

## **A Comparative Anatomical and Morphological Study of Spleen in Rabbit (*Oryctologuscuniculus*) and Guinea pig (*Caviaporcellus*).**

**دراسة شكلية وتشريحية مقارنة للطحال في الأرنب**

**المحلي (*Oryctologuscuniculus*) وخنزير غينيا (*Caviaprocillus*)**

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البحث مستل من رسالة ماجستير للباحث الأول.

### **Abstract:**

The present study was carried out to elucidation the main anatomical differences between the spleen of rabbit and guinea pig. Conducted on 30 animals. (15 for each type) divided into two parts. The first part (10 animals) cared for determined shape, position and ligaments of spleen as well as estimated the length, width, thickness, size, weight and relative weight of spleen in each animal. The second part (5 animals) was specified to investigate the arterial blood of spleen. The results appeared that the spleen of rabbit was tongue in shape situated in left abdominal cavity while it was quadrilateral in guinea pig located in left hypochondrial subregion. The present findings revealed that the length, width, thickness, size, weight and ratio of spleen to total body weight in rabbit was  $3.314 \pm 0.16$  cm,  $0.544 \pm 0.04$  cm,  $0.128 \pm 0.07$  cm,  $0.488 \pm 0.03$  cubic mm,  $0.547 \pm 0.035$  gr,  $0.0006782 \pm 0.00001988$  ; while in guinea pig was  $2.450 \pm 0.15$  cm,  $1.22 \pm 0.08$  cm,  $0.2080 \pm 0.04$  cm,  $1.174 \pm 0.02$  cubic mm,  $0.6418 \pm 0.88$  gr,  $0.0017000 \pm 0.00021909$ , respectively , in order. Our finding revealed that the spleen of rabbit was supplied with blood by several numbers of small splenic arteries, which branched from splenic artery (continuous of lineal artery). lineal artery branched from celiac trunk. While in guinea pig the arterial blood comes from splenic artery that arises from celiac trunk directly.

**Key words:** comparative, anatomical, spleen, rabbit, guinea pig.

### **الخلاصة**

صممت هذه الدراسة لإظهار الصفات التشريحية في كل من طحال الأرنب وخنزير غينيا والمقارنة فيما بينهما. لتحقيق أهداف هذا البحث , تم استعمال 30 حيوان (15 لكل نوع) مقسمة الى مجموعتين. إستهدفت المجموعة الاولى التي تضم (10 حيوانات لكل نوع) وصف شكل , موقع , وأربطة الطحال إضافة الى تعيين طول, عرض, سمك, حجم, وزن الطحال و نسبة وزن الطحال الى وزن الجسم الكلي. بينما خصصت المجموعة الثانية (5 حيوانات لكل نوع) لمعرفة التجهيز الدموي للطحال. أظهرت نتائج المجموعة الأولى ان طحال الأرنب يكون شبيه بشكل اللسان ويقع في الجهة اليسرى من التجويف البطني, بينما يكون رباعي الشكل ويقع في الجهة اليسرى من أعلى البطن في خنزير غينيا. وإن طول, عرض, سمك, حجم, وزن, ونسبة وزن الطحال الى وزن الجسم في الارنب كانت على الترتيب  $3.314 \pm 0.16$  سم ,  $0.544 \pm 0.04$  سم ,  $0.128 \pm 0.07$  سم,  $0.488 \pm 0.03$  ملم مكعب,  $0.547 \pm 0.035$  غم,  $0.0006782 \pm 0.00001988$ , بينما كانت في خنزير غينيا  $2.450 \pm 0.15$  سم,  $1.22 \pm 0.08$  سم,  $0.2080 \pm 0.04$  سم,  $1.174 \pm 0.02$  ملم مكعب,  $0.6418 \pm 0.88$  غم,  $0.0017000 \pm 0.00021909$  على الترتيب. أما نتائج المجموعة الثانية فقد بينت إن طحال الارنب يجهز بالدم عن طريق عدة شرايين صغيرة متفرعة من الشريان الطحالي والذي بدوره ينشأ من الشريان الطحالي الرئيسي الذي يعتبر أحد فروع الشريان البطني, بينما يجهز طحال خنزير غينيا بالدم ايضا من عدة شرايين صغيرة تنشأ من الشريان الطحالي المتفرع مباشرة من الشريان البطني.

الكلمات المفتاحية / مقارنة تشريحية, طحال, أرنب, خنزير غينيا.

**Introduction:**

The spleen is a secondary lymphoid mass attends in all vertebrates. It's the most embryonic version present in cyclostomes, wherever the splenic tissue represents part of the wall of digestive tract. In higher vertebrates, the spleen parenchyma is divided into two considerable compartments, the white pulp and red pulp, which can distinguished by color in fresh spleen sections at faint magnification (1).

Spleen is Situated in the abdomen, immediately beneath the diaphragm, and bind to the stomach, the spleen is the body's greater filter of the blood , in fact, the spleen is well-arranged as a 'tree' of ramified arterial vessels, in which the minimal arterioles terminus in a venous sinusoidal system. The organ (spleen) is enclosed by a fibrous capsule of connective tissue, stemming from which many trabeculae are extending to support the major vasculature (2).

In mammals, the spleen has about three main functions: first, it is considered a large mass of systematic lymphatic tissue passed by redistribution lymphocytes, which are able to at once extract specific T or B lymphocyte-mediated immune reactions against antigens that carried by blood. Second function related with splenic red pulp which has a filtering role for the blood. This function includes the removal of substance that can be phagocytosed via red pulp macrophages. Third, in few species of mammalian (but not in humans) the spleen could serves as reservoir of red blood cells, which are carried into the circulation by sympathetic stimulation (3).

Animal models are predominantly used for pre-clinical experimentation of different drugs and vaccines type. In order to select the right species that can be used in a particular research, its immune system has to be closely correlated to that of humans. These similarities give a better understanding to large number of human diseases as well as they are helpful for developing many drugs that applied in human medicine (4).

**Materials and Methods**

To investigate the aim of this study , 30 healthy male laboratory models of rabbit and guinea pig were used, (15 models for each animal) weighted about (800-1000 gr) for rabbit and (350-500 gr) for guinea pig which obtained from National Center for Drugs Control and Researches. These animals were divided into two parts of studies; the first part (include 10 animals of each type) used for gross description of shape, position and attachments of spleen and to detect the morphometric measurements of spleen; length, width, thickness, size, weight, and the ratio of splenic weight to whole body weight, while the second part (include 5 animals of each type) was used to show the arterial blood supplying the spleen. The present work was accomplished in laboratory of Anatomy and Histology department in collage of Veterinary Medicine – Baghdad University. Each animal weights alive and euthanized, cleft was done in abdominal wall and make longitudinal incision in the animal med line, then transverse incision beneath pectoral muscle carefully.

**Determination of anatomical and morphological of spleen:**

After exposures of abdominal viscera in euthanized animal, Shape and position of spleen were described (invivo) in addition to determined spleen's ligaments that connected it with other abdominal organs.

All the results of previous anatomical parameters were photographed with digital camera (Nikone Coolpix P500, 12.1 Megapixels).

According to the Newtonian low, the volume of spleen of each animal was extracted by dipping the spleen in graduated cylinder 5 ml scale containing normal saline (0.85) which colored some times to distinguished the level of scale. The change in normal saline rise scale expressed the cubic millimeters of splenic volume. (5).

Spleens were extracted gently from animals by cut all its attachments with other viscera and then ensure that the spleen had no any obvious abnormalities or pathological lesion. The length, width and thickness of spleen were evaluated with assistance of Vernier caliper in centimeters unit.

Excised spleen was freed from any tissue adherent, and then weighed using sensitive balance. The ratio of splenic weight to body weight was calculated as in following equation: (6).

$$\text{Ratio of organ weight / body weight} = \frac{\text{weight of spleen (gr)}}{\text{weight of animal (gr)}}$$

### **Blood Supply of spleen:**

To examine the blood vessels that supply spleen in studied animals; each animal was set on suitable plate, fixed with pins; remove all of the muscles and articulation in thoracic region to expose the heart. The anesthetized animal had given a time for complete bleeding through a pinhole opened in the left ventricle until they dead .Firstly the animal were injected with normal saline using a catheter in order to washing the blood vessels, then injected a mixture fluid composed of three parts latex, two part ammonium hydroxide, in addition to carmine stain for coloring the arterial blood supply. To prevent flow of the mixture from arteries within the body, glacial acetic acid was added and the heart pinhole was closed by artery forceps. After complete injection of this mixture, animal body was placed in 10% formalin for 24 hours before carefully dissection the specimens to study the blood vessels that supply spleen (7).

### **Results and Discussion**

#### **Anatomical and morphological**

The present work showed that the rabbit had a little elongated ,slim, tongue like spleen, light red in color, situated in the left abdominal subregion, on left side of dorsal or parietal surface of stomach .it composed of body and 2 ends (dorsal and ventral) also it had visceral and parietal surface).visceral surface of spleen characterized by a shallow depression extend along the surface that was a hillus which divided the spleen into 2 unequal parts and connected it to the stomach by gastro- splenic ligament (the only ligament in spleen of rabbit).Fig 1,2,3.While the results of spleen of guinea pig is quadrilateral in shape, dark red to blackish in color, situated in left hypochondrial subregion, directed ventrally, along the greater curvature of stomach. The body is decreases in width from ventral to dorsal ends. Similar to the spleen of rabbit the hillus was found along the course of visceral surface and divided it into two un equal parts.Spleen of guinea pig was fixed by 3 ligaments that join it with other adjacent organ. Gastro splenic ligament which is part of greater omentum connects the spleen at the hillus to the greater curvature of stomach, while the spleno-phrenic ligament was a part of peritoneum extending between dorsal edge of spleen and diaphragm. In addition to that, the spleno-renal ligament joins the dorsal end of spleen to the cranial extremity of left kidney.

The findings of this study was parallel to what reported whom described the spleen of mouse as anarrow ribbon – like form suspended between the greater curvature of the stomach and the posterior abdominal wall by the gastro-splenic and lieno-renal ligaments(8).

( 9 ) In ( 1975) and (10) in (1997), described the ligaments of spleen in equine and human in order and there results were agreement with the results of present work in guinea pig but disagreement with results of rabbit whom reported that the equine and human spleen fixed by gastrosplenic ligament as well as spleno- phrenic and renosplenic ligament.

As in (fig.1) our results revealed that the mean length of spleen in rabbit was  $(3.314 \pm 0.16)$  cm and mean width was  $(0.544 \pm 0.04)$  cm, mean thickness was  $(0.1280 \pm 0.07)$  cm, mean size was  $(0.488 \pm 0.03)$  mm<sup>3</sup> , mean weight was  $(0.547 \pm 0.035)$  gr and the mean value of ratio of spleen weight to body weight was  $(0.0006782 \pm 0.00001988)$ .

On the other hand the results showed that the mean length of spleen in guinea pig was  $(2.450 \pm 0.15)$  cm , mean width was  $(1.22 \pm 0.08)$  cm, mean thickness was  $(.2080 \pm 0.04)$  cm , mean size was  $(1.174 \pm 0.02)$  mm<sup>3</sup> , mean weight was  $(0.6418 \pm 0.88)$  gr , and the mean value of ratio of spleen weight to body weight was  $(0.0017000 \pm 0.00021909)$  .

These results show there was significant differences in length, width, thickness and size of spleen between rabbits and guinea pig at level(  $p < 0.05$ ), while the splenic weight and the ratio of spleen weight to whole body weight show no significant differences between these animals at the same level.

Our findings on the spleen of rabbit was near to what reported by (11) who found the mean length, width, weight, and ratio of spleen weight to body weight in rabbit (*Oryctolagus cuniculus*) as following: 3.33 cm , 0.81 cm , 0.635 gr , 0.00037 respectively.

The results of present study on spleen of guinea pig was different in morphometric measurements from what showed by (12) on spleen of mice and (13) on spleen of rat whom recorded the mean length of spleen was 1.813 cm in mice and 4.99 cm in rat, the mean width of spleen was 0.52 cm in mice and 1.45 cm in rat, the mean weight was 0.240 gr in mice and 0.295 gr in rat, and the mean ratio of organ weight to body weight was 0.0063 in mice and 0.0031 in rat.

#### **Blood Supply:**

Our finding revealed that the spleen of rabbit was supplied with blood by several numbers of small splenic arteries, which branched from splenic artery (continuous of lineal artery).

After originated from abdominal aorta, more than 1 cm in length, the celiac artery was divided into two main vessels; these are lineal artery and left gastric artery.

Lineal artery directed ventrally on the visceral surface of stomach and gave two short gastric branches on this surface , then transformed into splenic artery that supply the spleen with blood by 5\_8 branches , and then the splenic artery lasts on the greater curvature of stomach to give the left gastric epiploic artery.(fig.7)

On the other hand, the results of present work showed that the spleen of guinea pig supplied with blood through 2 branched of splenic artery which in turn branched from celiac trunk that come from celiomesentric artery.(fig.8).

These findings (in rabbit or guinea pig) were not correspond with the findings of (14) in cat ; (15) in dog and (16) in White New Zealand Rabbit whom found there are two main trunks originated from celiac artery; the first one was called common trunk which give rise to hepatic ,right gastric and gastro-duodenal branches while the second trunk was divided into splenic artery and left gastric artery.

The finding of present work was in agreement with findings of (17) and (18) in rabbit as well as the same results was reported by the ( 19) in Baladi Rabbit.

**Table (1): morphometrical measurements of spleen in rabbit and guinea pig**

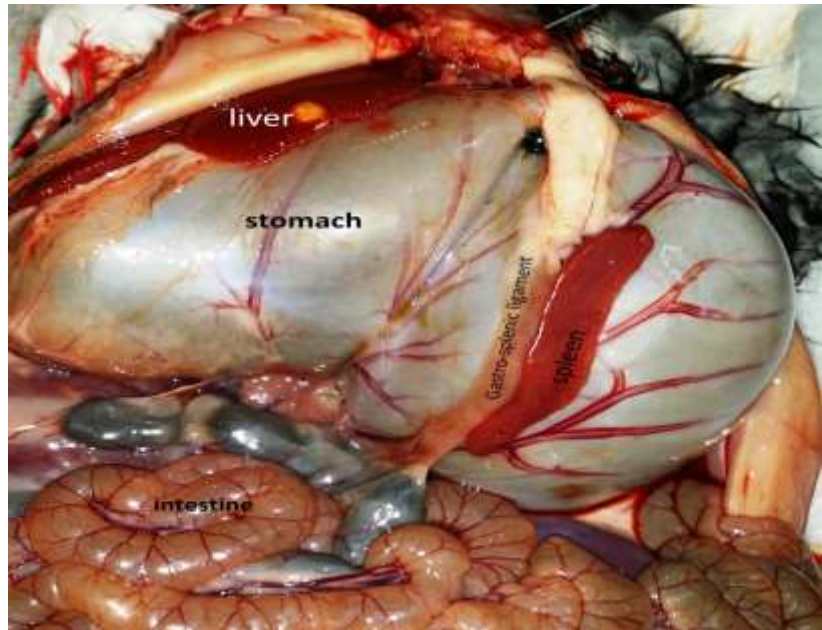
organ parameter	Rabbit	Guinea pig
Length (cm)	3.314±0.16 A	2.450±0.15 B
Width (cm)	0.544±0.04 A	1.22±0.08 B
Thickness (cm)	0.128±0.07 A	0.2080±0.04 B
Size Mm3	0.488±0.03 A	1.174±0.02 B
Weight (gr)	0.547±0.035 A	0.6418±0.88 A
Ratio of spleen to total body weight	0.0006782±0.00001988 A	0.0017000±0.00021909 A

- The numbers represent the mean ± standard error.

- The similar letters (A) denoted no significant differences between rabbits and guinea pig at level  $p < 0.05$ .
- The different letters (A,B) denoted significant differences between rabbits and G.pig at level  $p < 0.05$
- Statistical analysis: The data were statistically analyzed using SPSS(version 16.0)

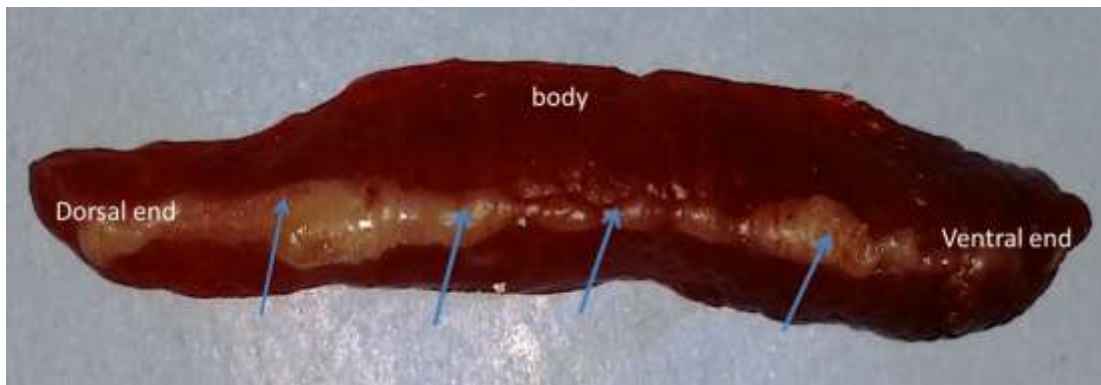
**(Fig.1)**

spleen of rabbit that appears attached to the stomach by gastrosplenic ligament. And situated in the left abdominal sub region.on the left side of dorsal surface.



**(Fig.2)** The tongue shape of spleen of rabbit ( parietal surface).

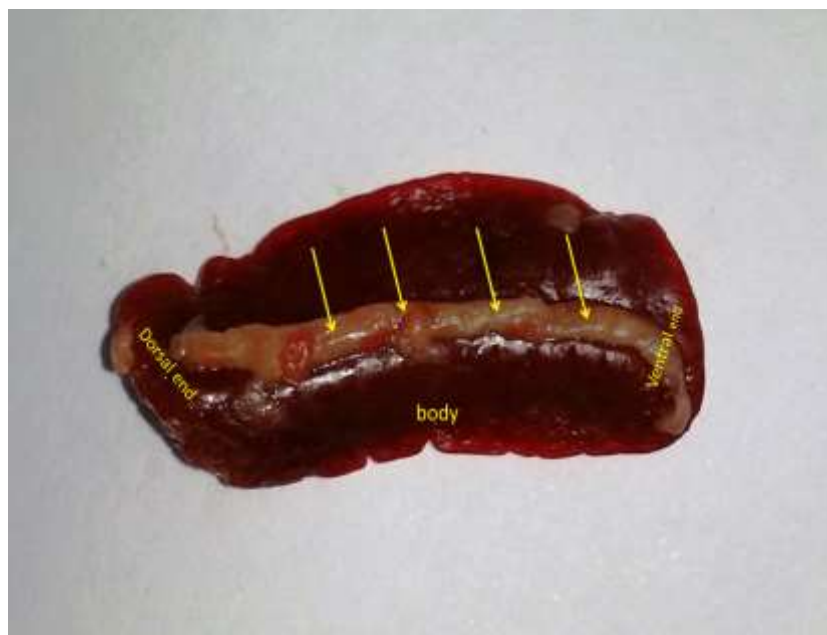




**(Fig.3)** Hillus of spleen in rabbit which extends along visceral surface.

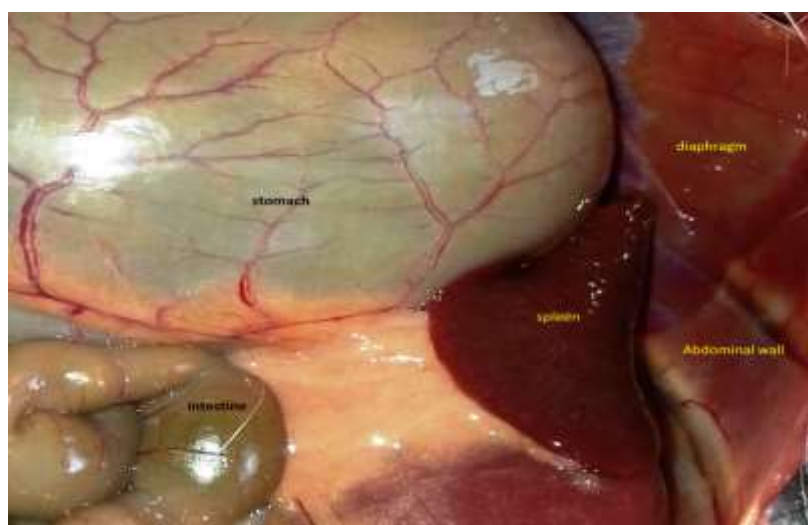
**(fig.4)**

visceral surface of spleen of guinea pig in which the hillus ( yellow arrows) extend along the surface.its shape was quadrilateral and narrowing toward the dorsal end



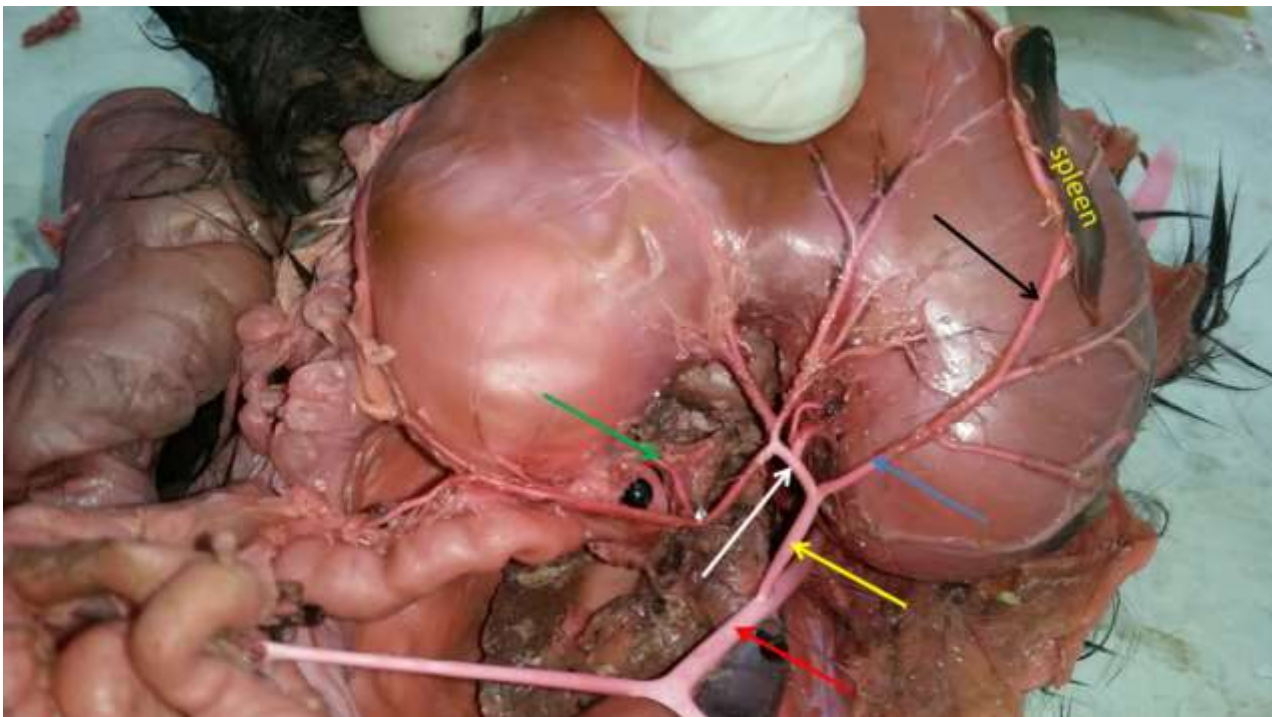
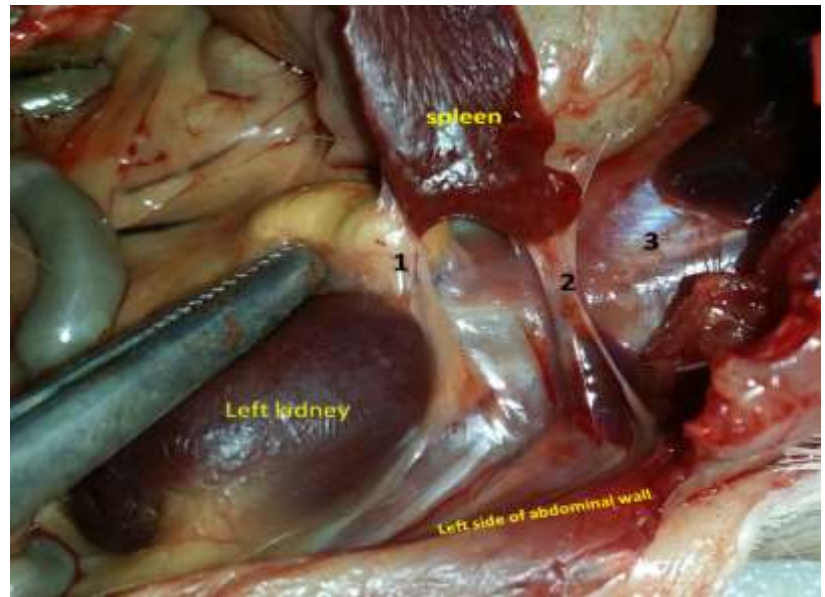
**(fig.5)**

position of spleen in guinea pig. Attached to the parietal surface of stomach and to the left side of abdominal cavity, as well as to the muscular part of diaphragm.



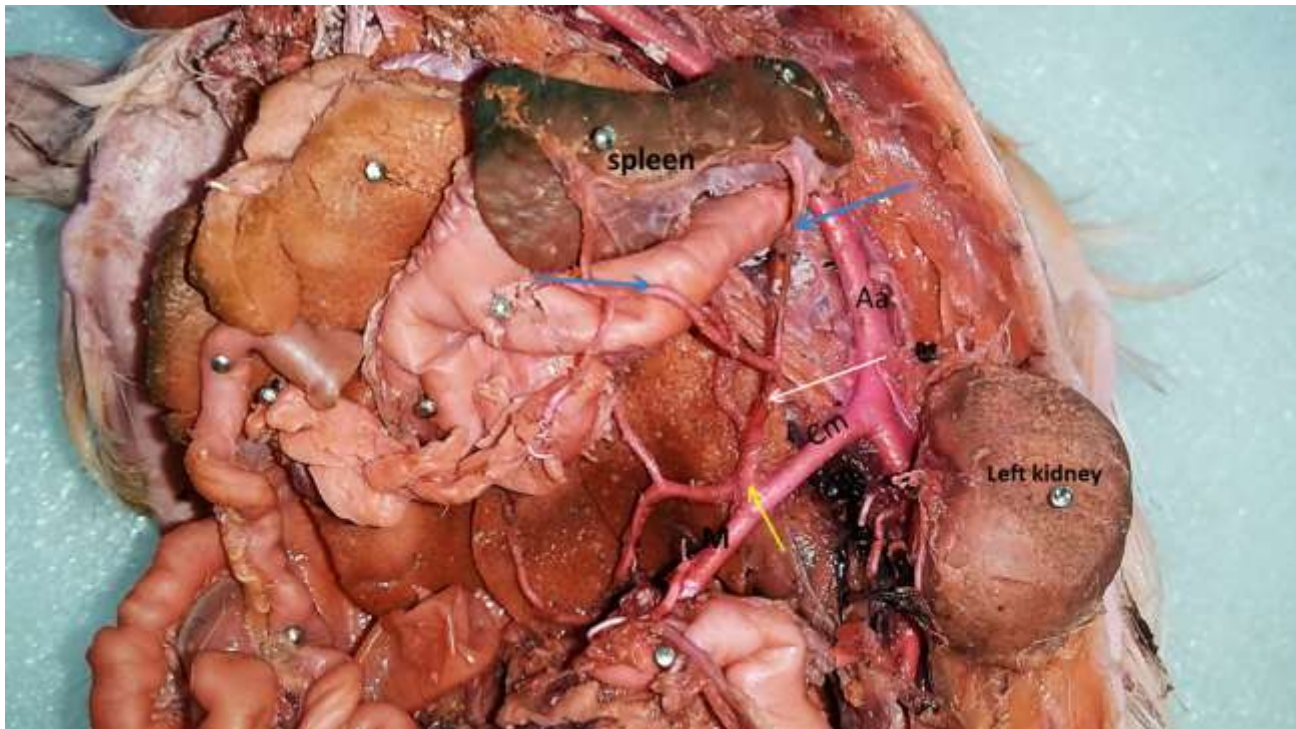
**(Fig.6)**

spleen of guinea pig attached to the left kidney with spleno-renal ligament (1) and to the diaphragm with spleno-phrenic ligament (2).and to the stomach by gastro-splenic ligament.



**(fig.7)** arterial blood supply of spleen of rabbit. Abdominal aorta (red arrow) .The celiac trunk (yellow arrow).lineal artery (blue arrow).Splenic artery (black arrow).Left gastric artery (white arrow) .and hepatic artery (green arrow).





(fig.8) arterial blood supply of spleen of guinea pig. Abdominal aorta(Aa) .Celiomesentric artery (Cm).Celiac trunk(yellow arrow).splenic artery(white arrow). Dorsal and ventral branches of splenic artery(blue arrows).

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