REVISTA ESPAÑOLA DE FISIOLOGIA, **43,** (1), 123-124, 1987

Sodium, Chloride and Bicarbonate Dependence of Iodide Secretion in Rat Mid-Small Intestine

PASTAN (3) and ACLAND and ILLMAN (1) reported that the central region of rat small intestine transfers iodide from the serosal to the mucosal side against a concentration gradient. We have previously shown (2) that iodide secretion across rat small intestine was dependent upon both, metabolic energy and tissue Na^+ -pump. Also the absence of Ca^{2+} from the incubation solution decreased net iodide secretion, and theophylline stimulated the process (2).

The data herein show the ionic requirements of iodide secretion across the central region of rat small intestine. Wistar rats weighing about 150 g were anaesthetized with ether and killed by ether overdose. The mid-small intestine was removed and rinsed with ice-cold Ringer's solution. The Ringer's solution contained, in mM: 140 NaCl, 10 $KHCO_3$, 0.4 KH_2PO_4, 2.4 K_2HPO_4, 1.2 $CaCl_2$, 1.2 $MgCl_2$, $3 \cdot 10^{-3}$ KI and 0.1 μCi ^{135}I, and was continuously bubbled with 95% O_2/ 5% CO_2. The Na^+-free solution was made by replacing Na^+ with choline. A HCO^-_3-free solution was obtained by replacing HCO^-_3 with isethionate. The Cl^- -free solution was prepared by replacing Cl^- with isethionate and adding calcium and magnesium as the sulphates. The everted sac technique of WILSON and WISEMAN (4) has been used in the current study. The sacs filled with 1 ml of Ringer's solution were incubated for 45 min at 37ºC in 10 ml Ringer's solution. The amount of radioactivity present in the original Ringer's solution and in the mucosal and serosal fluids at the end of the experiment was measured in a γ-counter. Net secretion is expressed as total nmol of iodide disappeared from the serosal fluid per gram of wet tissue.

The results summarized in table I show that removal of Na^+ from the mucosal solution abolished net iodide secretion. When Na^+ was absent from the serosal bathing solution iodide secretion was partially inhibited. A small net iodide absorption was observed when the Na^+ was removed from both, mucosal and serosal bathing solutions simultaneously. The effects of either serosal or mucosal Na^+ replacement were additive and equal to that found when sodium was eliminated from both bathing solutions simultaneously.

Net iodide secretion was also decreased by mucosal removal of either chloride or bicarbonate. Serosal substitution of either of these two ions by isethionate did not alter net iodide secretion. Therefore, the effect of removal of either chloride or bicarbonate from the mucosal and serosal

Table I. *Effects of replacement of chloride, sodium and bicarbonate in the bathing solutions on net iodide secretion across rat mid intestine.*

The ions were removed from either the mucosal (m), or serosal (s) or both (m + s) bathing solutions. Values are means ± S. E. of 15 independent determinations (nmol iodide x g^{-1} w.w.) Negative sign represents net absorption.

	Control	m	s	m + s
Na^+ -free	3.80 ± 0.30	0.55 ± 0.60*	2.40 ± 0.10*	–0.75 ± 0.20*
Cl^- -free	3.81 ± 0.40	2.30 ± 0.15*	3.91 ± 0.14	2.64 ± 0.30*
HCO_3^- -free	3.79 ± 0.20	2.20 ± 0.10*	3.40 ± 0.15	2.50 ± 0.10*
Cl^- + HCO_3 -free	3.91 ± 0.23	1.00 ± 0.12*	3.44 ± 0.14	0.90 ± 0.08*

Significant test determined by Student's t-test. Test vs control: * $p < 0{,}001$

bathing solutions simultaneously on net iodide secretion, did not differ from that induced by its mucosal removal alone.

The sum of the inhibition in net iodide secretion caused by chloride-free solutions and that induced by bicarbonate free solutions was equal to that produced by the simultaneous omission of both, chloride and bicarbonate, and smaller than that observed in Na^+-free solutions. These results suggest that both, chloride and bicarbonate may mediate part of the efflux of iodide across the mucosal border.

Together these findings are consistent with the following conclusions: a) iodide enters the cell across the mucosal and serosal border co- transported with sodium, the entry across the mucosal border being the larger, b) the presence of Cl^-/I^- exchange mechanisms that mediate mucosal iodide exit, c) that the inhibition in iodide secretion induced by the simultaneous removal of Cl^- and HCO_3^- was lower than that observed in Na^+ -free solutions is consistent with the presence of other mechanism (s) that mediate mucosal iodide efflux, perphaps anionic channels.

Key words: Iodide secretion, Small intestine, Na^+, Cl^-, HCO_3^- - dependence.

Palabras clave: Secreción de ioduro, Intestino delgado, Na^+, Cl^-, HCO_3^- - dependencia.

Acknowledgements

This work was supported by the Spanish «Comisión Asesora» n.º 0172/81.

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(Received on October 21, 1986)

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