all the mobile potassium from both muscles of the pair, and they stimulated only for 2 seconds out of every minute with 30 minutes out of every hour for rest. Mond and Netter[2] and Ernst and Csucs[4] also used perfused muscles. The former authors stimulated for 30 minutes only, while the latter used short tetani every second until fatigued, repeating this several times, but do not mention the total duration of the stimulation. Ernst and Takács[5] quote 3 experiments showing a loss of potassium from perfused muscle indirectly stimulated but ascribe this result to the use of high potassium in the perfusate which was supposed to have increased the permeability of the muscle, thus permitting loss of potassium. Our results show that a high potassium concentration outside the muscle is not necessary for the phenomenon. We have not tried to introduce the unnecessary complication of perfusions in order to see whether a loss of potassium in activity can still be demonstrated by suitable stimulation under these conditions.

Summary. Frog muscles which are kept twitching rhythmically for 1.5 hours with well maintained contractions show a consistent average loss of 5.7% of the potassium originally present and a gain of water.

9460 P

Effect of Benzedrine Sulphate on Stomach Activity and Emptying Time.*

KARL H. BEYER AND W. J. MEEK.

From the Department of Physiology, University of Wisconsin Medical School, Madison.

Benzedrine sulphate is used clinically for the relief of pylorospasm and the facilitation of fluoroscopic and roentgenoscopic examination. Meyerson and Ritvo[1] reported that the drug brought about satisfactory disappearance of spastic manifestations in 85% of their cases.

On the other hand ephedrine sulphate, a closely related sympathomimetic compound, in doses of 65 mg. was reported by Van Liere, Lough, and Sleeth[2] as prolonging the emptying time of the stomach from 72.8 to 118%.

---

[5] Ernst, E., and Takács, I., *Arch. ges. Physiol.*, 1931, **228**, 690.

* Aided by a grant from the Wisconsin Alumni Research Foundation.

[1] Meyerson and Ritvo, *J. A. M. A.*, 1936, **107**, 24.

[2] Van Liere, Lough, and Sleeth, *J. A. M. A.*, 1936, **106**, 535.

We were interested in determining the effect of benzedrine on initial and final emptying intervals and to what factors this action might be attributed.

Two series of fluoroscopic studies were carried out on normal dogs. Dogs in series A were selected for long initial opening intervals and were fed an opaque meal of 4.1 gm. of barium sulphate and 12.1 gm. of milk per kilo. The dogs weighing from 8.5 to 10 kilos were given 20 mg. of benzedrine orally; those from 10 to 14 kilos were given 30 mg. Dogs in series B were fed a thicker meal of 4.1 gm. barium sulphate, 5 gm. of powdered dog biscuits, and 12.1 gm. of milk per kilo of body weight. These were litter mates and weighed within 2 kilos of each other. They were all given 30 mg. doses of benzedrine, orally. In both series the interval between the time the drug was given and the opaque meal fed was from 10 to 15 minutes.

Table I summarizes the data concerning the effect of benzedrine sulphate on initial emptying of the stomach. In series A benzedrine reduced the average interval between the time the meal was given and its appearance in the intestine to 30.8% of the normal. The standard deviation of the normal initial emptying was ±3.4 minutes. The standard deviation of the initial interval following benzedrine

TABLE I.
Effect of Benzedrine Sulphate 20-30 mg. Orally, on the Initial Emptying Time of the Stomach. Series A and B.

Dogs	Normals		Benzedrine	
	Trials	Av. time	Trials	Av. time
A-1	3	13 min.	2	3 min.
A-2	5	10 ”	5	5 ”
A-3	4	15 ”	3	4 ”
A-4	5	14 ”	4	4 ”
B-1	3	15 ”	2	3 ”
B-2	3	14 ”	2	6 ”
B-3	3	12 ”	2	3 ”
B-4	3	14 ”	2	3.5 ”
B-5	3	11 ”	2	3 ”
B-6	3	10 ”	2	4 ”
B-7	3	11 ”	2	3.5 ”
Series A Average	17	13 ”	14	4 ”
Series B Average	21	12.5 ”	14	4 ”

was ±1 minute. In series B the average interval was reduced to 32% of the normal. In series B the standard deviation of the normal initial emptying was ±2.2 minutes, and the following benzedrine was ±1.2 minutes.

From Table II it may be seen that benzedrine lengthened the final emptying periods by from 8 to 76 minutes, the average being 36 minutes.

TABLE II.
Effect of Benzedrine Sulphate, 20-30 mg. Orally, on Final Emptying Time of the Stomach. Series A.

Dogs	Normals Trials	Normals Av. Time hr.	min.	Benzedrine Trials	Benzedrine Av. Time hr.	min.
A-1	4	3	39	2	4	55
A-2	4	4	12	3	4	44
A-3	4	4	29	5	4	37
A-4	4	5	17	3	5	27
A-5	5	4	33	3	5	47
A-6	3	3	53	4	4	14
Aver.	20	4	21	20	4	57

For the data in Table II the standard deviation of the difference of the averages is approximately ± 20 minutes. The critical ratio is about 1.5, which would mean the data are probably not very significant. However, it must be noted that the average time of final emptying was increased for every one of 6 dogs under benzedrine. The chance that all would increase in this way is one in 64. The conclusion that benzedrine does cause a slight delay in final emptying seems, therefore, to be justified.

Records of the effect of benzedrine on stomach activity of dogs fasted for 12 to 18 hours were obtained by the balloon method. The balloon was connected through a water manometer to an air tambour so that a known pressure could be maintained in the balloon within the stomach. The drug, in solution (30 mg.), was introduced into the stomach through a second tube.

We find that the initial effect of the benzedrine occurs in about 8 minutes after it is given orally. The effect is one of increased tonus and rate of activity. Its secondary effect is one of marked inhibition of activity, even to cessation, which may or may not be accompanied by a slight loss of tonus. This latter effect takes place within 40 minutes.

We could demonstrate no constant effect of benzedrine on the intestine of the intact dog by manometrically recording the activity of the intestinal fistulæ. Water and mercury manometers were used. The benzedrine was administered orally, subcutaneously, intravenously, and by infusion into the fistulæ.