

Histogenesis of the Abomasum in One-Humped Camel (*Camelus dromedarius*)

E. Salimi Naghani, I. Pousty and M. Abedi
Department of Veterinary Anatomy, Faculty of Veterinary Science,
Science and Research Branch, Islamic Azad University (IAU), Iran

Abstract: Histogenesis of the abomasum was studied in the one-humped camel (*Camelus dromedarius*). According to histodifferentiation of the abomasum in fetuses of the camel, they were divided into four groups: group I (5-24 cm Crown-Rump Length (C-RL); 50-140 days); group II (24-30 cm C-RL; 140-160 days); group III (30-36 cm C-RL; 160-178 days); group IV (36-108 cm C-RL; 178-390 days). At 50 days, the abomasum consisted of four layers: the epithelial layer (pseudostratified), lamina propria-submucosa, tunica muscularis and serosa. The muscularis mucosa was observed from 140 days between lamina propria and submucosa in the abomasum to the birth day. The primary lymphatic nodules appeared in lamina propria of cardiac region of the abomasum at 160 days. The epithelium of the abomasum was a mixture of simple columnar and pseudostratified at 176 days in the third group. The whole all epithelium was simple columnar in the last group. The abomasal folds in size, number and in thickness of tunica muscularis layer as well increased throughout prenatal life as the abomasum developed. However, its prenatal developing was later than the abomasum in cow, sheep and goat.

Key words: Histogenesis, abomasum, one-humped camel, muscularis mucosa, parental development

INTRODUCTION

The abomasum is the fourth and final gastric compartment of the ruminant stomach and is glandular portion, too. In contrast to the compound stomach of typical ruminants that comprised of four compartments, the camel's stomach has only three compartments. The first compartment is huge and saccular, the second, small kidney-shape and the third, tubular with its distal part slightly distended. The third compartment (abomasum) in the camel's stomach is glandular and the abomasum wall comprises of four tunics: mucosa, submucosa, muscularis and serosa (Abdel-Majied and Taha, 2003). This study on the histogenesis of camel's abomasum during prenatal development is as a continuation of the studies carried out on the development of the abomasum of ruminants during intra uterine life. The aim of this study was to provide a sequential description of the histology of camel's abomasum during fetal stage until the birth day.

MATERIALS AND METHODS

The present study was carried out on 33 fetuses of the one-humped camel, which were collected from the slaughterhouses in Yazd Province, Iran. After measuring the Crown-Rump Length (C-RL) for determining the age of

fetuses, they were collected and fixed in 10% formalin and ranged from 50-110 cm Crown-Rump Length (C-RL, approximately 50-392 days of gestation). The fetuses were fixed in 10% formalin for 1-2 week (sec). After fixing in formalin, the abomasums were separated and small pieces of the tissue of abomasums were dissected from the cardiac, fundic and pyloric regions of the abomasum of each fetus. The specimens of the regions were dehydrated in graded alcohol series, cleared in methyle benzoate, embedded in parafin and 5 µm thick sections were cut with microtome. The sections were prepared and stained with Haematoxylin and Eosin (HandE) stain for histological studies. The stained sections were examined under light microscope (Pousty and Adibmoradi, 2006).

RESULTS AND DISCUSSION

The abomasum was histologically differentiated into four stages during prenatal development of the camel. The fetuses of the camel were divided in four groups according to histodifferentiation of the abomasum in the fetuses:

Group I: 5-24 cm C-RL; 50-140 days of gestation

In this group, the abomasal wall consisted of four layers: epithelial layer, lamina propria-submucosa, tunica



Fig. 1: Photomicrograph of transversal section of the abomasal wall at 5 cm C-RL. Epithelium (ep), lamina propria-submucosa (ls), internal (circular) layer of tunica muscularis (arrow), external (longitudinal) layer of tunica muscularis, serosa (se) 120x



Fig. 3: Photomicrograph of transversal section of the abomasal wall at 30 cm C-RL. Epithelium (ep), primary lymphatic nodule (arrow) 150x



Fig. 2: Photomicrograph of transversal section of the abomasal wall at 24 cm C-RL. Muscularis mucosa (arrow), internal (circular) layer of tunica muscularis (tm1), external (longitudinal) layer of tunica muscularis, (tm2) 82x

muscularis and serosa. The epithelial layer was pseudostratified and located on a basal lamina. The surface of the abomasum began to display a series of undulations, representing the first outlines of the abomasal folds. In this group, these folds that were not numerous increased as the abomasum developed. The lamina propria-submucosal layer was separated from the epithelium by a clearly defined basal lamina and was formed by connective tissue with mesenchymal or

undifferentiated cells and extracellular matrix. The tissue entered into the primitive abomasal folds. At 45 days of gestation, the tunica muscularis composed in two layers of myoblasts an internal circular layer and an external longitudinal layer. The internal circular layer wasn't complete in this group. The serosa was formed by a subserosa that was covered by a mesothelium (Fig. 1).

Group II: 24-30 cm C-RL; 140-160 days of gestation

The abomasal wall in this group was made of four layers: mucosa, submucosa, tunica muscularis and serosa. Mucosa was formed by the epithelial, lamina propria and muscularis mucosa. The epithelia cells were pseudostratified, the lamina propria and submucosa were formed by connective tissue with mesenchymal and a large amount of fibroblasts.

From 140 days to the birth day, the submucosa was separated from the lamina propria by the muscularis mucosa. The muscularis mucosa consists of two, three and more cells of smooth muscle originating from the internal circular layer of the tunica muscularis and protruding into the greater folds (Fig. 2). At 160 days, the lamina propria in cardia region of abomasum appeared the primary lymphatic nodules which contained many lymphocytes. The lymphatic nodules were observed at 160 days to the birth time in the lamina propria of cardia region (Fig. 3).

The tunica muscularis, as in the previous stage, consisted of two layers. The serosa had a loose connective tissue that had been covered by a mesothelium and was observed an intense vascularization in this stage.

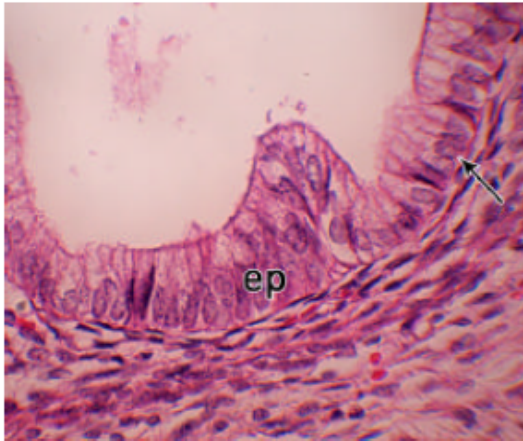


Fig. 4: Photomicrograph of transversal section of the abomasal wall at 36 cm C-RL. Epithelium (ep), simple columnar cells (arrow) 440x

Group III: 30-36 cm C-RL; 160-178 days of gestation

The abomasal folds were increased more than the previous groups. The epithelial cells of the mucosa was a mixture of the simple columnar cells and pseudostratified at 178 days (Fig. 4). The simple columnar cell with nuclei were arranged along the basal or middle of the cells.

The lamina propria and the submucosa were formed by loose connective tissue with an amount larger than blood vessel from the previous group. The submucosa was separated from the lamina propria, the same as the previous group by the muscularis mucosa.

The tunica muscularis consisted of external (longitudinal) and internal (circular) layers and an (oblique) smooth muscle layer inside the circular layer have been observed. The connective tissue was absent between the oblique and the circular layer of the tunica muscularis. Such this reason, the oblique layer wasn't distinguished from the internal circular layer. The internal circular layer of the tunica muscularis in pyloric region of the abomasum had greater thickness than the other regions. The serosa did not show significant variation with respect to the previous group.

Group IV: 36-108 cm; 178-390 days of gestation

In this group, the abomasal folds in comparison with the previous groups showed a strang increase in size and number. The epithelial of the mucosa was formed by the simple columnar cells and the lamina propria was separated from the submucosa by the muscularis mucosa which appeared better than the previous groups (Fig. 5). The vascularization of this layer was greater than the

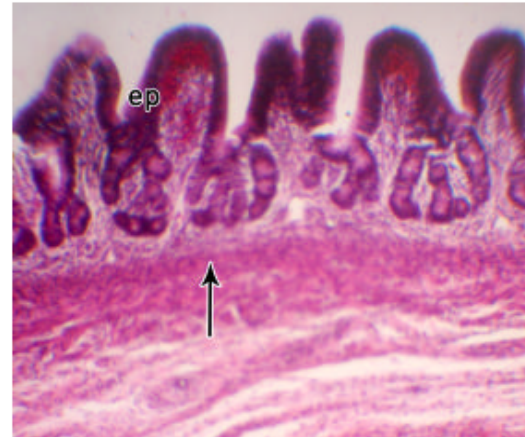


Fig. 5: Photomicrograph of transversal section of the abomasal wall at 108 cm C-RL. Epithelium (ep), muscularis mucosa (arrow) 65x

previous groups. The tunica muscularis was observed by clearly defined bundles arranged in the manner commonly found in the digestive system as a whole and the serosa in comparison with previous groups shown intense vascularization.

In 178 days to birth, the epithelial of the mucosa of abomasum was covered by simple columnar cells. This important modification has been reported in cow at 87 days of gestation (Asari *et al.*, 1985) and 73 days of gestation (Vivo *et al.*, 1990), in sheep at 65 days of gestation (Franco *et al.*, 1993).

The lymphatic nodules were shown in cardia region of abomasum from 160 days of gestation until the birth day. These instructions are absent in the stomach of the ruminants (Alzo *et al.*, 2004).

The muscularis mucosa was formed by longitudinal projection of the internal circular bundle of the tunica muscularis that was placed between the lamina propria and submucosa. It was estimated at around 140 days of gestation in camel. In the ruminants, the appearance was placed in perinatal stages in buffalo (Panchamuki and Srivastava, 1980) and in sheep at approximately 114 days of gestation (Franco *et al.*, 1993) or during postnatal development (Kitamura *et al.*, 2003).

The tunica muscularis containing of two layers: longitudinal and circular layers that were arranged by myoblasts. In the prenatal development of the abomasum of sheep, its appearance is described at 33 days (Duncan and Phillison, 1955; Franco *et al.*, 1993) and at 50 days (Fath-E1-Bab *et al.*, 1983). The serosa, meanwhile, showed continuity in growth as well as differentiation. About 140 days an intense vascularization was apparent.

CONCLUSION

We can deduce from the findings that the fetuses of the camel are less precocious than small and large domestic ruminants. As well, the presence of the lymphatic nodules in cardiac region of the abomasum did show a high level immunity in the camel's abomasum in comparing with ruminants.

ACKNOWLEDGEMENT

The researchers thank gratefully the kind help of Dr. Gholami.

REFERENCES

- Abdel-Majied, E.M. and A.A.M. Taha, 2003. Morphological, morphometric and histochemical characterization of the gastric mucosa of the camel (*camelus dromedaries*). *Anat. Histol. Embryol.*, 32: 42-47.
- Alzo, R.H., M.D. Ghezzi and M.C. Lupido, 2004. Topography and morphology of the llama (*lama gama*) stomach. *Int. J. Morphol.*, 22: 155-164.
- Asari, M., H. Oshige, S. Wakui, K. Fukaya and Y. Kano, 1985. Histological development of bovine abomasum. *Anat. Anz.*, 159: 1-11.
- Duncan, D.L. and A.T. Phillison, 1955. The development of motorresponses in the stomach of the foetal sheep. *J. Exp. Biol.*, 28: 32-40.
- Fath-El-Bab, M.R., R. Schwarz and A.M. Ali, 1983. Micromorphological studies on the stomach of sheep during prenatal life. *Anat. Histol. Embryol.*, 12: 139-153.
- Franco, A., A. Robina, M.T. Guillen, A.I. Mayoral and E. Redondo, 1993. Histomorphometric analysis of the abomasum of sheep during development. *Ann. Anat.*, 175: 119-125.
- Kitamura, N., A. Yoshiki, M. Sasaki, E.T. Baltazar, E. Hondo, Y. Yamamoto, S. Agungpriyono and J. Yamada, 2003. Immunohistochemical evaluation of the muscularis mucosa in the ruminant forestomach. *Anat. Histol. Embryol.*, 32: 175-178.
- Panchamuki, B.G. and H.C. Srivastava, 1980. Histogenesis of the reticulum of the buffalo (*Bulbalus bubalus*) stomach. *Indian J. Anim. Sci.*, 50: 1064-1070.
- Pousty, I. and M. Adibmoradi, 2006. *Histotechnique*. University of Tehran Press, Iran, pp: 34-50.
- Vivo, J.M., A. Robina, S. Regodón, M.T. Guillén, A. Franco and A.I. Mayoral, 1990. Histogenetic evolution of bovine gastric compartments during prenatal period. *Histol. Histopathol.*, 5: 461-476.