CONTRACTILE PROPERTIES OF THE ISOLATED HUMAN AND RABBIT'S APPENDIX

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Only one reference could be found in the literature [2] to the study of the contractile properties of morphologically unchanged isolated surviving specimens of the human appendix removed at surgical operation. No reports could be found of investigations of the motor activity of the isolated appendix of the rabbit.

The object of the present investigation was to compare the contractile properties of the isolated surviving appendix of man and the rabbit.

EXPERIMENTAL METHOD

Specimens of the human appendix were obtained from surgical clinics 1-2 h after appendectomy. Morphologically unchanged appendices were used, and were stored in a refrigerator at 1-3°. The contractions of segments of the human and rabbit's appendices of equal length were recorded by Magnus's method. The surviving appendices were treated with acetylcholine in concentrations of between $2 \cdot 10^{-8}$ and $2.5 \cdot 10^{-5}$ and cooled to 7°. In a series of experiments, the contractions of the longitudinal and circular muscles of the human and rabbit's appendices were recorded separately. Altogether 245 experiments were carried out on human (16) and rabbits' (16) appendices.

EXPERIMENTAL RESULTS

The results showed that the mean length of the rabbit's appendix is 10 cm and its diameter 1 cm, while the mean length of the human appendix is 7 cm and its diameter 0.5 cm.

The isolated surviving human appendices reacted to acetylcholine with tonic and periodic contractions (Fig. 1a; Fig. 2a). Visible contractions of the appendices appeared during the action of acetylcholine in a concentration of $1 \cdot 10^{-8}$. Periodic contractions of the appendices developed after a tonic contraction, during the phase of relaxation. In some experiments, periodic contractions developed spontaneously. However, it should be noted that spontaneous contractions were observed after the appendix had been subjected to the previous action of acetylcholine. With an increase in the period of survival, the tonic contractions became weaker, and on the 4th-16th day after isolation of the appendix, the organ ceased to react to acetylcholine (Fig. 1a). A similar pattern was observed with the periodic contractions. The human appendices reacted to cooling with a marked tonic contraction (Table 1).

The results of the experiments in which the contractions of the longitudinal and circular muscles were recorded separately showed that the longitudinal muscle of the isolated human appendices reacted to acetylcholine with characteristic tonic and periodic contractions, whereas the circular muscle responded with hardly visible contractions (Fig. 3a).

The isolated surviving appendices of the rabbit also reacted to acetylcholine with tonic and periodic contractions (Fig. 1b; Fig. 2b). The appendix of the rabbit was characterized by a higher threshold of contraction to acetylcholine than the human appendix ($5 \cdot 10^{-7}$).

The tonic contractions of the rabbit's appendix were weaker and shorter in duration than the corresponding contractions of the isolated human appendix (Table 2).

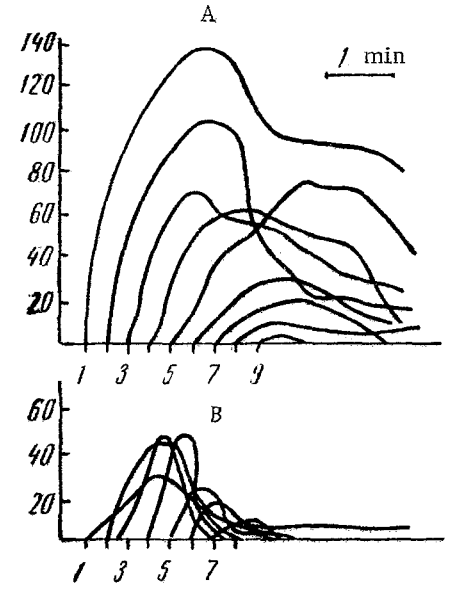

Fig. 1. Tonic contractions of the isolated human (A) and rabbit's (B) appendix in response to acetylcholine ($5 \cdot 10^{-6}$) in the course of survival. The height of elevation of the pen (in mm) is plotted along the axis of ordinates; the days of survival, along the axis of abscissas.

TABLE 1. Characteristics of Tonic Contractions of Isolated Surviving Human Appendices during Cooling (mean data)

Day of survival	Height of elevation of pen (in mm)	Duration of phase of contraction (in sec)
1	32	40
4	29	84
6	25	167
8	26	267
9	56	308

The periodic contractions of the rabbit's appendix were less intensive and shorter in duration, but faster in rate than those in the human appendix, and they appeared not during, but after the phase of relaxation, replacing the phase of tonic contraction (Fig. 2b). In some experiments, spontaneous contractions of a periodic character were observed, and these also were associated with the previous administration of acetylcholine. In the experiments in which the contractions of the longitudinal and circular muscles of the rabbit's appendix were recorded separately, it was found that the longitudinal muscle reacted to acetylcholine with tonic contractions and the circular muscle with periodic (Fig. 3b). During the process of survival, the tonic contractions of the rabbit's appendix, like those of the human appendix caused by acetylcholine, gradually became weaker, and they disappeared completely on the 4th-16th day after isolation (Fig. 1b). The same pattern was observed with the periodic contractions. The rabbit's appendix, unlike the isolated human appendix, did not react by a contraction to cooling.

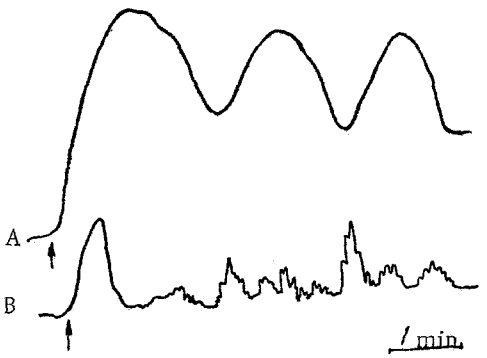

Fig. 2. Periodic contractions of the isolated human (A) and rabbit's (B) appendix. The arrow points to the moment of administration of acetylcholine ($5 \cdot 10^{-6}$).

The tonic contractions of the human and rabbit's appendix were due to the activity of the longitudinal muscles. The tonic contractions of the human appendix differed from those of the rabbit's appendix by their greater strength and longer duration. This may be attributed to the fact that the longitudinal muscle of the human appendix is better developed and more readily excited than the longitudinal muscle of the rabbit's appendix, as shown by the lower value of the threshold of its contraction to acetylcholine and the fact that it reacted to cooling.

The periodic contractions of the isolated human appendix were also due to the activity of the longitudinal muscle, whereas the corresponding contractions of the rabbit's appendix were due to the activity of the circular muscles. The periodic contractions of the human appendix differed from those of the rabbit's appendix by their greater strength and longer duration, and also by their lower frequency. These distinctive features of the periodic contractions of the isolated human appendix were determined by the fact that they were associated with the activity of the longitudinal muscle which, according to information given in the literature [2] and personal observations, differs from the circular muscles of the appendix by its greater excitability and strength of contraction.

The results of the experiments in which the contractions of the longitudinal and circular muscle of the appendix were recorded separately, showed that the longitudinal muscle is more highly developed in the human appendix while the circular muscle is less highly developed by comparison with the rabbit's appendix. These distinctive features of the human appendix are evidently associated with the vertical position of the body [1] and the character of the human diet.

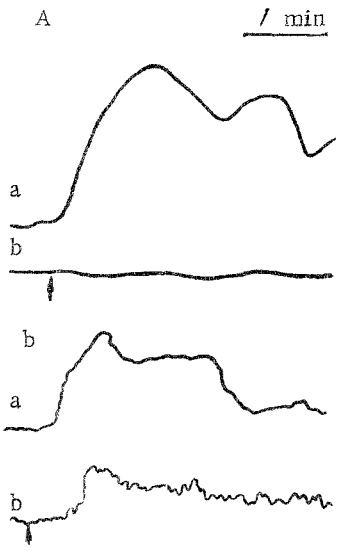

Fig. 3. Contractions of the longitudinal (a) and circular (b) muscles of the isolated human (A) and rabbit's (B) appendix during the action of acetylcholine ($5 \cdot 10^{-6}$).

TABLE 2. Comparative Characteristics of Tonic Contractions of Isolated Surviving Human and Rabbit's Appendix during the Action of Acetylcholine (mean data)

Concentration of acetylcholine	Day of survival	Height of elevation of 10 (in mm)		Duration of phase of contraction (in sec)	
		Human	Rabbit's	Human	Rabbit's
$5 \cdot 10^{-6}$	1	83	24	124	31
	4	93	39	161	85
	7	58	46	243	44
	9	10	2	73	10
$2{,}5 \cdot 10^{-6}$	1-	107	21	172	48
	4-	78	14	165	24
	5-	59	27	302	34
$1 \cdot 10^{-6}$	1-	90	18	148	137
	2-	52	11	143	45
	3-	44	3	58	42
	4-	75	25	220	56

LITERATURE CITED

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2. U. Dacha and O. Rossi, Boll. Soc. ital. Biol. sper., 29 (1953), p. 430.