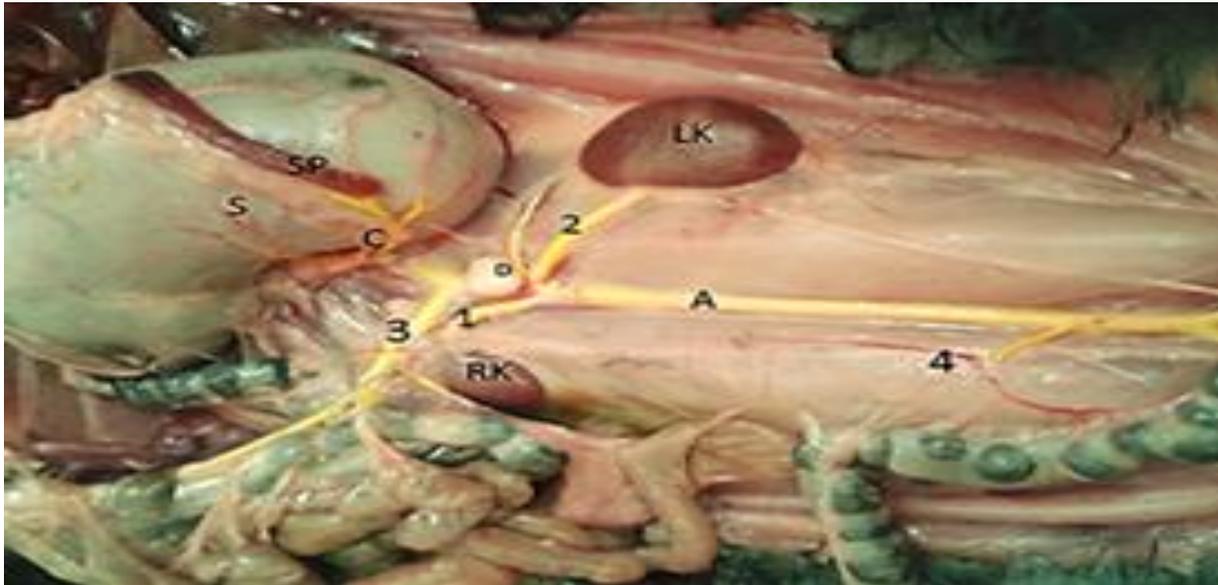


Figure (2): Showing branches of abdominal aorta: (A) abdominal aorta (C) celiac artery (S) stomach (SP)spleen (LK)left kidney (RK)right kidney (D)adrenal gland (1) right renal artery (2) left renal artery (3) cranial mesenteric artery (4) caudal mesenteric artery



Figure (3): (A) Celiac artery branches into (1) splenic artery (2) left gastric artery and (B) the cranial mesenteric artery branches into (3) jejunal arteries

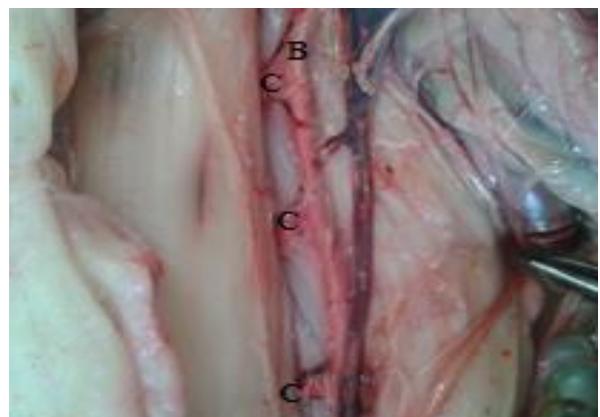


Figure (4) Cranial mesenteric artery branches into (A) Ileocecolic artery and (B) abdominal aorta branches into (C) Lumbar arteries



Figure (5) Showing terminal branches of abdominal aorta:- (A) abdominal aorta (1) caudal mesenteric artery (2) profound circumflex arteries (3) left and right external iliac arteries (4) left internal iliac arteries (5) Umbilical artery

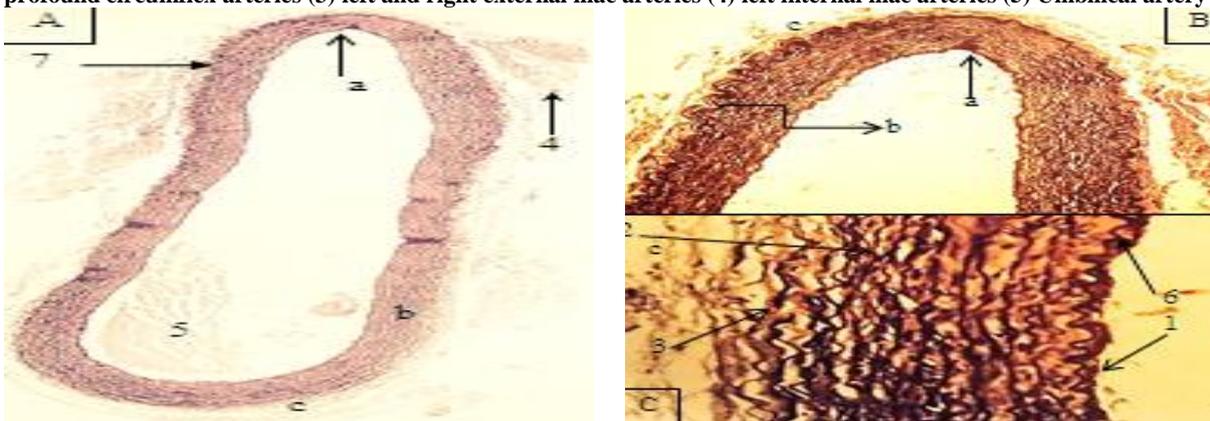


Figure (6) Cross section in abdominal aorta of local breed rabbits: - (a) T. intima. (b) T. media. (c) T. adventitia (1) Endothelial cell layer (2) elastic laminae. (3) Smooth muscle cells (4) Vasa vasorum. (5) Erythrocyte. (6) Internal elastic laminae. (7) External elastic laminae (A- 40X, B- 100X & C- 400X Verhoeff stain)

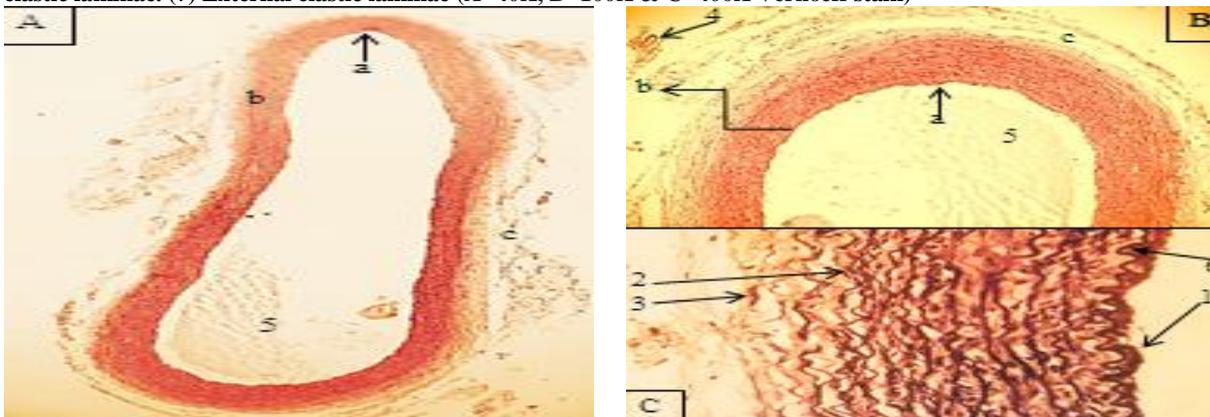


Figure (7): Cross section in abdominal aorta of local breed rabbits:- (a) T. intima. (b) T. media. (c) T. adventitia. (1) Endothelial cell layer. (2) Elastic laminae. (3) Smooth muscle cells. (4) Vasa vasorum. (5) Erythrocyte. (6) Internal elastic laminae. (A- 40X, B- 100X & C- 400X H&E stain).



## Discussion

The study of abdominal aorta in rabbits is the last and longer portion of the aorta. The first branch was celiac artery arise from abdominal aorta at the level of T 12 vertebra vascularized the stomach, liver, spleen and duodenum this result is agreed with (12), while show variations in the celiac artery reported in many researches of (19, 20, 21) it arise at T13 to L1, this difference may be result from differ in breed of rabbits. Celiac artery divided into common trunk for splenic and left gastric artery, the second trunk for hepatic, gastroduodenal and right gastric arteries and the splenic artery gave off branch for greater curvature of the stomach the same pattern described in porcupine (5) and rabbits (19). Cranial mesenteric artery arise caudally to the celiac artery about (1.5cm) as a major second branch from abdominal aorta to supply the largest part of small intestine, the same result noticed in opossum (22) but in porcupine it arise after (6 cm) from celiac artery (6). The cranial mesenteric artery gives four branches were caudal pancreatic duodenal, middle colic, ileocecolic and jejunal arteries, the same finding was seen in (6, 23, 24). In our observation the caudal pancreatic duodenal originated as the first branch, but in porcupine (6) it's third branch of cranial mesenteric artery and in goat (24) pancreatic and caudal duodenal originated separately from cranial mesenteric artery, we have observed in the present study all dissected rabbits possessed (16-18) jejunal arteries, but this number varies according to animal species like in, porcupine (10-15) arteries, opossum (6-10), rabbits (18-20) as in (6, 22, 25) respectively. Renal arteries arise as paired arteries from abdominal aorta at the level between (L2-L3) vertebrae, usually right renal artery arise firstly in most dissected rabbits ,but in single case both renal arteries originated at the same level and the left renal artery is longer than the right renal artery and the cranial abdominal arteries arise from renal arteries, similar result was seen when we compared our

finding with in rabbits, wolf, guinea pig and rat (26, 27, 28, 29, 30). Testicular arteries in males and ovarian arteries in females descended asymmetrically below the cranial mesenteric artery, many researches described the same pattern observed in guinea pigs (28) they originated immediately behind the origin of the renal arteries, but in carnivores (31) they arise below caudal mesenteric artery. Lumber arteries arose from the dorsal aspect of the A.A. it reported by some authors (9) in rabbit and European hare. Abdominal aorta ends by the paired external and internal common iliac arteries and the profunda iliac circumflex arteries originated from external iliac artery in all dissected rabbits, this respected with (32) in opossum. In histological study of our investigation the abdominal aorta wall was composed of three tunics, and we observed in our study at three regions (celiac artery, renal artery and common iliac trunk), T. intima was a thinnest layer it consist of single layer of endothelial cells resting on basal lamina and abdominal aorta was an elastic type artery because the T. media was the thickest layer among three tunics and consisted of numerous elastic laminae, the same finding agreement with many research like in guinea pig (14), rabbits (33), the proportion between elastic and muscle component is (50-55%) in T. media so we cannot be considered the abdominal aorta typical elastic artery (33,34), but the number of elastic laminae was decreased according to size and distance of abdominal aorta from the heart (35). The thickness of elastic laminae was increased in malnourished rats (35), there were greater number of elastic laminae seen at thoracic aorta compared to the abdominal aorta in guinea pigs and rats and the number of elastic laminae in abdominal aorta of guinea pigs (6-8) layers. T. adventitia thinner than T. media and composed of connective tissue of collagen fibers, few elastic fibers, smooth muscle and vasa vasorum (13), the number of



collagen bundles in T. adventitia of the abdominal aorta was decreased in (35).

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