



## The Arterial Vascularization of the Small and Large Intestine in Adult Male Turkeys (*Meleagris gallopavo*)

Rabab Naser<sup>1\*</sup> , and Iman M Khaleel<sup>2</sup> 

<sup>1</sup>Department. of Anatomy and Histology, College of Veterinary Medicine, Diyala University, Iraq,

<sup>2</sup>Department. of Anatomy and Histology, College of Veterinary Medicine, University of Baghdad, Iraq

\*Correspondence:  
[dr.raba72@gmail.com](mailto:dr.raba72@gmail.com)

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### A B S T R A C T

The aim of this study was to reveal the blood supply of the intestinal tract in male adult turkey. Five healthy birds were collected from local suppliers at Baaqoba province. All birds were euthanized and their coelomic cavity was dissected. The descending aorta was cannulated and injected with colored latex, and then the course of arteries along the intestinal tract investigated. Small intestine received the blood by celiac artery, cranial and caudal mesenteric artery. Celiac was split into two branches right and left, the right branch of celiac artery supplied the proventriculus, gizzard, duodenum, pancreas, jejunum and distal part of ileum and cecum while left branch supply the stomach. The cranial mesenteric artery nourished the terminal parts of duodenum, jejunum ileum and cranial part of the two ceca, on the other hand. Caudal mesenteric artery was the third artery that supplied the intestine which was short branch originated from descending aorta and divided into two groups cranial groups supplied distal part of ileum and base of ceca while the caudal groups supplied the rectum and cloaca and anastomosed with cranial mesenteric artery. Form the above results, it was concluded that the small and large intestine are nourished by the three major arteries namely Celiac, Cranial and Caudal mesenteric arteries and its branches.

**Keywords:** turkey, celiac, cranial and caudal mesenteric, small and large intestine

### INTRODUCTION

The popular Bronze turkey birds are originated in temperate region of the world. The domestic male turkey is referred to as toms but the Female domestic turkey are referred to as hens, and the chicks may be called poult or turkey lings. In the United States, it is a popular form of poultry (1-3). There are several studies in different types of birds globally about the blood supply of the stomach and small intestine such as in fowl (4-6) and

authors also describe the celiac arteries branches in duck (*Anas platyrhynchos*) (7, 8).

In Iraqi, birds were described like mallard (*Anas platyrhynchos*) and pigeon (9), red falcon (*Buteo rufinus*) (10), kestrel (*Falco tinnunculus*) (11), goose (*Anser anser*) (12); cattle egret (*Bubulcus ibis*) (13), greater flamingo *Phoenicopterus roseus* (14). Other seekers described the jejunal arteries branches supplied the Meckel diverticulum in geese (15) and previously, it was also reported in different kinds of birds in small and large intestine of these

birds received the blood by main arteries raised from ascending aorta including cranial mesenteric artery and caudal mesenteric artery in goose and chicken (16), in the cattle egret (*Bubulcus ibis*) (17) in White-eared bulbul (*Pycnonotus leucotus*) (18), in pigeon (*Columba Livia domestica*) and in Iraqi mallard (*Anas platyrhynchos*) (9, 8). The aims of the study was to reveal the blood supply of the intestinal tract (small and large) intestine in bronze male adult turkey

## MATERIALS AND METHODS

All procedures conducted in this study was reviewed and approved by the scientific committee in the College of Veterinary Medicine, University of Baghdad in accordance with the ethical standards of animal welfare.

The study included five healthy adult male turkeys (*Meleagris gallopav*) to study the blood supply in intestine canal). These birds were purchased from a local supplier in Diyala city, Iraq. The birds were collected in the period between March to October 2019. All birds were euthanized by lethal dose injection of xylazine (Rompum<sup>®</sup>) of does 10 mg/kg BW with Ketamin<sup>®</sup> 15 mg/kg. BW (19). The skin and the muscle of the thorax were removed and the sternum was cut by bone cutter to expose the heart and subsequently the left ventricle was opened and catheter was inserted in it for evacuating the blood then injected with gum milk latex<sup>\*\*\*</sup> colored with carmin pigment **Rotring®** for coloring the arteries. After 24 hours, the specimen kept in 10% formaline solution, after that the coelomic cavity was opened and the specimens dissected

very carefully to study the arteries that supplied small and large intestine. The obtained results were photographed using Sony digital camera 5 mega pixels.

## RESULTS

This small and large intestine showed to be supplied by three major arteries namely: celiac, cranial mesenteric, and caudal mesenteric arteries. They were raised from descending aorta. Generally, at the level of fifth ribs, it gave off unpaired visceral arteries which were distributed in the stomach, pancreas, liver, spleen and segments of small intestine. Caudal mesenteric artery supplied the distal part of small intestine (ileum), large intestine (rectum and two caeca) and cloaca (Figures 1, and 2).

### Celiac Artery

Generally, the celiac artery was the main artery arose from the right aspect of descending aorta which supplied the proventriculus, gizzard and duodenum, pancreas, jejunum, liver, spleen and it splited at the caudal border of liver into small left ramus artery and larger right ramus artery (Figures 1, and 2). The Celiac artery included two ramus, the left ramus and right ramus. The left ramus of the celiac artery passes along the left side of the proventriculus then it nourished the spleen and glandular stomach (Figure 2). The right ramus of the celiac gave off gastroduodenal, jejunal and one or more substantial ileocecal arteries. It extended dorsally to the distal ileum

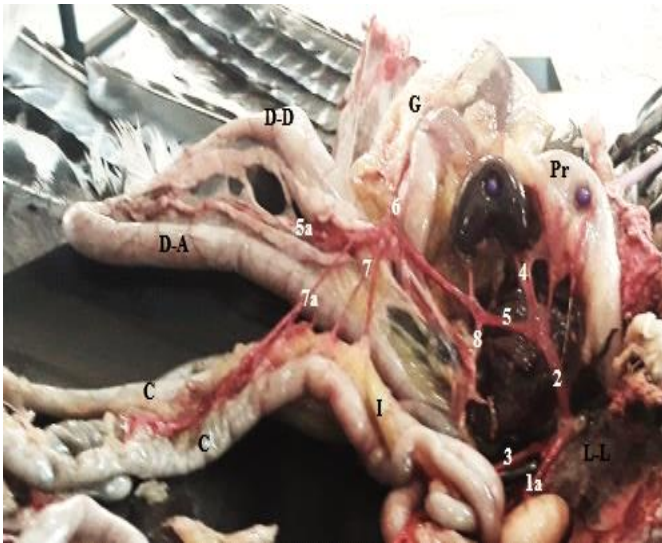
and cecum and it continued as the pancreaticoduodenal (Figures 2, and 3).



**Figure 1.** Photograph illustrates the blood supply of intestinal tract. 1: Aorta, 1a: Descending aorta, 2: Celiac a, 3: Cranial mesenteric a., 4: Left ramus a., 5: Right ramus a., 9: Jejunum, Pr: Proventriculus, S: Spleen, L-L: left lung.



**Figure 2.** Photograph illustrates arterial blood supply of small intestine, 2: Celiac, 3: Cranial mesenteric a., 4: left ramus, 5: right ramus a., 5a: pancreatico-duodenal a., 6a, 6b: right and left gastro duodenal a., 7a: ileocecal a., 8, 9: jejunal a., 10: marginal intestinal artery 11: ilial a.: s: spleen, G: Gizzard, Pr: proventriculus, D: duodenum (D-D&D-A; descending& ascending duodenum), J: Jejunum, I: ileum, C: cecum, L-L: left lung, T: testis, L: liver, red star: ileocecal ligament



**Figure 3.** Photograph illustrates, 1a :green arrow descending aorta, 2:celiac a., 3: Cranial mesenteric a., 4: Left ramus a., 5: right ramus a., 5a: Pancreaticoduodenal a., 6: gastroduodenal artery, 7, 7a : ileocecal a. (ilial a., cecal a.), 8: jejunal a., Pr: Proventriculus, A- D& D-D: ascending and descending duodenum, C: ceca, G-Gizzard, L-L :left lung



**Figure 4.** Photograph illustrates the branches of the celiac artery, 3: cranial mesenteric artery, 5: Right celiac a. 5a: pancreaticoduodenal, 7, 7a : ileocecal branches a., 7&7a: cecal branches, 8: jejunal a.; 11: ileal a. A-D& D-D: ascending and descending duodenum, C

### Celiac Right Ramus

The celiac right ramus branches included:

- A. Gastroduodenal artery: It was short artery; arose from the right ramus artery and it is split into 2-3 small branches that supplied the gizzard (Figure 2).
- B. Jejunal artery: Short branch arises from celiac artery at the caudal pole of spleen, it was supplied the proximal part of the jejunum (Figure 2).
- C. Pancreatoduodenal artery: This artery considered as the continuous of the right ramus artery, entered between the descending limb and ascending limb of the duodenum which gave series branches on each side of both limbs of duodenum and distributed in all lobes of the pancreas (Figures 2, 3, and 4).
- D. Ileocecal Artery: There are two to three branches that arose from right ramus of celiac artery, these arteries pass through the ileocecal ligament. It supplied the caudal third portion of the ileum, cecum and anastomosed with the ileocecal artery which originated from the cranial mesenteric artery (Figures 2, 3, and 4).

### Cranial Mesenteric Artery

Cranial mesenteric artery was the second large artery originated from descending aorta to supplied jejunum (Figures 1, and 2), ileum and two ceca (Figure 2).

The branches of the cranial mesenteric artery:

- A. Duodenojejunal artery: It is the largest branch that arose from cranial mesenteric artery passing through mesentery which supplied the terminal part of the duodenum and the initial portion of jejunum at the duodeno-jejunal flexure (Figures 2, 4, and 5).

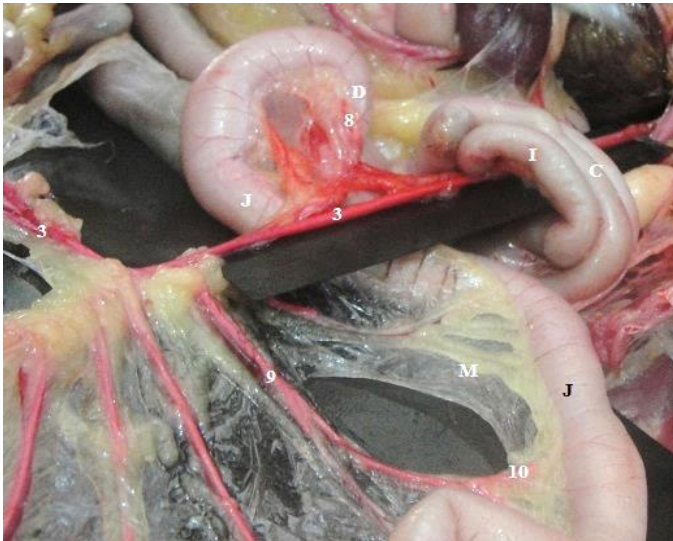
- B. Jejunal arteries: It was a group of arteries, included seven-ten in various sizes of jejunal arteries to these arteries continuous to reach the large intestinal (two ceca) then anastomosed with the ileocecal artery of the celiac artery (right ramus) passing along the mesentery of jejunum that supplied last part of the jejunum and the first part of the ileum, each one of jejunal artery split into two small primary branches which anastomosed with another branches of adjacent arteries supplied each side of jejunal wall (Figures 2, 6, and 7).
- C. Ileal artery: The small branch originated from terminal portion of the cranial mesenteric artery supplied the jejunum and ileum then it anastomosed with ileo-cecal branch of the celiac artery (Figures 6, and 7).
- D. Ileo-cecal artery: The ileum and the two ceca passed in parallel direction. They are nourished by last branch of the cranial mesenteric artery (ileo-cecal branches) (Figure 7).

The ileum was near the ileocecal junctions which was supplied by anastomotic branches of the celiac and cranial mesenteric arteries (Figure 6), The ileal arteries of cranial mesenteric artery anastomosed with the ileocecal branches from pancreatico-duodenal artery (Figure 7).

### Caudal Mesenteric Artery

It is short branch arose from the aorta at the level of caudal lobe of the left kidney supplying the ileum, rectum, and all segments of the ceca with arteries that originated from the cranial mesenteric artery (Figure 8). It is divided into two groups of arteries, cranial and caudal groups. The cranial group arteries consisted of 7-8 branches extended

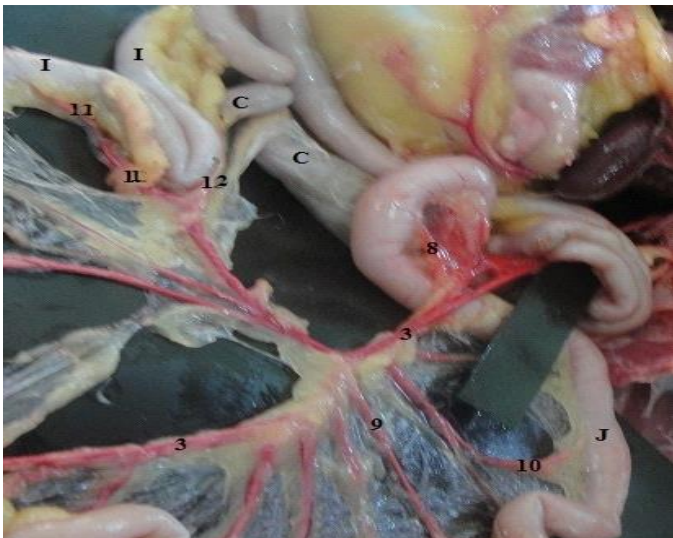
on the dorsal aspect of the ceca, distal ileum, and cranial rectum. The branches passed cranially and anastomosed with the ileocecal artery branch of celiac artery (Figure 8).



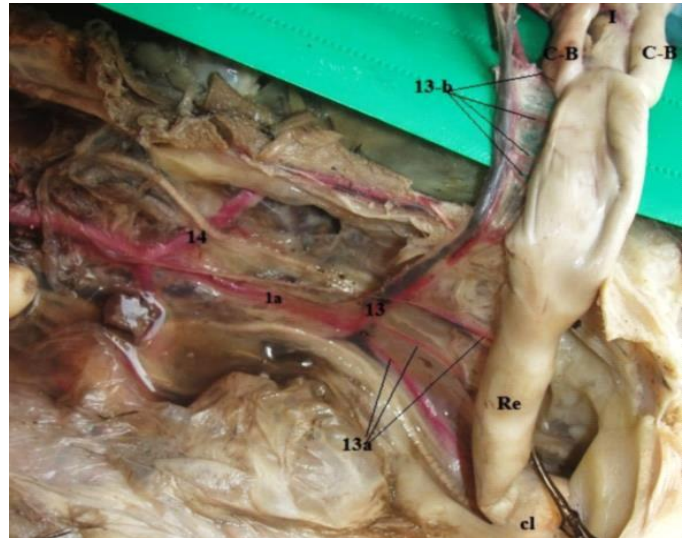
**Figure 3.** Photograph illustrates arterial blood supply of jejunum in male turkey, 3: Cranial mesenteric a., 9: jejunal a., 10: marginal intestinal a., D: duodenum j: jejunum, I: ileum, green arrow duodenal-jejunal flexure, M: Mesentery



**Figure 6.** Photograph illustrate blood supply of the jejunum, I: ileum, C: ceca 3: cranial mesenteric a., 7, 7a: ileocecal arteries, 11: cecal branch from jejunal a., 9: jejunal branches a., 10: marginal a.



**Figure 7.** Photograph illustrates blood supply of the J: jejunum, I: ileum, C: ceca, 3: cranial mesenteric a., 8, 9: jejunal artery, 10: marginal intestinal artery, 11: ileal artery, 12: Cecal a.



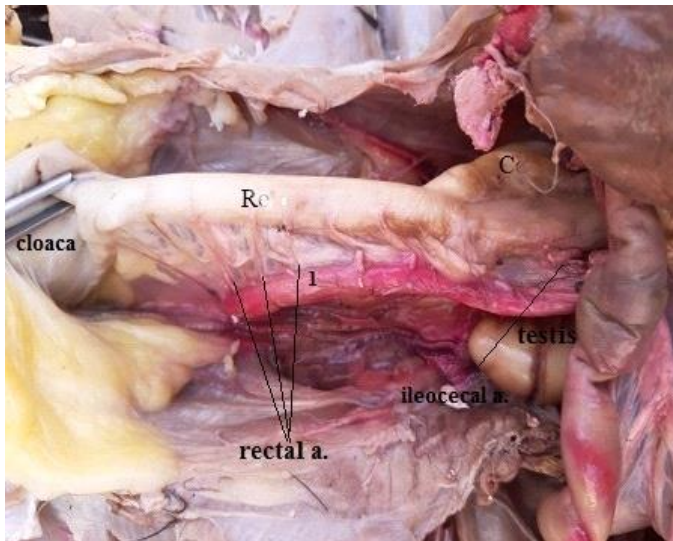
**Figure 8.** Photograph illustrates blood supply of the large intestine in male turkey. The caudal mesenteric artery supplies the ileum and rectum. C-B: base cecum, R: rectum, 1a: descending aorta 13: Caudal mesenteric artery, a: 13a: cranial, 13b: caudal group. 14: ischiatic a.

## DISCUSSION

The descending aorta gave off unpaired arteries (celiac and cranial mesenteric) at the caudal border of the lung that supplied the muscular and glandular stomach, duodenum, jejunum, ileum, cecum, pancreas, liver, and spleen. This result was in agreement with (3-6) in fowl, (10) in red falcon (*Phoenicopterus roseus*), (14) in greater flamingo,

(17, 13) in cattle egret (*Bubulcus ibis*), and with (14) in greater flamingo. The celiac artery ramified into two branches including large right ramus of the celiac and large and small left ramus provided the proventriculus and muscular stomach, while the right ramus of the celiac was supplying the ascending limb of the duodenum and continued as pancreatic-oduodenal artery. These results were in agreement with those reported in red falcon,

indigenous ducks, domestic fowls, cattle egret (*Bubulcus ibis*), and in bulbul (*Pycnonotus leucotis*) (10, 7, 6, 13, 17). However, our results were different from the findings observed in kestrel celiomesentric trunk named cranial mesenteric to supply duodenum in different regions of ascending and descending limbs which is called duodenal branch (11).



**Figure 9.** Photograph illustrates caudal mesenteric artery of adult turkey: 1: caudal mesenteric artery, C: cecum, R: Rectum

The gastroduodenal artery represented by a short vessel raised as one of the terminal branches of the right ramus and continuation of celiac artery which divided immediately into small branches supplying the muscular stomach and the descending limb of duodenum while the jejunum received blood supply by many arteries due to the most nutrients absorption is taken place at the jejunum and thus higher vascularization is needed. The first group was the jejunal arteries originated from cranial mesenteric artery. This finding was similar to that observed by (15) in goose, where the jejunum was supplied by jejunal artery. The present study showed that the proximal portion of the jejunum, at duodenojejunal flexure, was supplied by the jejunal artery, the first branch of celiac artery. This result agreed with (13, 17) in cattle egret, and (11) in white-eared bulbul (*Pycnonotus leucotis*) but differed in what was reported in kestrel (*Falco tinnunculus*) in which the small intestine of kestrel receive the blood through two main sources namely cranial and caudal mesenteric arteries (11).

The current investigation found that the ileum was a short part of small intestine and received the blood by the ileal artery which raised from two or three branches from right ramus of celiac artery, then ramified with the ileocecal artery which originated from cranial mesenteric artery. Ileocecal branches entered the ileocecal fold, and these

results are in agreement with the results of (7) in indigenous duck (*Anas platyrhynchos*), (13) in the cattle egret (*Bubulcus ibis*) and in greater flamingo (*Phoenicopterus roseus*).

The present study investigated that, the ileocecal artery raised from the right branch of celiac artery and this was similar to cattle egret (*Bubulcus ibis*) (13), in domestic fowl (6) and in red falcon (10). In greater flamingo (14), it was recorded that ileocecal artery to be arise from the pancreatico-duodenal artery. The present study stated that the last branch of the cranial mesenteric artery supplied the ileum and this was in agreement with what was reported in the pigeon (*Columba Livia domestica*) and mallard (9).

The cecum received the blood by two ileocecal branches. These results were in agreement with study was done in chicken and goose (16, 6). Sometimes it appeared as one branch, in addition to give this artery from a cecal artery that originated from the pancreatico-duodenal artery. This study accepted with (16) in goose and disagree with (13) and (17) in cattle great.

The cranial and caudal mesenteric arteries supply blood to the two ceca and rectum, according to the current analysis. These results were similar to those recorded in goose and chickens (16), white-eared bulbul (*Pycnonotus leucotis*) (18), cattle egret, and bulbul (*Pycnonotus leucotis*) (17, 18).

The cranial branches extended cranially between the ileum, cecum and supplying the last third of the ileum, and right and left ceca, and by reaching to the ileocecal junction ramified (anastomised) with the caudal branches of the caudal mesenteric artery. In fowl (3) and (17) in cattle egret (*Bubulcus ibis*).

The blood supply of the small intestine that received the blood by the celiac artery and cranial mesenteric artery,

2-The study of blood supplied of large intestine in Adult bronze male turkeys by some branches originated from carinal and caudal mesenteric artery

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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## التجهيز الشرياني للأمعاء الدقيقة والغليظة لذكور الديك الرومي البالغ

رباب عبد الامير ناصر<sup>1</sup>، و ايمان خليل موسى<sup>2</sup>

<sup>1</sup>فرع التشريح و الانسجة كلية، الطب البيطري، جامعة ديالى، العراق، <sup>2</sup>فرع التشريح و الانسجة كلية، الطب البيطري، جامعة بغداد، العراق

### الخلاصة

تهدف هذه الدراسة إلى الكشف عن التجهيز الدموي للقناة المعوية (الأمعاء الدقيقة والغليظة) في الديك الرومي البالغ (الذكور). تم الحصول على خمسة طيور سليمة من الموردين المحليين في محافظة بعقوبة. وبعد تخدير جميع الطيور وفتح التجويف البطني ووضع انبوب صغير قطر داخل شريان الابهر وحقن مادة الالانكس الملونة، وذلك للمتابعة عن مسار الشرايين على طول القناة المعوية التي تجهز الدم إلى الأمعاء الدقيقة والغليظة. وقد أظهرت نتائج الدراسة تزويد الدموي الأمعاء الدقيقة عن طريق الشريان الجوفي والمساريقي الامامي والخلفية. والشريان الجوفي ينقسم إلى فرعين رئيسيين الايسر والأيمن، الفرع الأيمن من الشريان الجوفي الذي تزود المعدة العضلية، الاثنى عشر، البنكرياس، الصائم والجزء البعيد من اللفانفي والاعورين بينما الفرع الايسر يغذي المعدة الغدية. الشريان الثاني الذي يغذي الأمعاء هو المساريقي الامامي الذي يزود الصائم واللفانفي والاعور اما الشريان الثالث الذي يغذي الأمعاء هو الشريان المساريقي الخلفي هو شريان قصير ينشأ من الابهر النازل ويقسم إلى فرعين الامامي يعطي فروع إلى اللفانفي و اجزاء من الاعور (الأيمن والايسر) والمستقيم والخلفي يغذي المستقيم والمجمع

الكلمات المفتاحية: ديك رومي، الشريان الجوفي، المساريقي الامامي والخلفي، الأمعاء الدقيقة والغليظة