PERIODIC MOVEMENTS OF THE PROXIMAL PART OF THE JEJUNUM IN RABBITS

G. F. Leskova and N. N. Lebedev

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The phenomenon of periodic activity of the gastrointestinal tract (GIT) unrelated to digestion has been demonstrated in many species of mammals. The first laboratory animal in which periodic activity was discovered, in Pavlov's laboratory, was the dog [2]. In rats, under conditions of physiological hunger, chyme is constantly present in the GIT. After its removal, distinct periodic activity is found in the stomach and intestine, and it has been widely studied [6, 8, 14, 15]. Only the periodic activity of the intestine, which is found during relatively prolonged food deprivation, mainly in the distal part of the small intestine, has been studied in cats [12]. Data on periodic activity of the GIT in guinea pigs are contradictory.

The rabbit is a convenient object for models of pathological states, during which it is important to study the functional state of the GIT and its periodic activity.

In the first experiments to study periodic activity, rabbits were subjected to food deprivation for more than 72 h [13], which caused catabolic stress. Examples of "hunger" movements, in the form of continuous contractions of the stomach, in these experiments must therefore be regarded as pathological. Comparison of the electromyographic and contractile activity in the small intestine of rabbits does not give a clear and detailed picture of the periodic activity of the small intestine [10].

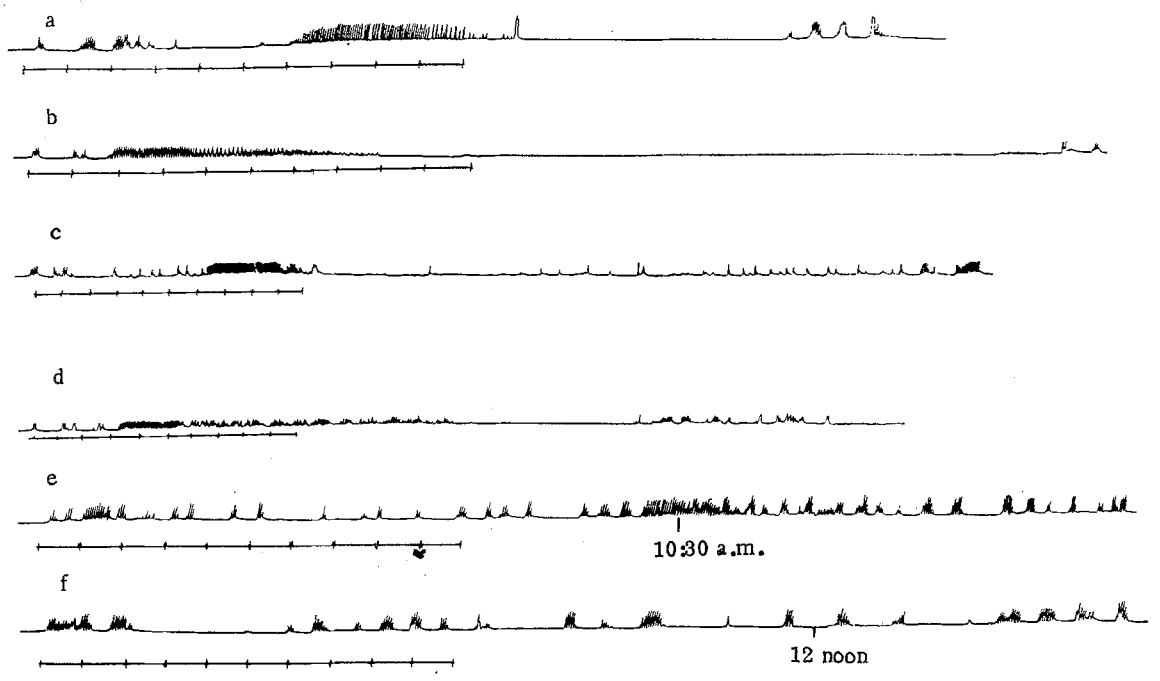

Fig. 1. Phases of motor activity of proximal part of jejunum in rabbits: a, e, f) rabbit No. 12 (Feb. 10, 1984, control); b) rabbit No. 19 (March 27, 1984, control); c) rabbit No. 21 (July 4, 1984, control); d) rabbit No. 23 (July 4, 1984, feeding). Time marker 1 min.

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TABLE 1. Movements of Beginning of Jejunum in Rabbits (control)

Rabbit No.	Duration of period, min	RP		Total number of experiments	Number		
		duration, min	frequency, min^{-1}		with more than one RP	with one RP	with no RP
10	75,5±0,3	3,0±0,3	19,0±0,7	9	1	3	5
11	110,2±13,0	4,6±0,3	20,2±0,4	12	7	1	4
12	68,0±10,2	3,0±0,3	19,7±0,4	11	3	5	3
13	75,5	3,2±0,4	20,3±0,4	5	1	1	3
14	—	4,2	22	1	0	1	0
16	97,7±4,5	7,4±1,2	17,6±0,4	12	6	3	3
17	90,8±17,8	4,4±0,6	21,6±0,7	8	2	5	1
19	71,0±5,0	7,4±0,7	18,8±0,5	3	1	2	0
Mean . . .	83,5±5,7	4,7±0,6	20,0±0,5	61	21	21	19

TABLE 2. Movements of Beginning of Jejunum in Rabbits (feeding)

Rabbit No.	No. of expt.	Period from start of feeding to appearance of 1st RP, min	RP				Weight of food eaten, g
			control		experiment with feeding		
			duration, min	frequency, min^{-1}	duration, min	frequency, min^{-1}	
20	1	67,5	5,1±0,5	17,5±0,5	18,0	18,0	5 (cabbage)
21	1	131,0	3,4±0,3	19,1±0,7	2,5	20,0	100 (cabbage)
	2	171,0			1,5	20,0	80 (carrot)
	3	293,0			2,0	20,0	90 (carrot)
22	1	250,5	3,2±0,4	18,0±0,0	5,0	19,0	100 (cabbage)
	2	107,5			2,5	18,0	80 (carrot)
	3	204,0			3,0	20,0	100 (carrot)
23	1	105,0	7,5±0,9	17,4±0,6	10,5	19,0	80 (cabbage)
	2	113,0			12,5	15,0	80 (cabbage)
	3	87,0			11,0	20,0	80 (carrot)
					15,5	18,0	
	4	274,0			12,0	20,0	90 (carrot)
24	1	134,0	9,3±1,2	18,7±0,9	20,5	18,0	94 (carrot)
Mean for rabbit Nos. 20, 23, and 24			130,1±30,8	7,3±1,2	17,9±0,5	14,3±1,5	18,3±0,7
Mean for rabbit Nos. 21 and 22			197,6±25,3	3,4±0,2	18,8±0,3	2,8±1,5	19,5±1,0

The aim of this investigation was to make a further study of the periodic activity of the GIT in rabbits.

EXPERIMENTAL METHOD

Experiments were carried out on 13 male rabbits weighing 3-3.5 kg with fistulas in the proximal part of the jejunum. Fistula tubes described previously [7], 20 mm long, were used. The investigaton started 2 weeks after the operation. The animals were taken for the experiments from the animal house from 10 a.m. without any previous restrictions of diet, and were placed in experimental cages with electrified floor, specially made in the laboratory. The top and side wall of the cage could be moved depending on the size of the animals, so that they could sit or lie quietly. The rabbits could not stand up or turn around a vertical axis. Thus coprophagy during the experiments was prevented. The rabbits were first accustomed to being kept in the cage. The animals were given no food during the day-long experiment (except in a special series). Intestinal movements were recorded for 6 h twice or three times a week. The volume of the recording balloons did not exceed 0.2 cm^3 of air under a pressure of 3-5 cm water. To study the effect of feeding on jejunal movements the rabbits were given cabbage or chopped carrot (100 g). The animals remained in the experiment for up to 3 months.

Movements of the beginning of the jejunum were investigated in 61 experiments on eight rabbits under food deprivation conditions throughout the day-long experiment (Series I). In 12 experiments on five rabbits the effect of feeding on jejunal movements was studied (series II).

EXPERIMENTAL RESULTS

Three phases of motor activity were distinguished in the proximal segment of the jejunum: rest, irregular contractions, and regular contractions. They correspond to the principal phases of periodic movements in man and animals [1, 3-6, 9, 11]. The regular phases (RP; Fig. 1a-d) were closely linked with periods of complete or relative rest. The predominant form of motor

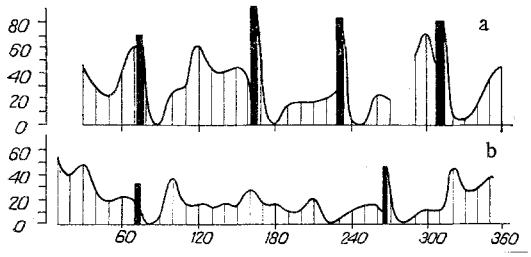

Fig. 2. Movements of proximal part of rabbit jejunum (control). Abscissa, time (in min). Ordinate, number of intestinal contractions: a) rabbit No. 11 (Jan 28, 1984); b) rabbit No. 11 [sic] (Jan 10, 1984). Black columns — RP.

activity was irregular groups of contractions (Fig. 1f). Sometimes (more often at the beginning of the experiment) the RP were difficult to distinguish because of the absence of the resting phase (Fig. 1a). Observations showed that the frequency of peristaltic movements during continuous contractions and in RP was identical, namely 20 contractions/min. In the course of the experiment the duration of RP (1.5-11 min) was more stable, whereas the duration of irregular activity fluctuated considerably.

The complete cycle of periodic activity of the jejunum (based on intervals between RP) lasted on average 80 min (Table 1), but no clear regularity of appearance of the consecutive cycles was observed. In the same animals, on different days of the experiments, both relative uniformity of the cycles (Fig. 2a) and prolonged irregular activity without RP (Fig. 2b) could be observed.

Changes in motor activity of the proximal part of the jejunum after feeding with cabbage or carrot were similar (Table 2). Almost simultaneously with the beginning of feeding the contractile activity of the jejunum increased (Fig. 3). In all rabbits the appearance of the usual RP was delayed. Meanwhile differences were observed in the character of the effect of feeding on the duration of RP: In rabbits with long control RP (mean 7 min) it was doubled ($P < 0.01$), whereas in rabbits with short RP (average 3 min) no significant changes were found.

Thus in the proximal segment of the rabbit jejunum, during continuing digestion, all three principal components of periodic motor activity, similar to those in the corresponding part of the GIT in man and in certain animals, are thus present. Irregular alternation of a state of rest and of motor activity of the jejunum may be connected with the entrance of chyme from the stomach, whose composition is evidently still insufficiently stabilized. The relative constancy of the frequency of contractions in the irregular and regular phases may be evidence of a common course of the motor activity of the jejunum.

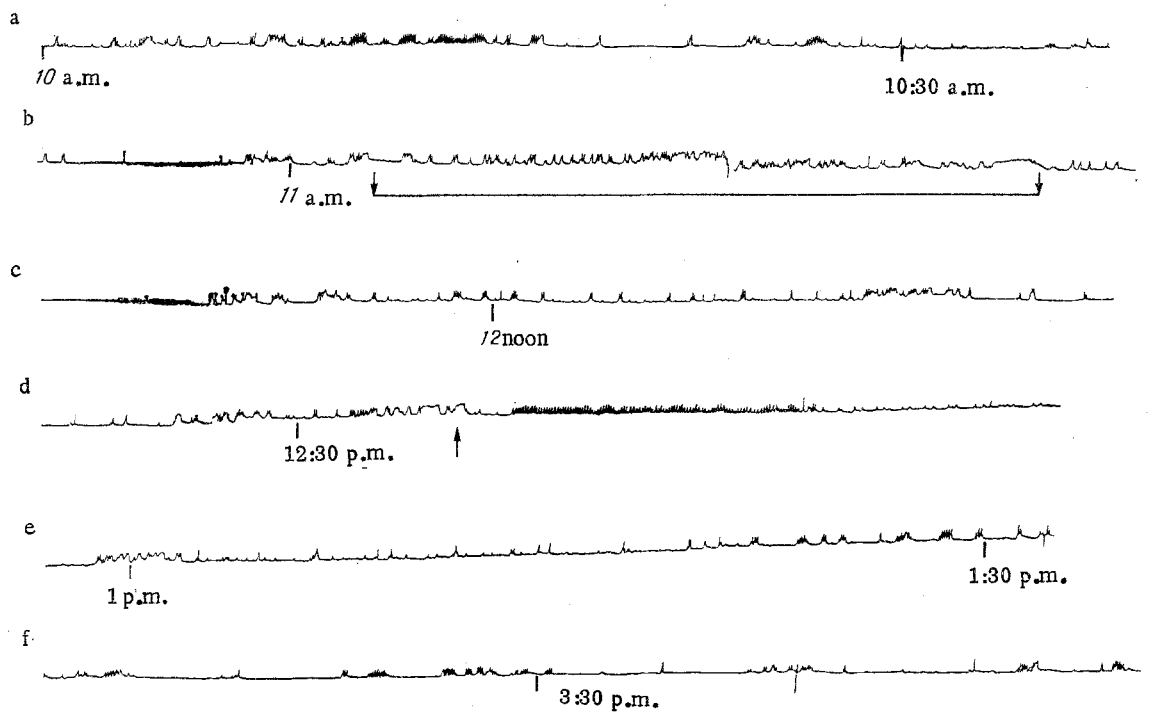

Fig. 3. Continuous recording of movements of proximal part of jejunum in rabbit fed with cabbage (rabbit No. 23, July 2, 1984). Line between arrows indicates feeding time; arrow by itself indicates urination. Clock times are indicated.

Feeding did not change the intrinsic frequency of the peristaltic contractions in the regular and interrupted phases, but increased the duration of RP in some of the experiments. It can be tentatively suggested that the motor components of periodic activity in rabbits, just as in other animals, are a physiological mechanism controlling the rate of evacuation and transit of chyme in the GIT.

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