Intestinal Slow Waves: Effect of Transection on Propagation Velocity* (33369)

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Electrical slow waves in the upper small intestine appear to propagate aborally (1, 2). As they progress, they slow from about 14 cm/sec in the duodenum of dogs to about 2 cm/sec in the jejunum (1). About 17–20 slow waves pass along the upper small intestine of unanesthetized dogs each minute (2–6). Below a transection only about 14 slow waves pass along the upper jejunum each minute (5–7). The purpose of this report is to show that not only frequency but also propagation velocity of slow waves is severely reduced below a transection of upper small intestine in dogs.

Methods. Platinum electrodes embedded in Silastic platforms were premanently implanted on the antimesenteric surface of dog small intestine. Two electrodes were implanted on the duodenum of each dog below the ampulla of Vater and two on the upper jejunum. The electrodes of each pair were about 10 cm apart. They were wired to a miniature connector implanted in the abdominal wall. All recordings were obtained from healthy unanesthetized animals trained to lie quietly on a table. Monopolar recordings were made on a Grass Model 5 polygraph with a stainless steel hypodermic needle in the left thigh as a common indifferent electrode. Further information concerning these procedures may be found in a previous publication (8).[2] The electrodes were modified from those described by McCoy and Bass (3).

Control records were obtaintd 8–20 days after electrode implantation. Each intestine was transected just below the ligament of Treitz about 20 days after electrode implantation. Physical continuity was immediately reestablished by end-to-end anastomosis. The electrodes were left in place. Another series of electrical recordings was made 10–20 days after transection.

Propagation time was measured as the interval between the peak (called "b" by Bass *et al.*, ref. 2) of a slow wave from the upper duodenal or jejunal electrode and the peak of the corresponding slow wave from the lower electrode.

Results and Discussion. Propagation velocity in the duodenum of three dogs averaged about 14 cm/sec and was uninfluenced by transection of the upper jejunum. This velocity is similar to that previously found in intact dog duodenum by other investigators (1, 4). Frequency of slow waves in the duodenum averaged 18.2 cycles/min and was also uninfluenced by transection.

The results from jejunal electrodes are shown in Table I. In each dog there was a marked increase in propagation time (i.e., decrease in velocity) below the site of transection. The velocity after transection was approximately half its pretransection value.

The data in Table I, in addition to providing new information regarding propagation velocity, also confirm previous findings of decreased frequency below a transection (5–7).

The drop in frequency below a transection could be caused by elimination of pacemaker influence via longitudinal muscle, but it is not obvious why discontinuity of longitudinal muscle should influence propagation velocity. We propose that discontinuity of the intrinsic nerve plexuses after transection is responsible for decreasing propagation ve-

* This paper includes a portion of the work presented in the Doctoral Dissertation of E. J. McCoy, University of Texas Medical Branch, Galveston, Texas, entitled "Studies of Electrical Activity in the Small Intestine of the Dog."

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2 In our previous paper the length of the recording surface of each electrode was erroneously given as 3 cm; actually it was 3 mm.

TABLE I. Effect of Transection on Frequency and Propagation Time of Slow Waves in Upper Jejunum of Dogs.

Dog	Frequency[a] (cycles/min)		Propagation time[b] (sec)	
	Before transection	After transection	Before transection	After transection
1	18.70 ± 0.15	15.05 ± 0.14	2.1 ± 0.42	4.2 ± 0.55
2	17.85 ± 0.11	13.30 ± 0.08	1.6 ± 0.25	4.6 ± 0.55
3	17.65 ± 0.08	12.65 ± 0.11	2.5 ± 0.61	4.2 ± 0.75

[a] Each value for frequency is the mean (± SE) of 18 separate determinations—nine from each jejunal electrode obtained on three different days. Data from both jejunal electrodes are combined since there was no detectable difference in frequency between them.

[b] Each value for propagation time is the mean (± SE) of either 20 or 30 separate determinations made on two or three different days. Propagation times, rather than velocities, are presented to eliminate the imprecisely measured and variable factor of interelectrode distance. The latter was roughly 10 cm in each dog.

locity, and, therefore, that intrinsic nerves have a role in maintaining normal propagation velocity. This concept is analogous to the well known nervous influence on propagation velocity in the heart (9). The aboral decrease in concentration of nerve cells in the myenteric plexus (10, 11) possibly explains the aboral decrease in propagation velocity along normal intestine (1).

Other evidence in available to support the idea of intrinsic nerves influencing slow waves. McCoy *et al.* (12) produced temporatry ischemia in segments of dog jejunum with the technique of Hukuhara (13), a procedure that selectively damages intrinsic nerves. The same drop in frequency occurred below the treated segment as occurs below a transection. The frequency of slow waves from the treated segment itself was even less than below a transection. Similar observations have been made by others (14, 15).

Bass and Wiley (4) reported that ligating a Biebl loop of dog duodenum increased propagation velocity both orad and caudad to the ligature, but these increases were not significant. We suggest that the increases in velocity observed by Bass and Wiley could have been caused by irritation of intrinsic nerves by the ligature.

Summary. The velocity of electrical slow waves recorded from the upper jejunum in unanesthetized dogs was markedly reduced below a transection. This observation suggests that intrinsic nerves are involved in propagation of slow waves.

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Received July 1, 1968. P.S.E.B.M., 1968, Vol. 129.