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SOME ANATOMICAL STUDIES ON THE ABDOMINAL AORTA IN THE MALE RED FOX (*Vulpes Vulpes*)

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SUMMARY

The present study was carried out on three adult male red foxes to clarify the obscure abdominal aorta in this animal. A suspension of 5% Barium sulphate was tested in the present work as both radio-opaque and vessel filler material to overcome specimens shortage of the wild animals. Hence the same specimens were radiographed, then photographed in the fresh state after opening the abdominal wall, then kept in formalin in a chilling room then carefully dissected and described, then re-photographed. The results showed that barium sulphate was an excellent vessel filler in the small vessels, while in the large vessels it was poorly hardened and may ooze if vessel leakage occurs during dissection. The abdominal aorta extended from the level of the first lumbar vertebra cranially, as a continuation of the thoracic aorta, to the level of the iliac crest caudally, slightly cranial to the promontory of the sacrum where it divided into a median sacral and a paired internal iliac arteries. All the parietal branches of the aorta were paired, they included the caudal phrenic, cranial abdominal, 7 lumbar, deep circumflex iliac and the external iliac arteries. The visceral branches were either single (celiac, cranial mesenteric and caudal mesenteric arteries) or paired (renal, middle adrenal and testicular arteries). The level of origin of the right paired visceral arteries was cranial to that of the left ones. The adrenal gland received a cranial adrenal branch from the caudal phrenic artery, a middle adrenal artery from the abdominal aorta and a caudal adrenal branch from the renal artery. Several photographs and radiographs were prepared. The obtained results were compared with their correspondings in the domestic animals, especially the domestic carnivores.

INTRODUCTION

Barium sulphate is a well known radio-opaque material, usually prepared in a fine colloidal suspension for the investigation of the alimentary tract (Douglas et al., 1987).

In addition to the importance of the red fox as a zoo animal, the valuable fur provides the fox a noble situation among wild animals, therefore fox specimens are rare.

Because of rareness of the fox specimens, the author intended to substitute the routinely used vessel-filler gum milk latex by barium sulfate. Thence, the same specimen can be used for both gross and radiographical anatomy.

The description of the aorta and or its branches attracted the attention of many investigators as Krupp (1943) in silver fox, Brudnicki et al. (1996) in the blue fox, kosik (1923), Berg (1962) and Reis and Tepe (1965) and Adams (1986) in the dog, Brudnicki et al. (1986) in the racccon dog, Jantosovicova and Jantosovicova (1983) in stallion, Bednarova and Malinovsky (1990) in Guinea pig, Wiland and Indykiewicz (1999) in mink and dog, Hudson and Hamilton (1993) in the cat, Ghoshal (1975) pig and horse, May (1970) in the sheep, Habel (1975) in the ruminants and Smuts and Bezuidenhout (1987) in the camel. However, the abdominal aorta in the red fox was not dealt with according to the available literature.

For these reasons, the present work was carried out in order to describe the obscure abdominal aorta in red fox to help in the field of comparative anatomy and veterinary sorgery. The present work aims also to test barium sulphateas a vessel filler Latex substitute, to overcome the specimen rareness of wild animals.

MATERIALS AND METHODS

The present work was carried out on three healthy adult male red foxes. The foxes were obtained from the Libyan Al-Hamada Desert. The animals were anaesthetized by chloroform, then bled via the common carotid artery. Thence the thoracic aorta was approached via an incision through the dorsal end of the left 7th intercostal space, cannulated then gently injected with a convenient amount of 5% barium sulphate suspension (Micropaque® Guerbet) indicated for barium meal before bowel radiography. After that the specimens were radiographed.

After radiography the fresh red fox cadavers were photographed. After that, the specimens; with their abdominal wall opened; were kept in a solution of 10% formalin, 4% glycerin and 1% phenol in a chilling room. Thence, the formalized red fox cadavers were thoroughly dissected, perfectly described and photographed. One formalized red fox cadaver was radiographed after dissection and removal of the abdominal and pelvic viscera to overcome the shadows of the crowded organs.

The nomenclature used in this work was that adopted by the Nomina Anatomica Veterinaria (N.A.V., 2005). The formalized red fox cadavers and the isolated abdominal and pelvic viscera were kept for future researches.

RESULTS

The abdominal aorta represented the caudal continuation of the thoracic aorta just after its emergence from the aortic hiatus of the diaphragm, opposite to the first lumbar vertebra (Figs. 2& 3). It proceeded caudad to the left of the median plane and caudal vena cava and ventral to the psoas muscles. At the level of each of the iliac crest and the caudal border of the root of the 7th lumbar transverse process (slightly cranial to the promontory of the sacrum), the abdominal aorta divided into a median sacral (5 & 6 / 4) and paired internal iliac arteries (5 & 6 / 3) that supplied the pelvic wall and viscera as well as the tail (Figs. 5 & 6). The internal iliac artery gave the umbilical artery (5/5), the internal pudendal artery (5/7) then continued as caudal gluteal artery (5/6). The internal pudendal artery ramified in the rectum, penis, perineum and scrotum, and detached the prostatic artery (5/8) that supplied the accessory genital glands, ductus deferens , pelvic urethra and the caudal portion of the urinary bladder.

Barium sulphate appeared excellent as a vessel filler in demonstrating the small vessels, while in the large vessels the substance was poorly hardened and may ooze if vessel leakage occurred during dissection or vessel cutting was necessary (12/2). But in addition of its radio-opaque property it can be considered as acceptable vessel filler material, especially when vessel leakage is avoided and purposed cutting of large vessels is preceded by legation.

Along its course, The Aorta abdominalis detached parietal branches to the diaphragm , abdominal wall and pelvic limb, and visceral branches to abdominal and scrotal viscera (Figs.1-14).

A) Parietal branches of the Aorta abdominalis:

1- A. phrenica caudalis: The caudal phrenic artery (1/3, 3/2 & 7/6) was a paired vessel, the left one arose separately from the lateral aspect of the aorta abdominalis, opposite to the free end of the 2nd lumbar transverse process and at about 1.1-1.3 cm caudal to the Hiatus aorticus. The right one arose together with the right cranial abdominal artery by a common stem (phrenicoabdominal artery) from the lateral aspect of the right renal artey. It coursed cranioventrally towards the crura of the diaphragm where it ramified. Its final ramification can be traced up to the tendinous center of the diaphragm. It detached two twigs to the cranial portion of the adrenal gland (Rami adrenals craniales) (12/8).

2- A. abdominalis cranialis:

The cranial abdominal artery (1/6, 3/6 & 4/4) was a paired vessel, the left one sprang from the lateral aspect of the abdominal aorta, opposite to the free end of the 3rd lumbar transverse process, at about 0.5 cm caudal to the origin of the caudal phrenic artery. The right cranial abdominal artery arose together with the right caudal phrenic artery by a common stem (phrenicoabdominal artery) from the lateral aspect of the right renal artey. The cranial abdominal artery proceeded caudolaterally for about 2 cm. crossing the ventral aspect of the psoas muscles, to them it gave twigs. Then, it penetrated the transverse abdominal muscle and coursed caudoventrally between this muscle and the internal oblique abdominal muscle, till the transverse plane of the free end of the transverse process where it faded out. Along its course, the cranial abdominal artery detached branches that supplied the psoas, transverse abdominal, internal and external oblique abdominal muscles as well as muscle cutaneous trunci and the skin of the lateral abdominal wall as far caudal as the level of the 5th lumbar vertebra.

3- Aa lumbales:

The lumbar arteries (1/2, 2/ L3, 3/3, 7 / 2-5, 8/2, 9/2 & 9/4) were 7 pairs in number. Each lumbar artery arose from the dorsal aspect of the abdominal aorta, opposite to the caudal border of the root of the transverse process of the corresponding vertebra. The two arteries of each pair arose separately except for the last (7th) pair of lumbar arteries which arose by stem vessel of 0.3- 0.5 cm. long, The first pair of lumbar arteries arose at the aortic hiatus of the diaphragm, while the last pair arose at the terminal division of the abdominal aorta into two internal iliac arteries. The interval between the alternative lumbar arteries ranged from 1-2.3 cm, depending on the vertebral body length.

Each lumbar artery passed dorsad to reach the body of the corresponding vertebra, then continued caudodorsally along its ventrolateral aspect to gain the intervertebral foramen. Here the lumbar artery detached a spinal branch and a dorsal branch then turns ventrolaterally in the inter transverse space, detaching twigs to Mm. Longissimus lumborum, muscles iliocostalis lumborum and intertransversarii lumborum. Before reaching the intervertebral foramen , the lumbar artery detached 1-2 twigs to the psoas muscles and a branch to the body of the corresponding vertebra. The latter entered through a foramen in the caudal portion of the lateral aspect of the body of the vertebra.

The Ramus spinalis (Fig.8/3) arose from the medial aspect of the lumbar artery, opposite to the intervertebral foramen, where it entered to supply the lumbar spinal cord and meninges.

The Ramus dorsalis (8/4) of the lumbar artery coursed caudodorsally deep to muscles longissimus lumborum, then divided under the last mentioned muscle into a medial and a lateral branches. The medial branch passed caudodorsally between Mm. multifidi and interspinales medially and M. longissimus lumborum laterally, supplying these muscles and the skin of the dorsal abdominal wall close to the median plane (Ramus cutaneus medialis). The lateral branch of Ramus dorsalis of the lumbar artery turned laterally then divided into a dorsal twig and a ventral twig. The dorsal twig passed dorsolaterally piercing M. longissimus lumborum, supplying this muscle and terminated in the skin of the dorsal abdominal wall away from the median plane (Ramus. cutaneus lateralis). The ventral twig passed laterad undercover of the muscles M. lumborumn, supplying this muscle, muscles M. intertransversarii lumborum and muscles iliocostalis lumborum.

4- A. circumflexa ilium profunda:

The deep circumflex iliac artery (Fig. 4/7, 5/9, 9/3 & 10/4) sprang from the lateral aspect of the Aorta abdominalis, opposite to the caudal border of the arch of the 6th lumbar vertebra, just cranial to the origin of the external iliac artery. It proceeded laterally for about 1- 1.5 cm, crossing the ventral surface of the psoas minor muscle, then divided into a small cranial branch and a large caudal branch. The cranial branch (10/5) entered the M. psoas major supplying it. The caudal branch (10/6) converged with, then accompanied the lateral cutaneous femoral nerve (10/7) to insinuate themselves between the transverse (10/c) and internal oblique (10/d) abdominal muscles, then penetrated the latter muscle and the external oblique abdominal muscle, opposite to the root of the 6th lumbar transverse process, at about 3 cm cranioventral to the coxal tuber and continued to supply the stifle fold and M. tensor fasciae latae. Along its course through the abdominal wall, the caudal branch gave twigs to the transverse and oblique abdominal muscles.

5- A. iliaca externa:

The external iliac artery (Fig. 1/10, 2/5, 4/8, 5/2, 9/6, 10/2 & 13/4) appeared as a stout vessel, which sprang from the lateral aspect of the abdominal aorta, opposite to the free end of the 7th lumbar transverse process, at about 0.5 cm cranial to the terminal division of the abdominal aorta into middle sacral and internal iliac arteries. The external iliac artery coursed caudoventrolaterally, then detached the deep femoral artery (Fig. 6/5& 10/8) from its caudal border after 2-3 cm from its origin and the caudal abdominal artery from its cranial border after another 0.5- 1 cm, then traversed the femoral canal as femoral artery (Fig. 6/6 & 10/9) to be continued in the pelvic limb. The caudal abdominal artery was a small vessel that passed cranially for about 1 cm then divided into a dorsal and a ventral twigs. The former ramified in the internal oblique abdominal muscle, and the latter entered the caudal portion of the transverse abdominal muscle.

B) Visceral branches of Aorta abdominalis:

1- A. coeliaca:

The celiac artery (1/4, 2/3, 3/4, 4/2, 7/7& 8/5) originated from the ventral aspect of the abdominal aorta, opposite to a midpoint between the roots of the 2nd and 3rd lumbar transverse processes. The initial course of the celiac artery formed a cranioventrally facing angle of about 80° with the abdominal aorta, and a caudoventrally facing angle of about 70° with the cranial mesenteric artery. After a short course, the celiac artery reached the fundus of the stomach where it divided into splenic, left gastric and hepatic arteries that ramified in the spleen, stomach, liver, pancreas as well as the cranial and the descending parts of the duodenum.

2- A. mesenterica cranialis:

The cranial mesenteric artery (1/5, 2/4, 3/5, 4/3, 7/8& 8/6) arose from the ventral aspect of the abdominal aorta at the level of the caudal border of the arch of the 2nd lumbar vertebra, opposite to the shot of the cranial abdominal artery and at about 3 mm caudal to the origin of the celiac artery. The cranial mesenteric artery formed a caudoventrally facing angle of about 30° with the abdominal aorta. It entered the root of the mesentery, ramifying in the ascending duodenum, jejunum, ileum, cecum as well as the ascending, transverse colon and beginning of the descending colon.

3- A. adrenalis media:

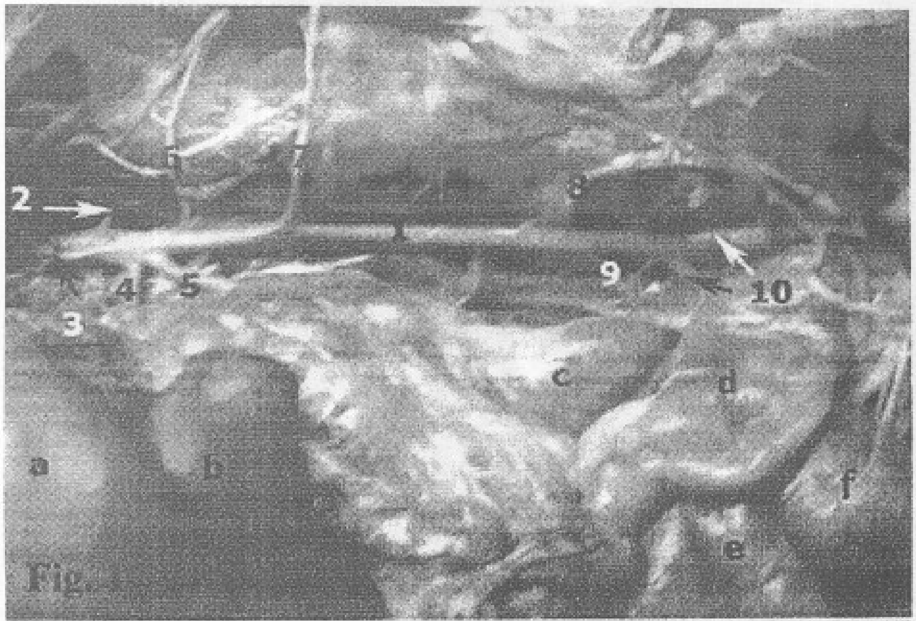
The middle adrenal artery (11/2& 12/4) arose from the lateral aspect of the abdominal aorta immediately prior to the origin of the renal artery, so the origin of the right one was cranial to that of the left one. It coursed laterally to gain the middle part of the adrenal gland where it entered.

4- A. renalis:

The paired renal artery (1/7, 3/7, 4/5, 11/3, 12/5& 14/1) arose from the lateral border of the abdominal aorta. The left renal artery arose opposite to the caudal border of the free end of the 4th lumbar transverse process. The right renal artery arose opposite to the caudal border of the root of the 3rd lumbar transverse process, at about 1 cm cranial to the origin of the left renal artery. After a course of about 3-4 cm., the A. renalis gained the renal hilus where it entered to supply the corresponding kidney and ureter. The renal artery; prior to its entery to the renal hilus; detached from its cranial border Ramus adrenalis caudalis that entered the caudal part of the adrenal gland (12/6).

4- A. testicularis:

The testicular artery (1/8, 7/10, 9/5, 10/3, 13/3& 14/2) originated from the lateral border of the abdominal aorta. The left testicular artery arose midway between the roots of the 5th and 6th lumbar transverse processes. The right testicular artery (4/9) sprang at about 0.5 cm cranial to the origin of the left one(4/10), opposite to the caudal border of the root of the 5th lumbar transverse process.



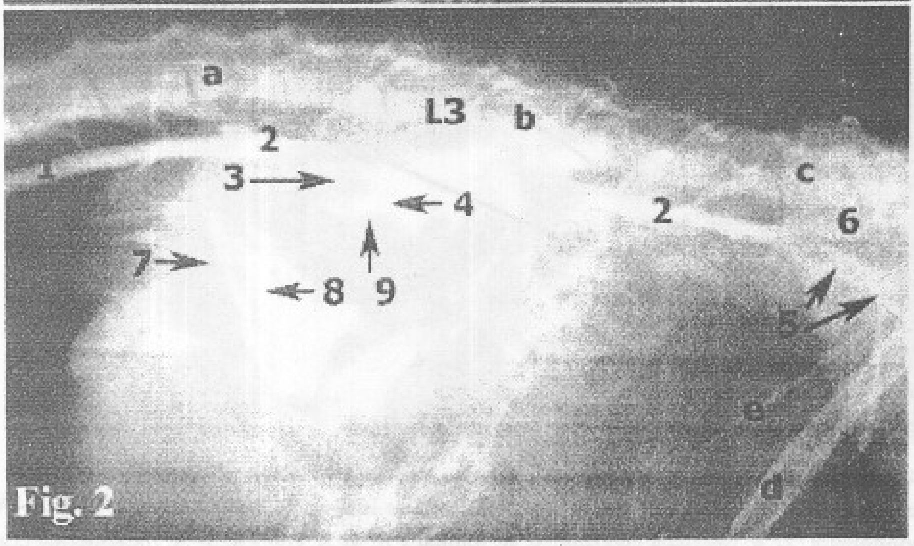
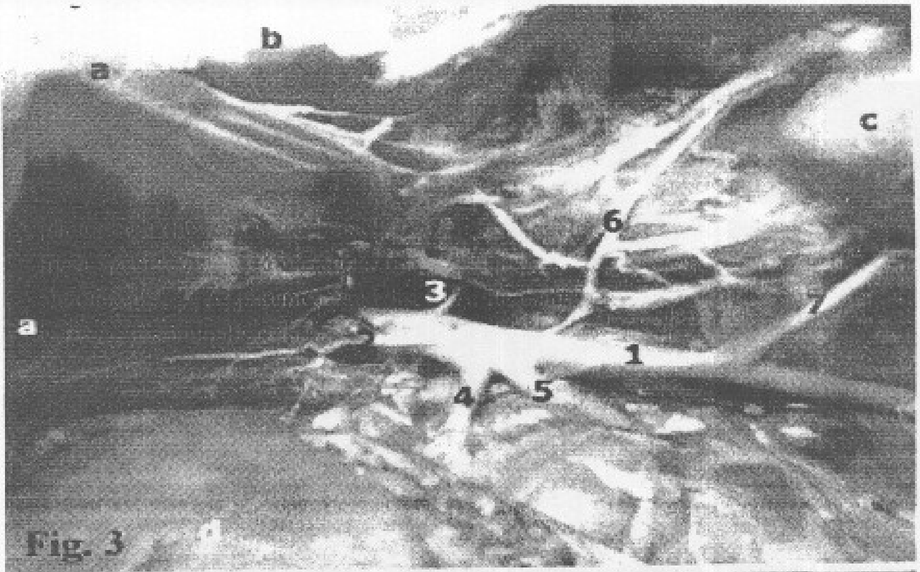


Fig. 1 : A photograph showing the course and most branches of the abdominal aorta in a fresh specimen. Left aspect. a- Lobus hepatis sinister lateralis, b-Lien, c- Cecum, d- Colon descendens, e -Jejunum, f- Vesica urinaria, 1- Aorta abdominalis, 2- A. lumbalis II, 3- A. phrenica caudalis, 4- A. celiaca, 5- A. mesenterica cranialis, 6- A. abdominalis cranialis, 7- A. renalis, 8- A. testicularis, 9- A. mesenterica caudalis, 10- A. iliaca externa.

Fig. 2: A radiograph showing most branches of the abdominal aorta. Left lateral view. a- Vertebra lumbalis I, b- Vertebra lumbalis IV, c- Vertebra lumbalis VII, d- Femur, e- A. epigastrica caudalis, L3- A. lumbalisIII, 1-Aorta thoracica, 2- Aorta abdominalis, 3- A. celiaca, 4- A. mesenterica cranialis, 5-A. iliaca externa, 6- A. iliaca interna, 7- A. gasterica sinister, 8- A.hepatica, 9- A. lienalis.



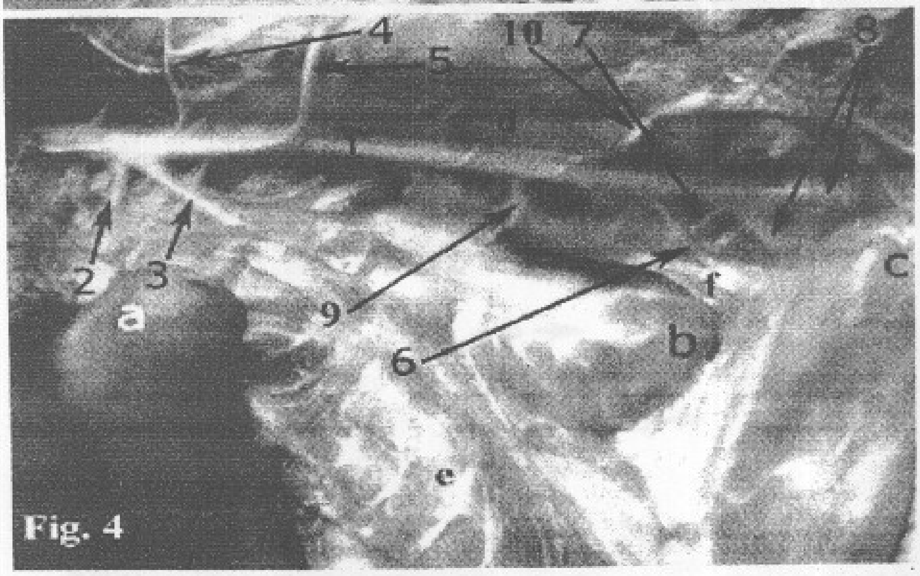
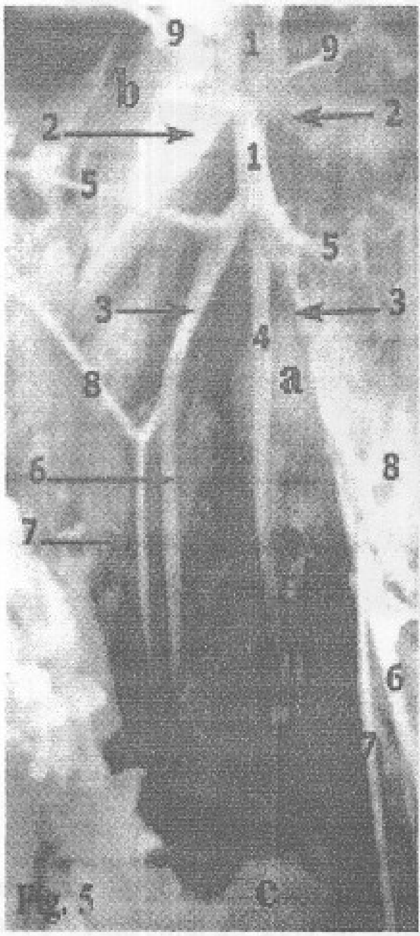


Fig. 3 : A photograph showing some branches given from the cranial portion of the abdominal aorta in a fresh specimen. a- Diaphragma, b-Mm. intercostales interni, c- Ren sinister, d- Lein, 1- Aorta abdominalis, 2- A. phrenica caudalis, 3- A. lumbalis II, 4- A. celiaca, 5- A. mesenterica cranialis, 6- A. abdominalis cranialis, 7- A. renalis sinister.

Fig. 4: A photograph showing some branches given from the caudal portion of the abdominal aorta in a fresh specimen. a- Lein, b- Cecum, c- Colon descendens, d- M. psoas minor, e- Omentum majus, f- Mesocolon descendens, 1- Aorta abdominalis, 2- A. celiaca, 3- A. mesenterica cranialis, 4- A. abdominalis cranialis, 5- A. renalis sinister, 6- A. mesenterica caudalis, 7- A. circumflexa ilium profunda, 8- A. iliaca externa, 9- A. testicularis dexter, 10- A. testicularis sinister.



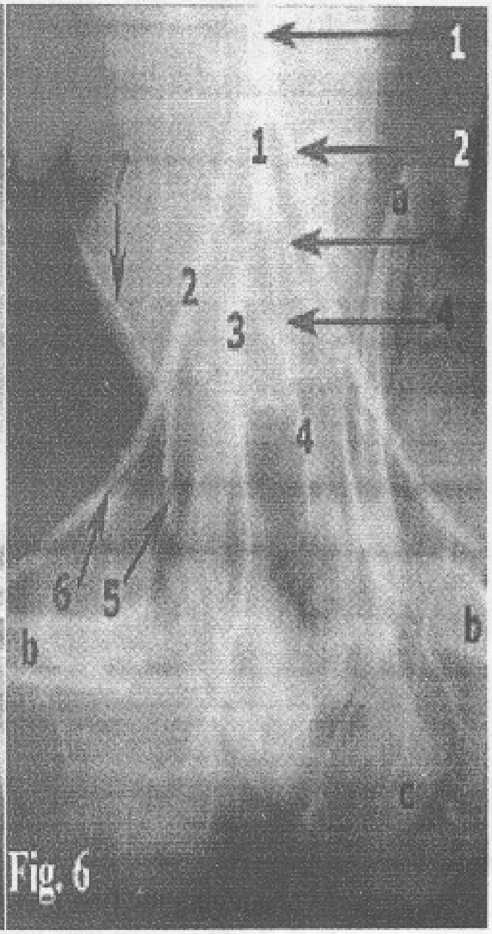
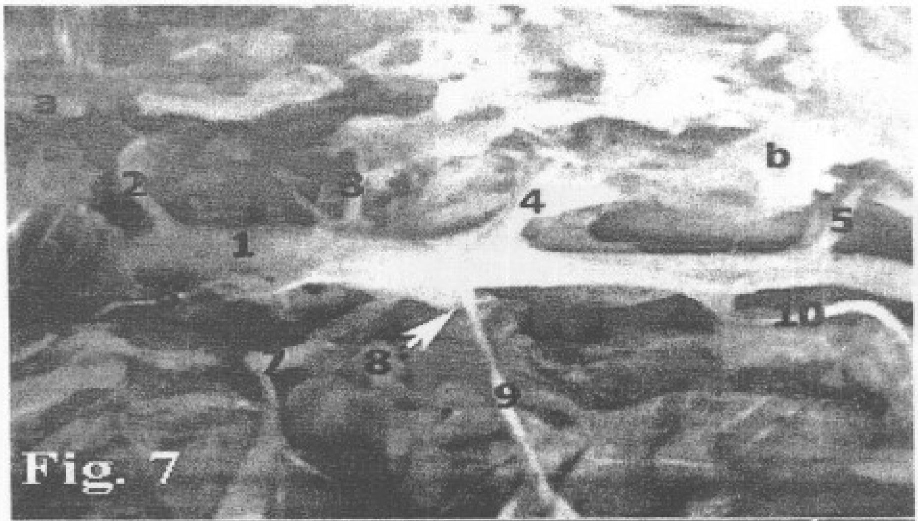


Fig. 5 : A photograph showing the terminal branches of the abdominal aorta in a formalized specimen, Ventral view. añ Articulatio lumbosacralis, b- M. Psoas major, c- Rectum, 1- aorta abdominalis, 2- A. iliaca externa, 3- A. iliaca interna, 4- A. sacralis mediana, 5- A. umblicalis, 6- A. glutea caudalis, 7- A. pudenda interna, 8- A. prostatica.

Fig. 6: A radiograph showing the terminal branching of the abdominal aorta. Dorsoventral view. a- Ilium, b- Femur, c-Ischium, 1- Aorta abdominalis, 2- A. iliaca externa, 3- A. iliaca interna, 4- A. sacralis mediana, 5- A. profunda femoris, 6- A. femoralis, 7- A. epigastrica caudalis.



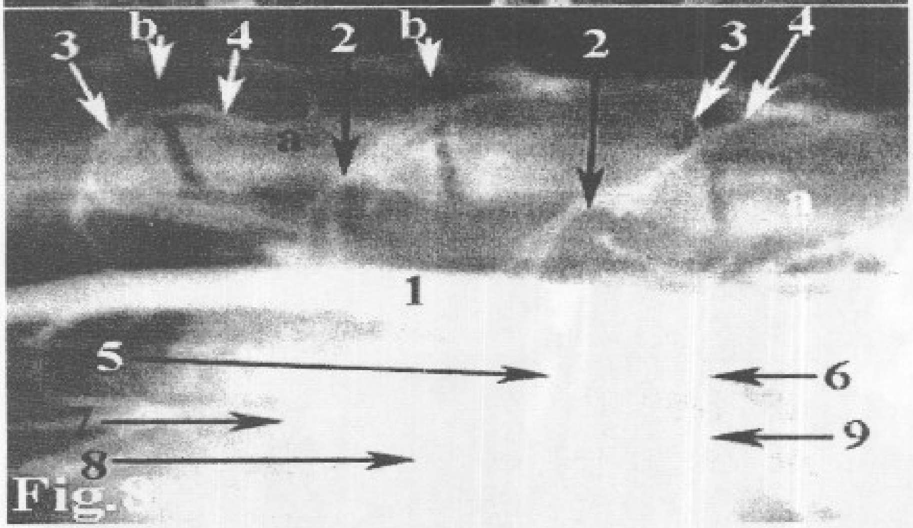
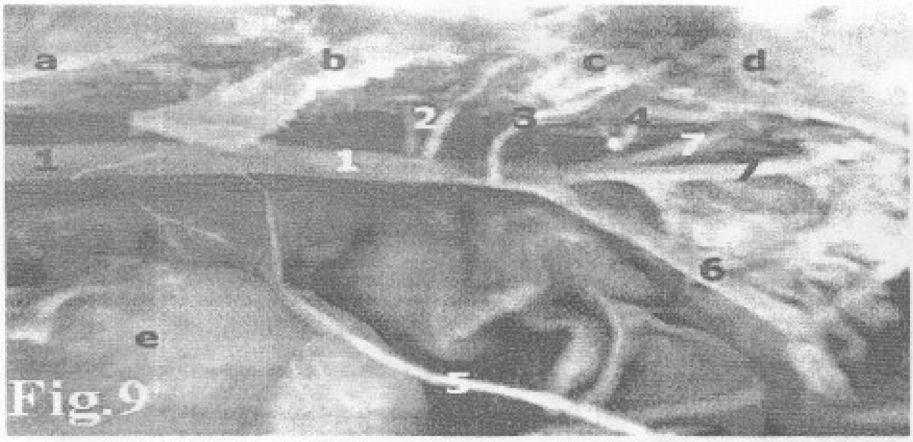


Fig. 7: A photograph showing the first four lumbar arteries in a formalized specimen. a- Vertebra lumbalis I (Processus transversus), b- Vertebra lumbalis IV (Processus transversus), 1- Aorta abdominalis, 2- A. lumbalis I, 3- A. lumbalis II, 4- A. lumbalis III, 5- A. lumbalis IV, 6- A. phrenica caudalis, 7- A. celiaca, 8- A. mesenterica cranialis, 9- A. abdominalis cranialis, 10- A. testicularis.

Fig. 8: A radiograph showing some branches given from the cranial portion of the abdominal aorta, left lateral view. a - Corpus vertebra lumbalis, b- Foramen intervertebrale 1-Aorta abdominalis, 2- A. lumbalis, 3- Ramus spinalis, 4- Ramus dorsalis, 5- A. celiaca, 6- A. mesenterica cranialis, 7- A. gasterica sinister, 8- A. hepatica, 9- A. lienalis.



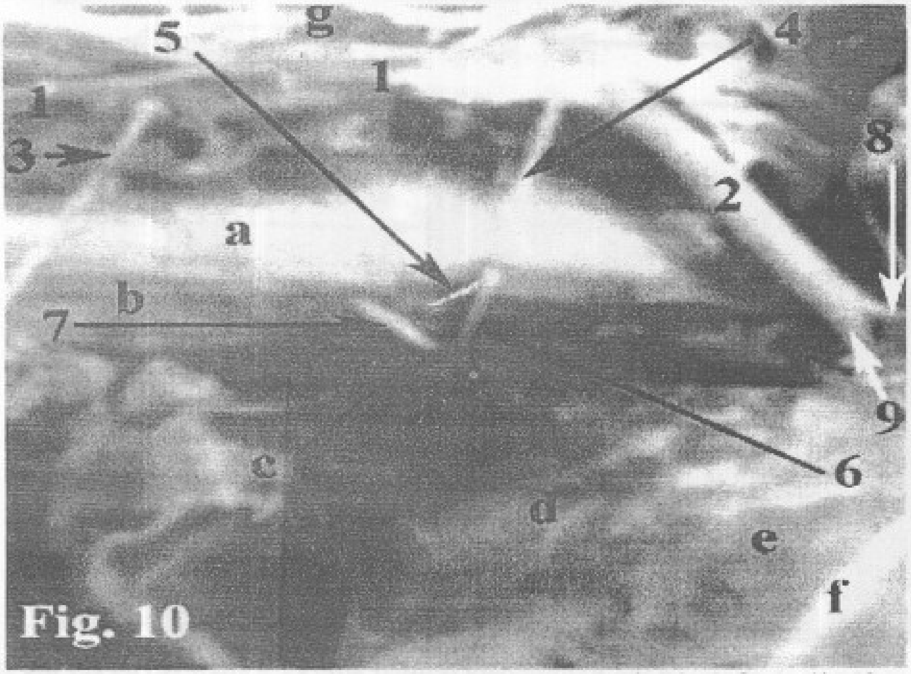
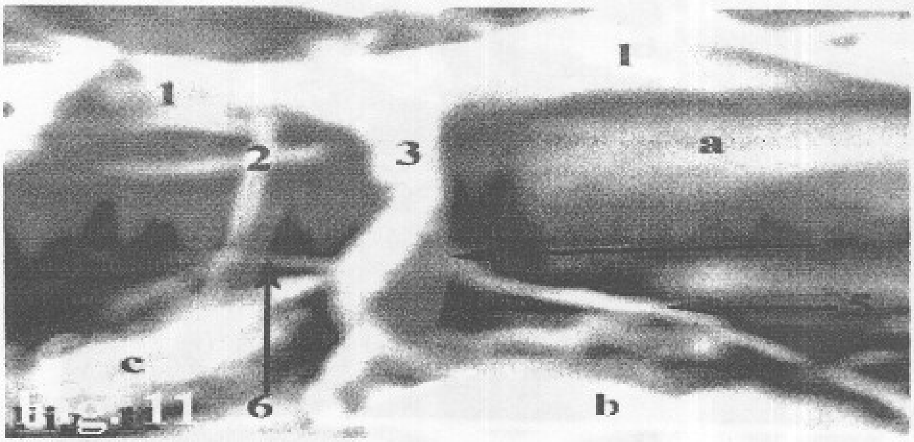


Fig. 9: A photograph showing the last two lumbar arteries in a formalized specimen. a- Vertebra lumbalis V (Processus transversus), b- Vertebra lumbalis VI (Processus transversus) c- Vertebra lumbalis VII (Processus transversus), d- Crista iliaca, e- Ren sinster, 1- Aorta abdominalis, 2- A. lumbalis VI, 3- A. circumflexa ilium profunda, 4- A. lumbalis VII, 5- A. testicularis, 6- A. iliaca externa, 7- A. iliaca interna

Fig. 10: A photograph showing the deep circumflex iliac artery in a formalized specimen. a- M. psoas minor, b- M. psoas major, c- M. transverses abdominis, d- M. obliquus abdominis internus,e- M. rectus abdominis, f- A. epigastrica caudalis, 1- Aorta abdominalis, 2- A. iliaca externa, 3- A. testicularis, 4- A. circumflexa ilium profunda, 5- Ramus cranialis ad 4, 6- Ramus caudalis, 7- N. cutaneus femoris lateralis, 8- A. profunda femoris, 9- A. femoralis.



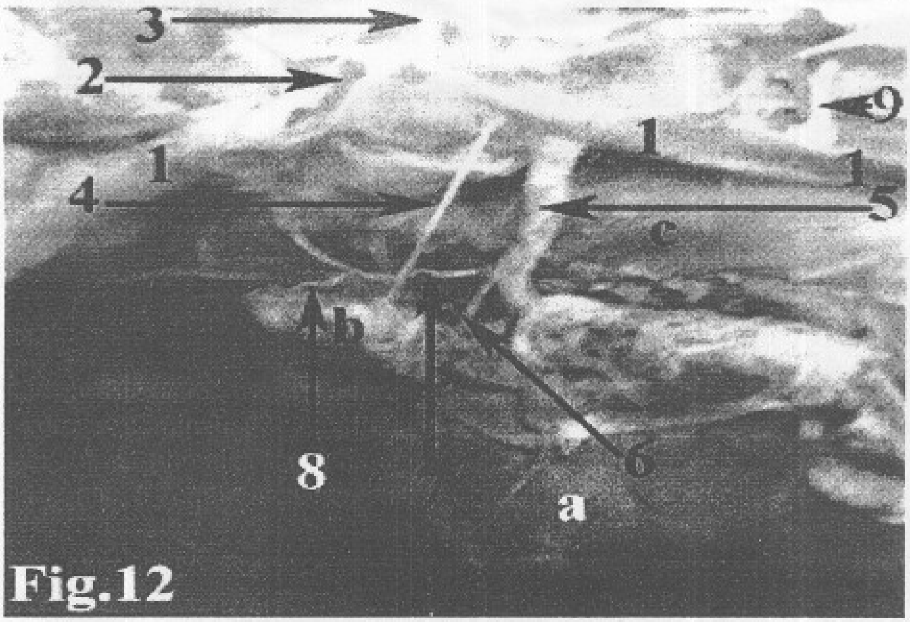
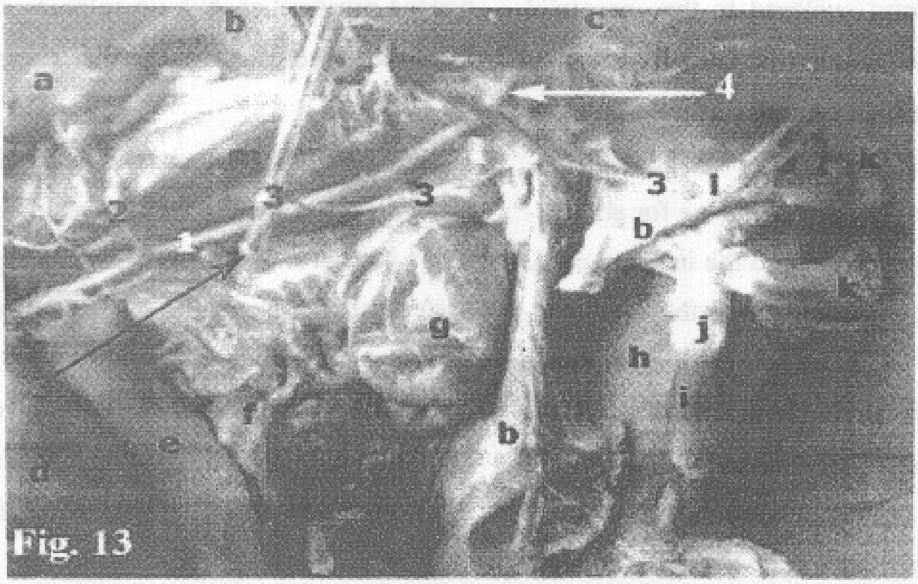


Fig. 11: A photograph showing the phrenicoabdominal artery (a stem vessel for the caudal phrenic and cranial abdominal arteries on the right side) in a formalized specimen. a- M. psoas minor, b- ren dexter, c- Glandula adrenalis dexter, 1- Aorta abdominalis, 2- A. adrenalis media, 3- A. renalis dexter, 4- A stem vessel for A. phrenica caudalis and A. abdominalis cranialis, 5- A. abdominalis cranialis, 6 A. phrenica caudalis.

Fig. 12: A photograph of a formalized specimen showing the arterial blood supply of the adrenal gland. a- Ren dexter, b- Glandula adrenalis dexter, c- M. Psoas minor, 1- Aorta abdominalis, 2- Origin of both celiac and cranial mesenteric arteries (cut). Notice: The abdominal aorta was empty because barium sulphatewas poorly hardened in large vessels, 3- A. abdominalis cranialis sinister, 4- A. adrenalis media, 5- A. renalis dexter, 6- Ramus adrenalis caudalis, 7- A. phrenica caudalis dexter, 8- Ramus adrenalis cranialis, 9- A. renalis sinister.



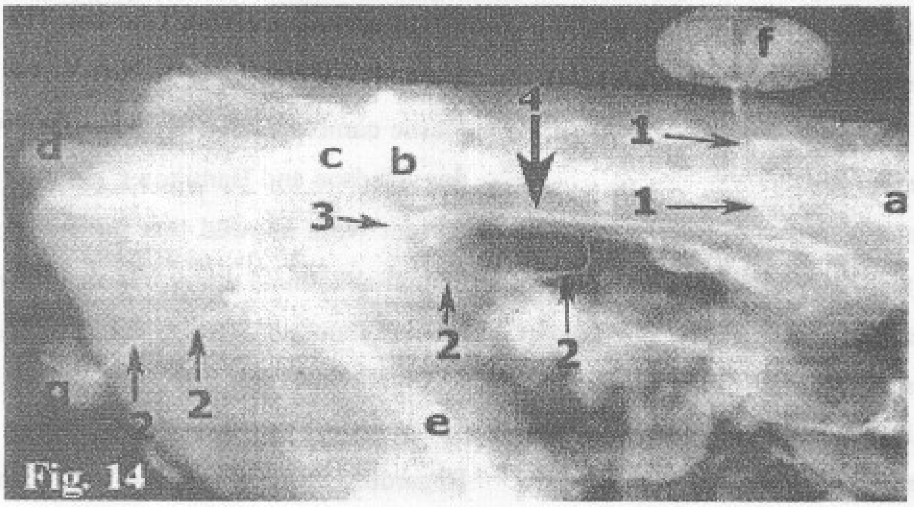


Fig. 13: A photograph showing the caudal portion of the abdominal aorta in a fresh specimena- Ren sinister, b- Abdominal wall, c- Left thigh, d- Lobus hepatis sinister lateralis, e-Lien, f- Omentum majus, g- Vesica urinaria, h- Right thigh, i- Pars longa glandis, j- Bulbus glandis, k- Testis, l-Canalis vaginalis, 1- Aorta abdominalis, 2- A. renalis, 3- A. testicularis, 4- A. iliaca externa.

Fig. 14: A radiograph showing the renal and testicular arteries in a specimen radiographed after dissection. Lateral view. a- Vertebra lumbalis III, b- Vertebra lumbalis VII, c- Ilium, d- Ischium, e- Femur, f- Ren (reflected), g- Testis, 1- A. renalis, 2- A. testicularis, 3- A. iliaca externa, 4- Aorta abdominalis.

The testicular artery; enclosed in the proximal mesorchium; passed at first laterally for about 2-3 cm crossing the ventral surface of the psoas muscles(4/10). After that, it coursed caudoventrally towards the deep inguinal ring for about 7-8 cm (9/5& 13/3), then entered the inguinal canal converging then participating with the ductus deferens to form the spermatic cord. After emerging from the inguinal canal the spermatic cord enclosed testicular artery passed caudad within the Canalis vaginalis (13/l), subcutaneously dorsolateral to Corpus penis for about 5-6 cm to reach the scrotal cavity in the perineal region, where it supplied the testis and epididymis (13/k&14/g).

5-A. mesenterica caudalis:

The caudal mesenteric artery (4/6) arose from the ventral aspect of the abdominal aorta, opposite to the caudal border of the root of the 6^{th} lumbar transverse process. It entered the descending mesocolon where it divided into branches that shared in the arterial supply of both the descending colon and rectum.

DISCUSSION

Barium sulphate was quietly precipitated in small vessels, but it was poorly hardened in large vessels with the resultant possible oozing when large vessels are injured or purposely cut. This defect can be manipulated by cautious dissection to avoid injury and legation before purposed cutting of large vessels. Thus and in addition to its radio-opaque prosperities, barium sulphate can be considered as acceptable vessel filler material.

The red color of some arteries in the fresh specimens was due to some blood residue, and as it didn't interfere with the radio-opaque property of barium sulfate. Hence it can be advised to mix a coloring material with barium sulfate, for more clarification of the vessels and their ease differentiation from nerves, that share them white appearance of the unstained barium sulfate.

In accordance with Ghoshal, (1975), Schummer and Wilkens (1981), N.A.V. (2005) in the domestic carnivores and pig , Adams (1986) in the dog, Hudson and Hamilton (1993) in the cat, the present work showed that the fox possessed a cranial abdominal artery. On the other hand, the cranial abdominal artery doesn't occur in horse and ruminants (N.A.V., 2005).

Regarding the origin of the lumbar arteries, the present study, showed that all the lumbar arteries arise from the abdominal aorta. On the other hand, Ghoshal (1975) and Schaller (1992) in carnivores, mentioned that the first 2 or 3 lumbar arteries arise from the thoracic aorta. Also, Marthen (1939) in carnivores, said that the 7^{th} lumbar artery may arise from the terminal part of the abdominal aorta, median sacral or internal iliac artery. May (1970) in the sheep, mentioned that the 6^{th} (last) lumbar artery arise from the external iliac artery. Schummer& Wilkens (1981) stated that the last lumbar artery issues from the middle sacral artery in carnivores, pig and small ruminants and from the iliolumbar artery in the ox. The latter authors added that the last two lumbar arteries (5^{th} & 6^{th}) originate from the internal iliac artery.

Concerning the origin of the caudal phrenic and cranial abdominal arteries, the present work revealed that they arose separately from the abdominal aorta on the left side, and arose together by a common stem from the right renal artery on the right side. such variation necessitates dissection of several red fox specimens to determine the exact percentage of each pattern. In this respect, they arise by a common trunk from the abdominal aorta in carnivores (Ghoshal, 1975; Schummer and Wilkens, 1981; Dyce et al., 1996 and N.A.V., 2005), dog (Adams, 1986) and cat (Hudson and Hamilton, 1993). The caudal Phrenic artery originates from the celiac artery in the sheep (May, 1970), ruminants (Habel, 1975), pig and ruminants (Schummer and Wilkens, 1981; N.A.V., 2005). On the other hand, the caudal phrenic artery is absent in the horse (Ghoshal, 1975; Schumme r& Wilkens, 1981).

The level of origin of the celiac artery in this work was opposite to a mid-point between roots of 2nd and 3rd lumbar transverse processes. In this respect, the artery arises at the level of the aortic hiatus in the carnivores (Ghoshal, 1975), first lumbar vertebra in the dog (Adams, 1986), the carnivores and ruminants (Schummer and Wilkens, 1981), one cm or less caudal to aortic opening of the diaphragm in the cat (Reighard and Jennings, 1966), between crura of diaphragm in the sheep (May, 1970), at the level of the 2^{nd} lumbar vertebra in the camel (Smuts and Bezuidenhout, 1987) and at the fundus of the stomach by a common trunk with the cranial mesenteric artery in the guinea pig (Bednarova and Malinovsky, 1990).

This study revealed that the origin of the cranial mesenteric artery in the red fox was opposite to the caudal border of the arch of the second lumbar vertebra, similar to that in carnivores (Ghoshal, 1975), carnivores and ruminants (Schummer and Wilkens, 1981). While it arises at the first lumbar vertebra in the dog (Adams, 1986), pig and horse (Schummer and Wikkens, 1981) and goat (Yousef, 1991). However, It arises caudal to the origin of the celiac artery by 1 cm in the cat (Reighard and Jennings, 1966) and 12 cm in the camel (Smuts and Bezuidenhout, 1987).

In agreement with May (1970) in the sheep, the interval between the origin of the right and left renal arteries from the abdominal aorta was about 1 cm. In the same respect, Ghoshal (1975) in carnivores, Hudson and Hamilton (1993) in the cat, Schummer ans Wilkens (1981) and Dyce et al. (1996) in the domestic animals, stated that the origin of the right renal artery is cranial to that of the left renal one.On the other hand, Reighard and Jennings (1966) in the cat, said that the two renal arteries arise about the same level so the right renal artery passes craniolaterad and the left one passes caudolaterad.

The occurrence of double renal arteries in some cases was described in the dog (Kosik, 1923; Berg, 1962; Reis & Tepe, 1965), blue fox (Brudnicki et al., 1996), raccoon dog (Brudnicki et al., 1986), mink and dog (Wiland and Indykiewicz, 1999). Such doubling was not met with in the present study.

The level of origin of the caudal mesenteric artery in this study was opposite to the caudal border of the root of the 6^{th} lumbar transverse process. A finding which disagrees Ghoshal (1975) and Schummer and Wilkens (1981) in carnivores, who stated that the level of origin of the caudal mesenteric artery is at the level of the 5^{th} lumbar vertebra. The latter authors added that it is at the level of the 4^{th} lumbar vertebra in the horse and the 6^{th} lumbar vertebra in the pig. However it arises about the level of the last lumbar vertebra in the cat (Reighard and Jennings, 1966), either cranial or caudal to the origin of the external iliac artery in the sheep (May, 1970) and between the origins of the external and internal iliac arteries in the camel (Smuts and Bezuidenhout, 1987). The level of origin of the left testicular artery in this study was midway between the roots of the 5^{th} and 6^{th} lumbar transverse processes, and the right artery sprang at about 0.5 cm cranial to the left. A finding which is in partial agreement with Ghoshal (1975) in carnivores, who mentioned that it is between the 4th and 5^{th} lumbar vertebre and the right is slightly cranial to the left. On the contrary, Koch (1970) in the same animals, stated that left testicular arises cranial to the corresponding right artery. While Schummer and Wilkens (1981) mentioned that the testicular artery arises at the level of 3^{rd}- 4^{th} in the dog, 4^{th} in the horse, 4^{th}- 5^{th} in the cat and sheep and at the 5^{th} lumbar vertebra in the pig, goat and ox. However, it arises from the abdominal aorta at the caudal end of the kidney and may arise from the renal artery ion the cat (Reighard and Jennings, 1966), near the origin of the caudal mesenteric artery in the sheep (May, 1970) and ventral to the 5^{th} lumbar vertebra in the camel (Smuts and Bezuidenhout, 1987).

In accordance with Reighard and Jennings (1966) in the cat, Schummer and Wilkens (1981) and N.A.V. (2005) in carnivores, the deep circumflex iliac artery, in the present work, arose from the abdominal aorta,. On the other hand, Marthen (1939) in the dog, said that it arises from caudal mesenteric. Ellenberger and Baum (1891) in the same animal, May (1970) in the sheep, Smuts and Bezuidenhout (1987) in the camel, Schummer and Wilkens (1981) and N.A.V.(2005) in the pig, horse and ruminants, mentioned that it arises from the external iliac artery.

In agreement with Schummer and Wilkens (1981) in the doestic animals, the level of termination of the abdominal aorta in this work was slightly cranial to the promontory of the sacrum. Similarly, it lies ventral to the body of 6th and 7th lumbar vertebrae in the carnivores (Ghoshal, 1975) or below the last lumbar vertebra in the dog (Dyce et al., 1996) and at the level of L5- L6 in the camel (Smuts & Bezuidenhout, 1987).

In accordance with Ghoshal (1975) and Dyce et al. (1996) in the dog, May (1970) in the sheep, Smuts and Bezuidenhout (1987) in the camel, Schaller (1992) in carnivores, swine and ruminants and Schummer and Wilkens (1981) in the domestic animals, the abdominal aorta of the red fox divided into a median sacral and two internal iliac arteries. The latter authors added that the median sacral artery is very short in the horse or may be absent.

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بعض الدراسات التشريحية على الأبهر البطني في ذكر الثعلب الأحمر

باستخدام سلفات الباريوم كمادة مالئة للأوعية ومعتمة للأشعة

حـــــاتم بهجـــــات

قسم التشريح والأجنة بكلية الطب البيطري جامعة بنها. ج.م.ع.

أجريت هذه الدراسة على ثلاثة ذكور بالغة للثعلب الأحمر لاستيـضاح الأبهـر البطني في هذا الحيوان البري، ولاختبار معلق سلفات الباريوم ٥% كمادة مالئة للأوعية ومعتمة للأشعة في نفس العينة, للتغلب علي نقص عينات الحيوانات البرية. وهكذا فـإن نفس العينات قد صورت بالأشعة السينية، ثم شُرحت في الحالتين الطازجة والمحفوظة بالفورمالين.

أظهرت النتائج أن سلفات الباريوم كانت مادة مالئة ممتازة للأوعية الـصغيرة، بينما في الأوعية الكبيرة فقد كانت ضعيفة التماسك، وتـسيل إذا قُطـع الوعـاء أثنـاء التشريح. امتد الأبهر البطني من مستوى الفقرة القطنية الأولى إلـى مـستوى العـرف الحرقفي ، قليلا أمام طنف العجز، حيث انقـسم إلـى الـشريان العجـزي الوسـطي والشريانين الحرقفيين الداخليين. كل الفروع الجدارية للأبهر البطني كانت مزدوجة، و هي: الشريان الحجابي الذيلي، والبطني الأمامي، والشرايين القطنية السبعة، والـشريان الحرقفي الدائر الغائر، والشريان الحرقفي الخارجي. الشرايين الحشوية كانت إما مفردة (الجوفي، والمساريقي الأمامي، والمساريقي الخلفي) أو مزدوجـة (الكلـوي، وجـار الكلوي، والخصوي). نشأت الشرايين الحشوية المزدوجة اليمنى أماميـا لـــ (قبـل) نظيرتها اليسرى. استقبلت الغدة جار الكلية الفرع جار الكلوي الأمامي مـن الـشريان الحجابي الذيلي، والشريان جار الكلوي الأوسط من الأبهر البطني، و الفرع جار الكلوي الذيلي من الشريان الكلوي.

تم إعداد صور فوتوغرافية وشعاعية عديدة، هذا وقد نوقشت النتائج مع مثيلاتها في الحيوانات المستأنسة، خصوصا آكلات اللحوم المستأنسة.