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Research Article

Gross anatomical studies on the arterial blood supply of the intestinal tract of the cattle egret (*Bubulcus ibis*)

S. H. El- Bably

Department of Anatomy and Embryology, Faculty of Veterinary Medicine, Cairo University
*Corresponding author: *drsamah.elbably@yahoo.com*

Abstract

The aim of this study was to investigate the arterial blood supply of the intestinal tract of cattle egret. Eight adults, apparently healthy egret of both sexes were used in the study. The specimens were slaughtered and the descending aorta was cannulated and flushed with warm normal saline (0.9%). Then egret were injected with colored gum milk latex. The origin, branching pattern and distribution of the different arteries supplying the small and large intestines were documented. The intestinal tract of egret received its arterial supply from; the right branch of the celiac artery, the cranial mesenteric, the caudal mesenteric and the internal iliac arteries. The right branch of the celiac artery was contributed to the blood supply of the duodenum, pancreas, last third of ileum and left cecum. The cranial mesenteric artery supplied the terminal portion of duodenum, jejunum, cranial two thirds of ileum, right cecum and cranial portion of colon. The caudal mesenteric artery supplied the rectum and the cranial portion of cloaca. The internal iliac artery supplied the caudal portion of cloaca and cloacal bursa.

Keywords: Intestinal tract – Cranial mesenteric artery- Caudal mesenteric artery- Egret.

Introduction

The **Cattle Egret** (*Bubulcus ibis*) is a wild bird, Family Ardeidae, Genus Ardea, species Cinerea, egrets are classified in the taxonomic order of Pelecaniforms, and they are found in the tropics, subtropics and warm temperate zones and feeds on insects, spiders, frogs, earth-worms and fishes. The importance of research on the cattle egret as a type from birds gives the anatomist the interest to study the normal anatomy of the arterial supply in the intestinal tract and also to show the difference between arterial supply in the cattle egret and in the domestic fowl. The major arterial supply of the descending aorta which supply the intestinal tract and other abdominal viscera in the domestic fowl are previously studied by **Baumel, J. J. (1975).**

Materials and Methods

The current study was conducted on eight adult, apparently healthy cattle egret of both sexes, the specimens were slaughtered and left to bleed for five minute, then cunnulated through the descending aorta and flushed with the warm normal saline solution. The specimens were injected with 60% gum milk latex colored red using **Rotring®** ink. ***(Tompsett and Wakelly, 1965).*** The specimens were left in a mixture of 10% formalin 4% phenol and 1% glycerin for two days before routine dissection. The obtained results were photographed using **kanon®** digital camera 20 mp, 16x. The nomenclature used in this study was that given by the ***Nomina Anatomica Avium (Baumel et al., 1993).***

Results

The intestinal tract of the egret received its arterial supply through four main sources namely; the right branch of the celiac artery, the cranial mesenteric, the caudal mesenteric and the internal iliac arteries.

I- Ramus dexter arteriae celicae:

The right branch of the celiac artery **(Fig. 1, 2 and 3/7)** was considered the direct continuation of the celiac artery on the right aspect. It gave off the ileocecal branches, jejunal branches, gastroduodenal and right gastric arteries and then continued as pancreaticoduodenal artery. The branches of the right celiac artery distributed to the ventriculus, duodenum, pancreas, jejunum and left cecum.

A. ileocecalis:

The ileocecal arteries **(Fig.1, 2 and 3/10)** were 2-4 branches, detached at intervals from the right branch of celiac artery. In some cases, the ileocecal branches originated by a common trunk. These branches entered the short ileocecal ligament and distributed to the last third of the ileum and the left cecum.

Aa. Jejunales:

The jejunal arteries **(Fig.1, 2 and 3/11)** were formed of large numbers of branches, distributed allover the jejunum. They were had different origins. The three jejunal arteries were originated from the celiac artery, the first jejunalartery arose from the right branch of celiac artery prior to the origin of gastroduodenal artery, it was distributed to the terminal part of the jejunum and the initial part of the ileum. The second and third branches either arose at short intervals or with a common trunk from the first third of the pancreaticoduodenal artery. The second jejunal artery passed dorsally supplying the initial portion of the jejunum and anastmosed with the duodenojejunal artery of the cranial mesenteric artery while the third branch supplies the terminal portion of the jejunum.

A. gastroduodenalis:

The gastroduodenal artery **(Fig.1, 2/8)** was represented by a short stem vessel that originated from the left side of right branch of the celiac artery. It was divided into two to three small branches that distributed to the pylorus and first part of the descending duodenum.

A. pancreaticoduodenalis:

The pancreaticoduodenal artery **(Fig.1 and 2/9**) was considered the direct continuation of the right branch of the celiac artery after the origin of the right gastric artery. It passed along the mesodudenum between the descending and ascending limbs of the duodenum where it gave off **pancreatic branches** and **duodenal branches (Fig.1 and 2/9a).**

A. duodenojejunalis:

The duodenojejunal artery **(Fig.4/12)** may be arisen as a single branch from the celiac or from the right celiac artery or as a continued branch from the pancreaticoduodenal artery to be anastomesed with the duodenojejunal artery of the cranial mesenteric artery **(Fig.4/15c).**

II- A. mesenterica cranialis:

The cranial mesenteric artery **(Fig.1, 5 and 6/14)** originated from the descending aorta about 0.7 to 1 cm caudal to the origin of the celiac artery, just ventral to the fifth thoracic vertebra, between the fifth and sixth vertebral ribs. It proceeded caudoventrally in the mesentery forming a semicircular curve that ended near the mesentery of the ileum. Along its course the cranial mesenteric artery released duodenojejunal, jejunal, ileal and ileocecal arteries.

A. duodenojejunalis:

The duodenojejunal artery **(Fig.4/15)** was the first vessel that arose from the cranial mesenteric artery and passed in the mesentery of the jejunum and divided into two branches at the duodenojejunal flexure, the **duodenal branch (Fig.4/15a),** it passed along the duodenojejunal flexure, gave off a smaller branches to the wall of it and anastmosed to the duodenojejunal artery of the right branch o celiac artery **(Fig.4/15c)** and the **jejunal branch (Fig.4/15b)**, it passed on the beginning of the jejunum suppling it and anastmosed with the first jejunal artery along the wall of the jejunum.

Aa. Jejunales:

The jejunal arteries **(Fig.5 and 6/16)** formed of 7-10 branches, which arose from the convex aspect of the cranial mesenteric artery at short intervals and extended in the mesojejunum to the mesenteric border

of the jejunum. On reaching the latter border, each jejunal artery was divided into two primary branches that anastomosed with the corresponding branches of the adjacent arteries forming the **intestinal arches (Fig.6/17).** From these arches fine numerous collateral twigs called terminal branches were detached and supplied both sides of the jejunal wall.

Aa. ileales:

The ileal arteries **(Fig.5 and 6/17)** represented by two branches originated from the the cranial mesenteric artery that proceeded dorsally then bifurcated into two branches. These vessels were distributed to the proximal portion of the ileum and anastomosed with the ileocecal artery of right branch of celiac artery.

A. ileocecalis:

The ileocecal artery **(Fig.9 /18)** was the last branch arising from the cranial mesenteric artery. It gave off the colic branch**,** that passed in a caudal direction giving 4-5 branches that distributed to the cranial portion of the colon. **The colic branch** supplied the cranial part of the colon by 3-4 bbranches and then anastmosed with the cranial branch of the caudal mesenteric artery, along the wall of the colon**.** Then the ileocecal artery proceeded cranially in the mesocolon where it terminated into 2-4 branches suppling the caudal third of the ileum and cecum.

III- A. mesentrica caudalis:

The caudal mesenteric artery **(Fig.7 and 8/19)** detached from the descending aorta just caudal to the caudal lobe of the right kidney. It was in the form of short stem vessel about 0.5 cm in length and divided into a cranial and a caudal branch.

The cranial branch of the caudal mesenteric artery **(Fig.7 and 8/20)** passed cranially alongside the dorsal wall of the colon. It divided into large cranial and small caudal branches. **The cranial branch (Fig.8 and 9 /22)** passed cranially to be anastomose with the colic branch of the ileocecal artery. Along its course it released 3-5 twigs supplying the cranial portion of the colon, while **the caudal branch (Fig.8 and 9/23)** supplied the caudal portion of the colon by 2-3 twigs
The caudal branch of the caudal mesenteric artery extended caudally on the dorsal aspect of the colon and gave off **2-3 colic branches (Fig.8/24)** that distributed to the caudal portion of the colon and **about two cloacal branches (Fig.8/25)** that ramified in the cranial portion of the cloaca and anastomosed with the cloacal branches of the internal pudendal artery.

IV- A.iliaca interna:

The internal iliac artery **(Fig.8/28)** originated by the bifurcation of the descending aorta on a level with the 6th synsacral segment. In between the latter two vessels arose the **median caudal artery (Fig.7/29).** The internal iliac artery extended caudolaterally and gave off the **internal pudendal artery ((Fig. 7and 8/30)** which gave off two small **cloacal branches (Fig.7 and 8/31)** that ramified in the caudal portion of the cloaca and cloacal bursa.

Discussion

In agreement with ***Khalifa (2013)*** in the cattle egret, ***Rezk*** and ***El-Bably(2013), Kuru, 2010; Kurtul*** and ***Haziroglu, 2002; Aslan*** and***Takci, 1998; Silva et al., 1997;Fowler, 1991; King*** and ***Mc Lelland,1984; Lauper et al., 1975)*** in domestic fowl, the intestinal tract of the cattle egret supplied by celiac, cranial mesenteric, caudal mesenteric arteries mainly and also fine branches from the internal pudendal artery.

In accordance to***.Khalifa (2013)*** in the cattle egret, ***Rezk*** and ***El-Bably (2013)*** in the fowl, ***Farag et al., (2013)*** in turkey and ***Haligu*** and ***Duzler (2010)*** in red falcon, the right branch of the celiac artery distributed to the intestinal tract through only gastroduodenal and pancreaticoduodenal arteries, while ***(Aslan and Takci, 1998)*** in geese***; (Baumel, 1975)*** in fowls; ***(Franz and Salomon, 1993)*** in domestic fowls; ***(Silva et al., 1997)*** in domestic fowls; ***Kuru, 2010*** in domestic fowls also added ileal arteries arose from the right branch of celiac and distributed to the ileum.

This study similar to ***Khalifa (2013)*** in the cattle egret, also added ileocecal arteries detached from the right branch of celiac artery while ***Rezk*** and ***El-Bably (2013), Kuru, (2010)*** and ***Silva et al. (1997)*** in domestic fowl, ***Farag et al., (2013)*** in turkey and ***Haligu*** and ***Duzler (2010)*** in red falcon, recorded that it arose from the pancreaticoduodenal. On the other hand, ***Kurtul and Haziroglu (2002)*** reported that, the

ileocecal artery arose from the cranial mesenteric artery in the pigeon.

In the present study, the gastroduodenal artery was a short vessel, originating from the right branch of the celiac artery and distributed to the pylorus and first part of the descending duodenum Similar results were recorded by ***Khalifa (2013)*** in the cattle egret, ***Rezk*** and ***El-Bably (2013)*** in the fowl, ***Kuru, 2010*** in the domestic fowl and ***Haligur and Duzler, (2010)*** in red falcon. On the other hand ***Baumel et al. (1993)***, stated that the gastroduodenal arose from the left branch of celiac artery.

The present study as well as ***Khalifa (2013)*** in the cattle egret, ***Rezk*** and ***El-Bably, 2013*** in the fowl, ***Farag et al., (2013)*** in turkey and ***Pinto et al. (1998)*** in domestic duck revealed that the pancreaticoduodenal artery was the direct continuation of the right branch of the celiac artery after the origin of the right gastric artery. On the other hand ***Baumel (1975), Franz*** and ***Salomon (1993)*** and ***Malinovsky*** and ***Novotna (1977)*** in the fowl mentioned that, the duodenojejunal artery was the direct continuation of the right branch of the celiac artery between the ascending and descending part of the duodenum.

The present study added that, duodenojejunal artery arose from the right branch of celiac and anastmosed with the duodenojejunal artery of the cranial mesenteric at the duodenojejunal flexure.

This study reported 2 to 3 jejunal branches, the first one detached from the right branch of celiac while the other two branches detached from the pancreaticoduodenal artery, these results similar to ***Khalifa (2013)*** in the cattle egret.

The current study revealed that a colic branch was detached from the ileocecal artery of the cranial mesenteric artery. This branch passed in a caudal direction giving 3-4 branches that distributed to the cranial portion of the colon and anastomosed with the cranial branch of the caudal mesenteric artery. The latter branch was not recorded in any of the available literatures. ***Ebada et al. (2006)*** in the ostrich recorded a proper colic artery arising from the cranial mesenteric artery and added its division into an ascending and a descending branch. However the latter proper colic artery could be matched with the ileocecal artery mentioned in the present study.

In agreement with ***El karmoty (2014)*** in ducks and geese, ***Farag et al., (2013)*** in turkey, ***Santana et al. (2001)***, ***Campos et al. (2006)*** in the fowl and ***Pinto et al. (1998)*** in the domestic duck. the caudal mesenteric artery, originated from the aorta as a single vessel, caudal to the caudal lobe of the kidneys. It was divided into two branches cranial and caudal .Similar findings were recorded by On the other hand ***Ebada et al. (2006)*** in the ostrich mentioned that the caudal mesenteric artery gave off 10-12 long branches and added that each of these branches provided four subdivisions before reaching the mesenteric border of the colon.

According to the present study the anastomosis between the cranial and caudal mesenteric arteries was established through the colic branch ileocecal artery and the cranial branch of the caudal mesenteric artery, this finding similar to ***Farag et al., (2013)*** in turkey. On the other hand ***Pinto et al. (1998)*** in the domestic duck recorded that the caudal mesenteric artery anastomosed with one of the three main branches arising from the cranial mesenteric artery.

In cattle egret, the internal pudendal artery arose from the internal iliac artery, similar to ***Baumel (1975)*** in the fowl**.** On the other hand ***Nickel et al. (1977)*** in the fowl described it as paired vessel arising directly from the aorta immediately caudal to the origin of the caudal mesenteric artery. The present study also recorded two small cloacal branches arisen from the internal pudendal artery that ramified in the caudal portion of the cloaca and cloacal bursa while ***Baumel (1975)*** in the fowl recorded 3-4 cloacal rami .

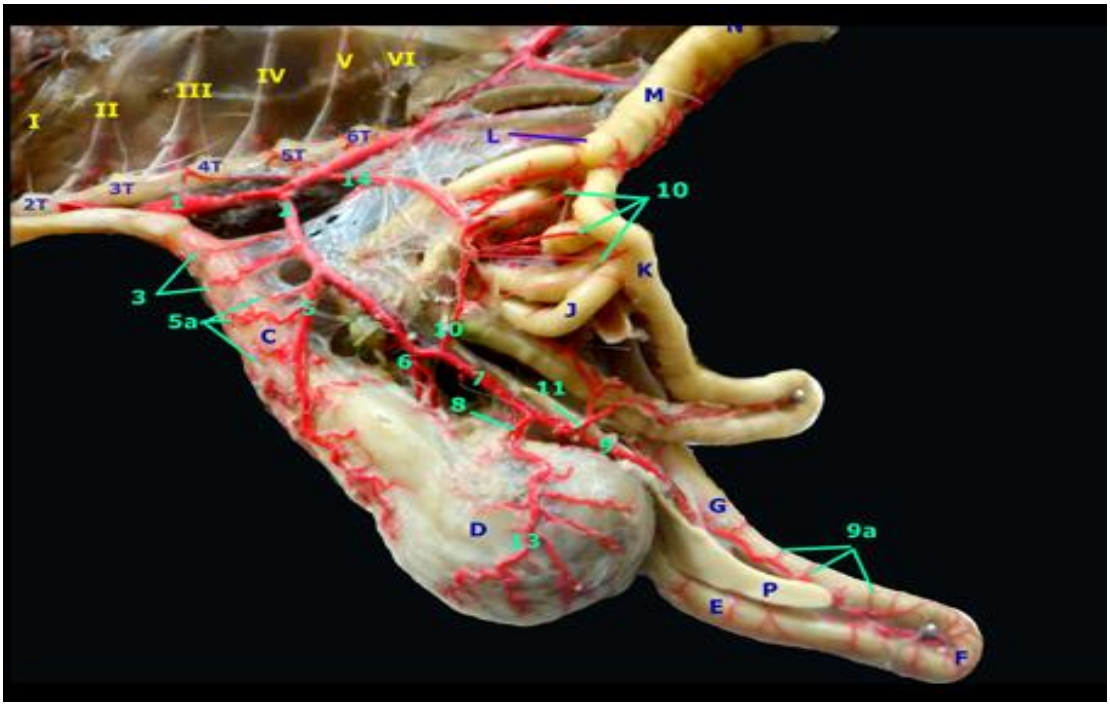

Fig. (1): A photograph showing the branches of the right branch of the celiac artery in the cattle egret.

Fig. (2): A photograph showing the branches of the right branch of the celiac artery in the cattle egret.

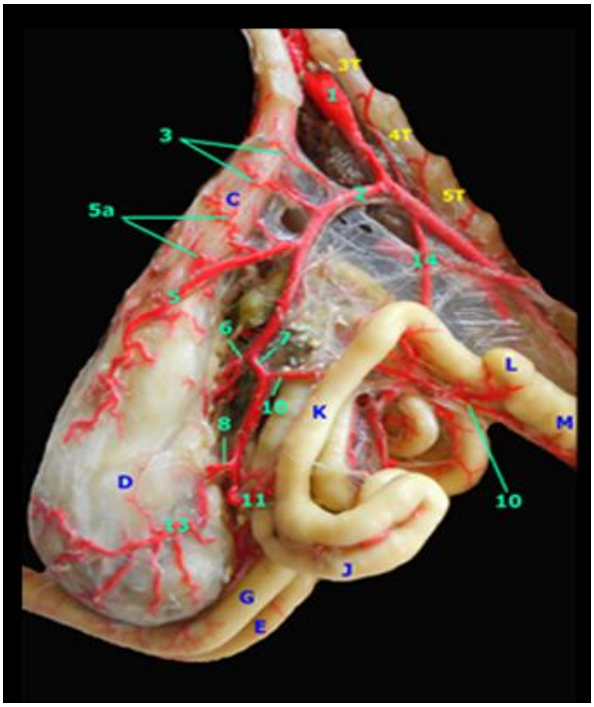

Fig.3: **A photograph showing the distribution of the ileocecal artery of the right celiac artery to ileum, cecum & colon in the cattle egret**

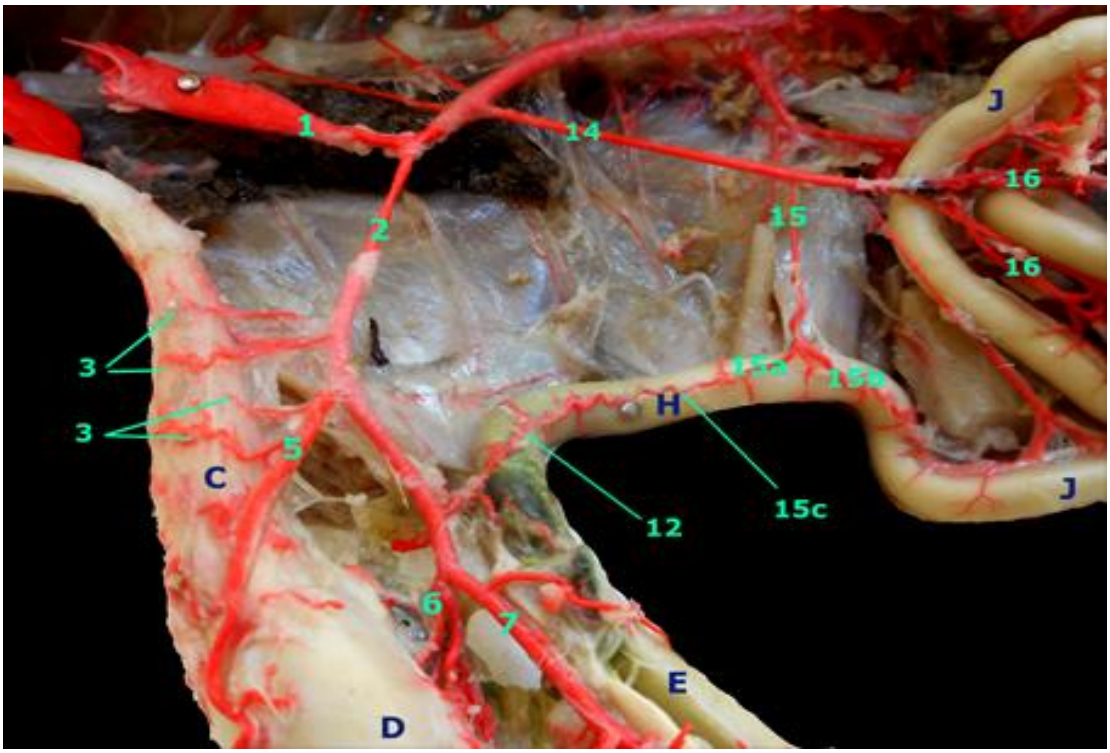

Fig. (4): A photograph showing the anastomosis between the celiac and cranial mesenteric artery in the cattle egret.

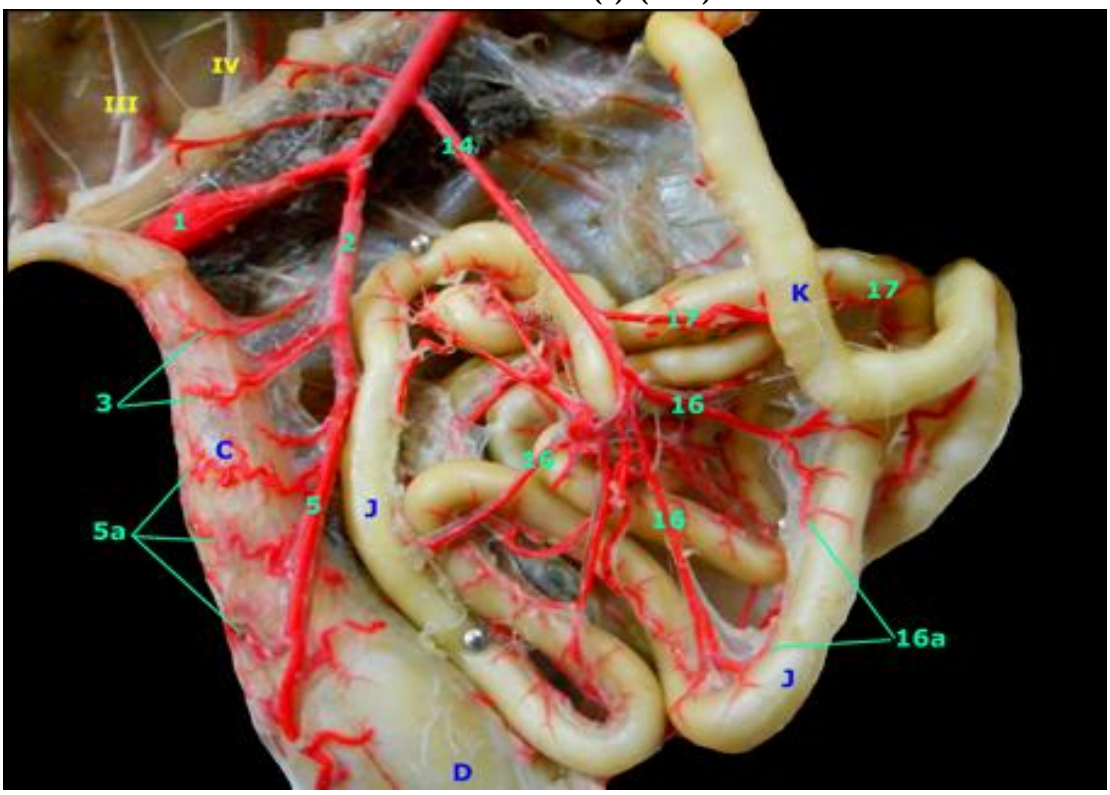

Fig. (5): A photograph showing the branches of the cranial mesenteric artery in the cattle egret.

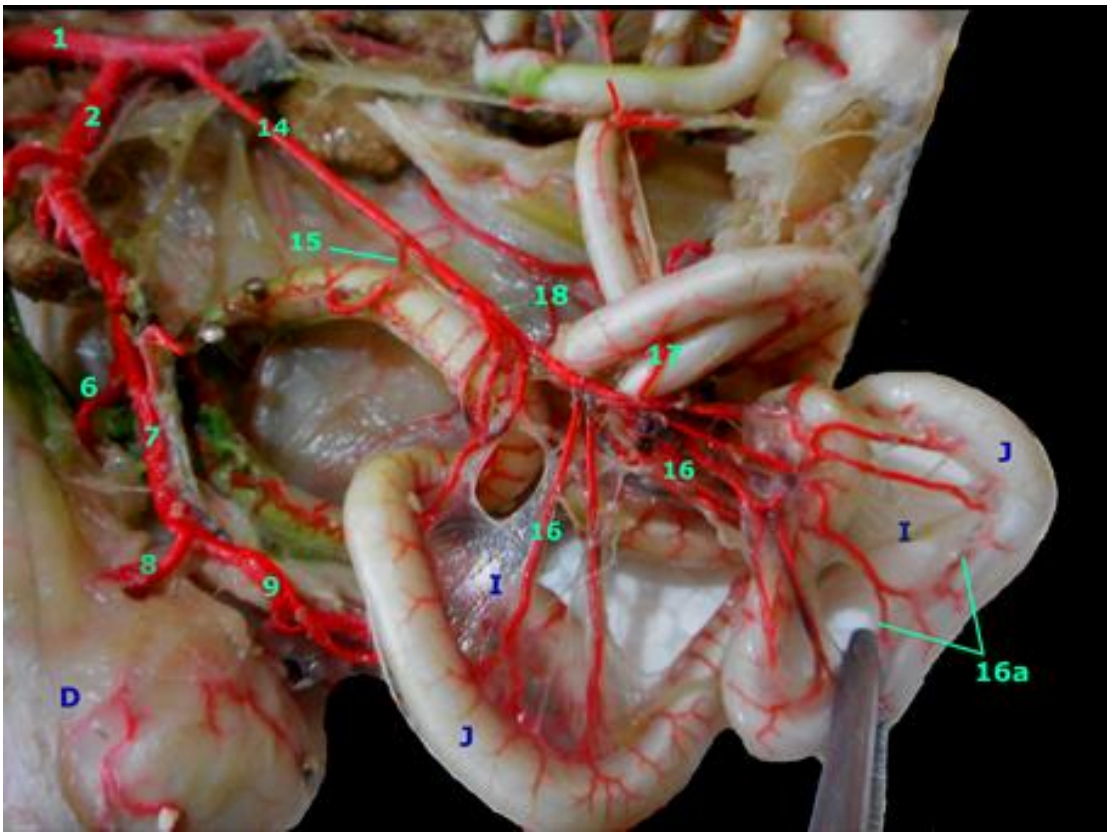

Fig. (6): A photograph showing the branches of the cranial mesenteric artery in the cattle egret.

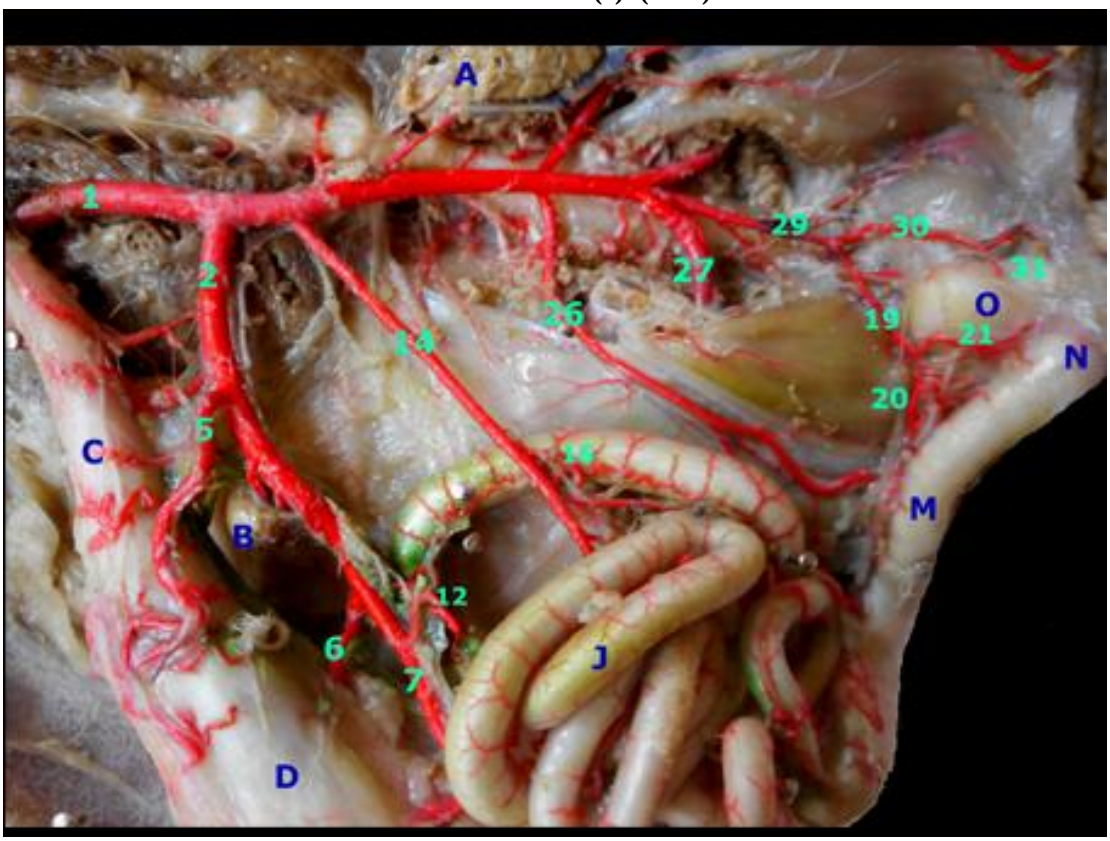

Fig. (7): A photograph showing the branches of the descending aorta of in the cattle egret.

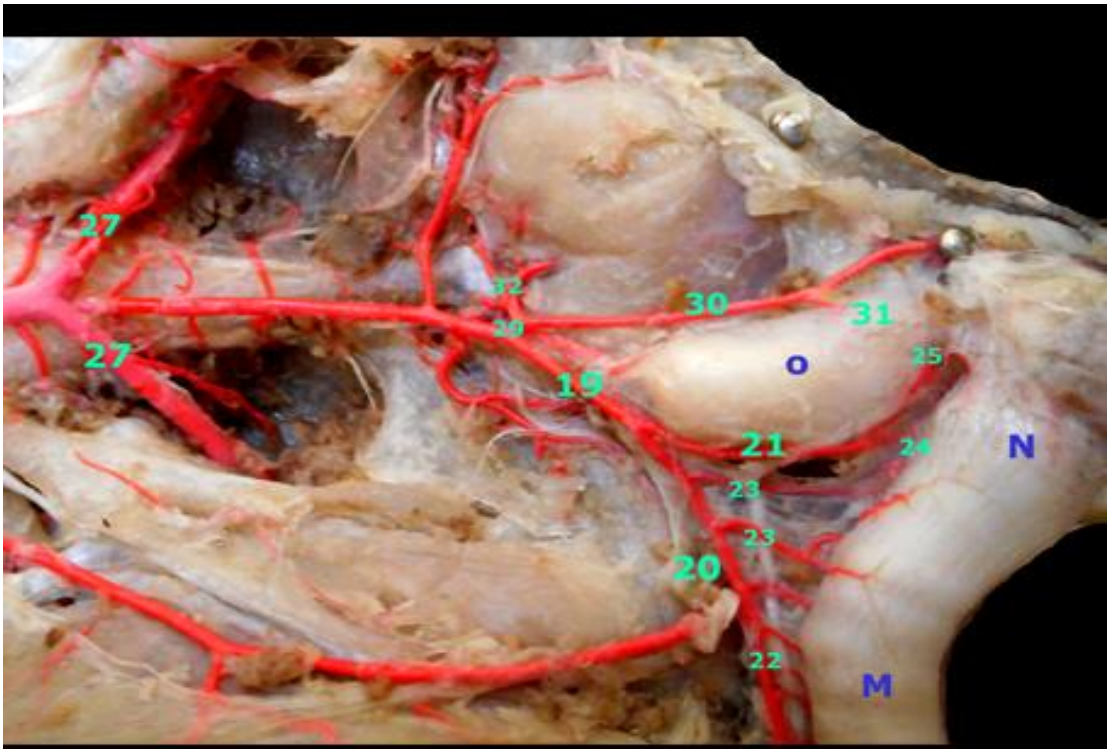

Fig. (8): A photograph showing the branches of the caudal mesenteric artery in the cattle egret.

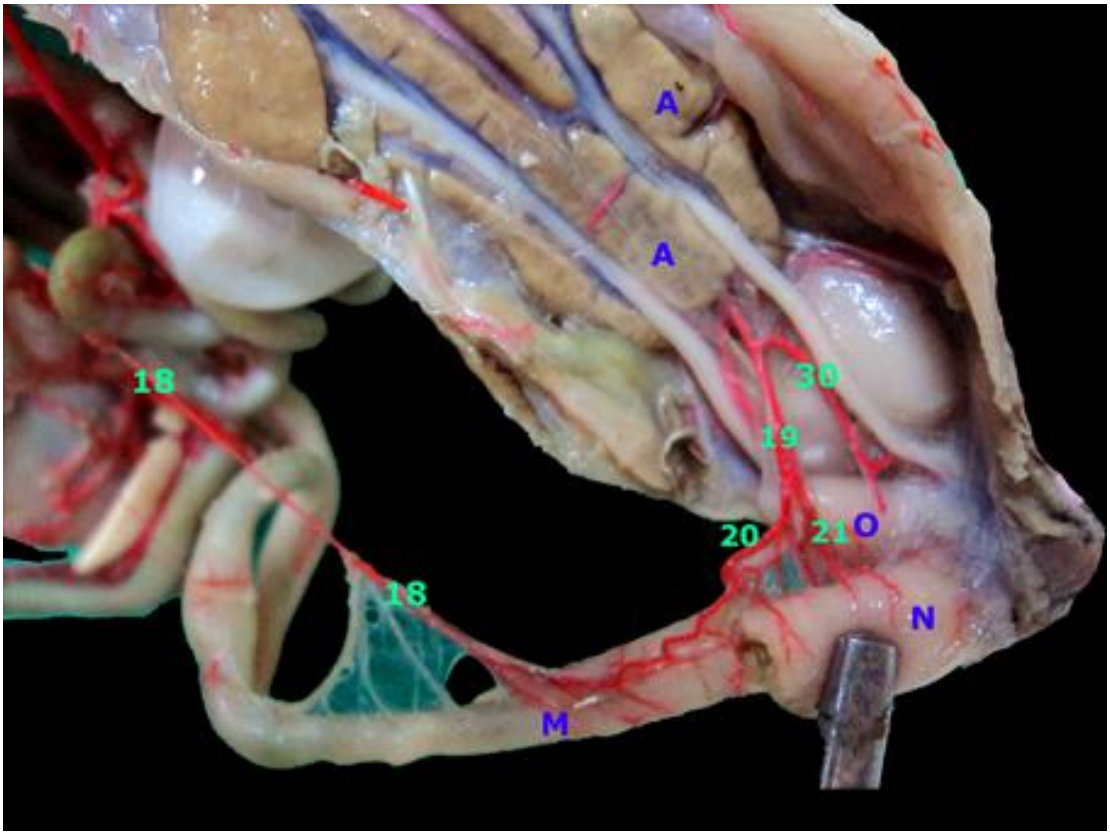

Fig. (9): A photograph showing the anastmosis between the cranial and caudal mesenteric arteries in the cattle egret.

Legend for the figures from 1-9

1-Aorta descenedens	26- A. iliaca externa
2-A.celiaca	27- A.schiatica
3- Aa. Esophagealis	28-A.iliaca interna
4- Aa. lienales	29-A.caudalis mediana
5- A. proventricularis dorsalis	30-A.pudenda interna
5a- Aa. Esophagealis of 5	31-Rr.cloacales of 30
6- R. sinster arteriae celiacae of 2	32- A.pudenda externa
7-R. dexter arteriae celiacae of 2	
8- A. gastroduodenalis of 7	I- first rib
9- A. pancreaticoduodenalis of 7	II-second rib
9a- Rr.duodenales of 9	III-third rib
10- Aa.ileocecales of 7	IV- fourth rib
11- Aa.Jejunalis of 7 & 9	V- fifth rib
12- A.duodenojejunalis of 7	VI-six rib
13- A. gastrica dextera of 7	A- Kidney
14-A.mesenterica cranialis	B- Spleen(Lien)
15- A.duodenojejunalis of 14	C- Proventriculus
15a- R.duodenales of 15	D- Ventriculus
15b- R.Jejunales of 15	E-Pars descendens duodeni
15c- Anastomosis arteriarum	F-Flexura duodeni
16-Aa. Jejunales of 14	G-Pars ascendens duodeni
16a-Arcus intestinalis	H- Flexura duodenijujenl
17- Aa.ileae	I- Mesojejunum
18- Aa.ileocecales of 14	J-Jejunum
19- A.mesentrica caudalis	K-Ileum
20-R.cranialis of 19	L-Left cecum
21- R.caudalis of 19	M- Rectum(Colon)
22- R.cranialis of 20	N- Cloaca
23- R.caudalis of 20	O- Cloacal bursa
24-Rr.colica of 21	P- Pancreas
25-Rr.cloacales of 21	

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