

# Gross anatomy of the intestine and their peritoneal folds in the chinchilla (*Chinchilla lanigera*)

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## Abstract

The species belonging to the order Rodentia have great noticeable differences in their intestinal anatomy, particularly in the cecum and ascending colon. The anatomy of the intestines and its their mesenteries of *Chinchilla lanigera* have not been completely described. In the present study, ten adult *Chinchilla lanigera* were studied using gross dissection. The small intestine was divided into duodenum, jejunum and ileum as usual. The duodenum started at the pylorus with a cranial portion, which dilated forming a duodenal ampulla. The ileum was very short and attached to the coiled cecum by means of the iliocecal fold. The ascending colon presented three parts. The first one, starting from the cecum and attached to it by the cecocolic fold presented sacculations on its external part. This could be named proximal loop (Ansa proximalis coli), having two parts, a proximal and distal one. The second part of the ascending colon was simple (Pars intermedia). The last part of the ascending colon (Ansa distalis coli) extended from the intermediate part to the right colic flexure. The distal ansa was formed by two parts parallel to each other and joined by an apical flexure and the ascending mesocolon. The descending duodenum was fixed to the pars intermedia of the ascending colon by a peritoneal fold named accessory duodenocolic fold. The ascending duodenum was fixed by the duodenocolic fold to the descending colon. This study indicates that there are minor differences in the divisions of the intestine and their peritoneal folds, as it usually happens when comparing other rodents.

**Keywords:** rodentia, digestive system, abdominal organs, mesentery.

## 1 Introduction

The digestive anatomy has been studied in only a few species of the order Rodentia. Previous studies demonstrate that species belonging to the order Rodentia have great differences in their intestinal anatomy (BONFERT, 1928; SNIPES, 1979a,b; PERRIN and CURTIS, 1980; SNIPES, 1981, 1982a,b; SNIPES, HÖRNICKE, BJÖRNHAG et al., 1988; SNIPES, NEVO and SUST, 1990; NIETERS, SCHNORR and KRESSIN, 2003; KOTZE, VAN DER MERWE and O'RIAIN, 2006; PÉREZ, LIMA and BIELLI, 2008, PÉREZ, LIMA, MACHADO et al., 2009). Especially the cecum and ascending colon shows large differences among rodent species.

There is no consensus on the anatomical nomenclature for this species. The description of the anatomy of the digestive organs and the mesentery of the rodents requires concise definitions, particularly regarded to the divisions of the intestine. Pérez, Möller and Martin (2005, 2007) have described the divisions of the intestine and the peritoneal folds of the *Oryctolagus cuniculus*, and recently the intestine and peritoneal folds of the nutria (PÉREZ, LIMA and BIELLI, 2008) and *Ctenomys pearsoni* (PÉREZ, LIMA, MACHADO et al., 2009).

The objective of this work is to give a complete and detailed description of the anatomy of the intestine of the chinchilla, including its length and its mesentery, with a defined nomenclature, in order to improve the existing knowledge on these species.

## 2 Material and methods

The study was carried out using 10 healthy adult chinchillas (6 females and 4 males). They were euthanized with an overdose of ketamine administered intramuscularly. All animals were weighed and promptly dissected fresh, without fixation. The ventral abdominal wall of each animal was removed and after the observation of the topography of the organs and the peritoneal folds, the intestinal tract was separated after sectioning the pylorus just before the duodenum, and separating it from its attachments to the dorsal abdominal wall. The rectum was tied off at its union with the canal anal and transected. After removal of all mesenteric attachments, the lengths of the different sections of the intestinal tract on the anti-mesenteric side were taken with a standard measuring tape. Stomach and intestine contents were measured by weighing the unopened organs and re-weighing it after been opened and contents were rinsed with tap water and dried with paper towels. The results were recorded and tabulated. Pictures were taken with a Nikon D 80 digital camera. Terms were used in agreement with the NAV (INTERNATIONAL..., 2005).

## 3 Results

### 3.1 Divisions of the intestine

The body weight and measurements from the individual intestinal sections are presented in Table 1.

**Table 1.** Corporal length, body weight and lengths of the stomach and intestinal parts in the *Chinchilla*.

Animal number	1	2	3	4	5	6	7	8	9	10
Sex	M	M	F	F	F	F	F	F	F	F
Body weight (g)	520	460	640	580	660	640	600	680	760	660
Lenght stomach C Major (cm)	11.2	12.7	13.6	16.3	19	14.5	14.5	15	17.5	16.2
Lenght stomach C Minor (cm)	2.5	2.3	3	2.5	2.6	1.5	2.1	2.3	2.1	2.4
Small intestine lenght (cm)	122.5	141	131.1	142	150	142.3	146	152	156.2	192
Caecum lenght (cm)	17	20.5	14	13.5	12.5	16.1	13.5	13.5	16.5	15.7
Ascending colon lenght (cm)	76.5	76.1	100	85	85	90.5	89.7	94	104.5	97.6
Rest of the colon and rectum lenght (cm)	84.4	98.2	103	82	96	105	113.7	112.6	141	115
Weight stomach full (g)	13.7	18.75	13.87	14.3	19.93	11.59	14.84	10.68	23.47	21.11
Weigth stomach empty (g)	7.17	5.4	3.54	3.68	5.8	3.3	6.16	5.15	8.3	5.47
Weight small intestine full (g)	16	12.1	12.34	14.33	17.4	10.08	13.21	11.28	15.08	17.98
Weight small intestine empty (g)	7.4	5.27	5.05	4.85	8.2	4.13	6.11	4.32	9.83	13.4
Weight caecum full (g)	20	21.74	15.75	22.72	30.38	20.58	15.41	24.67	25.25	33.33
Weight caecum empty (g)	3.77	4.11	2.94	3.33	3.29	4.77	3.53	4.78	5.47	9
Weight ascending colon full (g)	24.7	16.65	18.36	20.02	22.45	12.39	20.3	16.75	19.37	16.72
Weight ascending colon empty (g)	9.3	5.07	6.1	6.14	6.42	5.98	7.35	6.38	10.19	6.6
Rest of the colon and rectum full weight (g)	11.23	7.04	5.17	4.9	10.05	4.21	6.08	8.84	8.15	11.2
Rest of the colon and rectum empty weight (g)	5.63	2.38	2.43	1.78	3.53	1.87	3.29	3.51	4.13	3.32

The small intestine was divided into duodenum, jejunum and ileum. The duodenum started at the pylorus with a cranial, dilated portion, directed to the right and forming a duodenal ampulla. The following portions of the duodenum were the cranial flexure and the descending duodenum that ended at the caudal flexure. From the caudal flexure the duodenum goes cranially as the ascending portion.

The jejunum followed up to the beginning of the ileocecal fold. The ileum was very short.

The abdominal part of the large intestine was divided in ascending colon, transverse colon and descending colon. The cecum and the ascending colon were the most voluminous sections of the intestine of the chinchilla (Figures 1 and 2). The cecum had a coiled proximal part composed of the base and the body, and an elongated distal part that ended at the apex.

The ascending colon was mostly situated on the right side of the abdominal cavity and presented three parts (Figures 1 and 2). The first one, starting from the cecum and attached to it by the cecocolic fold presented sacculations on its external part. This could be named proximal loop (Ansa proximalis coli), having two parts, proximal and distal. The second part of the ascending colon was simple (Pars intermedia) and run from left to right side of abdomen. The last part of the ascending colon (Ansa distalis coli) extended from the intermediate part to the right colic flexure. The distal ansa was formed by two parts parallel to each other and joined by an apical flexure and the ascending mesocolon. The transverse colon was continued at the left flexure of the colon by the descending colon. The descending colon formed numerous circunvolutions from the left flexure of the colon, until it continued with the rectum, at the left side of the ascending duodenum.

In accordance to what we observed and to the criteria of the NAV, we made the following list of anatomic terms for the intestine of the *Chinchilla lanigera*:

### Intestinum Tenue

#### Duodenum

Pars cranialis

Ampulla cranialis

Flexura duodeni cranialis

Pars descendens

Flexura duodeni caudalis

Pars ascendens

#### Jejunum

#### Ileum

### Intestinum Crassum

#### Cecum [Caecum]

Basis ceci [caeci]

Corpus ceci [caeci]

Apex ceci [caeci]

Curvatura ceci [caeci] major

Curvatura ceci [caeci] minor

#### Colon

##### Colon ascendens

Ansa proximalis coli

Pars intermedia

Ansa distalis coli

##### Flexura coli dextra

##### Colon transversum

##### Flexura coli sinistra

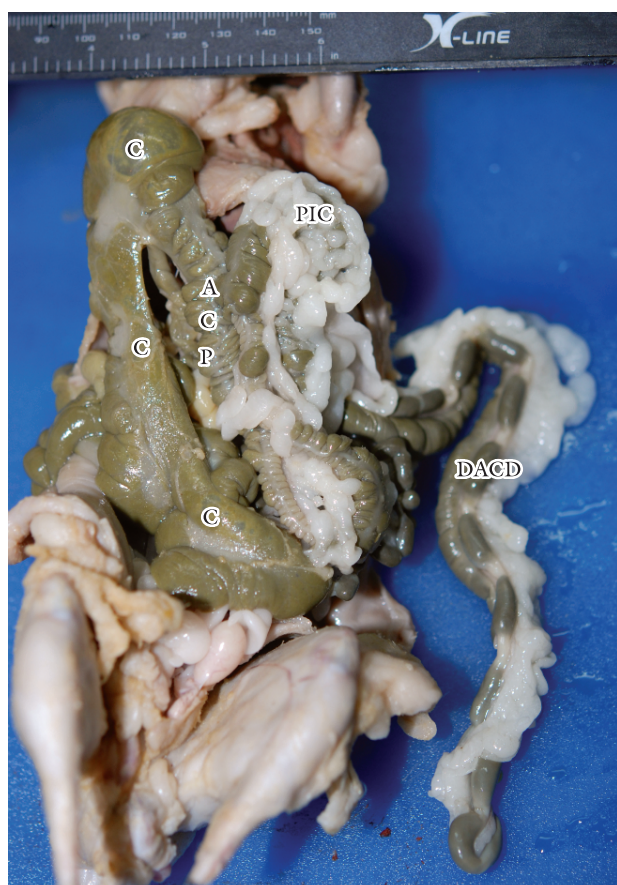
##### Colon descendens

##### Rectum

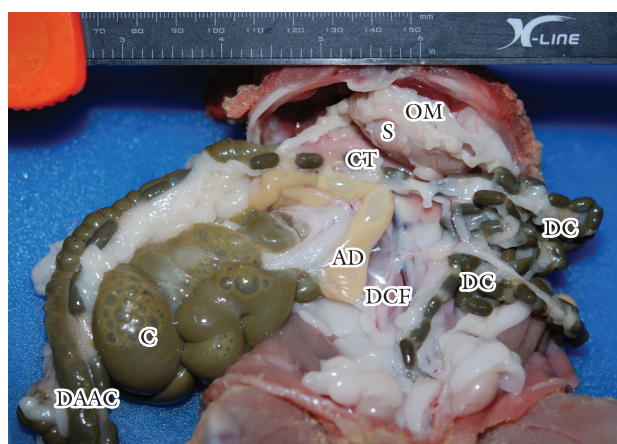
### 3.2 Mesentery and peritoneal folds of the intestine

The duodenum was sustained by the mesoduodenum, with the pancreas being included in the mesoduodenum and in the deep wall of the greater omentum.

The jejunum was sustained by the mesojejunum, which contained the jejunal vessels between its sheets. The ileum was attached to the cecum by the ileocecal fold.



**Figure 1.** Ventral view of the abdominal organs of the *Chinchilla lanigera*. C: cecum; ACP: ansa proximalis coli; PIC: pars intermedia; DACD: ansa distalis coli.



**Figure 2.** Ventral view of the abdominal organs of the *Chinchilla lanigera*. C: cecum; CT: transverse colon; DC: descending colon; S and OM: stomach and omentum; AD: ascending duodenum; DCF: duodenocolic fold.

The descending duodenum was fixed to the intermediate part of the ascending colon by a peritoneal fold named accessory duodenocolic fold. The ascending duodenum was fixed by the duodenocolic fold to the descending colon (Figure 2).

In all examined animals, the ascending mesocolon was large. The ascending mesocolon, which linked both parts of the ansa of the ascending colon was very narrow, especially between ansa proximalis and distalis, but very long in the pars intermedia.

The greater omentum was attached to the transverse colon, which in turn, was attached to the mesoduodenum. The transverse mesocolon was wide. The descending colon was held by a wide mesentery and by the duodenocolic fold.

## 4 Discussion

According to our knowledge, this is the most detailed anatomical description of the intestinal tract and the mesenteric folds of the *Chinchilla lanigera* reported until now.

Comparing the rabbit (BARONE, 1997) and the chinchilla, we found that the duodenal ampulla is much more evident in the – chinchilla, very similar to our findings in the tucu-tucu (PÉREZ, LIMA, MACHADO et al., 2009). On the other hand the ileal ampulla or sacculus rotundus, the last portion of the ileum that is markedly extended in the rabbit (BARONE, 1997), absent in the chinchilla.

In the rabbit, the ileum, cecum and a part of the ascending colon are coiled together forming a spiral with one and a half loops (BARONE, 1997). However, in the chinchilla, the cecum, ileum and the ascending colon were separated.

The cecum of rodents has been divided into ampulla ceci (Basis ceci), corpus ceci and apex ceci (SNIPES, 1979a,b; PERRIN and CURTIS, 1980; SNIPES, 1981, 1982a,b; SNIPES, HÖRNICKE, BJÖRNHAG et al., 1988; SNIPES, NEVO and SUST, 1990). In the chinchilla, we recognized the same parts. The fact that the cecum was voluminous agrees with the general trend in rodents (PERRIN and CURTIS, 1980; KOTZE, VAN DER MERWE and O'RIAIN, 2006).

The colon, in particular the ascending colon one, has received less attention in studies about rodents. We found that the parts of the colon were well differentiated topographically. This is in accordance with the terms established by the NAV (INTERNATIONAL..., 2005). The ascending colon of the chinchilla had two ansae, with a proximal and a distal part, and an intermediate part, but in the nutria we described two ansae, proximal and only the distal with two parts (PÉREZ, LIMA and BIELLI, 2008). The distal ansa of the nutria is analogous to the ansa coli of the tucu-tucu. The tucu-tucu had only one ansa in their colon (PÉREZ, LIMA, MACHADO et al., 2009).

We recognize the transverse colon in the chinchilla, but Snipes, Hörnicke, Björnhag et al. (1988) did not mention the transverse colon in their study about the nutria and Alogninouwa, Agba, Agossou et al. (1996) did not mention the transverse colon in the grasscutter.

## 5 Conclusion

This study indicates that there are minor differences in the divisions of the intestine and their peritoneal folds, in similar form as happens when comparing other rodents.

This report is a further contribution to the anatomy of the chinchilla.



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