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Anatomical Investigation of the Portal Vein in the Rabbit *(Oryctolagus cuniculus)*

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ABSTRACT

The present work was carried out to investigate the course and distribution of the portal vein, which received all the blood draining from the gastrointestinal tract mainly, in addition to spleen, pancreas and gall bladder. Anatomical studies on the venous drainage of the gastrointestinal tract of the rabbit were necessary to know the pattern of its blood supply to gain information in benefit of experimental surgery, pharmacology and toxicology, which could be applied to domestic animals and human, also helped in the field of veterinary comparative anatomy. Six adult, apparently healthy rabbits of both sexes were carried out in this study the animals were slaughtered, cannulated and flushed with warm normal saline (0.9%). Then animals were injected with blue gum milk latex, the specimens were subjected to fine dissection. The main tributaries of the portal vein were; the gastroduodenal, splenic, left gastric, caudal pancreaticoduodenal and cranial pancreaticoduodenal veins.

1. INTRODUCTION

Rabbits were a widely distributed animal species being used for economical purposes as a pets and producing animals, due to its easily housing and cheap reproduction *(*Shively, 1979, Nicholson, 2001 and Meredith, 2009). The rabbits were considered as laboratory animals, which suitable for much modern experimental and biomedical research, including metabolic and immunological studies, tumor and cancer investigation, anatomical, physiological, biochemical research, and experimental transplantation. Many structures or organs of the body of rabbits were studied by many authors, (Barone et. al., 1973 and Abidu-Figueiredo, et. al., 2008). Also, rabbits were used as animal models for veterinary and human researches. The knowledge of anatomical variations was more important for experimental investigation and surgical practice. The investigation of anatomy, comprising the morphology of the vessels in laboratory animals, was nearly related to ischemia and transplantation of the organs (Katarína,et. al., 2016)

Rabbits were also hind-gut fomenters, adapted to digest a high fibers diet consisting mainly of grass. The gastrointestinal tract consisted about 10 - 20% of a rabbit's body weight, food passed rapidly through the gut and fibers were eliminated from the digestive tract as soon as possible, this permitted the rabbit to be quite small and light, which is advantageous in a prey species due to the importance of the gastrointestinal tract in the rabbit and the close relationship between it and portal vein so studying the portal vein was necessary (Wilson, 2010).

The rabbit veins were thin-walled. Hematomas formed easily following the vein puncture, so that studying the portal vein and its peripheral tributaries were very importance in the rabbit (Sisson and Grossman, 1969).

2. MATERIALS AND METHODS

The current study was conducted on six adult freshly slaughtered, apparently healthy rabbits of both sexes, obtained from the physiology department of Veterinary Medicine-Cairo University. The animals were anesthetized and bled through the common carotid arteries cannulation. The vessels were thoroughly washed with warm normal saline solution.

The animals were injected with 150ml of 60% gum milk latex colored blue with Rotring® ink. through the extrahepatic part of the portal vein (Tompsett and Wakelly, 1965).

The animals were taken and put on a mixture of 10% formalin, 2% phenol and 1% glycerin then left about 48 hrs before the routine dissection. The obtained results were photographed using Sony® digital camera 12.1 mp, 4x.

The nomenclature use was that recommended by the Nomina Anatomica Veterinaria (N.A.V) (2005).

3. RESULTS

The main tributaries of the portal vein were; the gastroduodenal, splenic, left gastric, caudal mesenteric and cranial mesenteric veins, those veins drained the gastrointestinal tract, as well as pancreas and spleen.

Portal vein (V. Portae)

The portal vein (fig. 1 & 2/1) was a huge trunk, passed along the left surface of the stomach, which conveyed the blood from the stomach, pancreas, spleen, small and large intestine to the liver, its peripheral tributaries were the gastroduodenal. Splenic, left gastric, caudal mesenteric and cranial mesenteric veins.

Gastroduodenal vein (V. Gastroduodenalis)

The gastroduodenal vein (fig. 1/2) was the first tributary of the portal vein opposite to the origin of the hepatic part of the portal. It passed to the dorsal curve of the cranial part of the duodenum where it gave off a cranial pancreaticoduodenal vein and continued as right gastroepiploic vein.

Cranial pancreaticoduodenal vein (V. Pancreaticoduodenalis cranialis)

The cranial pancreaticoduodenal vein (fig. 2 /7) passed caudally along the cranial part of the descending duodenum, being covered by the right lobe of pancreas, it drained the right lobe of pancreas and proximal part of the duodenum and anastmosed with caudal pancreaticoduodenal vein at the initial part of the desecending duodenum.

Right gastroepiploic vein (V. Gastroepiploica dextra)

The right gastroepiploic vein (fig. 1 & 2/8) was considered the direct continuation of the gastroduodenal vein, along the greater curvature of the stomach where it anastmosed with the left gastroepiploic of the splenic vein, it received blood from the pylorus and greater curvature of the stomach.

Left gastric vein (V. Gastrica sinistra)

The left gastric vein (fig. 1 /3) represented by two main veins entered directly to the portal vein, it gave off 8-12 large twigs to the parietal and visceral surfaces of the stomach as well as lesser curvature and terminal part of the esophagus.

Splenic veins (V. Lienalis)

The splenic vein (fig. 1/4) joined the portal vein at the visceral surface of the stomach, it delivered splenic veins, pancreatic veins, short gastric veins and left gastroepiploic vein, which drained the spleen, left lobe of pancreas and stomach.

Short gastric veins (Vv. Gastricae breves)

The short gastric veins (fig. 1/10) represented by 4-5 branches opened directly into the splenic vein, passed into the gastrosplenic ligament to the left extremity of the stomach.

Left gastroepiploic vein (V. Gastroepiploica sinster)

The left gastroepiploic vein (fig. 1/12) was the dirct continuation of the splenic vein after the apex of the spleen, it passed along the greater curvature of the stomach anastmosed with the right gastroepiploic vein.

Caudal mesenteric vein (V. Mesenterica caudalis)

The caudal mesenteric vein (fig. 1 & 6/5) was the smallest tributary of the portal vein in diameter, it received left colic vein and cranial rectal one; those veins drained the descending colon and cranial part of the rectum.

Left colic vein (V. Colica sinistra)

The left colic vein (fig. 6/14) was about 2-3 twigs to the initial part of descending colon, passed cranially along it to be anastmosed with the middle colic vein of the cranial mesenteric vein.

Cranial rectal vein (V. Rectalis cranialis)

The cranial rectal vein (fig. 6/15) passed within the meseodescending colon directed caudally, it drained the terminal part of the descending colon and cranial part of the rectum.

Cranial mesenteric vein (V. Mesenterica cranialis)

The cranial mesenteric vein (fig. 1, 2, 3, 4, 5 & 6/6) was considered the direct continuation of the portal vein, just caudal to entry of the caudal mesenteric vein, it was received caudal pancreaticoduodenal, duodenujejunal, jejunal, ileocolic and middle colic veins, those veins collect blood from the duodenum, right lobe of pancreas, jejunum, ileum, cecum, ascending and transverse colon.

Caudal pancreaticoduodenal vein (V. Pancreaticoduodenalis caudalis)

The caudal pancreaticoduodenal vein (fig. 2 /16) was the first tributary of the cranial mesenteric vein, represented by main long vein; it drained the remaining part of the ascending duodenum, transverse duodenum and descending duodenum by several twigs. It anastmosed with the cranial pancreaticoduodenal vein of the gastroduodenal vein

and with the duodenal twig of the duodenujejunal vein at the duodenujejunal flexure.

Duodenojejunal vein (V. Duodenjejunales)

The duodenujejunal vein (fig. 2 /17) was the second tributary of the cranial mesenteric vein, detached near to caudal pancreaticoduodenal vein, it detached two twigs; **duodenal branch** passed to last part of ascending duodenum and **jejunal** one passed to the first part of the jejunum,, then detached terminal branches to wall of duodenujejunal flexure.

Jejunal veins (Vv. Jejunales)

The jejunal veins (fig. 1, 3 & 4/18) represented by 12 - 15 jejunal veins, passed accompanying the jejunal arteries extended in the mesojejunum to the mesenteric border of the jejunum. Each jejunal vein was divided into two primary twigs that anastomosed with the corresponding twig of the adjacent jejunal vein forming the **intestinal venous arches** (Fig.6/17), from these arches fine numerous draining twigs, were detached to the jejunal wall. It anastmosed with the jejunal twig of the duodenujejunal vein at the duodenujejunal flexure.

Ileomesenteric vein (V. Ileomesentericalis)

The ileomesenteric vein (fig. 3, 4 & 7/19) were 2 twigs, the first twig passed towards the ileojejunal flexure, collected blood from it and anastmosed with the last jejunal vein. The second one passed along the initial part of the ileum draining it and anastmosed with the ileal branch of the ileocolic vein.

Ileocolic vein (V. IIeocolica)

The ileocolic vein (fig. 1 & 6/20) was considered the largest and the direct continuation of the cranial mesenteric vein, it drained the remaining part of the ileum, vermiform appendix, cecum and ascending colon. It received ileal veins, cecal veins and right colic vein.

Ileal Veins (Vv. IIei)

The ileal veins (fig. 4, 5, 6 & 7/21) were two veins, one passed along the vermiform appendix, draining it and anastmosed with the ileomesenteric vein. The second one passed along the remining part of the ileum.

Cecal Vein (V. Cecalis)

The cecal vein (fig. 5, 6 & 7/22) was the largest vein of the tributary of the ileocolic, distributed allover the mesentery, detached 14 - 15 twigs to the cecal wall, it drain the terminal part of ileum and cecum.

Right colic vein (V. Colica dextra)

The right colic veins (fig. 4, 5, 6 & 7/23) were 3 veins, distributed allover the ascending colon.

Middle colic vein (V. Colica media)

The middle colic vein (fig. 6/13) was the last tributary of the the cranial mesenteric vein, it drained the transverse colon.

Legend of figures (1-7):

21- Ileal Vv.
22- Cecal V.
23- Right colic v.
a- Esophageus
b- Liver.
c- Stomach.
d- Spleen.
e- Descending duodenum.
f- Transverse duodenum.
g- Ascending duodenum.
h- Duodenojejunal flexure.
i- Jejunum.
j- Jejunuileal flexure.
k- ileum.
l- Cecum.
m- Ascending colon.
n- Transverse colon.
o- Descending colon.
P-Appendix vermiform.

1- Portal vein.
2- Gastroduodenal V.
3- Left gastric V.
4- Splenic V.
5- Caudal mesenteric V.
6- Cranial mesenteric V.
7- Right gastroepiploic V.
8- Cranial pancreaticoduodenal V.
9- Splenic Vv.
10-Short gastric Vv.
11- Pancreatic Vv..
12-Left gastroepiploic V.
13-Middle colic V.
14- Left colic V.
15-Cranial rectal V.
16- Caudal pancreaticoduodenal V.
17- Duodenojejunal V.
18- Jejunal Vv.
19- Ileomesenteric V.
20- Ileocolic V.

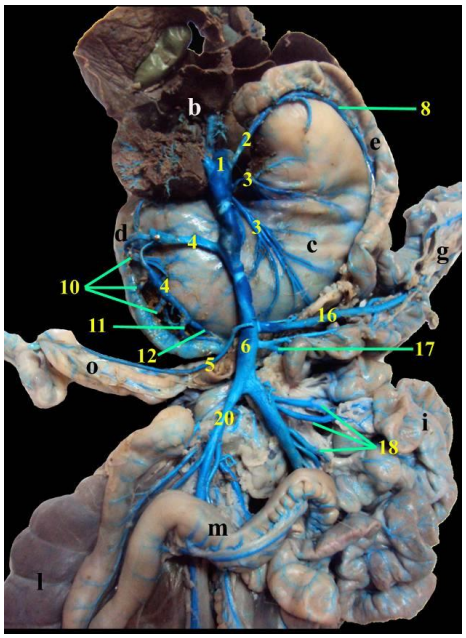

Fig.1: A photograph showing the main Tributaries of the portal vein in the rabbit.

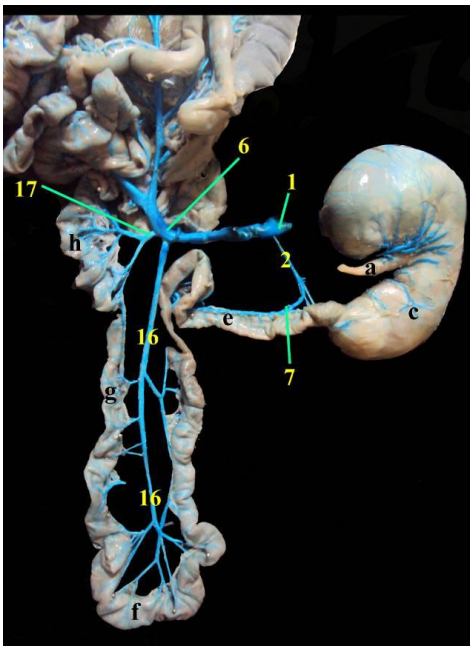

Fig.2: A photograph showing the venous drain of the duodenum in the rabbit.

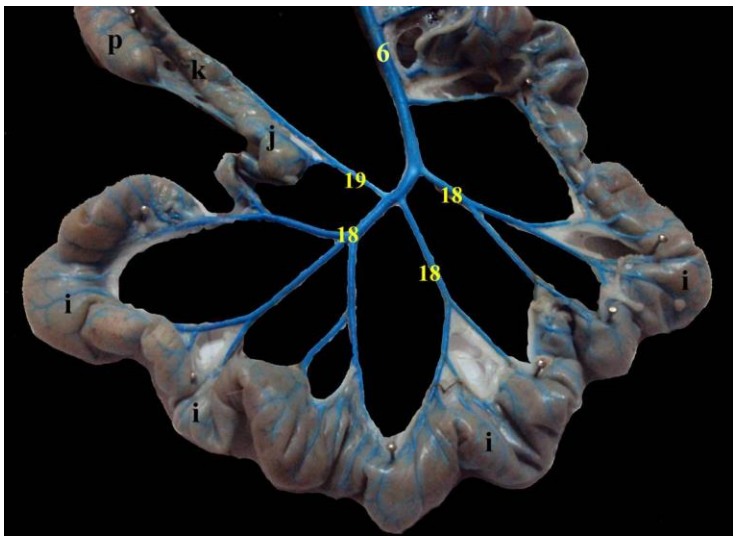

Fig.3: **A photograph showing the venous drainage of the jejunum and initial part of the ileum in the rabbit**

Fig.4: **A photograph showing the venous drainage of the jejunum, ileum and appendix vermiform in the rabbit.**

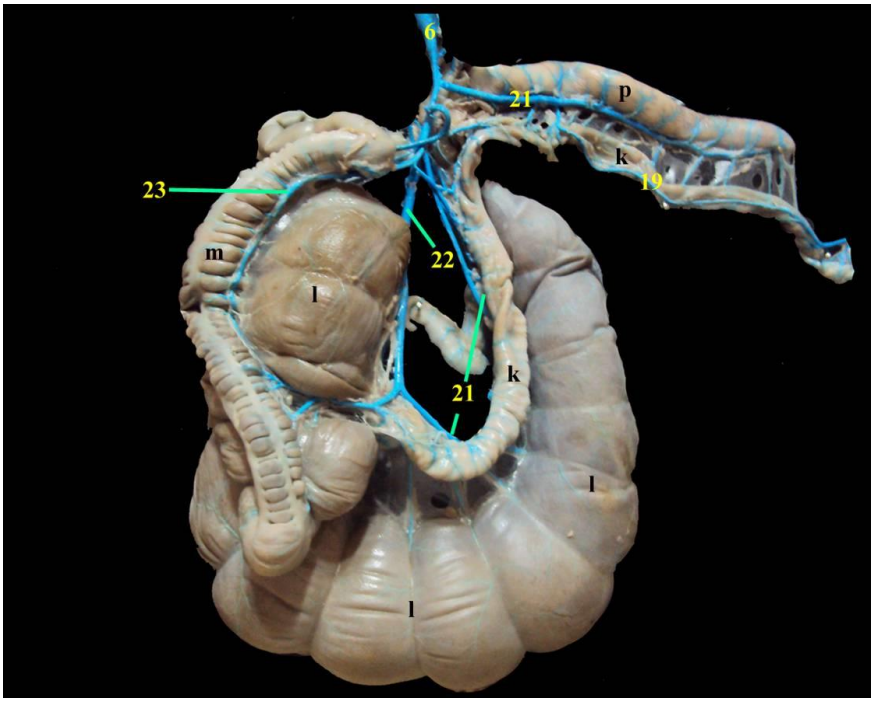

Fig.5: **A photograph showing the venous drainage of the ileum, appendix vermiform, ascending colon and cecum in the rabbit.**

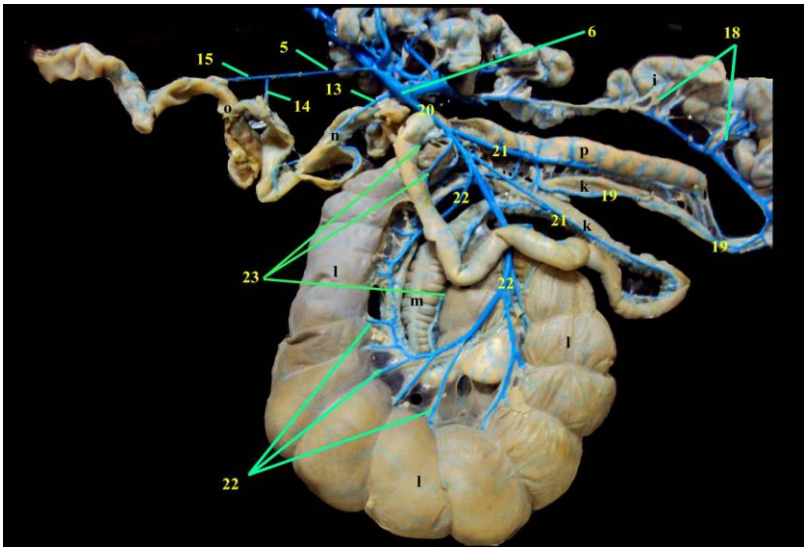

Fig.6: **A photograph showing the venous drainage of the jejunum, ileum, appendix vermiform, cecum, ascending colon, transverse colon and descending colon in the rabbit.**

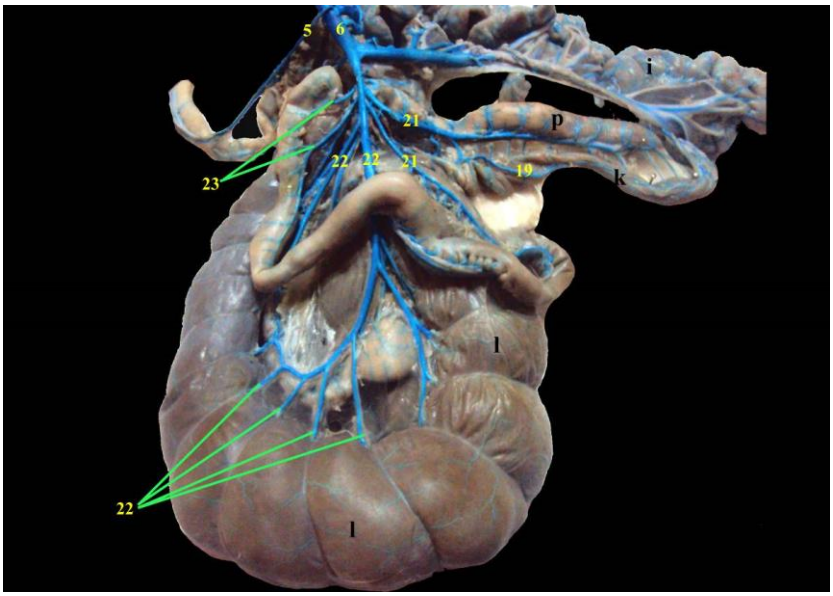

Fig.7: **A photograph showing the venous drainage of the jejunum, ileum, appendix vermiform, cecum and ascending colon in the rabbit.**

4. Discussion

In the present work, the portal vein gave rise to gastroduodenal, splenic, left gastric, caudal mesenteric and continued as cranial mesenteric veins but the portal only received gastroduodenal, Splenic, caudal mesenteric and cranial mesenteric veins in the rabbit *(Hussein, 2014)*, in dog and cat *(Miller, 1996)* and in all domestic animals *(Wilkens and Munster, 1981)*. *Wingerd (1985)* in the rabbit, reported that, the gastric veins and caudal pancreaticoduodenal vein detached directly from the portal vein, but *Heath and House (1970)* in the rabbits, reported only three branches, gastrosplenic vein, mesenteric vein and caudal pancreaticoduodenal tributaries..

The gastroduodenal vein was the first tributary of the portal vein, it gave off a cranial pancreaticoduodenal vein along the cranial part of the duodenum and continued as right gastroepiploic vein, Similar finding obtained by *Heath and House (1970)* and *Hussein (2015)* in the rabbits, *El-Bably (2007)* in donkey, *Koch* and *Ghoshal (1981)* in ox, *Wally (1986)* and *Moustafa et al., (1986)* in camel.

In the present study, showed the existence of a cranial and caudal pancreaticoduodenal veins similar to *Heath and House (1970)* and *Hussein (2015)* in the rabbits, *El-Bably (2007)* in donkey, *Wilkens and Munster (1981)* in all domestic animals, in this respect, *Sisson and Grossman (1969)* in the

horse and *Omar (1978)* in camel observed only a single pancreaticoduodenal vein.

In agreement with Heath and House (1970), Ozudgora et al., (2005), Hussein (2015) in rabbits and Wilkens and Munster (1981) in all domestic animals the right gastroepiploic vein drained pylorus and greater curvature of the stomach and anastmosed with the left gastroepiploic vein, while Artico et al., (1998) in cat, this anatmosis not presented.

The left gastric vein represented by two main veins entered directly to the portal vein, it gave off 8-12 large twigs to the parietal and visceral surfaces of the stomach as well as lesser curvature and terminal part of the esophagus, while Ozudgora et al., (2005) and Hussein (2015) in rabbit recorded that, the left gastric vein was represented by two branches, originated separately from the splenic vein.

The short gastric veins represented by 4-5 branches opened directly into the splenic vein, this finding similar to *Hussein (2015)* in rabbit, while *Ozudgora et al., (2005)* in rabbit recorded that it represented by 4-b branches and formed common trunk before entry to splenic vein.

The caudal mesenteric vein was the smallest tributary of the portal vein simulating that recorded by Wingerd (1985) and Hussein (2015) in rabbit, Koch and Ghoshal (1981) in horse and El-Bably (2007) in donkey. On the other hand, it was originated from the cranial mesenteric vein in the ox, sheep, goat *(Koch* and *Ghoshal, 1981)*, dog *(Evans, 1993)* and in camel *(Wally, 1986)*.

The caudal mesenteriv vein gave off left colic and cranial rectal veins in this study, while Wingerd (1985) and Hussein (2015) in rabbit, Koch and Ghoshal (1981), Wilkens and Munster (1981) in horse and ruminants and El-Bably (2007) in donkey, added the middle colic as a one of tributaries of the caudal mesenteric vein and Vitums (1959) in dog and Ozudgora et al., (2005) in the cat, it arose from the ileocolic vein and from the right colic in the *camel (Wally, 1986)*.

The cranial mesenteric vein was considered the direct continuation of the portal vein, and detached caudal pancreaticoduodenal, duodenujejunal, jejunal, ileocolic and middle colic veins, that's not recorded in available literatures.

The caudal pancreaticoduodenal vein was the first tributary of the cranial mesenteric vein, represented by main long vein; It anastmosed with the cranial pancreaticoduodenal vein of the gastroduodenal vein at initial part of descending duodenum, similar to *Wingerd (1985)* and *Hussein (2015)* in rabbit and this study added that, also it anastmosed with the duodenal twig of the duodenujejunal vein at the duodenujejunal flexure.

This study added that, duodenujejunal vein was the second tributary of the cranial mesenteric vein, detached near to caudal pancreaticoduodenal vein, it detached duodenal branch and jejunal one. But Hussein (2015) in rabbit recorded that the duodenojejunal flexure drained by first two jejunal veins and arose from the caudal pancreaticoduodenal vein in one case.

The present investigation revealed the numbers of jejunal veins were ranged from 12 - 15 in the rabbit. In this respect, the jejunal veins are ranged from 8-10 in the rabbit (*Hussein, 2015)*, 7-15 in the dog (Vitums, 1959 and Evans, 1993), 25-35 in the goat (Scupin, 1960), 10-14 in the horse (Koch and Ghoshal, 1981), 16-19 in the donkey (El-Bably, 2007) and 5 in the camel (Wally, 1986 and Mostafa et. al., 1986).

In agreement with Hussein (2015) in rabbit, the ileomesenteric vein were 2 twigs present only in rabbits and not recorded in other animals, it opened in the ieal vein of the vermiform appendix, while opened directly in the cranial mesenteric vein by (Hussein, 2015).

The present work gave a great resemblance to the statement of *Hussein (2015)* in rabbit, *Koch* and *Ghoshal (1981)* in goat, *May (1970)* in the sheep, *El-Bably (2007)* in donkey and *Omar (1978)* in camel, in that, the ileocolic vein was considered the direct continuation of the cranial mesenteric vein.

The current investigation emphasized the existence of two ileal veins, which originated from the ileocolic vein such results was confirmed by *Hussein (*2015) in rabbit, Omar (1978), Wally (1986) and Moustafa et al., (1986) in camel. However.Koch and Ghoshal (1981) in horse, pig, dog, Maala and sack (1983) in the ox and El-Bably (2007) in donkey gave only one ileal vein.

According to the observation of *Hussein (2015)* in rabbit, the cecal vein was the largest vein of the tributary of the ileocolic, distributed allover the mesentery, detached 14 - 15 twigs to the cecal wall, only one cecal vein in goat, pig , dog, ox (Koch and Ghoshal, 1981), in the camel (Wally, 1986) and two cecal veins in the horse (Koch and Ghoshal, 1981), in the donkey (El-Bably, 2007).

In the current investigation, the right colic veins were 3 veins, distributed allover the ascending colon. This finding similar to Maala and sack (1983) in the ox, while Hussein (2015) in rabbit and Ozudgora et al., (2005) in cat recorded, one right colic vein detached from the portal vein and Sisson and Grossman (1969) in the horse recorded two right colic veins.

5. REFERENCES

Abidu-Figueiredo, M., Xavier-Silva, B., Cardinot, T. M., Babinski, M. A., Chagas, M. A. 2008. Celiac artery in New Zealand rabbit: anatomical study of its origin and arrangement for experimental research and surgical practice. *Pesquisa Veterinária Brasileira*. 2008;28(5):237–240.

Artico, M., Malinovsky, C., Cavallotty, C., De, Antony, E., Biancari, P., D, Andrea, V., and Colaiuda, S. 1998. Venous drainage of the stomach in the domestic rabbit *(*Oryctolagus cuniculus F. domestica, breed large chinchilla) and the domestic cat (felis catus L. F. domestica) Anatomischer Anzeiger.

Barone, R., Pavaux, C., Blin, P., Cuq, P. 1973. *Atlas d'Anatomie du Lapin*. Paris, France: Mason.

El-Bably S. H. 2007. Anatomical studies on the blood supply of the intestinal tract of the donkey. Thesis, M. V. Sc., Cairo Univ.

Evans, S. E. 1993. Millers anatomy textbook of the dog. 3rd ed. W. B. Sunders co. Philadelpia London. Toronto.

Heath, T and House, B. 1970. Origin and distribution of the portal blood in the cat and the rabbit, American journal of anatomy.

Katarína , V., Eva, P., Marcela, M., Lenka, K., Jana, T., Mario, Z., Joao, E., and Darina P., 2016. Surgical Anatomy of the Gastrointestinal Tract and Its Vasculature in the Laboratory Rat, Gastroenterol Res Pract. 2016; 2016: 2632368.

Koch, T. and Ghoshal, N. G. 1981. The venous drainage of the domestic animals. W.B. Saunders Co. Philadelphia Toronto Syndery.

Hussein, M. A. 2015. Comparative anatomical studies on the gastrointestinal tract of the rabbits and cats with special reference to the venous drainage. Thesis, Ph. D., Cairo Univ.

Maala, C. P. and Sack, W. C. 1983. the venous supply to the ileum, ceum and proximal row of the ascending colon in the ox. Zbl. Vet. Med. C. Anat. Histo. Embry. , 12, 154-166.

May, N. D. S. 1970. the anatomy of the sheep, 2nd ed. University of the Queenstand PressSt. Laucia.

Meredith, A. 2009. Rabbits, Royal (Dick) School of Veterinary Studies, University of Edinburgh http://www.aquavet.i12.com/Rabbit.html (accessed 02.04.09).

Moustafa, M. S.; Abu-Zaid, S. M.; El. Nahla, S. M. and Wally, Y. R. 1986. Some anatomical observation on the venous drainage of the intestinal tract of the one humped camel (Camelus dromedaries). Alex. J. Vet. Sci. Vol. 2, 57-70.

Nicholson, M. 2001. British Rabbit Council. www.thebrc.org/index.html

Nomina anatomica veterinaria 5th ed. 2005. published by Committee on Vet. Anat. Nominclature of the world association of Vet. Anatomists Vienne.

Omar, A. M. 1978. Some anatomical studies on the portal vein of the one humped camel (Camelus dromedarius) Thesis, M. V. Sc., Zagazig Univ.

Ozudogru, D., Soyguder, Z., Akosy, G. and Karadag, H. 2005. Macroscopical investigation of the portal vein of the van cat. Vet. Med. Czech.

Tompsett, and Wakeley, 1965. Anatomical Techniques. 1st Edition. E & Living Stone Ltd. Edinburgh and London.

Schively, M.J. 1979. Xeroradiographic anatomy of the domesticated rabbit (Oryctolaguscuniculus) part I..

Scupin, E. 1960. Blutegefassversorgung der Verdavungs-organe und Bauchspecicheldruse einsliesslich Leber, milk. Hannover, Tierarztl. Hochsch. Diss.

Sisson and Grossmans, 1969. The anatomy of the domestic animals- 4th ed.W.B. Saunders comp., Philadelphia London. Toronto.

Vitums, A. 1959. Portosystemic communication in the dog. Acta Anat., 39, 271-299.

Wally. Y. R. 1986. Some anatomical observation on the intestinal tract of the one humped camel (Camelus dromedarius). Thesis, M. V. Sc., Cairo Univ.

Wingerd, B. D. 1985. Rabbit Dissection Manual. The Johns Hopkens, University press.

Wilkens, and Munster, 1981. The circulatory system. In the Nickel, Schummer and Seiferle. Lehruch der Anatomie der Haustiere, Bd. III. Verlag paul parey, Berlin und Hamburg.

Wilson, A. 2010. The rabbit digestive system,This article is based on a lecture presented at the recent RWF HealthMatters conference.