



## RESEARCH ARTICLE

### Gross Anatomical Study on the Hepatic Portal Vein Tributaries in the Common Domestic Pigeon “*Columba Livia Domestica*”

Tolba AR

Anatomy & Embryology Department, Faculty of Veterinary Medicine, Cairo University

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#### \*Corresponding Author

Tolba AR

Draymantolba@hotmail.com

#### ABSTRACT

The present study was carried out on ten adult, apparently healthy domestic pigeons of different ages and sexes. Each bird was exsanguinated; the caudal vena cava was cannulated and flushed with warm normal saline solution (0.9%), then injected with blue colored gum milk latex to study the tributaries of the hepatic portal vein. The origin, the course and the drainage of the right and left hepatic portal veins were studied. The hepatic portal venous system collected venous blood from the abdominal viscera including; glandular and muscular stomachs, liver, pancreas, spleen, small and large intestines. The hepatic portal vein drained from left and right hepatic portal veins. The small left hepatic portal vein drained blood from parts of glandular and muscular stomachs through the ventral proventriculus and the left gastric veins. While the main right hepatic portal vein drained blood from the rest of the gastrointestinal tract and spleen through the proventriculosplenic, the gastropancreatico-duodenal and the common mesenteric veins.

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#### INTRODUCTION

Domestic pigeon belongs to family *Columbidae*, originates from Europe, North Africa, and India. The pigeon for many centuries has been one of the avian species often used for human nutrition (*Eleonora et al.*, 2008). Pigeons have been domesticated for thousands of years, as "pigeon posts" which have been established all over the world. Recently pigeon's breeders used pigeons in the field of "racing". This study was designed to give a large scale and clear investigation on the venous drainage of the gastrointestinal tract of domestic pigeon.

#### MATERIALS AND METHODS

The current study was conducted on ten adult, apparently healthy domestic pigeons of both sexes. Before exsanguinations, pigeons were anaesthetized by IM injection of 0.5 cc of 2% xylazine HCL (3 mg/kg) to provide muscle relaxation and to prevent vasoconstriction, followed by the injection of heparin (Cal Heparin, 5000 I.U.) into the wing vein to prevent blood clotting.

Each pigeon was then exsanguinated through the common carotid arteries and left to bleed for five minutes, the breast muscle and sternum were carefully removed to expose the heart. The caudal vena cava was cannulated

and flushed with normal saline solution. The birds were injected with 60% gum milk latex colored blue with Rotring® ink.

The pigeons were left in a mixture of 10% formalin, 2% phenol and 1% glycerin for three days before dissection. The obtained results were photographed using Sony® digital camera 12.1 mp, 4x. The nomenclature used was that recommended by the Nomina Anatomica Avium (*Baumel et al.*, 1993).

#### RESULTS

##### V. hepatica porta

The portal vein (Figs. 1 and 2/1) collected venous blood from the left and right portal veins. It was located at the porta hepatis between the right and the left lobes of the liver cranially, and the pyloric part of the stomach ventrally.

##### V. hepatica porta sinistra

The left hepatic portal vein (Figs. 2, 5 and 6/2) was a small vessel, and measured about 1 cm. It passed craniodorsally till reaching the left ventral surface of the proventriculus where it received the following tributaries: the ventral proventriculus and the left gastric veins.

### **V. proventricularis ventralis**

The ventral proventricular vein (Figs. 5 and 6/4) extended from the cranial aspect of the left hepatic portal vein and directed cranioventrally on the ventral border of the proventriculus. It drained the restricted part of the proventriculus through 5-6 fine twigs. While

### **V. proventricularis dorsalis**

The dorsal proventricular vein (Figs. 2 and 7/5) passed on the dorsolateral wall of the proventriculus before its drainage into cranial vena cava.

### **V. gastrica sinistra**

The left gastric vein (Figs. 3, 5, 6 and 7 /6) extended from the ventral aspect of the left hepatic portal vein and directed obliquely caudoventrally on the left lateral aspect of the ventriculus then terminated nearly at the central tendentious part of the muscular stomach by two veins; the dorsal and the ventral left gastric veins. During the course of the parent vein, it drained the blood from the craniodorsal tentius and the cranioventral crassus muscles by 2 -3 fine collateral twigs.

### **V. gastrica sinistra dorsalis**

The dorsal left gastric vein (Figs. 3, 5, 6 and 7/7) passed caudodorsally on the dorsal border of the central tendon where it diverged into two veins; the first vein received blood from the craniodorsal tenuis and the caudodorsal crassus muscles and terminated by anastomosis with corresponding one of the dorsal right gastric vein on the restricted border of the ventriculus. The second vein received blood from the caudoventral tenuis and the caudodorsal crassus muscles by anastomosing with the corresponding one of the right ventral gastric vein on the caudal groove of the ventriculus.

### **V. gastrica sinistra ventralis**

The ventral left gastric vein (Figs. 3, 5, 6 and 7/8) extended caudoventrally from the left gastric vein at the left lateral aspect of the cranial groove of the ventriculus. It drained blood from the left aspect of the central tendinous part and cranioventral crassus muscle of the gizzard by the 2 -3 fine veinules.

### **V. hepatica porta dextra**

The right hepatic portal vein (Figs. 1, 2 and 3/3) was the main dominant tributary of the portal vein. It was a short vessel measured about 2 cm. It drained venous blood from the proventriculosplenic, the splenic, the gastropancreaticoduodenal and the common mesenteric veins.

### **V. Proventriculosplenica:**

The proventriculosplenic vein (Figs. 1 and 2/9) was a long cylindrical tributary which ended at the cranioventral aspect of the right hepatic portal vein. It was formed by the union between the splenic and the dorsal proventricular veins.

### **V. lienalis:**

The splenic vein (Figs. 1 and 2/8) was a very short vessel measured about 0.3 cm in length. It originated at

the ventromedial wall of spleen (splenic hilus) and joined proventriculosplenic vein on the dorsal wall of spleen. It drained venous blood from the spleen and its capsule.

### **V. gastropancreaticoduodenalis:**

The gastropancreaticoduodenal vein (Figs. 1, 2, 3 and 7/11) was a long tributary, measured about 3.5 cm in length. It was formed by the union of the right gastric and the pancreaticoduodenal veins. It was insinuated between the ascending part of the duodenum and the right side of the muscular stomach and extended obliquely cranioventrally to open into the ventral wall of the right hepatic portal vein.

### **V. gastrica dextra:**

The right gastric vein (Figs. 1 and 2/12) was a small tributary, measures about 1 cm in length. It was formed by the union of 3-4 venules that originated from the right aspect of the muscular stomach then proceeded cranioventrally to open in the left lateral wall of the gastropancreaticoduodenal vein, then directed cranioventrally; on reaching the first part of the descending part of the duodenum it gave off two main tributaries; the dorsal and the ventral right gastric veins.

### **V. gastrica dextra dorsalis:**

The dorsal right gastric vein (Figs. 1, 2 and 7/13) extended from the dorsal wall of the right gastric vein and passed craniodorsally on the right aspect of the cranial groove of the ventriculus between the craniodorsal tenuis, the caudoventral crassus muscles and the central tendon of the gizzard. On reaching the dorsal border of the ventriculus gave off two tributaries that anastomosed with that of the opposite side. Along its course it received 1 - 2 fine tributaries that drain the craniodorsal tenuis, the caudodorsal crassus muscles and the central tendon of the gizzard.

### **V. gastrica dextra ventralis:**

The ventral right gastric vein (Figs. 1, 2 and 7/14) extended from the ventral wall of the right gastric vein and passed cranioventrally on the right aspect of the caudal groove of the ventriculus insinuating the caudoventral tenuis, the caudodorsal crassus muscles and the central tendon of the gizzard. On reaching the ventral border of the gizzard, it anastomosed with the corresponding one; the left ventral gastric vein of the opposite side forming the ventral gastric vein. During its course, it received 2 -3 fine tributaries that drained the first part of the descending duodenum, the cranioventral and the caudodorsal crassus, the caudoventral tenuis muscles as well as the central tendon of the gizzard.

### **V. gastrica dorsalis:**

The dorsal gastric vein (Figs. 2, 3 and 7/15) extended from the contribution between the right and the left dorsal gastric veins on the caudal groove of the ventriculus. It proceeded craniodorsally along the dorsal border of the caudodorsal sac of the gizzard where it ramified on the caudodorsal crassus muscle by fine collateral veinules.

### **V. gastrica ventralis:**

The ventral gastric vein (Figs. 3, 5, 6 and 7/16) is extended from the contribution between the right and the

left ventral gastric veins. It ramifies by fine collateral veinules.

#### V. pancreaticoduodenalis

The pancreaticoduodenal vein (Figs. 1 and 2/17) considered the main tributary of the gastropancreaticoduodenal vein due to its size and course. It passed cranially between the pancreas and the two parts of the duodenum in the pancreaticoduodenal ligament. Along its course, it received V. pylorica (Fig. 2 /18) that drained blood from the pyloric region of the stomach and initial part of the descending duodenum, Vv. Pancreaticae (Fig. 2 /19) that drained venous blood from pancreas, Vv. duodenales (Fig. 2 /20) that drained venous blood from different parts of duodenum and Vv. jejunaes (Fig. 2 /21) that drained venous blood from the caudal part of the jejunum.

#### V. mesenterica communis

The common mesenteric vein (Figs. 1, 2, 3 and 7/22) was the greatest tributary of the right hepatic portal vein and measures about 5 cm in length. The common mesenteric vein was formed by the union of the cranial mesenteric vein and the cranial tributary of the caudal mesenteric vein just dorsal to the duodenojejunal flexure. It drained the blood of the intestinal tract from the jejunum till the cloaca.

#### V. mesenterica cranialis

The cranial mesenteric vein (Figs. 1, 2, 3, 5 and 7/23) was a stout and very short vessel where it was formed by the union of the jejunal veins. It insinuated between the caudal mesenteric (the larger cranial tributary) and the common mesenteric veins. It embedded in the mesojejunum between the jejunal loops.

#### V. jejunaes

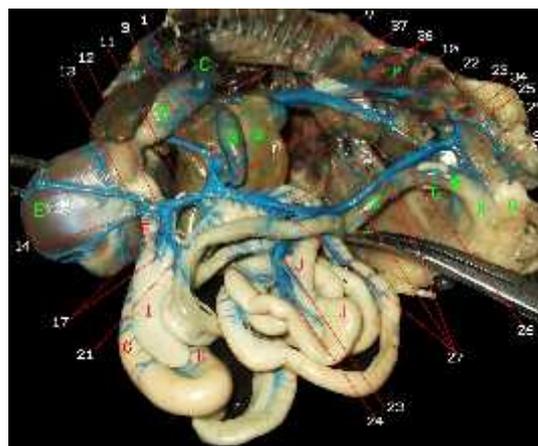
The jejunal veins (Figs. 1, 2, 3, 5 and 7/24) were 7-8 in number. Jejunal tributaries originated from the wall of jejunum. The jejunal veins passed in a radial manner in the jejunal mesentery to join each other to form the short cranial mesenteric vein.

#### V. mesenterica caudalis

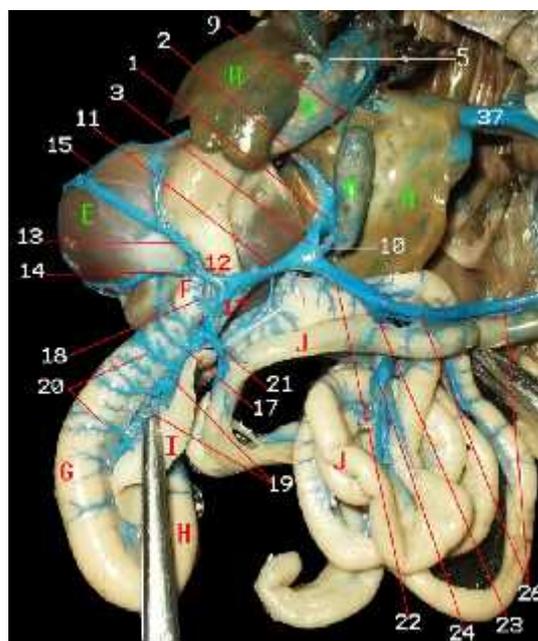
The caudal mesenteric vein (Fig. 1, 3 and 4/25) was a short stout vessel, measured about 1 cm and formed by the union of the cranial and caudal tributaries of the caudal mesenteric vein. It joined the interiliac Anastomosis dorsocaudally and the common mesenteric vein cranioventrally through its cranial tributary.

#### Rdx. cranialis cum V. mesenterica caudalis

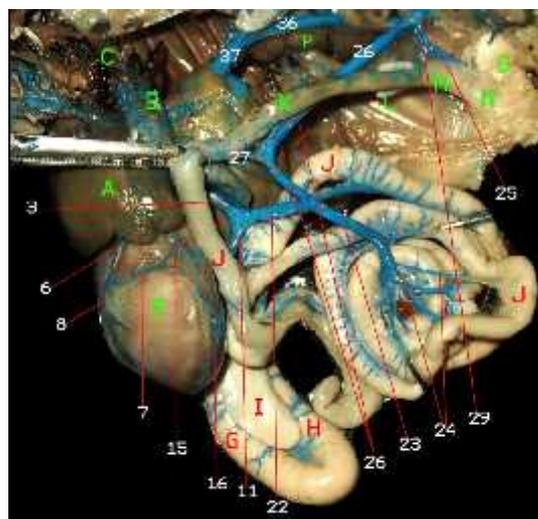
The cranial tributary of the caudal mesenteric vein (Figs. 1, 2, 3, 4 and 7/26) was larger than the caudal one and extended cranioventrally towards the common mesenteric vein close to the coloproctum. Just before its junction with the cranial mesenteric vein, it drained venous blood from the cecum by cecal tributary (Figs. 4 /28) two venules and the ileum by ileal tributary (Figs. 1, 3 and 4 /27) through 4-5 small venules.



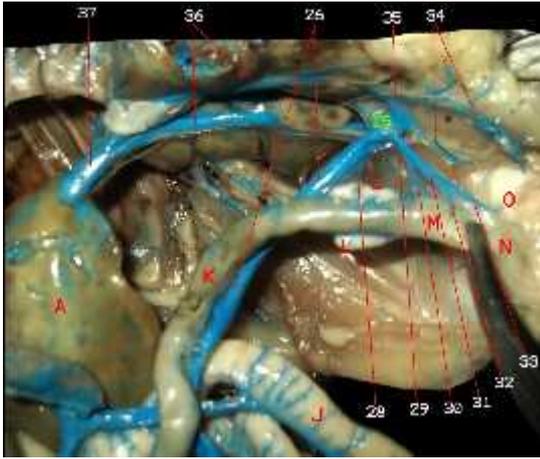
**Fig. 1:** A photograph showing the tributaries of the right portal vein in common pigeon injected with blue colored gum milk latex.



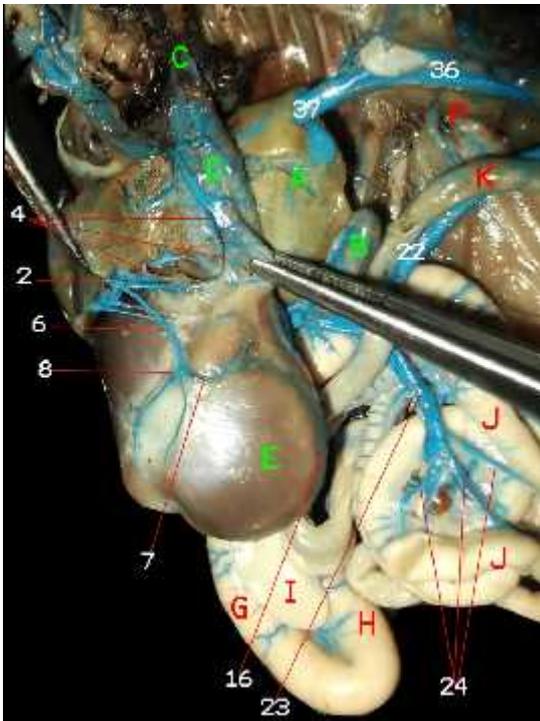
**Fig. 2:** A photograph showing the tributaries of the right portal vein in common pigeon injected with blue colored gum milk latex.



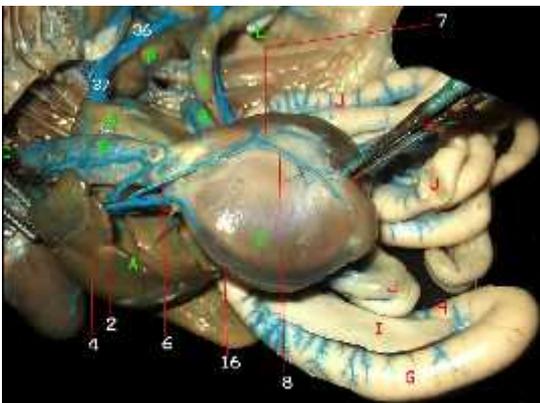
**Fig. 3:** A photograph showing the tributaries of the common mesenteric vein in common pigeon injected with blue colored gum milk latex.



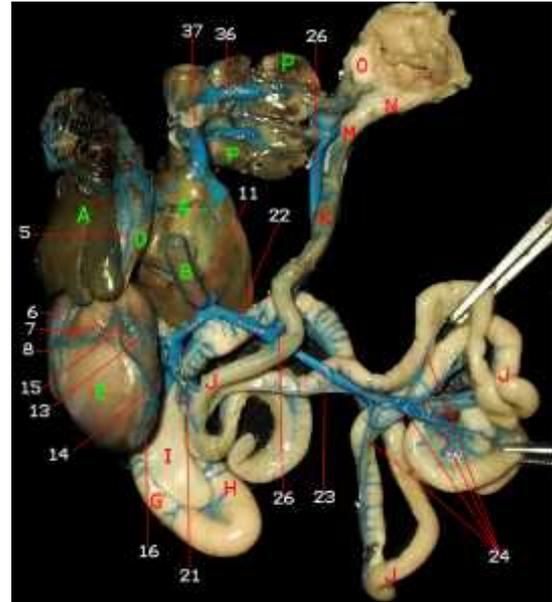
**Fig. 4:** A photograph showing the tributaries of the caudal mesenteric vein in common pigeon injected with blue colored gum milk latex.



**Fig. 5:** A photograph showing the tributaries of the left portal vein in common pigeon injected with blue colored gum milk latex.



**Fig. 6:** A photograph showing the tributaries of the left portal vein in common pigeon injected with blue colored gum milk latex.



**Fig. 7:** A photograph showing the tributaries of the hepatic portal vein in common pigeon injected with blue colored gum milk latex.

#### Legends of Figures 1-7

- |                                    |                                |
|------------------------------------|--------------------------------|
| 1. V. Hepatica porta               | 28. Cecal tributary of 26      |
| 2. V. Hepatica porta sinistra      | 29. Rdx. caudalis cum          |
| 3. V. Hepatica porta dextra        | V. mesenterica caudalis        |
| 4. V. Proventricularis ventralis   | 30. Rectal tributary of 29     |
| 5. V. Proventricularis dorsalis    | 31. V. Cloacobursales          |
| 6. V. Gastrica sinistra            | 32. Cloacal tributary          |
| 7. V. Gastrica sinistra dorsalis   | 33. Bursal tributary of 30     |
| 8. V. Gastrica sinistra ventralis  | 34. V. iliaca interna          |
| 9. V. Proventriculosplenic         | 35. V. iliaca communis         |
| 10. V. Lienalis                    | 36. Vv. renales                |
| 11. V. Gastropancreaticoduodenalis | 37. Vena cava caudalis         |
| 12. V. Gastrica dextra             | A. Liver                       |
| 13. V. Gastrica dextra dorsalis    | B. Spleen                      |
| 14. V. Gastrica dextra ventralis   | C. Esophagus                   |
| 15. V. Gastric dorsalis            | D. Glandular stomach           |
| 16. V. Gastric ventralis           | E. Muscular stomach            |
| 17. V. Pancreaticoduodenalis       | F. Pars pylorica (3rd stomach) |
| 18. V. Pylorica                    | G. Descending duodenum         |
| 19. Vv. Pancreaticae               | H. Ascending duodenum          |
| 20. Vv. Duodenales                 | I. Pancreas                    |
| 21. Vv. Jejunales of 17            | J. Jejunum                     |
| 22. V. Mesenterica communis        | K. Ileum                       |
| 23. V. Mesenterica cranialis       | L. Cecum                       |
| 24. Vv. Jejunales                  | M. Colorectum                  |
| 25. V. mesenterica caudalis        | N. Coloaca                     |
| 26. Rdx. cranialis cum             | O. Coloacal bursa              |
| V. mesenterica caudalis            | P. Kidney                      |
| 27. Ileal tributary of 26          |                                |

#### Rdx. caudalis cum V. mesenterica caudalis

The caudal tributary of the caudal mesenteric vein (Fig. 1, 3 and 4/29) was a small vessel and extended from the caudoventral wall of the parent vein. This vein was formed by the union of rectal tributary (Fig. 4/30) shared in collecting venous blood from the colorectum, and cloacobursal tributary (Fig. 4/31) which divided into cloacal tributary (Fig. 4/32) collected venous blood from the terminal part of the coloaca and bursal tributary (Fig. 4/33) collected venous blood from cloacal bursa.

## V. iliaca communis

The two common iliac veins (Fig. 4/35) received the venous blood from V. iliaca interna (Figs. 1 and 4/34) and two Vv. renales (Figs. 1, 3, 4, 5 and 7/36) which joined each other to form the Vena cava caudalis (Figs. 1, 2, 3, 4, 5 and 7/37).

## DISCUSSION

Our results obtained in this study, that the venous system in pigeon was formed by one left and one right hepatic portal veins agreed with that reported by El karmoty, (2014) in ducks and geese, Santos *et al.* (2009) in geese, Pinto *et al.*, (1999) in duck, Nickel *et al.*, (1977) in birds and Malinovsky, (1965) and Oliveira, (1959) in gallus. On the other hand, Jiaji (1997) in goose and duck observed that the corresponding venous system was formed by two left hepatic portal veins and one right hepatic portal vein.

The current investigation and El karmoty, (2014) in ducks and geese, stated that, the left hepatic portal vein received blood from the ventral proventriculus and the left gastric veins. But, Nishida *et al.*, (1969) in fowl revealed that the left hepatic portal vein was a small vessel, drained venous blood from glandular and muscular stomachs through, the ventral proventriculus, the left proventriculus and the left gastric veins. On the other hand, Pinto *et al.*, (1999) in duck declared that the left hepatic portal vein was formed by 1-2 left gastric veins that drained venous blood from the ventral margin of the gizzard in addition to the pyloric and the caudal proventricular veins. While Oliveira (1959) and Malinovsky (1965) in gallus recorded that the left hepatic vein was formed by the ventral gastric, the left gastric and the caudal proventricular veins.

Our results were similar to that reported by Nishida *et al.*, (1969) in fowl. On the other hand El karmoty, (2014) in ducks and geese, Pinto *et al.*, (1999) in duck, Malinovsky, (1965) in fowl and Oliveira (1959) in gallus, reported that the tributaries of the right hepatic portal vein were the gastropancreaticoduodenal and the common mesenteric veins. While El karmoty (2014) in ducks and geese, added the gall bladder and the duodenojejunal veins.

Our current investigations found that the spleen drained by the splenic vein and proventriculosplenic vein was formed by the union between the splenic vein and the dorsal proventricular vein. But Nishida *et al.*, (1969) in fowl added the splenic and right proventricular veins joined the right hepatic portal vein by a common trunk called proventriculosplenic vein, while El karmoty, (2014) in ducks and geese recorded that the two latter veins joined the right hepatic portal vein separately.

Concerning to the formation of the gastropancreaticoduodenal vein where it constructed by, right gastric and pancreaticoduodenal veins. This account was the same as recorded by Malinovsky (1965) and Oliveira (1959) in gallus. On the other hand, Pinto *et al.*, (1999) in duck designated that the corresponding vein was formed by the pancreaticoduodenal and the two right gastric veins. In contrast to our findings in pigeon that, the pyloric vein drained into pancreaticoduodenal veins, El karmoty, (2014) and Pinto *et al.*, (1999) in ducks mentioned that, the pyloric vein drained into the dorsal right gastric vein.

Our findings and El karmoty, (2014) in ducks and geese, showed that the common mesenteric vein was formed by the union of the continuity of the larger cranial tributary of the caudal mesenteric vein and the cranial mesenteric vein between the jejunal loops. While Pinto *et al.*, (1999) in duck and Malinovsky, (1965) and Oliveira, (1959) in gallus recorded that the common mesenteric vein was formed by the junction of the cranial and caudal mesenteric veins just dorsal to the duodenojejunal flexure.

This result had great similarity to that given by Nickel *et al.*, (1977) in birds and Malinovsky (1965) and Oliveira (1959) in gallus. The ileocecal vein in our study was not found while El karmoty, (2014) in ducks and geese, recorded that the ileocecal vein was a tributary drained into the cranial mesenteric vein.

Unlike our finding, El karmoty, (2014) revealed that the cranial mesenteric vein received ileal, ileocecal and (25-28) jejunal veins in ducks, while Pinto *et al.*, (1999) in duck revealed that the cranial mesenteric vein received (12-21) jejunal tributaries. El karmoty, (2014) added in geese that the cranial mesenteric vein received ileocecal and (19-21) jejunal veins. Nickel *et al.* (1977) recorded that the cranial mesenteric vein in fowl received a series of venous arches that found in the mesojejunum which drained the jejunum and collected the venous blood from to the terminal parts of the caeca and the ileum.

These results were in accordance with El karmoty, (2014) in ducks and geese. It was dissimilar to that given by Pinto *et al.*, (1999) in duck who mentioned that the caudal tributary of the caudal mesenteric vein received cloacal and bursal tributary separately.

## Conclusion

This investigation provided an anatomical guide to the venous drainage of gastrointestinal tract in the domestic pigeon that was to some extent differs from other domestic birds. Those birds were used as a guide for nomenclature of veins according to the drainage of relative parts of gastrointestinal tract.

The hepatic portal vein drained from left and right hepatic portal veins. The small left hepatic portal vein drained blood from parts of glandular and muscular stomachs while the main right hepatic portal vein drained blood from the rest of the gastrointestinal tract and spleen.

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