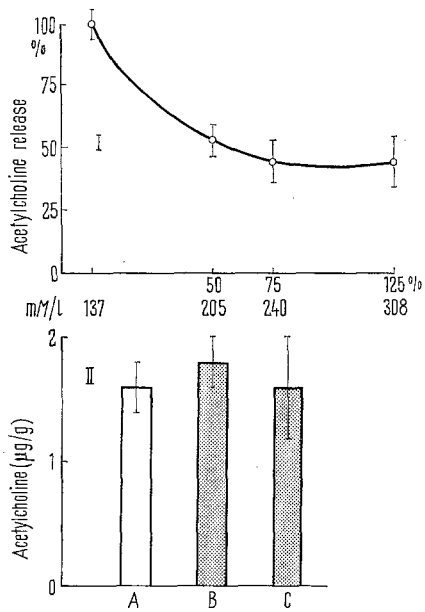
The Effect of NaCl on the Peristalsis of the Isolated Guinea-Pig Ileum

The effect of acetylcholine in sodium-free, chloride-deficient solutions and in a solution containing excess sodium on the smooth muscle cells of guinea-pig taenia coli has been already described[1]. When a nerve-sartorious preparation is soaked in a sodium-deficient solution, neuro-muscular block develops[2]. On the other hand, the effect of physiologically occurring ions on the peristaltic reflex has received very little attention. Recently, it has been shown that lithium, in the same molar concentration as sodium chloride (137 mM/l) in Tyrode solution, cannot replace the sodium ions and a peristaltic block develops[3]. The aim of the present experiments was to investigate the effect of NaCl in excess on the peristaltic reflex of the isolated guinea-pig ileum.

A modified Trendelenburg method[4] was used for studying the peristalsis of the isolated guinea-pig ileum. Volume changes in the intestinal segment were recorded by means of a float recorder[5] and contractions of the longitudinal muscle by an isotonic lever.

The intestine was suspended in a 20 ml bath containing Tyrode solution gassed with oxygen; its temperature was kept at 36°C. NaCl was added to the bath fluid and therefore acted from the serosal surface. Intraluminal pressure was maintained at 3 or 4 cm H_2O for the entire experiment.

Samples of the acetylcholine released during two 30 min time intervals were collected. After 30 min of peristaltic activity stimulated by neostigmine (25 ng/ml), 20 ml of the Tyrode bath solution were transferred to a test-tube containing 0.3 ml of 0.1N HCl. After the neostigmine was washed from the bath, the characteristic spontaneous activity reappeared. NaCl in excess (205 to 308 mM/l) was added and allowed to act for 1 h. Neostigmine (25 ng/ml) was again added for 30 min, and then this sample was also transferred into a test-tube containing 0.3 ml of 0.1N HCl. Both samples were kept on ice until they were assayed for acetylcholine.



The ordinates represent acetylcholine release (I) and its tissue content (II) in the isolated guinea-pig ileum during peristaltic block produced by excess NaCl. The percentage increase of NaCl in Tyrode solution is shown in the first row on abscissa of panel I. In the second row are the concentrations of NaCl in mM/l. A, B and C in panel II are the concentrations of NaCl: 137 mM/l, 205 mM/l and 308 mM/l, respectively. Each point or column represents the mean value of 10 experiments with its S.E.

Acetylcholine tissue content of ileum was extracted according to the method of CHANG and GADDUM[6] under the same conditions as the released acetylcholine was collected in Tyrode solution.

Acetylcholine released in Tyrode solution or its tissue content was assayed using PATON's[7] method. The segment of the isolated guinea-pig ileum was suspended in a 10 ml bath of Tyrode solution with neostigmine methylsulphate 20 ng/ml, morphine sulphate 20 µg/ml, and Synopene 'Geigy' 10 µg/ml. The contractions in response to samples were considered to be acetylcholine if, (1) the contractile response produced by some samples and acetylcholine were equally blocked by small doses of atropine, (2) if the spasmogenic substance lost its activity after boiling for a few minutes in a strongly alkaline medium and, (3) if the contractile response produced by some samples and acetylcholine were equally potentiated by neostigmine. Values are expressed in terms of acetylcholine chloride.

NaCl in excess (205–308 mM/l) blocked the peristalsis of the isolated guinea-pig ileum. The addition of NaCl in excess first produced a contraction of the longitudinal muscle followed by a few peristaltic waves. After this transient stimulant effect caused by excess NaCl, a peristaltic block developed. During peristaltic block, after 1 h exposure to excess NaCl (205–308 mM/l), the acetylcholine release was reduced by about 50%, while its tissue content did not change significantly (Figure). Since the peristaltic block by NaCl in excess was associated with decreased acetylcholine release, it was of further interest to investigate whether this excess of ions also produced alterations in the sensitivity of acetylcholine receptors. Therefore, acetylcholine, which is known to stimulate peristalsis[4], was applied to the bath fluid during the peristaltic block. In this series of experiments, it was found that the applied acetylcholine was without effect during the peristaltic block. Thus, excess NaCl affected both the acetylcholine release and the response to applied acetylcholine[8].

Résumé. On a étudié l'action de NaCl sur le péristaltisme. Après une heure, dans une solution de Tyrode saturée de NaCl (205–308 mM/l), un blocus neuromusculaire est apparu. Pendant cette inhibition du péristaltisme, la libération de l'acétylcholine a diminué de presque 50% et l'effet de cette substance a été annulé.

D. B. BELESLIN[9]

Department of Pharmacology, Medical Faculty, Beograd (Yugoslavia), 16 June 1969

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[9] Present address: Laboratory of Neuropsychology, Department of Psychology, Purdue University, Lafayette (Indiana 47907, USA).