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RESEARCH ARTICLE

Morphological and histological study of the stomach in local rodent species(guinea pig) Cavia porcellus

Dr. Shrmean Abdulla Abd AL-Rhman.

Department of biology , college of Education for pure science (Ibn Al-Haithum), university of Baghdad \ Iraq.

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Corresponding Author

Dr. Shrmean Abdulla Abd AL-Rhman.

Abstract

The study of stomach in adult male local guinea pigs rodents included the morphological description ,histometric measurments and histoarchitecture at the light microscope level by using Haematoxyline and Eosine stain methods.

The results revealed that the stomach had C shaped with the presence of two curvatures and shallow angular notch. It is simple (unilocular) smooth and homogenous grossly without external demarcation limiting ridge (margo plicatus) between its devisions , white grayish in color and slightly transparent. Blood was supplied to the stomach by the coeliacomesentric trunk.

The microscopic examination revealed that the wall of the stomach show the characteristic four compartmant tunics : Mucosa , Submucosa , Muscularis externa and Serosa.The stomach regions were cardiac type (A, B) , fundic and pyloric .The mean thickness of tunica mucosa was the maximum in fundic region (110±10) and the minimum in cardiac region type A (13 ± 2.7386). The mean thickness of tunica muscularis externa was the maximum in pyloric region (67± 4.4721) and the minimum in cardiac region type A(29.6 ± 0.5477). Non keratinized stratified squamous epithelium covers the tunica mucosa of cardiac region type A with visible stratum granulosum , while Simple columnar epithelium with gastric glands and pits covers the tunica mucosa of the other regions of stomach . Skeletal and smooth muscle fibers found in tunica muscularis externa of cardiac region type A ,while spiral ,circular and longitudinal arrangement of smooth muscle fibers found in tunica muscularis externa of the other regions of stomach. The simple tubular cardiac glands composed of predominate mucous secreting cells , mucous acinar cells found on the basal surfaces , few parietal cells, enteroendocrine cells and undifferenciated cells. The simple tubular fundic glands with shallow pits composed of mucous neck cells, parietal cells which were predominantly present in the upper and lower half of the fundic glands , chief cells and enteroendocrine cells that found in the lower third of each fundic glands. The long simple branched tubular pyloric glands with deep pits, composed of predominantly mucous acinar cells along the leng of the frontal and basal surfaces , randomly parietal cells,few chief cells and enteroendocrine cells.

Introduction:-

The stomach is a muscular organ located in the upper left abdominal cavity immediately inferior to the diaphragm [1]. It is important component of the gastrointestinal tract performs the function of storage ,digests and churning food into a chyme [2,3].

There are wide variation in mammalian stomachs,which are greatly influenced by adaptations , nature of the feed , frequency of food intake ,duration , need for food storage, body size and shape [4,5] .

The rodentia are the largest of all mammalian orders,they characterized by wide morphological diversity of its constituent species occupying various ecological niches [6].

The gross morphology of stomach differs substantially among rodent species in terms of the compartmentalization and type of mucosal surface, as studied by [7,8,9,10] .

A guinea pig is a mammalian member belong to the order Rodentia ,Suborder Hystricomorpha , Family Caviinae[11]. It characterized by large head , short legs , unfurred, short ears , no external tail, two large pairs of chisel like incisors and three to five molars, four digits on the forepaw and three on the hindfoot [12] .

This study aims to give better description for each gross and microscopic characteristics of stomach in local guinea pigs ,for the importance of this organ and for the limited detailed histoarchitecture studies of stomach concerning with this experimental rodents .

Materials and Methods:-

Adult healthy male local (guinea pigs) were used in this study obtained from the spining market during winter season . The experimental animals were anesthetized under cholroform inhalation then transferred to the dissection board . The skin and abdominal musculature had been dissected away to expose the abdominal organs [13].

Topography of the stomach was noted and photographed in situ , followed by harvested this organ from the digestive tract for each experimental animals , then carefully extended to their full length after stripped from the surrounded connective tissue .It was perform a linear incision along the greater curvature to open the stomach . Gastric content was removed carefully in order to noted and phtographrd the internal features of stomach .

For histological preparation, a small pieces from different stomach regions were fixed in 10% formalin for 24 hours, washed, dehydrated through ascending grades of ethanol alcohol , cleared and embeded in paraffin wax . Six micron thick sections were cut by using rotary microtome . The paraffin wax was removed by immersing the slides in xylene.The slides were passed through descending grades of alcohol, distilled water and stained with haematoxylinw and Eosin (H &E) stain methods . Stomach tissue sections were cleared and mounted as per usual methods [14] .

An ocular micrometer were used to measured the thickness of different components of stomach in experimental guinea pigs. Data were analyzed using the statistical methods [15]. The images of stomach tissue sections were taken by using light microscope with digital camera canon ,Japan .

Result:-

Morphological description:-

The stomach in guinea pig was a hallow organ located in the abdominal cavity retrodiaphragum and retrohepatic , it is situated transversely slightly deviated to the left median plane, Fig. (1).

Its topography simple (unilocular) smooth and homogenous grossly without external demarcation limiting ridge (margo plicatus) between its devisions , white grayish in color and slightly transparent ,Fig.(2).

The stomach had (C shaped) with the presence of two curvatures , the greater and lesser curvature ,where the greater omentum and lesser omentum were attached .The lesser curvature was small and forms anteriorly shallow angle with the oesophagal entrance to the stomach termed angular notch or (incisura angularis),Fig.(3).The greater curvature was descending ventrocaudally .

Blood was supplied to the stomach by the abdominal aorta via an independent single trunk ,the celiacomesentric trunk ,which was divided into four branches , the gastric arteries which supplies blood to the regions near the lesser curvature , the splenic and gastroepiploic arteries which supplies blood to the regions near the greater curvature and the superior pancreatcoduodenal artery which supplies blood to the regions near the pylorus , Fig.(3).

Well defined longitudinal and transverse wrinkles (rugae) had been noticed along the internal surface of the stomach , Fig.(4) .

Histological structure:-

The wall of the stomach in guinea pig show the characteristic four compartmant tunics : Mucosa i.e (epithelium , Lamina propria and Muscularis mucosa) , Submucosa , Muscularis externa and Serosa.

On histological examination by light microscope the cardiac region type A was small, folded area surrounds the oesophagal entrance. Non keratinized stratified squamous epithelium covers the tunica mucosa ,its thickness was (13±2.7386), the stratum granulosum was distinctly visible , Fig.(5,6). The tunica submucosa was thin (17± 2.7386) consisted of loose connective tissue .The tunica muscularis externa was thin , consisted of skeletal and smooth muscle fibers , its thickness was (29.6±0.5477) , Fig.(7).

As seen in Fig. (8) the cardiac region type B was glandular region and folded . Simple columnar epithelium with cardiac glands and pits covers the tunica mucosa,its thickness was more than that in cardiac region type A (40±3.5355) . The cardiac glands were simple tubular glands composed of predominate mucous secreting cells distributed along the frontal surfaces of the glands , mucous acinar cells found on the basal surfaces , few parietal cells, enteroendocrine cells and undifferenciated cells , Fig.(9).The mucous secreting cells had cuboidal shape with basally located nucleus and foamy cytoplasm , its apical portion filled with mucous. The lamina propria was occupied by tubes of cardiac glands , dense network of blood vessels and nerves .The muscularis mucosa was thin and consists of circular arranged smooth muscle fibers , Fig.(9). The tunica submucosa was thin (16± 8.2158) consisted of loose connective tissue , blood vessels,lymphoctes .

The tunica muscularis externa was thick (40±0) consisted of internal spiral and circular muscle fibers and outer thin longitudinal muscle fibers .

The tunica serosa form the outer most layer of the stomach , it consists of areolar connective tissue , adipose connective tissue , blood vessels and nerves , this tunica was extended and intermingles with the former tunic in some areas , Fig.(10).

The fundic region was the maximum , occupied the most entire area of the stomach between the cardiac region type B and pyloric region . Its was more thick and less folded than cardiac regions type A and B , Fig.(11). Simple columnar epithelium with fundic glands and shallow pits covers the tunica mucosa (110±10).The apical surface was covered by a thick layer of mucus . The fundic glands were simple tubular glands composed of mucous neck cells, parietal cells, chief cells and enteroendocrine cells , Fig.(12). The mucous neck cell was short columnar with large oval nucleus , it occupied a large proportion of the cytoplasm. The parietal cell were predominantly present in the upper and lower half of the fundic glands ,it was the largest cell types , had oval shape broad at the base , pink cytoplasm and central nucleus, there was a clear whitish region present in the cytoplasm of some of these cells . The chief cells had spherical shape with darkly stained basally located nucleus and the upper region were filled with pale granules . The enteroendocrine cells found in the lower third of each fundic glands ,it was small and had weakly stained cytoplasm .The lamina propria was occupied by heavily irregular tubes of pyloric glands , blood vessels and nerves. The muscularis mucosa was thin and consists of circular arranged smooth muscle fibers . The tunica submucosa (15.2±5497) consists of loose connective tissue ,collagen fibers , large blood vessels ,lymphoctes . The tunica muscularis externa was thick (38.6 ±3.1304) consists of internal spiral and circular muscle fibers and outer thin longitudinal muscle fibers . The tunica serosa form the outer most layer of the fundic region , it consists of areolar connective tissue , adipose connective tissue , blood vessels and nerves , this tunica was extended and intermingles with the former tunic.

Fig.(13). shows the bulk of the pyloric tunica mucosa which were occupied by pyloric glands opend into pyloric pits (51±4.1833). The apical surface was covered a prominent layer of mucus. The pyloric glands were long simple branched tubular glands with deep pits, . The pyloric glands composed of predominantly mucous acinar cells along the leng of the front and basal surfaces and randomly parietal cells , few chief cells and enteroendocrine cells Fig.(14). The tunica submucosa were thick (17±6.7082),extends and intermingles with the later tunic . It consists of loose connective tissue ,collagen fibers, blood vessels, lymphoctes. The tunica muscularis externa (67±4.4721) was consists of thick internal spiral circular muscle fibers and thin outer longitudinal muscle fibers , Fig.(13). The tunica

serosa form the outer most layer of the fundic region , it consists of areolar connective tissue , adipose connective tissue , blood vessels and nerves , this tunica was extended and intermingles with the former tunic ,Fig.(13).

Table (1) : The histometrical measurements of the stomach in experimental local guinea pigs.

Regions of stomach	Thickness of Tunica mucosa 10 x Mean (M.) Standard Deviation (SD. ±)	Thickness of Tunica submucosa 10 x Mean (M.) Standard Deviation (SD. ±)	Thickness of Tunica muscularis 10 x Mean (M.) Standard Deviation (SD. ±)
Cardiac region type A	M. 13 SD. ± 2.7386	M. 17 SD. ± 2.7386	M. 29.6 SD. ± 0.5477
Cardiac region type B	M. 40 SD. ± 3.5355	M 16 SD. ± 8.2158	M. 40 SD. ± 0
Fundic region	M. 110 SD. ± 10	M. 15.2 SD. ± 4.5497	M. 38.6 SD. ± 3.1304
Pyloric region	M. 51 SD. ± 4.1833	M. 17 SD. ± 6.7082	M. 67 SD. ± 4.4721

Discussion:-

Morphological observation revealed that the stomach in local guinea pig was simple (unilocular) smooth and homogenous grossly without external demarcation limiting ridge (margo plicatus) between its devisions. In comparison with those of other rodents , it was compound unilocular which possessed an unspecialized unilocular hemiglandular stomach in Southern African myomorph rodents *Thallomys paedulcus* , *Mystromys albicaudatus* [7] ; bilocular discoglandular with visible limiting ridge between three distinct nonglandular areas and one glandular area of stomach in Southern African myomorph rodents Saccostomus campestris [7] ; Sulawesi rodents Maxomys hellwaldii and Paruromys dominator [10] ; plurilocular (multichambered) markedly sacculated stomach in four African rodents , Cricetomys gambianus , Mystromys albicaudatus , Thallomys paedulcus and Saccostomus campestris [8] and in Laonastes aenigmamua which was sacculated into 9-10 small pouches [9,16] ; unilocular hemiglandular with visible limiting ridge between nonglandular area and glandular area of stomach in in Sulawesi rodents Rattus hoffmanni [10] ; five Saudi Arabia rodent species i.e. Meriones rex ,Meriones libycus, Acomys dimidiatus , Acomys cahirinus and Dipodillus dasyurus [17] ,] , in Eastern Brazil rodents Calassomys apicalis [18] .

In the present study the stomach had (C shaped) with the presence of two curvatures , while it had crescent shaped sac in rats [4] ; bullky sac like with marked ridges in Laonastes aenigmamua [6] and in four African rodents , Cricetomys gambianus , Mystromys albicaudatus , Thallomys paedulcus , Saccostomus campestris [8]; bag U shaped in in Sulawesi rodents Paruromys dominator [10] and laboratory mouse [20] ; bean shaped in five Saudi Arabia rodent species , Meriones rex ,Meriones libycus, Acomys dimidiatus , Acomys cahirinus and Dipodillus dasyurus [17]; elongated aspects in Inner Mangolia rodents Spermophilus daurica [19] ; oval aspects in Chinchilla lanige [21] and J shaped in Oligoryzomys nigripes [22].

The present study had shown that the small lesser curvature forms anterioly shallow angle with the esophagal entrance to the stomach termed angular notch or (incisura angularis)**.** This finding was similar to that of African rope squirrel Funisciurus anerythrus and Persian squieerl Sciurus anomalus with uncompartmentalization of the stomach [5] and differed from sharp and broad angular notch that found in five Saudi Arabia rodent species i.e. Meriones rex ,Meriones libycus, Acomys dimidiatus , Acomys cahirinus and Dipodillus dasyurus where the deep situted esophagal entrance close to the pyloric region [17] and in four African rodents i.e Cricetomys gambianus , Mystromys albicaudatus , Thallomys paedulcus , Saccostomus campestris, where the medially situted esophagal entrance to the lesser curvature [8] and Chinchilla laniger [23].

It was noticed that arterial supply of the stomach provided by the abdominal aorta via an independent single trunk ,the celiacomesentric trunk , while it was reported that the arterial supply of the stomach provided via separate celiac artery in other rodents like North American beaver Castor canadensis [24], hamster[25] , Muskrat Ondatra zibethicus [26], chinchilla lanigera [27].It was found that the celiacomesentric trunk was divided into four branches, it was similar to the number of branches of celiac trunk in chinchilla lanigera [27] ,while in North American beaver Castor canadensis and in rats,the coeliac trunk divided into two branches[24] , [27] respectively .

Well defined longitudinal and transverse wrinkles (rugae) had been noticed along the internal surface of the stomach in the experimental animals**.** This finding was agreement with that found in African rope squirrel Funisciurus anerythrus [5] and in Laonastes aenigmamua [9]. The internal surface of stomach had highly modification

structures in the regions anterior to the limiting ridge (margo plicatus) like numerous irregularly orientated filiform papillae and many diverticulla in the four African rodents , Cricetomys gambianus , Mystromys albicaudatus , Thallomys paedulcus , Saccostomus campestris, which act as small reservoirs for digesta [8] ; convoluted folds that found in Sulawesi rodents Maxomys hellwaldii and Paruromys dominator [10]. [6,9] stated that the main functions of the folds were to facilitate the transit of food , maintenance the internal volume of the stomach , maintenance the form of a stomach and its affixing to the abdominal cavity and analogous to the functions of taeniae fermenters .

The results of histological examination by light microscope revealed that the stomach in guinea pigs was a typical one . The glandular epithelium was common to all regions of the stomach with no keratinized stratified squamous epithelium , this result was differed from that seen in Laboratory mammals [4] ; Laonastes aenigmamua [6]; African rodents Cricetomys gambianus , Mystromys albicaudatus , Thallomys paedulcus , Saccostomus campestris [8] ; Sulawesi rodents Maxomys hellwaldii and Paruromys dominator [10]; laboratory mouse [20] , they had in addition a non glandular compartment situated anteriorly to the limiting ridge (margo plicatus) and lined by keratinized stratified squamous epithelium . [28] stated that the non glandular region of the stomach of rats and mice stores well chewed and salivated food in amounts as needed for one to three hours or longer and supplies its content for further digestion independently of filling degree and in relation to the host's actual energy need during the light period or lipid metabolism during the dark period.

The result indicated that the stomach had three regions cardiac, fundic and pyloric regions with characteristic four compartmant tunics : Mucosa (epithelium , Lamina propria and Muscularis mucosa), Submucosa, Muscularis externa and Serosa. These observations were agreement with[5] in African rope squirrel Funisciurus anerythrus and [22] in Oligoryzomys nigripes , they stated that the stomach was divided into three regions , the cardia , fundic or body which was the larger middle region and pyloric which was located toward the doudenum . The glandular cardiac region type B includes simple tubular glands , while it was branched coiled tubular glands in Albino rat Rattus norvegicus [29]. As stated by [6] the main part of the stomach was a cardiac region that includes typical cardiac glands . The mammals were the only class of animals that had unique cardiac epithelium containing mucus-secreting glands [30].

The histometrical measurements of the stomach in experimental guinea pigs indicated that the mean thickness of tunica mucosa was the maximum in fundic region (110$\pm$10) , these observations were agreement with[5] in African rope squirrel Funisciurus anerythrus. and [29] in Albino rat Rattus norvegicus. The tunica mucosa of stomach was specialized for secretary functions , producing local movement via muscularis mucosa and folding of the mucosa [30]. In the present study it was found that the fundic glands were simple tubular glands composed of mucous neck cells, parietal cells, chief cells and enteroendocrine cells. [5] stated that the mucous neck cells secrete mucous that provide a protective barrier against injury , toxins and pathogens in addition to contributing to the innate defense system . In the present study the parietal cell were predominantly present in the upper and lower half of the fundic glands , had oval shape broad at the base ,while it had pyramidal shaped , located in the lower two third of the fundic glands as stated by [29] in Albino rat Rattus norvegicus and a lot of them found only in the apical part of the tunica mucosa in Laonastes aenigmamua as stated by [6]. In the present study the chief cells had spherical shape with darkly stained basally located nucleus and the upper region were filled with pale granules, similar observation found by [29] in Albino rat Rattus norvegicus.

It was found that the smal enteroendocrine cells located in the lower third of each fundic glands , while it was few and scattered between the basement membrane and the chief cells in Albino rat Rattus norvegicus [29] .

The mean thickness of tunica muscularis externa was the maximum in pyloric region (67$\pm$ 4.4721) .[30] stated that the well defined tunica muscularis externa in the rat's stomachs provides the basis for peristalsis via the action of its muscle layers at right angles to each other , therefore during digestion the churning action on the food by the stomach muscles leading to finer particles is more efficiently achieved .While the minimum was in the cardiac region type A(29.6 $\pm$ 0.5477) , this suggests the possibility that the stomach wall significantly dilates at filling with ingests , as stated by [6].

Fig. (1) Gross photograph illustrates the position of stomach in local guinea pigs Cavia porcellus L. Liver ، L. In. Large intestine ، S. Stomach ، S. Spleen

Fig. (2) Topography of stomach in local guinea pigs Cavia porcellus

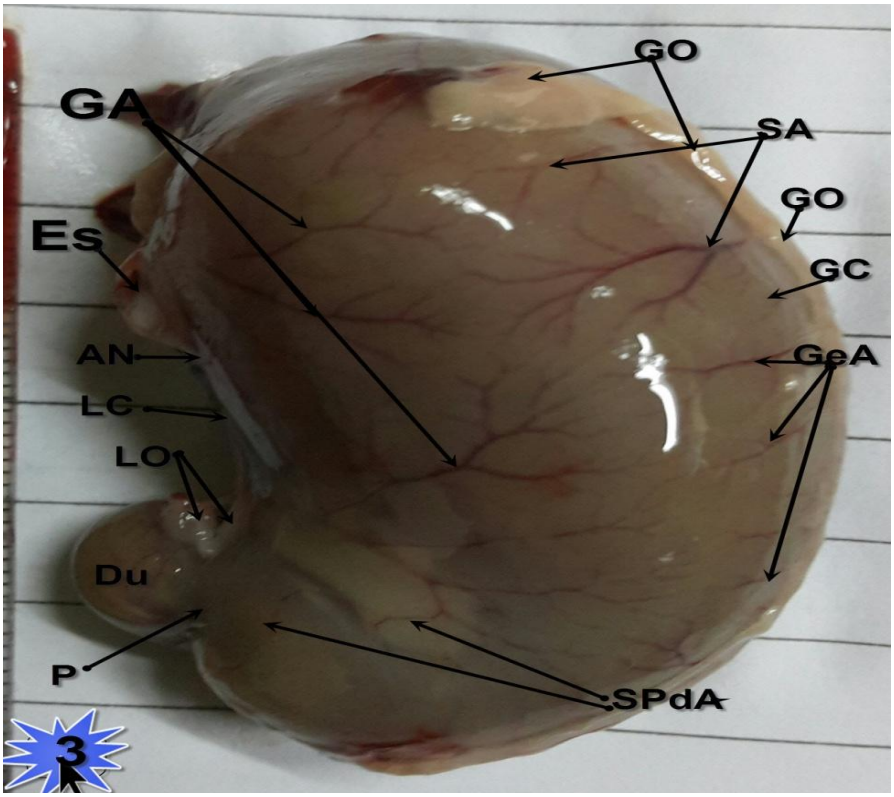

Fig. (3) Regions and blood supply of stomach in local guinea pigs Cavia porcellus
AN Angular Notch , Du Duodenum , Es Esophagus , GA Gastric Artery , GeA Gastroepiploic Artery GO Greater Omentum , GC Greater Curvature , LC Lesser Curvature , LO Lesser Curvature , P Pylorus , SA Splenic Artery , SPdA Superior Pancreatcoduodenal Artery .

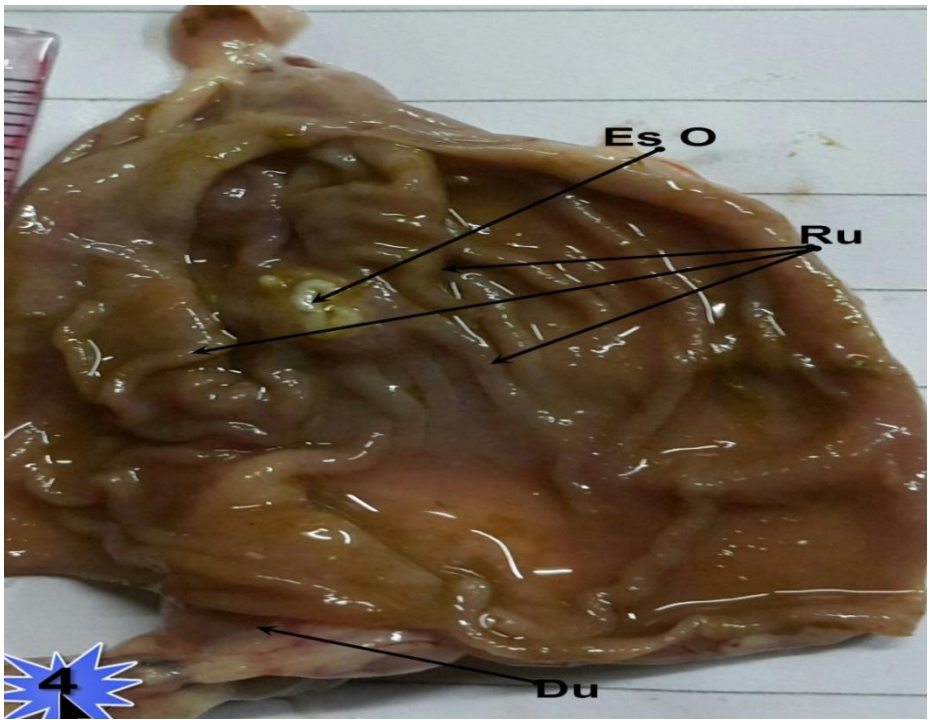

Fig. (4) Internal surface of stomach in local guinea pigs Cavia porcellus
Du Duodenum , EsO Esophagus Opening , Ru Rugae .

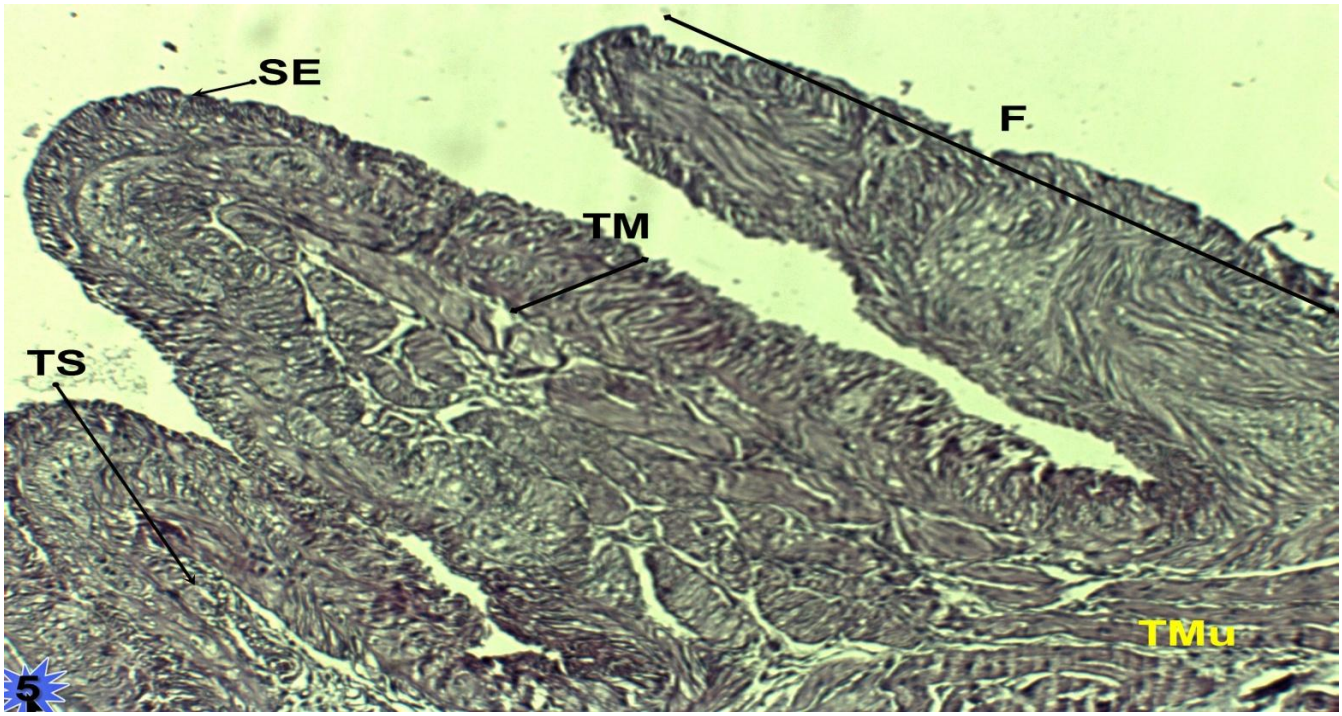

Fig.(5) Transverse section through the cardiac region type A illustrates :
F Fold , SE Stratified Squamous Epithelium , TM Tunica Mucosa , TMu Tunica Muscularis Externa , TS Tunica Submucosa . (H&E stain x10)

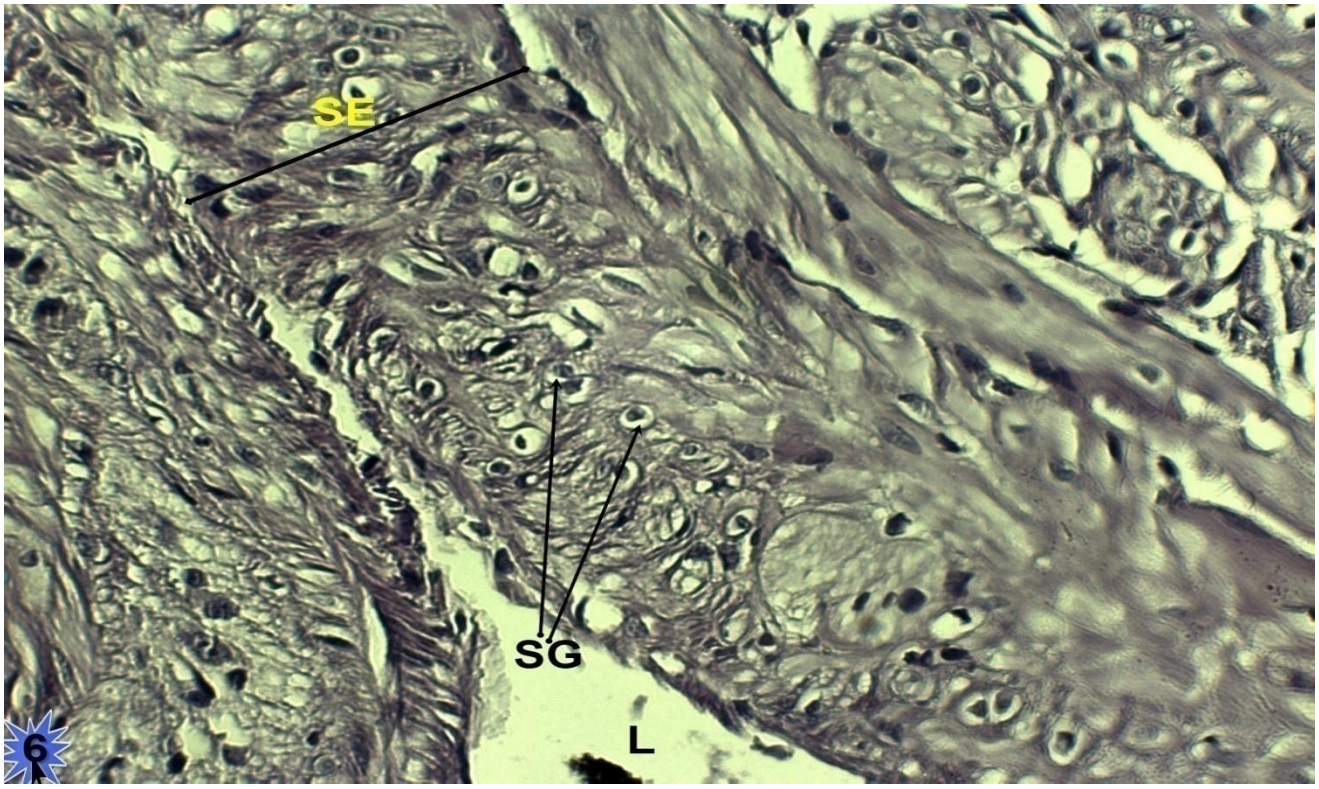

Fig.(6) Transverse section through the cardiac region type A illustrates :
L Lumen , SE Stratified Squamous Epithelium , SG Stratum Granulosum . (H&E stain x40)

(13)

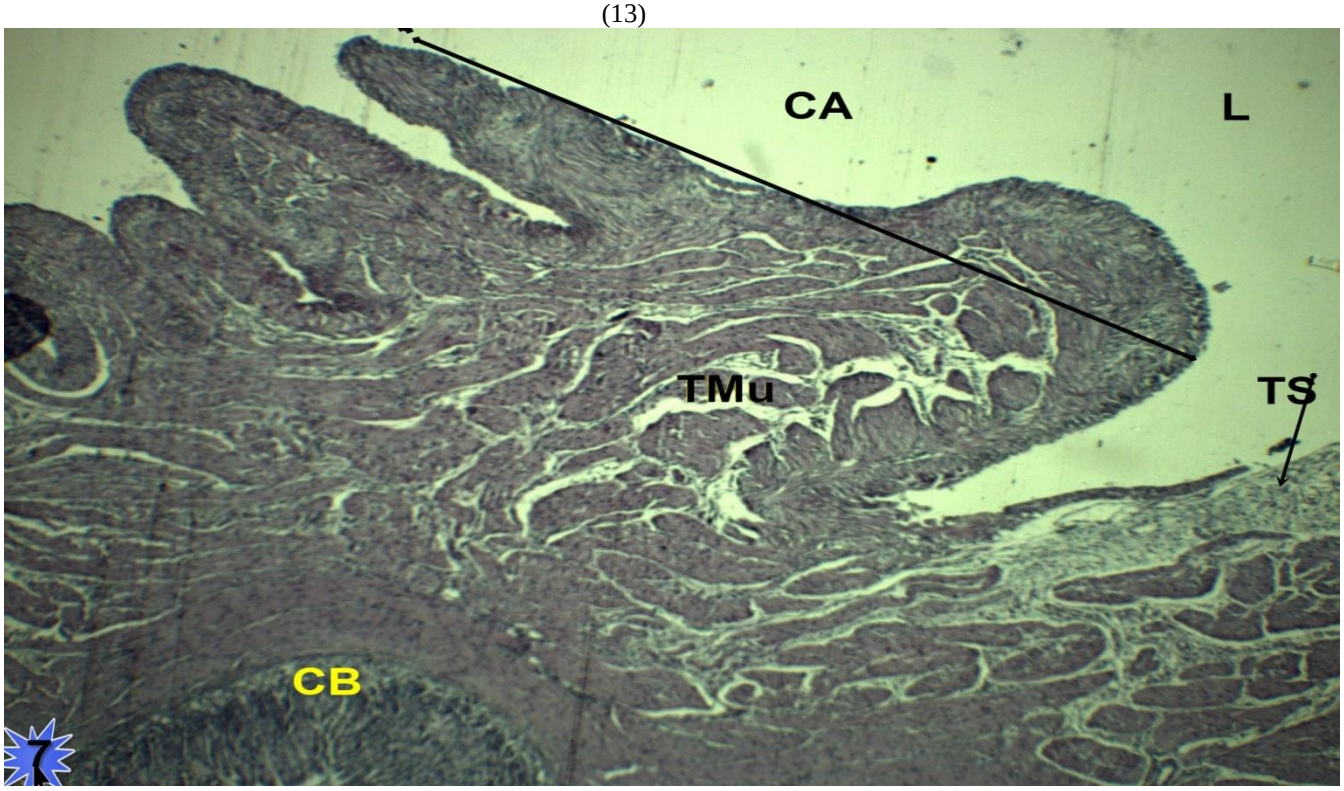

Fig.(7) Transverse section through the cardiac region type A and cardiac region type B illustrates :
CA Cardiac region type A (non glandular) , CB Cardiac region type B (glandular) , L Lumen , TMu Tunica Muscularis Externa , TS Tunica Serosa. (H&E stain x4)

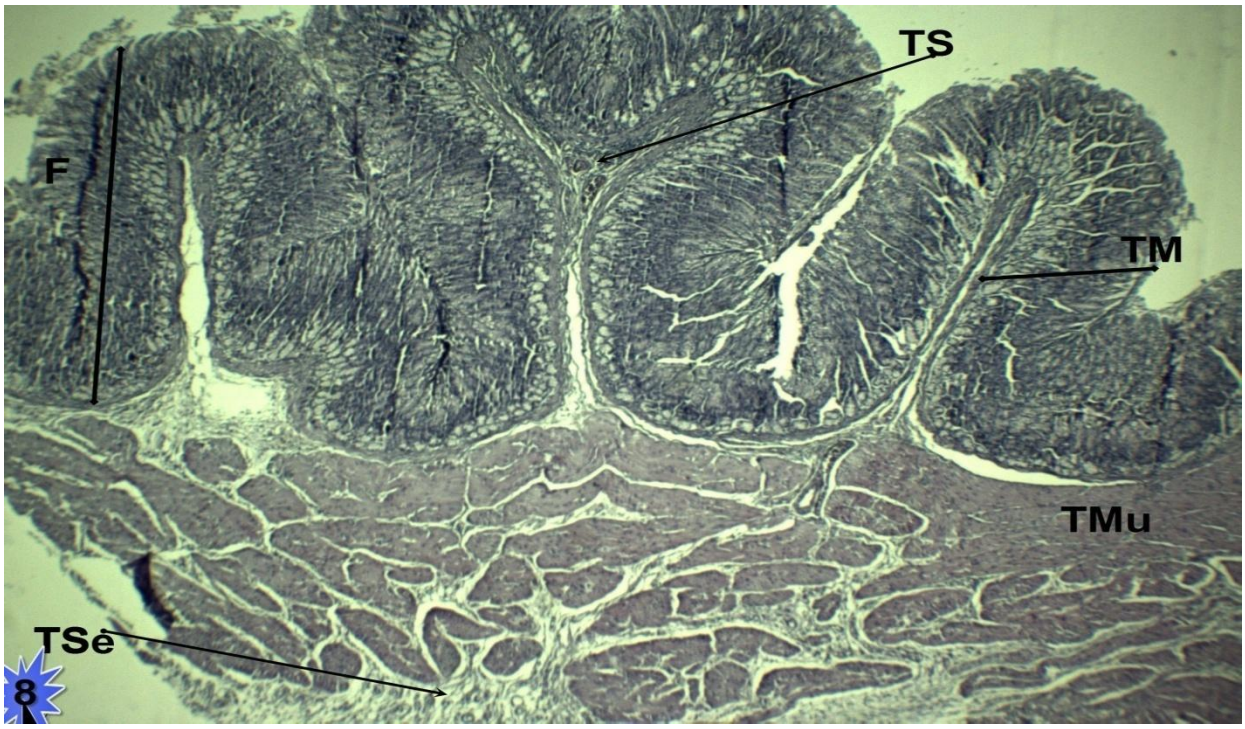

Fig.(8) Transverse section through the cardiac region type B illustrates :
F Fold , TM Tunica Mucosa , TMu Tunica Muscularis Externa , TS Tunica Submucosa , TSe Tunica Serosa (H&E stain x4)

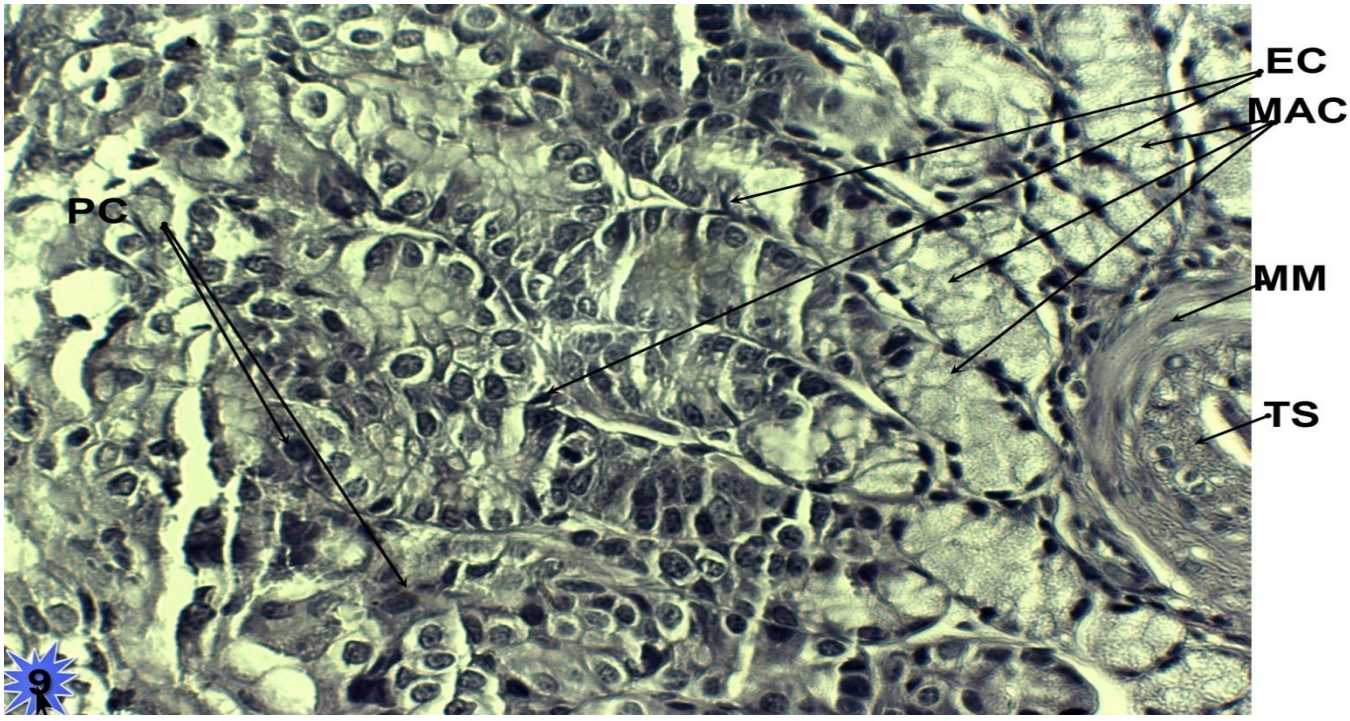

Fig.(9) The deeper pats of cardiac glands illustrates :
EC Enteroendocrine Cell , MAC Mucous Acinus Cell , MM Muscularis Mucosa , PC Parietal Cell , TS Tunica Submucosa . (H&E stain x40)

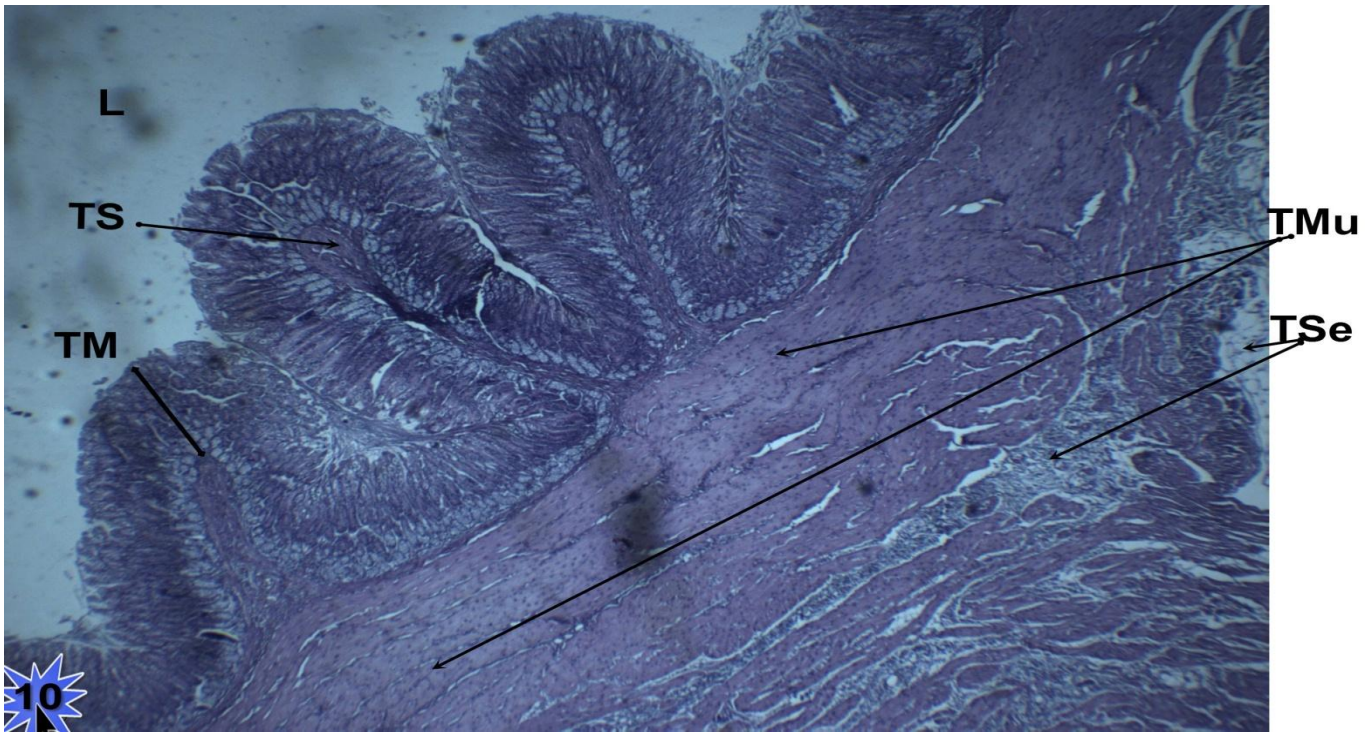

Fig.(10) Transverse section through the cardiac region type B illustrates :
L Lumen , TM Tunica Mucosa , TMu Tunica Muscularis Externa , TS Tunica Submucosa , TSe Tunica Serosa (H&E stain x4)

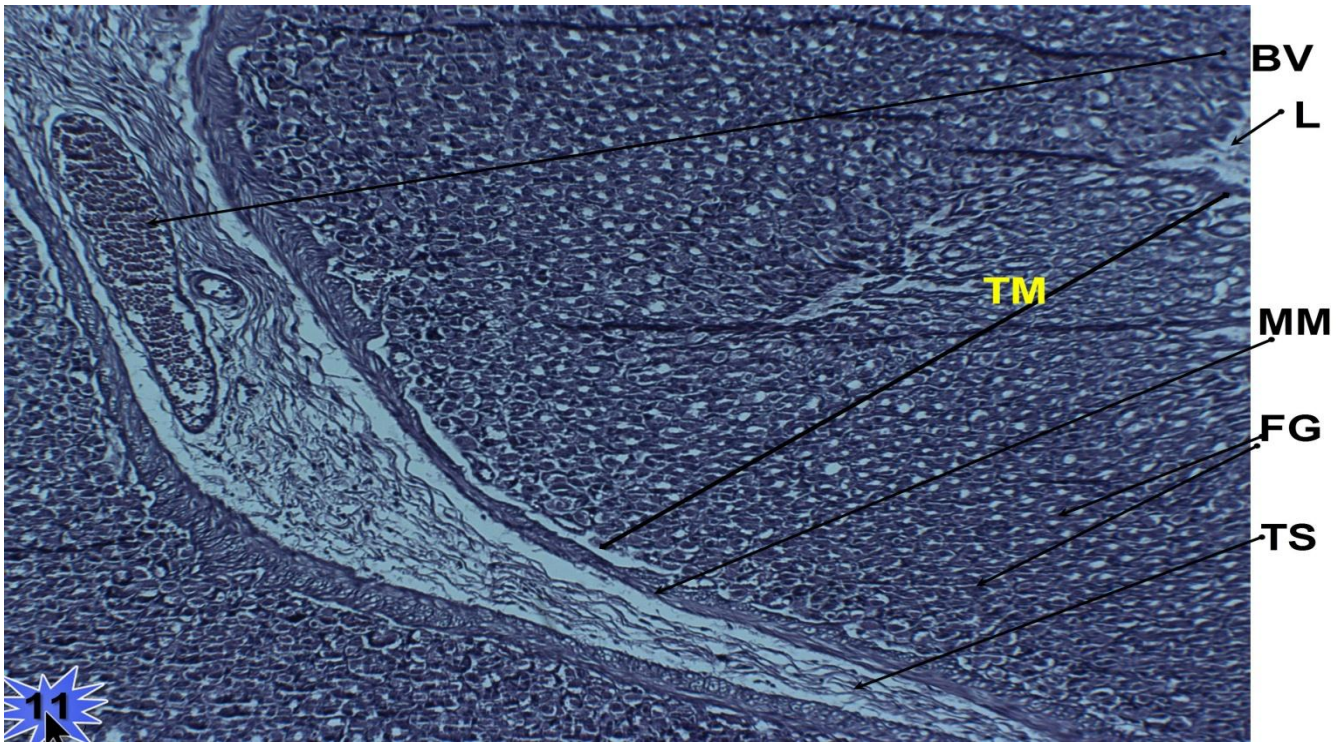

Fig.(11) Transverse section through the fundic region illustrates :
BV Blood Vessel , FG Fundic Gland , L Lumen , MM Muscularis Mucosa , TM Tunica Mucosa , TS Tunica Submucosa . (H&E stain x10)

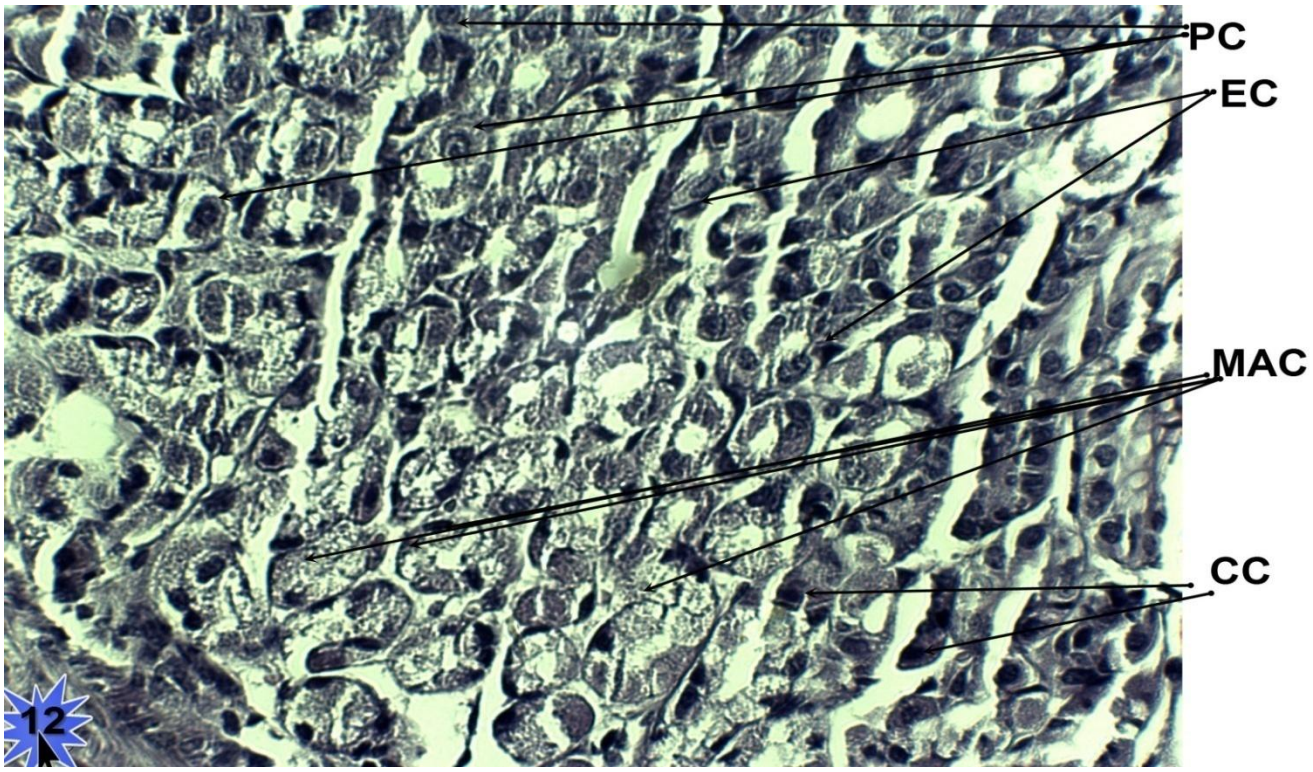

Fig.(12) Transverse section through the deeper pats of fundic region illustrates :
CC Chief Cell , EC Enteroendocrine Cell , MAC Mucous Acinus Cell , MM Muscularis Mucosa , PC Parietal Cell. (H&E stain x40)

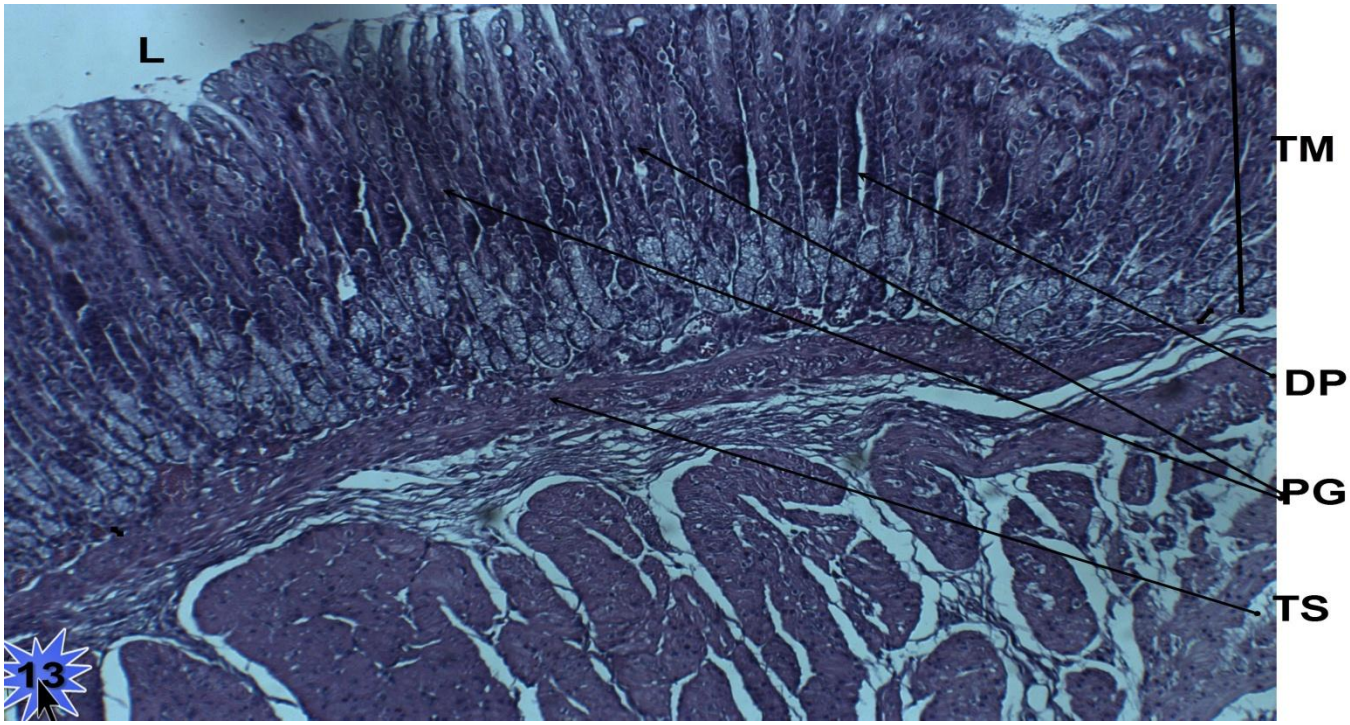

Fig.(13) Transverse section through the pyloric region illustrates :
DP Deep Pit , L Lumen , PG Pyloric Gland , TM Tunica Mucosa , TS Tunica Submucosa. (H&E stain x10)

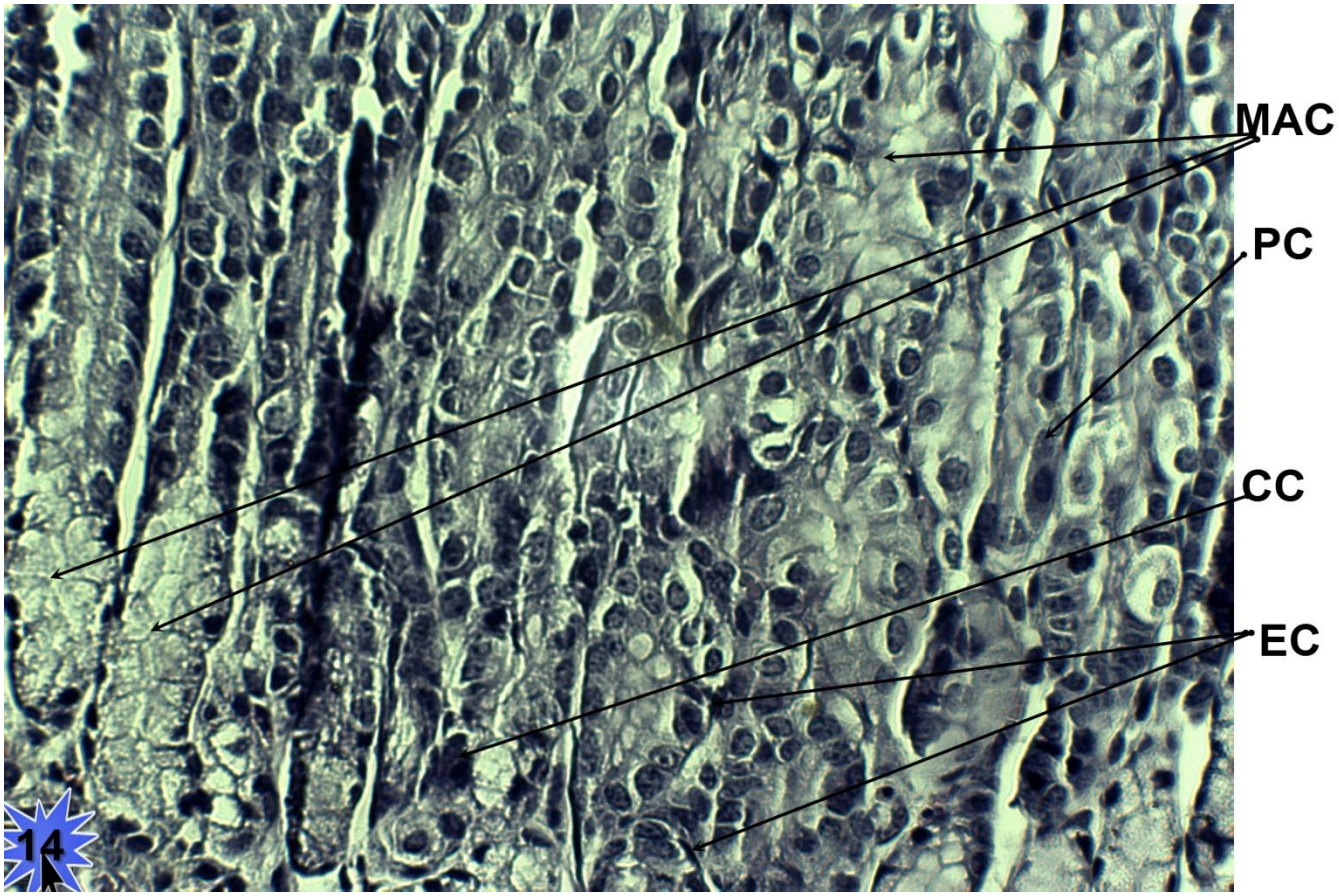

Fig.(14) Transverse section through the deeper pats of pyloric region illustrates :
CC Chief Cell , EC Enteroendocrine Cell , MAC Mucous Acinus Cell , PC Parietal Cell .(H&E stain x40).

References:-

1- Eric,W.(2009). Anatomy and physiology , the unity of form and function. The McGraw Hill Companies , Ch. 25 : PP. 1-31 .

2- Karali,T.T.(1995).Comparison of the gastrointestinal anatomy ,physiology and biochemistry of human and commonly used laboratory animals . Biopha and Dru. Dispo. , **16**: 351-380 .

3- Ofusori,D.A. and Martins,C.E.A.(2008). A comparative histomorphometric study of the stomach of Rat Rattus norvegicus , Bat Eidolon helvum and Dangolin Manis tricuspis in relation to diet . Ind. J. Morphol., **26(3)** :669-674.

4- Ghoshal,N.G. and Bal,H.S.(1989).Comparative morphology of the stomach of some laboratry mammals . Lab. Anim., **23** :21-29 .

5- Igbokwe,C.O. and Obinna, J. (2016).Oesophagal and gastric morphology of the african rope squirrel Funisciurus anerythrus (Thomas, 1890). J.of App. L. Sci. Intern. ,**4(2)** : 1-9 .

6- Scopin,A.E. ; Gashkova,I.V.; Saveljev, A.P. and Abramov,A.V.(2015).Histologic features of the gastrointestinal tract of Laonastes aenigmamns (Rodentia :Diatomyidae) .Verte. Zod., **65(1)** :151-163 .

7-Perrin,M.R. and Curtis,B.A. (1980).Comparative morphology of the digestive system of 19 species of South African myomorph rodents in relation to diet and evolution . S. Afr. J. Zool. , **15(1)** :22-33 .

8- Perrin, M.R. and Maddock , A.H. (1983). Anatomical and nutritional adaptation in african rodents . S. Afri. Anim. Sci., **13(1)** : 23-25.

9- Scopin,A.E. ; Saveljev, A.P. ; Suntsova, N.A.; Gnophanxay, S. and Tikhonov, A.N. (2011). Digestive system of the laotian rock rat Laonastes aenigmamua (Rodentia: Diatomyidae)from the evolutionary viewpoint. Proc. Of Zool. Insti., **315(1)** : 3-18 .

10- Musser, G.G. and Durden, L.A. (2002). Sulawesi rodents : description of a new Genus and species of Murinae (Muridae , Rodentia) and parasitic new species of sucking louse (Insecta , Anoplura) . Amer. Muse. of Natu. Hist., **3368** : 28-50.

11- Jaffe,K.E.(2009). Introduction to mammal taxonomy and evolution . Sonoma State University : PP. 1-100 .

12- httpi\\en,wikipedia .org\wiki\Guineapig (2008) .

13- Treuting,P.M. and Dintzis,S.M.(2012). Comparative anatomy and histology , 1st ed., Ch.3 . United State of America : PP.20-25.

14-Bancroft , J.D. ; Suvarna , K. and Layton , C. (2012). Bancrofts theory and practice of histological techniques, 7th ed. The Churchill Livingstone Edinburgh pp. 353-380 .

15- Todd , J.C. (1979). Clinical diagnosis by laboratory methods , Philadelphia, PAWB , Saunders Company : pp. 1-10

16- Laakkonen ,J. ; Kankaanpaa , T. ; Corfe, I.J. ; Jernvall, J. ; Soveri , T. ; Keovichit, K. and Hugot, J. (2014). Gastrointestinal and dental morphology of herbivorous mammals : where does the laotian rock rat fit . Ann. Zool. Fennici. **51**: 153-161 .

17-Walter,J. ; Marais,S. ; Johnson,O. ; Bennett, NC. ; Alagaili, AN. ; Mohammed , OB. and Kotze,SH. (2014).The comparative gastrointestinal morphology of five species of muroid rodents found in Saudi Arabia . J Morphol. **275(9)** : 980-990 .

18- Pardinas, U.F.J. : Lessa , G. ; Teta, P. ; Salazar-Bravo, J. and Camara, E.M.V.C. (2014) . A new genus of sigmodontine rodent from eastern Brazil and the origin of the tribe phyllotini . J. of Mamma. , **95(20)** : 201-215.

19- Wang,De.H. ; Pei,Ya. P. ; Yang,J.Ch. and Wang, Zu.W. (2003). Digestive tract morphology and food habits in six species of rodents . Folia. Zool., (5291) : 51-55 .

20- Berghes, C. ; Coman, T. ; Petrut, T. ; Parvu, M. and Damian, A. (2010). Contributions to the study of the esophagis and stomach morphology in laboratory Mouse . Bulle . Veter .Medic. **67 (1)** : 17-23.

21-Calamar,C.D. ; Patruica, S. ; Dumitrescu,G.; Bura,M.; Dunea,I.B. and Nicula,M.(2014). Morphhistological study of the digestive tract and the annex glands of Chinchilla laniger. Ani. Sci. And Biotech., **47(1)** : 269-274.

22- Borghesi,J. ; Mario, L.C. ; Carvalho, R.C. ; Rodrigues, M.N. ; Favavor, Ph. O. and Miglino, M.A.(2015). Morphology of the digestive apparatus in Oligoryzomys nigripes (Rodentia, Sigmodontinae). O.J.of Ani. Sci., **5**:132-141 .

23-Stan,F.(2013).Comparative study of the stomach morphology in rabbit and chinchilla. Agro.Sci. J. , **2(2)** : 73-78.

24- Bisaillon , A. and Bherer, J. (1979). Gross anatomy of the arterial supply of the stomach of the North American beaver Castor canadensis . Acta Anat. (Basel) , **104(1)** : 79-85 .

25-Moskalewski , S. ; Wawrzonek , D. B.; Klimkiewicz , J. and Zdun, R. (2002). Vessels involved in the venous outflow from glandular mucosa of hamster stomach . Folia. Morphol. , **61(2)** : 81-87.

26- Bisaillon , A. ; Grenier , A. and Bousquet , R. (2007). Arterial blood supply to the stomach of the Muskrat (Ondatra zibethicus) .Anat. Histol.Embryo. , 17 : 7-11.

27- Ozdermir, V. ; Demirkan , A.C. and Akosman , M.S. (2013). Subgross and investigation of the coeliac artery in the chinchilla chinchilla lanigera. Folia. Morphol. **72(3)** :258-262 .

28- Gartner,K.(2002).The forestomach of rats and mice , an effective device supporting digestive metabolism in muridae . J. of Exper. Ani. Sci. , **42(1)**: 1-20.

29- Chandana,G.S.S. ; Kishore,P.V.S.; Raju, N.K.B. ; Sreenu,M. and Rao,G.S.(2013). Histological studies on the stomach of Albino rat Rattus norvegicus .Ind. J. of Veter. Anat. , 25(2) :107-109 .

30- Nwafor, J.A. and Niabohs, F.A.(2014).Comparative histomorphological study of the Stomach of Rattus norvergicus ,Agama agama and Bufo marinus .Ann. of Bioanth. , **2(2)** : 54-58 .