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Gross Anatomical Studies on the Arterial Supply of the Intestinal Tract of the Goat

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Abstract: *The main purpose of this study was to convey a more precise explanation of the arterial supply of the intestinal tract of the goat. Fifteen adult healthy goats were used. Immediately after slaughtering of the goat, the thoracic part of the aorta (just prior to its passage through the hiatus aorticus of the diaphragm) was injected with gum milk latex (colored red) with carmine. The results showed that the duodenum was supplied by the cranial pancreaticoduodenal and caudal duodenal arteries. The jejunum was supplied by the jejunal arteries. The ileum was supplied by the ileal; mesenteric ileal and antimesenteric ileal arteries. The cecum was supplied by the cecal artery. The ascending colon was supplied by the colic branches and right colic arteries. The transverse colon was supplied by the middle colic artery. The descending colon was supplied by the middle and left colic arteries. The sigmoid colon was supplied by the sigmoid arteries. The rectum was supplied by the cranial; middle and caudal rectal arteries.*
Keywords*: Anatomy,Arteries, Goat, Intestine*

I. Introduction

Goats characterized by their high fertility rate and are of great economic value; being a cheap meat, milk and some industrial substances. The anatomical studies on the arterial supply of the intestinal tract of the goat are necessary to know the pattern of its arterial supply to gain information in benefit of experimental caprine surgery; pharmacology and toxicology which can be applied to domestic animals. Therefore; the present investigation aimed to describe fully the arteries of the intestine in goat; regarding the origin; course and ramifications.

II. Material And Methods

In this study, 15 adult apparently healthy goats of different ages and both sexes ranging from 20.30 kg. body weight. The animals were collected from the faculty farm and from several local farms. General anaesthesia was induced by xylazine (Rompun) 0.5 mg/kg and cyclohexanone (Ketalar) 10mg per kg body weight intramuscularly. Immediately after slaughtering; the abdominal cavity was opened by makinga longitudinal incision was made in the midventral line of the abdominal wall starting from the xiphoid cartilage of the sternum till the anus. Then gum red milk latex was injected via the thoracic aorta just prior to its passage through the hiatus aorticus of the diaphragm. Careful gross dissection of the arteries of the intestine was performed either before or after embedding in 10% formalin solution for 2.3 days. Dissected intestinal arteries were photographed in situ and after taken out the intestine with a camera a codak digital camera (12 mega pixels). The nomenclature employed in this study was in accordance with that of the Nomina Anatomica Veterinaria (2005) and the available literatures whenever possible.

III. Results And Discussion

The intestinal tract received its arterial blood supply primarily from the cranial and caudal mesenteric arteries. It also received additional branches from gastroduodenal as well as the middle rectal and caudal rectal arteries of the urogenital and dorsal perineal arteries, respectively.

Cranial mesenteric artery

The cranial mesenteric artery (Figs.1, 2, 3, 5, 7 and8) arose from the ventral aspect of the abdominal aorta at the level of the first lumbar vertebra, caudal to the origin of the celiac artery. The result was similar in goat (Youssef, 1991), sheep (Habel, 1975) and buffalo (Barnwal et al., 1982). However, Wilkens and Munster (1981) in ruminants and Wally (1986) in camel recorded that the origin of such artery is at the level of the second and third lumbar vertebrae,respectively. The cranial mesenteric artery entered the mesentery giving caudal duodenal artery, jejunal arteries, ileal arteries, ileocolic artery and middle colic artery and terminated by the last two jejunal arteries. This result was in accordance with that obtained by Youssef (1991) in goat. However, it terminates by the middle colic and ileocolic arteries in calves (Root and Tashgian, 1971) and by the

ileocolic artery or the last 6.7 jejunal arteries in camel (Wally, 1986 and Smuts and Bezuidenhout, 1987, respectively).

Caudal duodenal artery

The caudal duodenal artery (Figs.1 and 8) passed caudally within the mesentery of the ascending limb of the duodenum giving off duodenal branches to the mesenteric border of the ascending limb of the duodenum and first jejunal artery (Fig. 3) which passed towards the first part of the jejunum, thus confirming the result obtained by Youssef (1991) in goat. While, Constantinescu (2001) in goat, Constantinescu and Constantinescu (2004) in large ruminants, Machado et al. (2002) in and Wally (1986) in camel mentioned the same origin of such artery under the name of caudal pancreaticoduodenal artery. Whereas, the artery originated from the middle colic artery in goat (Nayar et al., 1983) and from the jejunal artery in camel (Smuts and Bezuidenhout, 1987).

Jejunal arteries

The jejunal arteries (Figs.1, 2, 3 and 7) were 24 - 27 in number. Each jejunal artery passed within the mesentery towards the mesenteric border of the jejunal convolutions and divided into two main branches; cranial and caudal which anastomosed to form primary arches and secondary arches which gave several twigs were given to the jejunal wall (Fig.2). Similar to that recorded by Youssef (1991) also in goat, while they 37 in buffalo (Machado et al., 2002) and 6.7 in camel animal (Wally, 1986).

Ileal arteries

The ileal arteries (Figs.1, 3 and 7) were 3-7 in number that arose from the terminal part of the cranial mesenteric artery towards the mesenteric border of the ileum; simulated that reported by Youssef (1991) in goat.

Ileocolic artery

The ileocolic artery (Figs.1,3, 4, 5, 6 and8) came from the cranial mesenteric artery. It gave a common trunk for colic branches and right colic arteries and mesenteric ileal artery (Figs. 4, 5, 6 and 7). The common trunk coursed on the ansa spiralis coli toward the central flexure where it terminated by dividing into the last colic branch and the first right colic artery. It gave off colic branches and right colic arteries. The colic branches (Figs.4 and6) supplied the ansa proximalis coli, the centripetal gyri and the central flexure of ansa spiralis coli. While the right colic arteries (Figs.4 and 6) supplied the centrifugal gyri and the dorsal part of the ansa distalis coli. Our findings were in accordance with those gained by Youssef (1991) in goat, Wilkens and Munster (1981) and Simoens et al. (1981) in ruminants.The mesenteric ileal artery (Fig.3) followed the mesenteric aspect of the terminal part of the ileum detaching 10-12 twigs which anastomosed with the antimesenteric ileal branches of the cecal artery confirmed those of Youssef (1991) in goat, May (1970) in sheep, Maala and Sack (1981) in ox and Machado et al.(2002) in buffalo.

The cecal artery (Figs.1, 3, 6 and 7) constituted the direct continuation of the ileocolic artery. It crossed the terminal part of the ileum to reach the ileocecal fold and extended along the ventral aspect of the cecum to its apex where it continued as antimesenteric ileal artery. Along its course; the cecal artery gave off cecal branches (Figs.1, 3 and 7) which ran within the ileocecal fold towards the ventral aspect of the cecum and antimesenteric ileal branches (Figs. 1, 3 and 7) which passed to supply the antimesenteric aspect of the ileum. The antimesenteric ileal artery (Figs.1, 3 and 7) passed towards the terminal part of the jejunum to join the last jejunal branch of the cranial mesenteric artery giving off antimesenteric ileal branches; confirmed those of Youssef (1991) in goat, May (1970) in sheep, Maala and Sack (1981) in ox and Machado et al.(2002) in buffalo.

Middle colic artery

The middle colic artery (Figs.1 and 8) coursed within the mesocolon towards the transverse colon and divided into right and left branches (Figs.1 and 8) which supplied the ventral gyrus of the ansa distalis, in addition to transverse colon and initial part of the descending colon; our findings coincided with those gained by Constantinescu (2001) in goat, May (1970) in sheep, Habel (1975) in ox and Barnwal et al. (1982) in buffalo, where it originated from the cranial mesenteric artery. On the contrary, such artery in camel arose from the right colic artery and was represented by 4-6 branches (Wally, 1986). Moreover, the right and left branches of the middle colic artery were destined to supply the transverse colon and initial part of the descending colon, in addition to the ventral gyrus of the ansa distalis coli of the ascending colon. Such result was similar to that reported by Youssef (1991) in goat and May (1970) in sheep.

Caudal mesenteric artery

The caudal mesenteric artery (Fig.9) descended from the ventral aspect of the abdominal aorta opposite the level of the 5th lumbar vertebra. It passed within the mesocolon where it divided near the sigmoid colon into

left colic and cranial rectal arteries, confirming what given by Youssef (1991) in goat, Wilkens and Munster (1981) in small ruminants and Raghavan and Kachroo (1964) in ox. However, it arises at the level between the 5th and 6th lumbar vertebra in goat and sheep (Habel, 1975) and opposite to of the 5th or 6th lumbar vertebra in camel (Wally, 1986).

The left colic artery (Fig.9) preceded within both mesocolon sigmoideum and mesocolon descendens till the initial part of the latter colon. It gave sigmoid artery and colic branches. The sigmoid artery descended ventrally within the mesocolon sigmoideum to supply the sigmoid colon. While the colic branches were 3-6 in number; passed within the mesocolon descendens to supply the descending colon. Such results confirmed those given by Youssef (1991) in goat and Wilkens and Munster (1981) in ruminants.

The cranial rectal artery (Fig.9) passes within the mesorectum. It gave off sigmoid arteries to the sigmoid arteries and rectal branches to supply the initial part of the rectum. Such observations were in accordance with that stated by Youssef (1991) in goat. However; the sigmoid arteries were detached from the caudal mesenteric artery itself in ruminants (Wilkens and Munster, 1981), whereas they were given off from the left colic artery only in buffalo (Machado et al., 2002).

Middle rectal artery

The middle rectal artery (Fig. 10) was detached from the urogenital artery giving several twigs to the caudal portion of the rectum, similar result was described by Youssef (1991) in goat and Wilkens and Munster (1981) in ruminants. However, May (1970) in sheep and Smuts and Bezuidenhout (1987) in camel mentioned that the middle rectal artery arises from the internal pudendal artery. While, Wally (1986) reported that the middle rectal artery arises from the ventral perineal artery in camel.

Caudal rectal artery

The caudal rectal artery (Fig.10) arose from the dorsal perineal artery of the urogenital artery supplying the caudal segment of the rectum and anus; a result which was also recorded by Wilkens and Munster (1981) in goat and ox and Habel (1975) in cow. On the other hand, Constantinescu (2001) in goat, Habel (1975) in goat and sheep and (Smuts and Bezuidenhout, 1987) in camelreported that the caudal rectal artery originates either from the dorsal or ventral perineal arteries. While, May (1970) in sheep and Habel (1975) in ox stated that the caudal rectal artery arises from the internal pudendal artery. It was observed in our study as well in sheep and goat (Habel, 1975), ox (Raghavan and Kachroo (1964) and camel (Wally, 1986) that the caudal rectal artery supplies the caudal segment of the rectum, in addition to the anus; while Saber (1979) in camel stated that such an artery supplies only the anal canal and orifice.

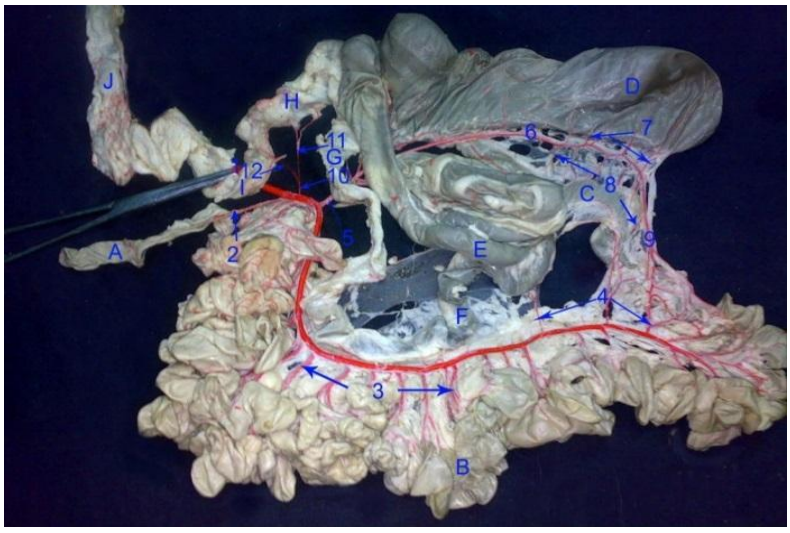

Fig. 1: A photograph showing the course and distribution of the cranial mesenteric artery of the goat.

A. Duodenum; B. Jejunum; C. Ileum; D. Cecum; E. Centripetal gyri; F. The most outer centrifugal gyrus; G. Dorsal gyrus; H. Ventral gyrus; I. Colon transversum; J. Colon descendens; 1.Cranial mesenteric artery; 2.Caudal duodenal artery; 3.Jejunal arteries; 4. Ileal arteries; 5.Ileocolic artery; 6.Cecal artery; 7.Cecal branches; 8.Antimesenteric ileal branches; 9.Antimesenteric ileal artery; 10.Middle colic artery; 11.Left branch of 10; 12.Right branch of 10.

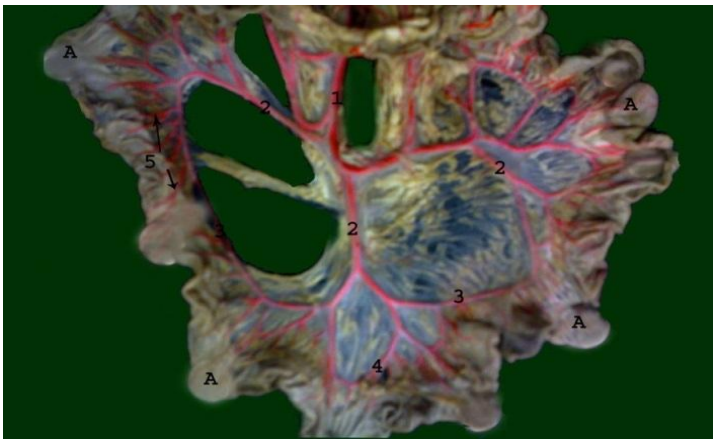

Fig. 2: A photograph showing the origin; course and distribution of the jejunal arteries of the goat
A. Jejunum; 1.Cranial mesenteric artery; 2.Jejunal arteries; 3.Primary arches of the jejunal arteries; 4. Secondary arches of the jejunal arteries; 5. Straight twigs to the jejunal convolutions

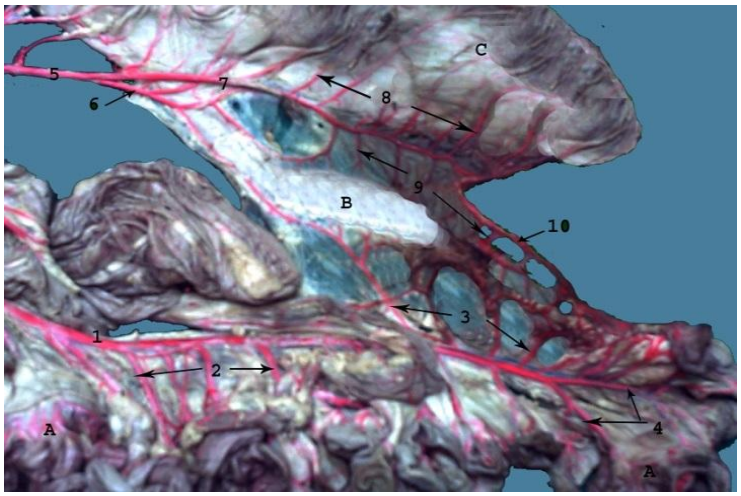

Fig. 3: A photograph showing the distribution of the Antimesenteric ileal artery and ileal arteries as well as the termination of the cranial mesenteric artery of the goat
A. Jejunum; B. Ileum; C.Cecum.1.Cranial mesenteric artery; 2.Jejunal arteries; 3.Ileal arteries; 4.Last two jejunal arteries; Ileocolic artery; 6.Mesenteric ileal artery; 7.Cecal artery; 8.Cecal branches; 9.Antimesenteric ileal branches; 10.Antimesenteric ileal artery.

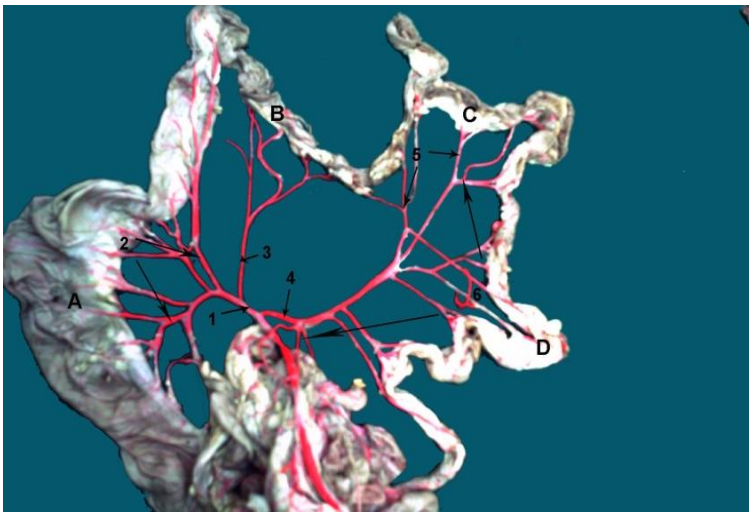

Fig. 4: A photograph showing the origin; course and distribution of the ileocolic artery of the goat
A. Proximal loop; B. centripetal gyri; C. Central flexure; D. Centrifugal gyri. 1.Ileocolic artery; 2.Colic branches; 3.First colic branch; 4.A common trunk for 5 and 6; 5.Colic branches; 6.Right colic arteries.

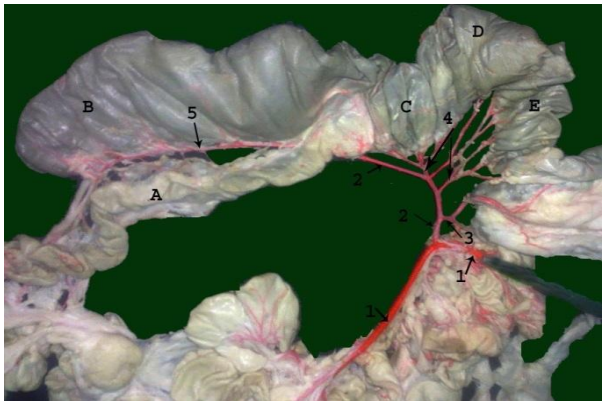

Fig. 5: A photograph showing the origin; course and distribution of the colic branches of the ileocolic artery of the goat
A.Ileum; B.Cecum; C. Ventral gyrus; D. Middle gyrus; E. Dorsal gyrus.1. Cranial mesenteric artery; 2. Ileocolic artery; 3. A common trunk for colic branches and right colic arteries; 4. Colic branches; 5. Cecal artery.

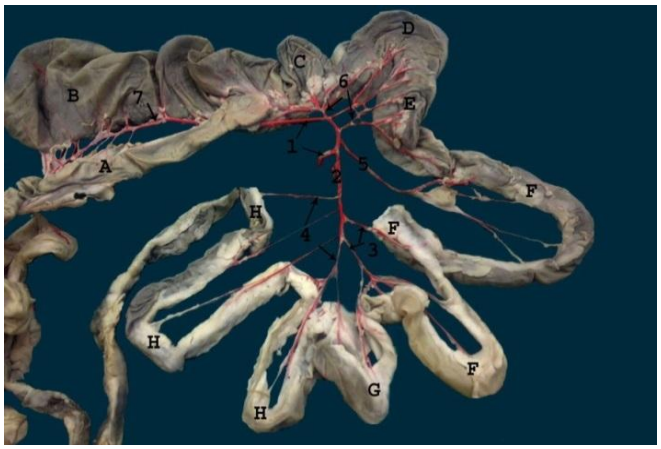

Fig. 6: A photograph showing the origin; course and distribution of the common stem of colic branches and right colic arteries of the goat

A.Ileum; B. Cecum; C. Ventral gyrus; D. middle gyrus; E. Dorsal gyrus; F. Centripetal Gyri; G. Central flexure; Centrifugal gyri. 1. Ileocolic artery; 2. A common trunk for 3 and 4; 3. Colic branches; 4. Right colic arteries; 5. First colic branch; 6. Colic branches; 7. Cecal artery.

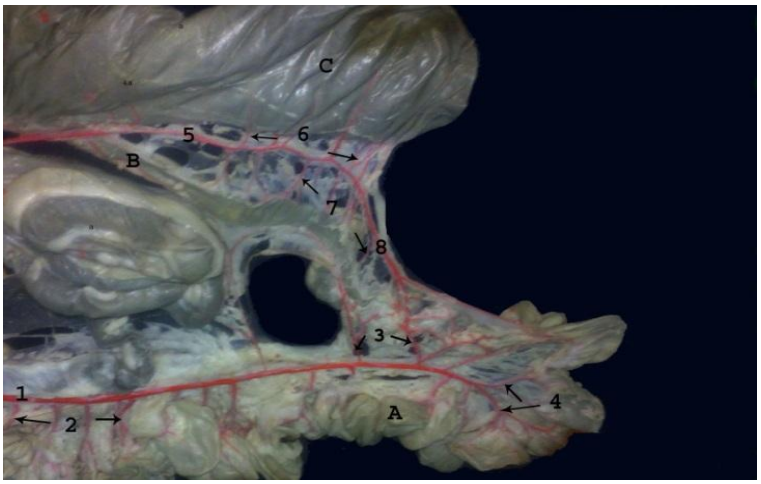

Fig. 7: A photograph showing the distribution of the cecal artery of the goat:
A. Jejunum; B. Ileum; C. Cecum. 1. Cranial mesenteric artery; 2. Jejunal arteries; 3.Ileal arteries; 4.Last two jejunal arteries; 5.Cecal artery; 6.Cecal branches; 7.Antimesenteric ileal branches; 8.Antimesenteric ileal artery.

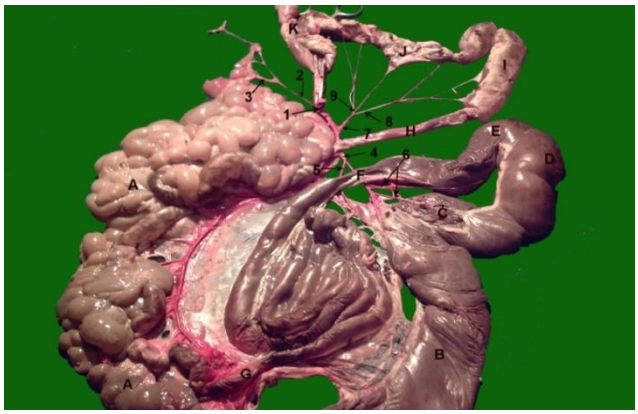

Fig. 8: A photograph showing the origin; course and distribution of the middle colic artery of the goat

A.Jejunum; B. Cecum; C. Ventral gyrus; D. Middle gyrus; E. Dorsal gyrus; F. First centripetal gyrus; G. the most outer centrifugal gyrus; H. Ventral gyrus; I. Dorsal gyrus; J. Colon transversum; K. Colon descendens. 1. Cranial mesenteric artery; 2.Caudal duodenal artery; 3.First jejunal artery; 4.Ileocolic artery; 5. A common trunk for colic branches and right colic arteries; 6. Colic branches; 7.Middle colic artery; 8. Left branch of 7; 9. Right branch of 7.

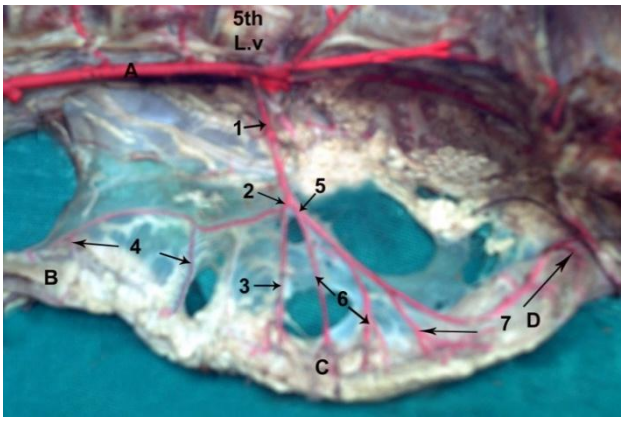

Fig. 9: A photograph showing the origin; course and distribution of the caudal mesenteric artery

A. Abdominal aorta; B. Descending colon; C. Sigmoid colon; D. Rectum. 1. Caudal mesenteric artery; 2. Left colic artery; 3.Sigmoid artery; 4.Colic branches; 5.Cranial rectal artery; 6.Sigmoid arteries; 7.Rectal branches.

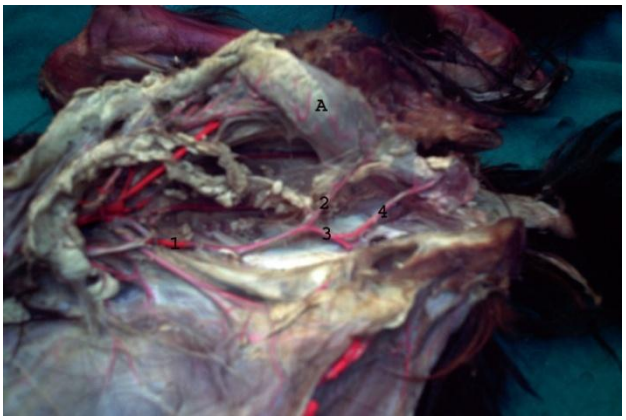

Fig. 10: A photograph showing the origin; course and distribution of the middle and caudal rectal arteries

A.Rectum. 1. Urogenital artery; 2. Middle rectal artery; 3. Dorsal perineal artery; 4. Caudal rectal artery.

IV. Conclusion

The intestinal tract of the goat was supplied by the branches of the cranial and caudal mesenteric arteries; in addition to middle and caudal rectal arteries. The small intestine was supplied by the caudal duodenal; jejunal and ileal arteries. While the large intestine was supplied by the ileocolic, middle colic, caudal mesenteric, middle rectal and caudal rectal arteries.

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