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Histometric Study of the Third Compartment in One-Humped Camel (*Camelus dromedarius*) During Prenatal Development

E. Salimi Naghani

Department of Veterinary Anatomy, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran

Abstract: Histometric study of the third compartment in one-humped camel (*camelus dromedaries*) was carried out on 66 fetuses from the initial stages of fetal period until birth. They were divided into four groups: group I (5-24cm crown-rump length (C-RL); 86-137 days); group II (25-29cm C-RL; 140-158 days); group III (30-35 cm C-RL; 160-175 days); group IV (36-108 cm CR-L; 178-390 days). In the organogenesis of the primitive gastric tube of one-humped camel, differentiation of the third compartment took place at 86 days, containing a four-layer structure: the epithelial layer (pesudostratified), pluripotential blastemic tissue, primitive tunica muscularis and serosa. The epithelial layer in group III was simple columnar and its thickness decreased in the groups of fetuses gradually. The pluripotential blastemic tissue, at 140 days, was differentiated to the lamina propria and the submucosa. The thickness of the lamina propria and the submucosa decreased in next groups. The tunica muscularis was consisted of two layers of myoblasts at 140 days and its thickness increased in next group and the final fetal period decreased. The serosa showed continuity in thickness as well as differentiation and formed a connective tissue with mesothelium layer in all groups. With advanving of age, the thickness of the wall of the third compartment in one-humped camel gradually decreased that is similar to the ruminant. Our observation revealed that the fetus of one-humped camel is less precocious than the small and large domestic ruminants.

Key words: Histometric · Prenatal development · One-Humped camel · The third compartment

INTRODUCTION

The stomach of the camel differs from the stomach of ruminant such as the bovine, in that it comprises three compartments. The third compartment consisted of wide cardiac glands, narrow gastric glands and pyloric glands [1]. Abdel-Majied and Taha [2] considered the third compartment of the dromedarian camel to be divided into three region; they regarded the first region is similar to cardiac region of other ruminants with thick mucosal layer and deep pits. They reported the second region is thick mucosal layer such as the gastric pits and so the third region of the third compartment is thick mucosal layer and the gastric pits are deeper than else where. The pyloric region of the third compartment in one-humped camel shows the histological and histochemical characteristics of pyloric region of other ruminants [3].

Histometric characterization of the third compartment in one-humped camel (*camelus dromedarius*) during prenatal development has not been studied. It is anticipated that this will constitute histometrical basis essential for a better understanding of the gastric development in camel.

MATERIALS AND METHODS

Camel fetuses (n=66) from the initial fetal stages until birth were studied. The specimens were collected from the slaughterhouse in semi-desert provinces of Iran. After measuring the crown-rump length (C-RL) for determining the age of fetuses, small pieces of tissue were dissected from the cardiac, fundic and pyloric region of the third compartment of each camel fetus. The specimens were fixed in %10 formalin for 1-2 week (s). They were dehydrated in graded alchol series, cleared in methyle benzoate, embedded in parafine and 5-μm-thick section were cut with microtom. The sections were treated with haematoxylin and eosin (H&E) stain for histometric studies [4]. The specimens for histometric analysis were viewed through a microscope (Optiphot, Nikon inc; Tokyo, Japan) equipped with a video camera. The images were reflected onto the screen of a semi-automatic image

Corresponding Author: Ehsan salimi naghani, Department of Veterinary Anatomy, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran.
Tel: +98-871-6387117, E-mail: vet_anatomy@iausdj.ac.ir.

analyzer. The variables studies were height of various tissue strata (epithelium, lamina propria, submucosa, tunica muscularis and serosa) and total wall thickness. The results are shown as the mean±SE. the data were analysed using analysis of variance. A value of P=0.05 was considered significant.

RESULTS

The third compartment was histologicaly 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 third compartment in the fetuses:

Group I (5-24cm C-RL; 86-137 days of gestation)

Histodifferentiation of the third compartment took place at 86 days of prenatal development. The wall of the third compartment (305±17µm) displayed a series of small undulations (the primitive fold of the third compartment). There were four layers: the epithelial layer, pluripotential blastemic tissue, primitive tunica muscularis and serosa. The epithelial layer (63±3µm) was pesudostratified (Fig.1). The pluripotential blastemic tissue (173±9µm) was separated from the epithelium by a clearly defined basal lamina. At 86 days of gestation, the tunica muscularis (30±82µm) composed in two layers of myoblasts: an internal circular layer and an external longitudinal layer. The tunica muscularis wasn't complete in this group (Fig.1). The serosa (39±60µm) was formed by a subserosa that was covered by a mesothelium.

Group II (25-29 cm C-RL; 140-158 days of gestation)

The wall of the epithelium was 295±8µm and made of four layers: mucosa, submucosa, tunica muscularis and serosa. The epithelial layer of the mucosa (57±12µm) was pesudostratified. The lamina propria (40±32µm) and submucosa layers (72±22µm) were formed by connective tissue with mesenchymal and large a mount fibroblasts that separated from together by the muscularis mucosa (Fig.2). The muscularis mucosa origination from the internal layer of the tunica muscularis and protruded into the greater fold. The tunica muscularis (88±32µm) was consisted of two layers of smooth muscle cells. The serosa (31±23µm) had a loose connective tissue that had been covered by a mesothelium and was observed an intense vascularization in this stage.

Table 1: Histometric data of the mean ± SE thickness of the third compartment layer in one-humped camel fetuses (µm)

CR-L (cm)	5-24	25-29	30-35	36-108
Age (day)	86-137	140-158	160-175	178-390
Epithelium	63±3[1]	57±12[1]	47±33	36±28
Lamina propria	pbt[2]	40±32	37±19	20±67
Submucosa	pbt[2]	72±22	70±42	62±57
Tunica muscularis	30±82	88±32	97±56	85±24
Tunica serosa	39±60	31±23	29±52	23±14
Wall thickness	305±17	295±8	280±45	226±36

1: Pesudostratified epithelium

2: LP+ Sub mucosa (pluripotential blastemic tissue)

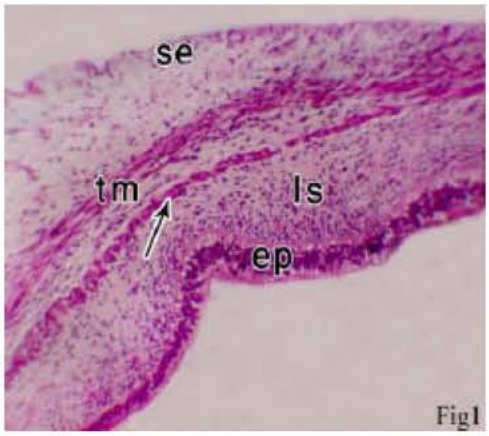

Fig. 1: Photomicrograph of a section of the third compartment at 86 days. Present pesudostratified epithelium (ep), lamina propria + submucosa (ls), tunica muscularis (longitodinal) (tm), circular (arrow) and tunica serosa (se). H-E, 120X.

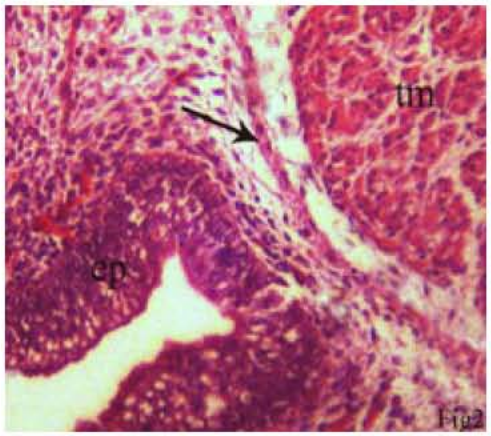

Fig. 2: Photomicrograph of asection of the third compartment at 140 days. Present pesudostratified epithelium (ep), muscularis mucosa (arrow) and tunica muscularis (tm). H-E, 150X.

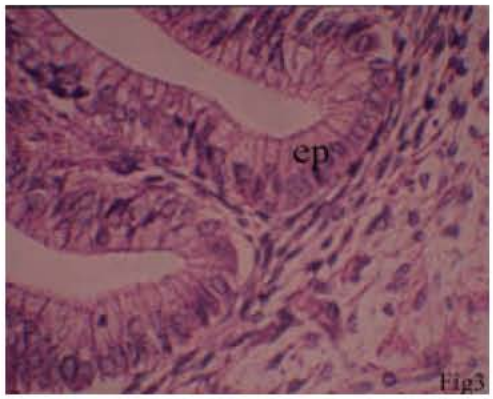

Fig. 3: Photomicrograph of asection of the third compartment at 175 days. Present pesudostratified and columnar epithelium (mixed) (ep). H-E, 440X.

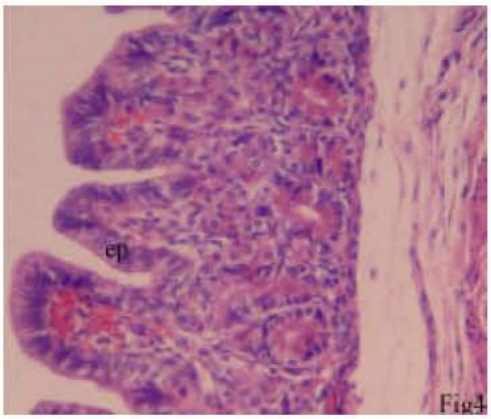

Fig. 4: Photomicrograph of asection of the third compartment at 340 days. Present columnar epithelium (ep). H-E, 180X.

Group III (30-35 cm C-RL; 160-175 days of gestation)

The wall of the third compartment showed five layers: mucosa, lamina propria, submucosa, tunica muscularis and serosa. The thickness of their compartment wall was 280±45 µm. The epithelial layer (47±33µm) of the mucosa was a mixture of the simple columnar cells and pesudostratified at 175 days. The lamina propria (37±19µm) and submucosa (70±42µm) were formed by loose connective tissue and separated by the muscularis mucosa. The tunica muscularis (97±56µm) consisted of external (longitodinal) and internal (circular) layers and an (oblique) inside the circular layer have been observed (Fig.3). The pyloric region of the third compartment had greater thickness than the other regions. The serosa (29±52µm) had a loose connective tissue that had been covered by a mesothelium and was observed an intense vascularization in this group.

Group IV (36-108 cm C-RL; 178-390 days of gestation)

The wall of the third compartment in this group was 226±36µm. The epithelial layer (36±28µm) was formed by the simple columnar cells (Fig.4). The lamina propria (20±67µm) was separated from the submucosa (62±57µm) by the muscularis mucosa which appeared better than the previous groups. The tunica muscularis (85±24µm) was observed by clearly defined bundles arranged in the manner commonly found in the digestive system as a whole. The serosa (23±14µm) did not show significant variation with the previous group.

DISCUSSION

Some studies showed the third compartment of camel to be same of the abomasum in ruminant [5]. The organogenesis of the third compartment in one-humped camel took place at 86 days of gestation (5 cm C-RL) and forming a three layered structure consisting of an epithelial layer, pluripotential blastemic tissue and tunica serosa. In comparison with the abomasum of the typical ruminant, the third compartment differentiation occurred later [6]. In cow, the organogenesis of the abomasum placed at 30 days of prenatal development [7]; in goat, placed at 28 days [8] and in sheep, abomasal differentiation was observed by Franco *et al*. [9] at 33 days of embryonic development.

The wall of the third compartment in size and number of the folds increased as the third compartment developed. At this early stage of development, 86 daysuntil 158 days of gestation, the epithelial layer was pseudostratified and at 160 days until to birth, the epithelial layer of the third compartment was observed characteristics of glandular structure. At 175 days, the epithelial layer was consisted of the columnar cell with a nuclear in basal of cytoplasmic area. The thickness of the epithelial layer, during prenatal development was decreased that similar of the ruminant. In sheep and goat [9-11]; and in cow, Vivo *et al*. [7] observed and reported in these researches.

The tunica muscularis was completed in group II (25-29 cm C-RL; 140-158 days of gestation) and its thickness increased in next groups. The thickness of the tunica muscularis in pyloric region was greater than from the other region of the third compartment. The tunica muscularis containing of two layers: longitudinal and circular layer that arranged by myoblasts. Its appearance is reported by other author during prenatal life in sheep;

Franco *et al.* [9] placed it at 50 days of prenatal life. Adjacent to the epithelial layer of the third compartment, two layers developing from the pluripotential blastemic tissue – the lamina propria and submucosa- were differentiated of 140 days until the birth. In sheep, [9, 12] placed it at 53 days of prenatal development and in cow, Vivo *et al.* [7] placed it at 50 days. The thickness of the lamina propria and submucosa were decreased. This has been previously been reported by Franco *et al.* [9] during the prenatal life of sheep. During fetal development in camel, the connective tissue underwent regression in its growth due primarily to the expansion of the structures between which the epithelial layer internally and externally the tunica muscularis are situated. The serosa, showed continuity in growth as well as in differentiation and in its thickness decreased during prenatal development. This has been described in sheep by Franco *et al.* [9] and Wardrop [12]. Results indicate that fetal development in the third compartment of one-humped camel is less precocious than the small and large domestic ruminants, because of that the period of gestation in camel longer than the typical ruminants. This has been reported by other authors; during gestation in sheep [9,10] in goat [11] and in cow [7,13].

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