Effect of the Volume of Intravenous Infusion of Normal Saline on Gastric Secretion in Rats (37072)

K. KOWALEWSKI

Surgical-Medical Research Institute and Department of Surgery, The University of Alberta, Edmonton, Alberta, Canada

One method of studying gastric secretion in rats is the collection of gastric content through a permanent gastric fistula (1, 2). In these animals gastric secretagogues may be administered intravenously through a permanent cannula placed in the vena cava or aorta (2–4). We usually infuse a secretagogue dissolved in normal saline. In most of our studies, the volume of fluid, infused for 24 hr, is 120 ml/kg of rat body wt (4–6). Animals infused with saline alone serve as controls and are compared with animals infused with a similar volume of saline containing a gastric stimulant (2–6). Does the volume of infused fluid influence the volume and composition of gastric juice collected during the infusion period? We did not find an answer to this question in the literature dealing with gastric secretion in rats. The purpose of the present experiment was, therefore, to look for this answer. Rats were infused with various volumes of normal saline for 24 hr and gastric secretions were collected, during the whole infusion period, through permanent gastric fistulas. Animals, grouped according to infusion volume, were then compared regarding the quantity and composition of gastric juice.

Materials and Methods. Chronic gastric fistulas were prepared in male Wistar rats with average body weight of 360 g (350–380) and, at the same operation, a polyethylene tube was implanted in the vena cava of each animal (2). Secretion studies were performed in all rats 3 wk after surgery. Prior to the collection of gastric juice, animals were fasted for 24 hr but water was allowed as desired. On the morning of the experiment, a sample of blood was taken from the tail vein of each rat and the animal was placed in a modified Bollman cage (7), which permits free movement of head, legs and tail. The stopper screw of the gastric cannula was removed for 30 min for the initial drainage of juice. This first sample was discarded. The infusion of normal saline into the vena cava and the collection of gastric content began simultaneously and lasted 24 hr (2–6). Uniform infusion of fluid was obtained by using an infusion pump (Harvard Apparatus Co., Dover, MA). In this experiment we used the following volumes of normal saline; 60, 120, 180 and 240 ml/kg body wt for 24 hr. Gastric juice was titrated in 0.5 ml aliquots using a Radiometer type TTT1 titrator, TTA3 titration assembly and type ABU1 Auto-Burette unit. The pH was read and the sample was then titrated with 0.1 *N* NaOH to pH 7. Pepsin (8) and electrolytes were also measured in the gastric samples. Concentrations of Na^+ and K^+ were determined using an Instrument Laboratories Model 143 flame photometer. Chloride was measured with a Buchler Cotlove chloridometer. Hemoglobin and hematocrit were determined in blood samples taken before and at the end of saline infusion. The 24 hr urine volume, collected during the infusion period (9), was recorded. The results were evaluated by Student's *t* test.

Results. Note in Table I that the volume of infused saline influenced the output of gastric secretion, HCl, and urine. It did not, however, affect the concentration of HCl and pepsin. It is interesting to note that the infusion did not produce an increase in body weight in any of the rats. A review of the values of hemoglobin and hematocrit suggests that no marked dilution of the blood resulted from intravenous infusion of fluid. Differences between the groups of rats are

TABLE I. Effect of Intravenous Infusion of Normal Saline on Gastric Secretion, Blood Hb and HCT, Urine Volume and Body Weight of Rats, Bearing Permanent Gastric and Venous Cannulas.[a]

Group:	A	B	C	D	p^b
Vol of 24 hr iv infusion of *N* NaCl (ml/kg body wt):	60	120	180	240	
Gastric secretion					
24 hr output (ml)	6.1 ± 4.5	19.6 ± 8.1	28.0 ± 7.3	39.0 ± 4.2	a
24 hr HCl (mEq)	0.5 ± 0.4	1.3 ± 0.6	1.9 ± 0.6	2.7 ± 0.7	a
Pepsin (mg/ml)	29 ± 6	27 ± 4	28 ± 2	29 ± 4	NS
HCl (mEq/liter)	70 ± 20	66 ± 19	72 ± 17	68 ± 10	NS
Na^+ (mEq/liter)	58 ± 18	57 ± 23	42 ± 7	40 ± 13	NS
K^+ (mEq/liter)	17 ± 3	18 ± 4	19 ± 3	20 ± 2	NS
Cl^- (mEq/liter)	150 ± 21	139 ± 11	140 ± 16	138 ± 49	NS
Blood					
Hb (g/100 ml)					
before infusion	15.9 ± 0.2	15.5 ± 0.7	16.2 ± 0.4	14.5 ± 1.2	NS
after infusion	15.8 ± 0.9	15.7 ± 0.8	15.9 ± 1.6	14.8 ± 1.9	NS
HCT (%)					
before infusion	49.0 ± 1.5	48.0 ± 3.7	49.0 ± 2.9	44.0 ± 5.4	NS
after infusion	49.0 ± 3.0	47.0 ± 4.9	46.0 ± 5.6	44.0 ± 5.3	NS
Urine					
24 hr output (ml)	7.0 ± 3.7	8.5 ± 4.9	11.2 ± 5.3	19.0 ± 6.5	b
Body wt					
Change after 24 hr infusion (range, %)	−7 to −10	−3 to −7	−1 to −6	0 to −3	NS

[a] Nine rats in each of four groups; av and SD.

[b] a, $p < .05$, A versus B, C and D; B versus D and C; C versus D. NS, $p > .05$, no significant difference between four groups. b, $p < .05$, A and B versus D; C versus D.

statistically evaluated in Table I.

Conclusions. Gastric secretion studied in the present experiment was interdigestive, spontaneous, gastric secretion. This secretion, in the rat, is known to represent a definite cephalic phase (10) and, being vagus dependent, is totally suppressed by vagotomy (4). Spontaneous gastric secretion in the rat can be influenced by the volume of intravenous fluid. The present experiment demonstrated that this influence is limited to the volume of secretion and to the output of some components of the juice. The volume of intravenous infusion did not significantly affect the concentration of HCl and pepsin. This is an interesting observation, considering the fact that such volumes as 180 and 240 ml/kg body wt/24 hr represented a marked load of fluid. The organism of the rat appears to have some defense mechanism against the unusually high load of intravenous saline. The secretion of gastric juice and urine does not remove the infused fluid. If we consider, for example, the group of rats receiving 240 ml/kg body wt/24 hr, the average load of saline per rat was 86.4 ml in 24 hr. The average output of measured fluid was only (39.0 + 19.0) 58.0 ml. About 28.0 ml or more was, therefore, not accounted for as the rats of this group did not gain any weight. Most of this fluid was probably lost through the lungs and skin, but this was not determined.

This short experiment demonstrates the effect of intravenous fluid load on gastric secretion in the rat. The information obtained may be useful for planning an experiment in which a gastric secretagogue, dissolved in normal saline, is administered for a prolonged period of time.

Summary. Rats bearing permanent cannulas of the stomach and of the vena cava

vein, were infused with various volumes of intravenous saline for 24 hr. Gastric secretion and urine were collected during the infusion period. Blood was sampled before and after infusion for determination of hemoglobin and hematocrit. Volumes infused to four groups of rats were 60, 120, 180 and 240 ml/kg body wt/24 hr, respectively. Outputs of gastric juice volume, HCl, and urine were affected by the volumes of infusion. Concentrations of HCl and pepsin remained constant, even after a marked load of intravenous saline. Body weight of the rats did not increase following the 24 hr infusion.

The technical assistance of Mr. P. Kim, Mrs. T. Hoogen and Mrs. M. McCubbin is gratefully acknowledged.

1. Bel, A., Levrat, R., Nesmoz, J., and Girard, M., J. Med. Lyon, p. 5 Oct. (1966).

2. Kowalewski, K., and Chmura, G., Arch. Int. Physiol. Biochim. **77**, 10 (1969).

3. Kowalewski, K., and Chmura, G., Amer. J. Dig. Dis. **13**, 753 (1968).

4. Kowalewski, K., Amer. J. Dig. Dis. **16**, 19 (1971).

5. Kowalewski, K., Arch. Int. Physiol. Biochim. **79**, 545 (1971).

6. Kowalewski, K., and Scharf, R., Arch. Int. Physiol. Biochim. **80**, 35 (1972).

7. Bollman, J. L., J. Lab. Clin. Med. **33**, 1348 (1948).

8. Aitken, M. A., Spray, G. H., and Walters, G., Clin. Sci. **13**, 119 (1954).

9. Kowalewski, K., Proc. Soc. Exp. Biol. Med. **127**, 1134 (1968).

10. Lin, T. M., and Alphin, R. S., Amer. J. Physiol. **192**, 23 (1958).

Received Oct. 13, 1972. P.S.E.B.M., 1973, Vol. 142.