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THE RELATIVE SIGNIFICANCE OF VARIOUS INTESTINAL SEGMENTS IN PLASMA CALCIUM REGULATION

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Previous investigations indicate that Ca transport occurs in all segments of intestine. The absorption of dietary Ca is greatest in the duodenum and proximal jejunum (Pansu et al. 1983) while Ca secretion from blood to gut lumen is prominent in ileum and jejunum (Walling and Kimberg 1973). Nonetheless there are no publications where the different intestinal segments of similar length and with the same volume of Ca applied are compared for their ablility to absorb and secrete Ca. In view of the differences in Ca flux between various intestinal segments, it may be that the intestine can act as an extra regulatory route for plasma Ca in addition to kidneys and bone. The present study aimed to compare the relative absorptive and secretory capacities of various intestinal segments and the possible role of intestinal segments in acute plasma Ca regulation during hyper- and hypocalcaemia.

Adult female wistar rats weighing between 170-240 g were used in all experiments. The rats were anesthetized, the femoral vein and femoral artery were cannulated and intestinal loops of exactly five cm were prepared in situ in the duodenum (D), proximal jejunum (PJ), jejunum (J), ileum (I), caecum (CE) and colon (CO). For absorption studies, only one loop was prepared in each rat and to the loop was added 0.5 ml of 0.3 or 10 mM $CaCl_2$ + ^{45}Ca. Blood samples were collected at time 0, 5, 10, 15, and 30 min for determination of plasma Ca and ^{45}Ca concentration. To compare the secretory capacities, the six intestinal loops were prepared in each rat and each loop was filled with 0.9% NaCl. Thereafter 0.3 ml of 2.5 mM $CaCl_2$ + ^{45}Ca was infused intravenously and the blood samples were again collected at time 0, 5, 10, 15, and 30 min. The rats were sacrificed at 30 min, each intestinal loop was removed and the contents analysed for Ca and ^{45}Ca. Hypocalcaemia was elicited by thyroparathyroidectomy (TPTX) 48 h before the experiment whereas hypercalcaemia was induced by the intravenous infusion of $CaCl_2$ to enhance plasma Ca to 3.2-3.4 mM.

	Cumulative Ca flux (n mole / 5 cm / 30 min)					
Intestinal segments	Normocalcaemia		Hypercalcaemia		Hypocalcaemia	
	absorb	secrete	absorb	secrete	absorb	secrete
Duodenum	18.0	241.3	13.3*	476.1**	11.3**	221.4
Proximal jejunum	14.1	127.4	6.6**	260.0*	7.9**	76.8*
Jejunum	10.5	168.9	5.2**	283.3**	7.7*	88.0**
Ileum	6.1	78.3	3.1*	179.3*	4.1*	39.9*
Caecum	6.3	87.3	2.8*	108.6	7.6	45.2*
Colon	14.5	58.0	8.6*	113.1**	3.5**	36.3*

* P<0.05, ** P<0.01 compared with corresponding values of normocalcaemia

The results demonstrated that, at luminal Ca concentration of 0.3 mM, the relative absorptive capacities as shown in Table were D, CO >PJ, J >I, CE. However, at 10 mM, the order changed to D, PJ> J, CO> I, CE. The proximal small intestine had a greater Ca secretory capacity than the distal part (D > PJ, J > I, CE, CO). During hypercalcaemia, Ca secretion was substantially increased in all segments except the caecum whereas Ca absorption was significantly reduced in all segments. In contrast, during TPTX-induced hypocalcaemia, intestinal Ca absorption markedly decreased in most of intestinal segments especially the duodenum and colon while Ca secretion decreased in all segments except duodenum. Therefore it appears that the intestine buffers plasma Ca concentration during hypercalcaemia but the intestinal handling of Ca does not contribute to the plasma Ca regulation during hypocalcaemia.

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