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ANATOMICAL STUDY ON THE POSTNATAL DEVELOPMENT OF THE GASTROINTESTINAL TRACT IN RABBITS

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المستخلص

أجريت هذه الدراسة على ٤٨ من الأرانب الرضيعة والمفطومة، تراوحت أعمارهم بين(٠ - ٣٠) يوما. تم تسجيل وزن الجسم، وطول محورالجسم الطولى من العظم الجبهى فى الرأس حتى آخر فقارة عجزية وكذلك طول الرجل الأمامية. تمت ملاحظة شكل وتوضع المعدة وقياس وزنها وحجمها ، وكذلك طول الإنحناءه الصغرى والكبرى لها. كما تم قياس وزن وحجم وطول الأمعاء الصغيرة والكبيرة. واظهرت النتيجة زيادة القياسات بتقدم العمر وتراجعها تحت تأثير الفطام. لم يلاحظ أي تغيير في شكل وتوضع المعدة في جميع الفئات العمرية.

Abstract

This study has been carried out on 48 suckled and weaned rabbits; their age ranged between 0- 30 days suckled and weaned neonates. Body0 weight, crown rump length and forelimb length were recorded. The shape and position of the stomach were observed and its weight, volume, and length of lesser and greater curvature were determined. Also the weight, volume and length of the small and large intestine were recorded. The result showed that the measurements increased with the advancing age and decreased under weaning effect. No change in the shape and position of the stomach was observed in all age groups.

Introduction

Rabbits are used in wide range of commercial purpouses such as meat in France, Spain, Italy and some middle East countries; as hair in production of coats and regal dresses in U.S.A. In addition to laboratory uses in medical research (Yousif and Abdelaziz, 1995).In Sudan, rabbits are used as pet and laboratory animals.

The gross anatomy of the gastrointestinal tract has been investigated in several birds including chicken (Humphery and Turk, 1974; Martinez, Rodriguez-Mmbrilla, Jimenz, Gonalons and vegara 1983; Yamauochi and Isshiki, 1991), domestic duck (Das, Mishra and Biswal, 1965), white leghorn (Yamauochi and Isshiki, 1991), fowl (Hodges, 1974), balady fowl (Abdel-shamy, 1996), and quail (Ahmed, 2002). In mammals, the gastrointestinal tract was studied in man (Carleson, 1981), newborn pigmy hippopotamus (McCance, 1974; Macdonald and Hartman, 1983) and pig neonates (Nickel, Schumer and Seiferle, 1960; McCance, 1974). In the rabbit, the gross anatomy of the gastrointestinal tract has only been briefly tackled by Yousif and Abdelaziz (1995); Yu, (1997). It is there fore decided that to carry out a gross anatomy of the postnatal development of the gastrointestinal tract of the rabbit.

Materials and Methods

48 Blanc de Bouscat male rabbits were used in this study. Six groups (each group contained 8 rabbits) of male neonates were used in this investigation and their ages were 0-day of age, 6 days of age, 12 days of age (suckling neonates), 18 days of age, 24 days of age (suckling &feeding neonates), and 30 days of age (weaned neonates). The nests were in 37°C and with normal day light. The diet/ dry matter physical compositions per ton were yellow corn 30.15%, soybean meal 16%, hay 40%, wheat bran 10.35%, ground limestone 2%, dicalcium phosphate 1%, minerals mixture 0.10%, premix (vitamins for broiler) 0.10%, sodium chloride (common salt) 0.30% and anti coccidian. The rabbits had access to milk, diet, and tap water, *ad libitum*. The means body weight (expressed in gm), length of crown rump, and length of forelimb (expressed in cm) were recorded for each group.The rabbits were anesthetized with chloroform. The wall of the abdomen was opened and the gastro-intestinal tract (GIT) was then dissected out carefully, without pulling or stretching it .The omentum, fat and mesenteric blood vessels associated with the different portions of the gut were dissected away with scissors, but the mesentery encircling the gut was left *in situ* (McCance, 1974). The stomach was emptied from its contents and then washed with normal saline. The stomach and small and large intestine were stretched by gentle pressure and the lumina were flushed out with normal saline and then emptied by pressure (McCance, 1974). The length of the greater and lesser curvatures of the stomach and the intestine (small and large) were measured. The stomach and the intestine were externally dried with absorbent paper and the weight of the stomach and the small and large intestine were recorded by using a sensitive balance. The stomach and the intestine were removed as quickly as possible, and the water displacement technique was carried out according to Auerbach, 2007 for the determination of the volume (expressed in cm^3) of the stomach and the small and large intestine by using graduated cylinder (Aherne and Dunnil, 1982).

Results

The mean body weight increased gradually with advancing age and then decreased at 30 days of age. The mean crown rump and forelimb lengths increased with advancing age and slightly decreased at 30 days of age. Table (1).

The stomach was seen as a large dilatation of the alimentary canal between the oesophagus and the small intestine. It was situated on the left side of the abdominal cavity behind the diaphragm in all investigated age groups. The stomach was a C-shaped sac when filled with food and the convexity was directed ventro-horizontally in all age groups (Fig.1). The mean weight and volume of the stomach increased with advancing age and slightly decreased at 30 days of age (Fig.2). The mean volume of the stomach at 0-day of age was equal to that of 6 days while at 30 days it was slightly decreased. The ratio of the mean weight of the stomach to the mean volume of the stomach was approximately 1 gm of weight equalled to 1cm³ of volume numerically. It was also observed that there was no change in the mean weight of the stomach at 12 and 18 days of age. The ratio between the mean weight of the stomach and the mean body weight decreased with increasing age and increased at 30 days of age.

The mean weight and volume of the small intestine increased with advancing age and decreased at 30 days of age. The ratio of the mean weight of the small intestine to its volume was 1 gm of weight equalled approximately to 1cm³of volume numerically (Fig.3) The mean weight and volume of the large intestine increased with advancing age but at 0-day and 6 days of age the mean weight and volume of the large intestine were the same (Fig.4). One gram of the mean weight of the large intestine approximately equalled to 1 cm³ of volume numerically.

The mean length of the greater curvature of the stomach increased with advancing age and slightly decreased at 30 days of weaned neonates. The mean length of the lesser curvature of the stomach has increased with advancing age. The mean length of the small intestine increased with advancing age and decreased at 18 days of age and increased at 24 days

and once again decreased at 30 days of age. The length of the large intestine increased with advancing age but decreased at 18 days of age and increased at 24 days and 30 days of age (Table. 2).

Table 1. Showing the means of the body weight (w), the crown rump length (C.R.L.) and the forelimb length (L.) in each of the six groups of the rabbits.

Age (days)	Body w. (gm)	C.R.L. (cm)	Fore limb L.
0	47.00	9.86	3.56
6	76.73	12.70	4.23
12	147.73	16.00	5.50
18	151.93	17.13	6.86
24	406.96	23.60	9.96
30	253.53	22.63	9.83

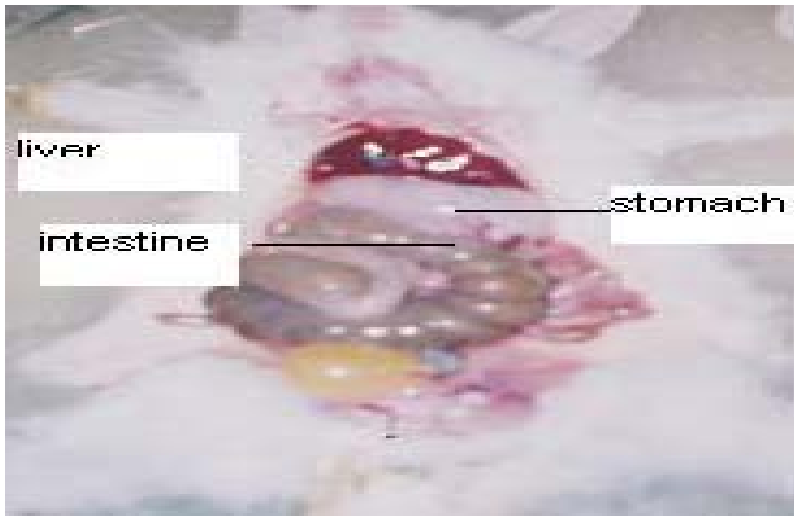

Fig.1. A photograph showing the location of the gastrointestinal tract of rabbit (30 days of age).

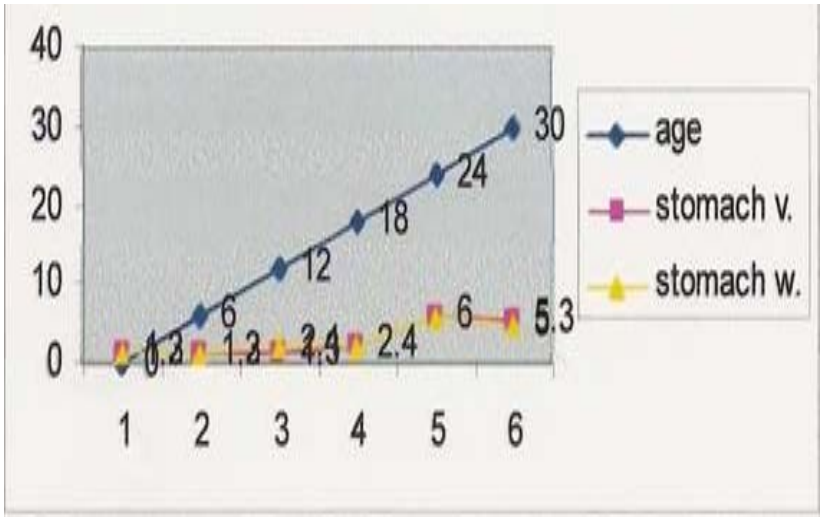

Fig.2.The mean weight and volume of the stomach in relation to age in days

XΞ the groups

YΞ the age in days

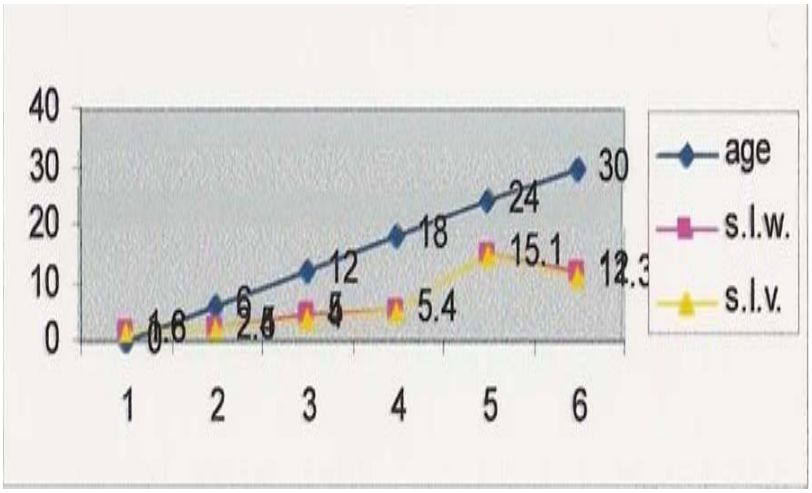

Fig.3. The mean weight (w) & volume (v) of the small (s) intestine (I) in relation to age in days

XΞ the groups

YΞ the age in days

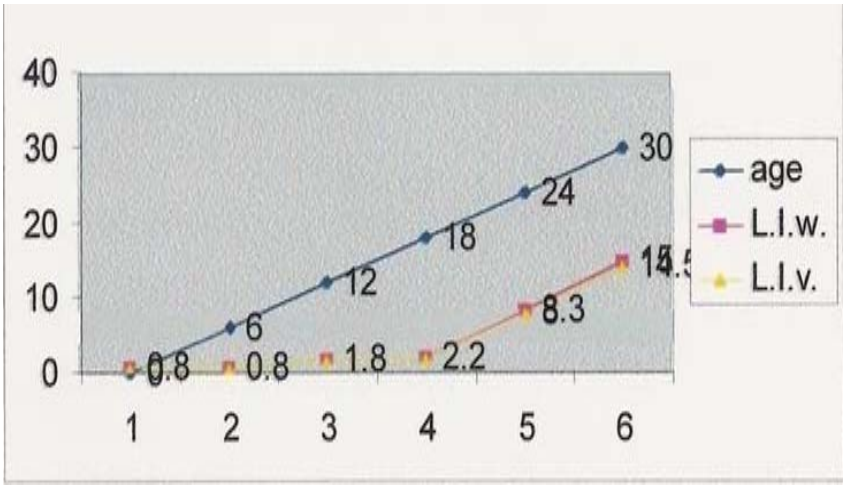

Fig.4. The mean weight (w) & volume (v) of the large intestine in relation to age in days

XΞ the groups

YΞ the age in days

Table 2. Showing the mean length of the greater (GC) and the lesser (LC) curvatures (C) of the stomach and the mean length of the small and large intestine in each of the six groups of the rabbits.

Age (days)	Stomach		Small intestine length (cm)	Large intestine length (cm)
	GC (cm	LG (cm		
0	6.0	19	45.5	20.7
6	7.3	2.4	54.6	27.6
12	10.0	3.0	102.0	44.3
18	11.0	3.2	93.4	43.0
24	15.2	4.7	137.3	72.3
30	14.0	4.9	123.2	92.0

Discussion

The mean body weight increased with advancing age in quail (Ahmed. 2002), but in the present study the weight increased steadily and then decreased at 30 days of age (weaned neonates) and this may be due to the physiological effects of weaning.

In the present investigation, the means of the crown rump length and the fore limb length in relation to age increased with advancing age but decreased at 30 days of age and this may be due to weaning effects. The proventriculus in the fowl is spindle in shape and short with thick wall (Hodges, 1974) and cylindrical in shape with uniform diameter in domestic duck (Das, *et al*., 1965) but in this study the stomach is C-shaped and has a thin wall. The stomach component topography in pigmy hippopotamus female is quite different, during postnatal life, from that of the adult male (Macdonald and Hartman, 1983). In this study, the rabbit stomach is simple and similar to that of the adult, and the mean of the it's weight and volume in relation to age has increased with advancing age but at 30 days of age, these measurements were decreased; this could be attributed to the change in the diet. The weight and the volume were approximately equal. The mean of the stomach weight and volume were the same at 0 and 6 days of age. The mean stomach weight at 12 and 18 days of age were equal. The means of the lengths of the stomach greater and lesser curvatures in relation to age have increased with advancing age but decreased at 30days of age and this may be due to the stress of weaning

In growing rabbits 2-8 weeks old, the small intestine segments were divided to duodenum as the upper fifth of the small intestine, the jejunum as the next three-fifths, and the ileum as the last fifth (Yu, and Chiou, 1997). In the present investigation, the differentiation of the jejunum and ileum is not clear so the small intestine could be divided into proximal small intestine (after the duodenum) and distal small intestine (before the caecum). These divisions were adopted by Nickel, *et al.* (1960) and McCance (1974) in the pig, Humphery and Turk (1974) in chicken, Ahmed (2002) in the quail and Yousif and abdelaziz (1995) in rabbits

during postnatal life. This was not the practice in white leghorn and broiler chickens (Yamauchi and Isshiki, 1991), balady fowl (Abdel-Shamy, 1996) and in chicken (Martinez, *et al.* 1983). The present findings on the development of the small and large intestines as a continuous tube were different from those reported by Macdonald and Hartman (1983). The present results agreed with those of MacCance (1974) in the pig and Ahmed (2002) in the quail, in that the growth of the small intestine is rapidly increased with advancing age. The growth of the large intestine was slower than that of the small intestine and the mean weight and length of the small and large intestine increased with advancing age (Yu, and Chiou, 1997).In the present investigation, the means of the small intestine weight or volume in relation to age in days have increased but they have decreased at 30 days of age. This may be due to the weaning effects on the neonates. The means of the small intestine weight and volume were approximately equal numerically. The mean of the small intestine length in relation to age in days is increased with advancing age but at 18 days of age, it is less than at 12 days, and this may be due to the change in the feeding, and at 30 days of age it is less than at 24 days and this may be due to the weaning effects. No similar information is available in the literature. In the present study, the means of the large intestine weight and volume in relation to age in days increased with advancing age and were approximately equal numerically. The mean large intestine length increased with advancing age but decreased at 18 days and this may be due to change in the feeding. The difference between the result of Yu, and Chiou (1997) and the present study may be due the composition of food specially the using of the essential amino-acid D.L.-methionine, anti coccidia and environment factors.

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