

GROSS ANATOMICAL STUDIES ON SMALL INTESTINE IN POSTNATAL AGE GROUPS OF GUINEA PIG

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Received: 19.03.21: Accepted: 30.07.21

ABSTRACT

Small intestine of guinea pig comprised of duodenum, jejunum and ileum. Duodenum, the first part of the small intestine of guinea pig started as a dilated part from the pylorus of the stomach and was covered ventrally by the left medial lobe of the liver. Jejunum of guinea pig was located on the right side of the abdominal cavity consisted of closely arranged coils hanging from the abdominal wall with the help of mesentery. Jejunum occupied space between the ventral part of stomach and the caecum. It was related to the visceral surface of right lobe of liver and gall bladder. Initial portion of ileum was somewhat tightly curved where as the terminal portion was straight and opened into the ampulla caeci through ileo-caecal orifice. The weight, length and volume of the duodenum, jejunum and ileum increased as the age advanced.

Keywords: Duodenum, Guinea pig, Jejunum, Small intestine

How to cite: Raja, K., Ushakumary, S., Ramesh, G., Ramesh, S., Rao, G.V.S. and Rajathi, S. (2022). Gross anatomical studies on small intestine in postnatal age groups of guinea pig. *Haryana Vet.* 61(1): 1-4.

Guinea pigs (*Cavia porcellus*) are small laboratory animals which constitute a small suborder (Hystricomorphic) from the order rodentia. This type of rodent is probably first introduced into Europe from South America some 400 years ago. Short haired American or English guinea pigs, are the most common popular laboratory and pet varieties. Other typically used laboratory varieties includes the Duncan-Hartley, Hartley, strain 2 and strain 13. The morphology of the digestive tract of animal was related to the nature of food, feeding habits and body size. The literature on detailed study of gross morphological features of small intestine of guinea pig is limited. Hence, the present study was conducted with an aim to explore the gross anatomical features of small intestine of guinea pig.

MATERIALS AND METHODS

Twenty four guinea pigs (twelve males and twelve females) of 0-2 week-old, 2-8 week-old, 8-16 week-old and 16-24 week-old from Duncan Hartley strain were obtained from Laboratory animal medicine, Madhavaram milk colony, TANUVAS, Chennai-600051. Approval from Institutional animal ethics committee (IAEC), TANUVAS was taken then careful dissection of the animals were done and after in-situ, gross anatomical observations of small intestine the intestines were dissected out. Normal morphometrical measurements *viz.* length, weight and volume of the intestines were recorded in postnatal age groups of guinea pig (irrespective of sex) after evacuating the contents. Length was recorded by using the scale and thread method. The weight of the organs was determined

by electronic weighing balance and the volume of the organs was recorded by using the water displacement method (Ali *et al.*, 2015). One way ANOVA with Arithmetic Mean and the standard error for the data were calculated as per Snedor and Cochran (1994).

RESULTS AND DISCUSSION

Gross anatomy of small intestine: The small intestine of guinea pig was observed as a musculo-membranous tube extended from the pylorus of the stomach to the ileo-caecal orifice. It was supported by the mesentery to the dorsal body wall. These observations were similar to the observations of Mitjans *et al.* (2004) in guinea pig. The small intestine of guinea pig consisted of three portions duodenum, jejunum and ileum (Fig. 1 & 2) as stated by Potter *et al.* (1956) in guinea pig Stan *et al.* (2014) in rabbit and chinchilla. Similar observations were also noticed by Ali *et al.* (2008) in African gaint rat, Bob *et al.* (2012) in rabbit and also by Byanet *et al.* (2008) in grasscutter.

In the present study, the weight, length and volume of the duodenum, jejunum and ileum increased as the age advanced. These findings were in accordance with findings of Ahmed *et al.* (2012) in Japanese quails (Table 1).

Duodenum: Duodenum, the first part of the small intestine of guinea pig started as a dilated part from the pylorus of the stomach and was covered ventrally by the left medial lobe of the liver. It then crossed transversely to the right side of abdomen under the right lobe of the liver where it formed a 'S' shaped curve as observed in guinea pig by Potter *et al.* (1956) and Snipes (1982). Common bile

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Table 1
Mean values of the weight (gm), length (cm) and volume (ml) of small intestine of guinea pigs in different age groups
(Mean±S.E. values)

S. No.	Age groups	Weight (gm)			Length (cm)			Volume (ml)		
		Duodenum	Jejunum	Ileum	Duodenum	Jejunum	Ileum	Duodenum	Jejunum	Ileum
1.	0-2 weeks	0.87±0.16	2.3±0.28	0.52±0.05	13.76±1.66	55.91±7.07	13.3±4.09	1.33±0.3	2.50±0.34	1.16±0.16
2.	2-8 weeks	1.26±0.17	3.8±0.36	2.32±0.30	15.96±1.44	56.85±4.45	14.83±3.58	1.00±0.0	1.83±0.30	1.00±0.00
3.	8-16 weeks	1.31±0.20	4.3±0.36	2.36±0.21	16.28±1.31	66.93±2.65	21.60±2.34	1.00±0.0	3.16±0.70	1.33±0.21
4.	16-32 weeks	2.62±0.42	11.8±0.58	2.57±0.84	22.28±1.99	110.9±9.26	23.00±5.75	2.60±0.21	9.33±1.4 ^a	1.00±0.00
	F-Value	8.31 ^{**}	30.4 ^{**}	4.21 [*]	4.98 [*]	16.41 ^{**}	1.36 [*]	8.37 ^{**}	30.41 [*]	4.25 ^{**}

* - Significant difference among groups (P≤0.05); ** - Highly significant difference among groups (P≤0.01)

duct opened into the S-shaped curve of the duodenum (Fig. 3) as noted by Mitjans *et al.* (1997) in guinea pig. Then, it continued downward and caudally on the right side of the abdominal cavity as descending duodenum. Descending duodenum formed a caudal flexure at the level of pelvic inlet and then ran forward cranially as ascending part of duodenum under the posterior end of the left kidney to join with coils of jejunum (Fig. 4). These findings were similar with the findings of Potter *et al.* (1956), Snipes (1982) and Mitjans *et al.* (1997) in guinea pig and Perez *et al.* (2011) in chinchilla.

Intestinal part of the pancreas was located between the loop formed by the ascending and descending duodenum (Fig. 4). During this entire course, duodenum was completely covered ventrally by parts of the large intestine as noted by the Potter *et al.* (1956) and Mitjans *et al.* (1997) in guinea pig, Bob *et al.* (2008) in rabbits and Byanet *et al.* (2008) in grass-cutter. Along with its contents the duodenum was observed to be deep pink in colour in 0-2 week-old guinea pigs which concurred with findings of Mitjans *et al.* (2004) in guinea pig. But, yellow coloured appearance of duodenum with its contents in other age groups of guinea pigs could not be correlated with available literature.

The mean length of duodenum varied from 13.76±1.66 cm to 22.28±1.99 cm in 0-2 week to 16-32 week of age, respectively. But, the length of duodenum was found to be 1.26±4.06 cm in white Newzealand rabbit (Nath *et al.*, 2016). However, the present finding with regard to the length of duodenum as 22.28 ± 1.99 cm in adult guinea pig is in accordance with the findings of Nzalal *et al.* (2012) where they reported the mean length of duodenum 20.15±0.93 cm in African giant rat. The mean weight of duodenum was 0.87±0.16 g to 2.62±0.42 g

in 0-2 week to 16-32 week of age, respectively. However, Nzalal *et al.* (2012) and Nath *et al.* (2016) observed that the mean weight of duodenum was 5.06±0.11g in African giant rat and 9.682±1.95g in white New Zealand rabbit, respectively. The increase in weight of organ as age advanced in the present study was similar to the report of Ahmed *et al.* (2012) in Japanese quail. Mean volume of duodenum varied from 1.33±0.3 ml to 2.66±0.28 ml in 0-2 week to 16-32 week-old guinea pigs, respectively.

Jejunum: In all postnatal age groups studied, jejunum of guinea pig was made up of closely arranged coils hanging from the mesentery and located on the right side of the abdominal cavity (Fig. 5). Jejunum occupied space between the ventral part of stomach and the caecum. These findings were closely related with findings of Potter *et al.* (1956) in guinea pig. Further, Mitjans *et al.* (1997) reported that in guinea pig, the jejunum was the longest portion and was highly coiled and lied mostly dorsal to the duodenum and ventral and caudal to the stomach. Ali *et al.* (2008) in African giant rat and Byanet *et al.* (2008) in grass-cutter opined that the jejunum occupied the abdominal floor between the stomach cranially and the urinary bladder caudally.

Jejunum was related to the visceral surface of right lobe of liver and gall bladder (Fig. 3). These findings are in accordance with the observations of Potter *et al.* (1956) and Mitjans *et al.* (1997) in guinea pig. In the present study, jejunum was the longest segment of the small intestine in all the postnatal age groups as reported by Mitjans and Ferrer (2004) in rats. Colour of the jejunum was pink in all the postnatal age groups studied. However, Mitjans *et al.* (1997) stated that colour of the jejunum was pink-brownish in colour in guinea pigs. In the present study, mean length of jejunum varied from 55.9±7.07 to

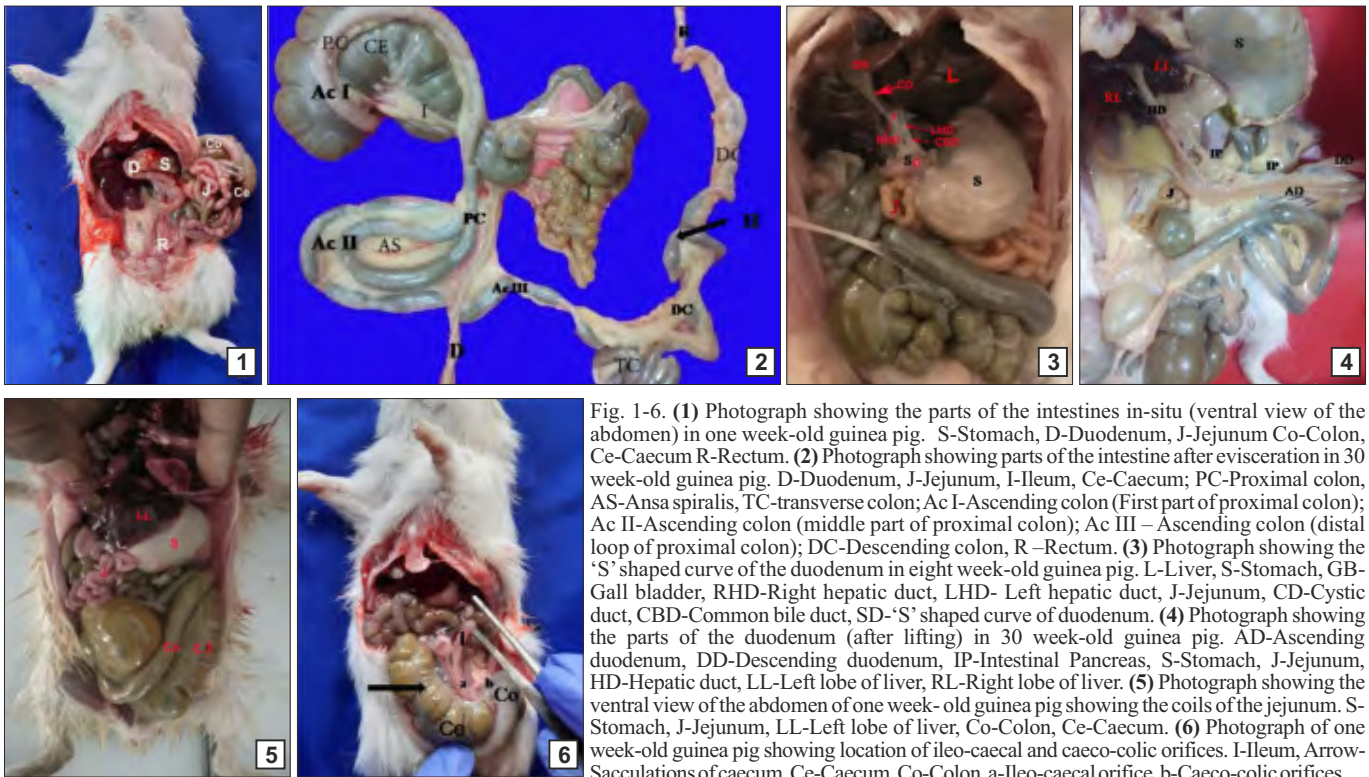


Fig. 1-6. (1) Photograph showing the parts of the intestines in-situ (ventral view of the abdomen) in one week-old guinea pig. S-Stomach, D-Duodenum, J-Jejunum Co-Colon, Ce-Caecum R-Rectum. (2) Photograph showing parts of the intestine after evisceration in 30 week-old guinea pig. D-Duodenum, J-Jejunum, I-Ileum, Ce-Caecum; PC-Proximal colon, AS-Ansa spiralis, TC-transverse colon; Ac I-Ascending colon (First part of proximal colon); Ac II-Ascending colon (middle part of proximal colon); Ac III – Ascending colon (distal loop of proximal colon); DC-Descending colon, R –Rectum. (3) Photograph showing the 'S' shaped curve of the duodenum in eight week-old guinea pig. L-Liver, S-Stomach, GB-Gall bladder, RHD-Right hepatic duct, LHD- Left hepatic duct, J-Jejunum, CD-Cystic duct, CBD-Common bile duct, SD-'S' shaped curve of duodenum. (4) Photograph showing the parts of the duodenum (after lifting) in 30 week-old guinea pig. AD-Ascending duodenum, DD-Descending duodenum, IP-Intestinal Pancreas, S-Stomach, J-Jejunum, HD-Hepatic duct, LL-Left lobe of liver, RL-Right lobe of liver. (5) Photograph showing the ventral view of the abdomen of one week- old guinea pig showing the coils of the jejunum. S-Stomach, J-Jejunum, LL-Left lobe of liver, Co-Colon, Ce-Caecum. (6) Photograph of one week-old guinea pig showing location of ileo-caecal and caeco-colic orifices. I-Ileum, Arrow-Sacculations of caecum, Ce-Caecum, Co-Colon. a-Ileo-caecal orifice, b-Caeco-colic orifices.

110.9±9.26 cms in 0-2 week to 16-32 week of age. However, Potter *et al.* (1956) recorded the length of jejunum along with the ileum as about thirty-five inches in guinea pig. Mean weight of jejunum of guinea pigs varied from 1.51±0.18 to 5.3±0.58 ml in 0-2 week to 16-32 week of age. The mean weight of jejunum of African giant rat was reported to be 9.46±0.20 g (Nzalak *et al.*, 2012). Mean volume of jejunum varied from 2.5±0.34 ml to 9.33±1.4 ml in 0-2 week to 16-32 week of age group. Similar observations were recorded previously by Nzalak *et al.* (2012) in African giant rat, Ahmed *et al.* (2012) in Japanese quails and Nath *et al.* (2016) in Newzealand rabbit (Table 1).

Ileum: The initial portion of ileum was somewhat tightly curved in all postnatal age groups where as the terminal portion was straight and opened into the ampulla caeci through ileo-caecal orifice. Ileo-caecal orifice was located at the left iliac quadrant of the abdomen. Ileo-caecal and caeco-colic orifices were located on the mesenteric attached border of caecum and they were a few millimetres apart from each other (Fig. 6) these findings were in accordance with those of by Brown and Breazile (1976), Snipes (1982), Mitjans *et al.* (1997) and Clemons and Robb (1997) in guinea pig. In present study, dilated sacculus rotundus of ileum as observed by Jordon and Verma (1983) in rabbit was not observed in the ileum of guinea pigs.

Ileum was dark green brown in colour along with its contents in all age groups of guinea pigs. Mean length of

ileum varied from 15.08 to 23.03 cm whereas the mean length was reported as 16.25 ± 0.37 cm in African giant rat and 21.64±46.32cm in New Zealand rabbit by Nzalak *et al.* (2012) and Nath *et al.* (2016), respectively. The mean weight of ileum varied from 0.54 g to 2.57 g in guinea pigs of 0-2 week to 16-32 week of age. However, Nath *et al.* (2016) reported that mean weight of ileum was 2.99±0.143g in New Zealand rabbit. In present study, mean volume of ileum varied from 1.0 to 1.75 ml in guinea pigs of 0-2 week to 16-32 week of age (Table 1).

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