IJAE
Vol. 118, n. 1 (Suppl.): 82-83, 2013
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

Muscular effects of relaxin on the mouse colon: mechanical and electrophysiological studies

Roberta Squecco, Rachele Garella, Fabio Francini, Maria C. Baccari*

Department of Physiological Sciences, University of Florence, Viale G.B. Morgagni 63, I-50134 Florence, Italy

Summary

Relaxin has been reported to influence gastrointestinal motility in mice. However, at present, nothing is known about the effects of relaxin on the electrophysiological properties of the gastrointestinal smooth muscle. In the present experiments relaxin, other than influencing the colonic motility pattern, has been shown to act on cell membrane properties. The results of the present study indicate that relaxin directly modulates the motility of the proximal colon and the membrane potential of smooth muscle.

Key words

Relaxin, colon, smooth muscle

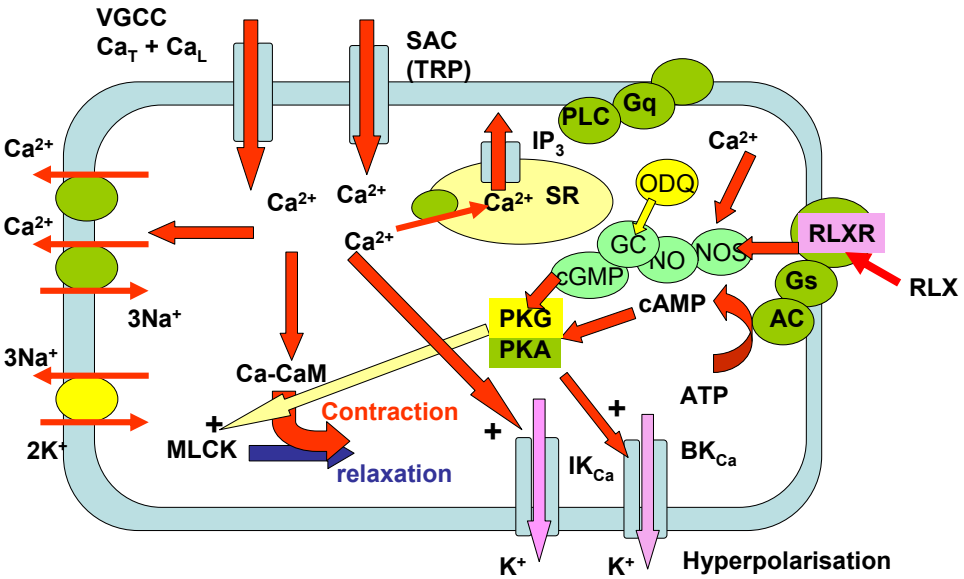
Relaxin (RLX) has been reported to influence gastrointestinal motility in mice acting at either the neurotransmission or the smooth muscle level, depending on the gut segment considered (1-4). However, at present, nothing is known about the effects of relaxin on the electrophysiological properties of the gastrointestinal smooth muscle. In the present experiments the effects of relaxin on colonic motility in mice were further investigated and electrophysiological records in a single smooth muscle cell were also performed. For this combined approach, preparations from the proximal colon were mounted in organ baths for isometric recording of the mechanical activity, whereas changes in resting membrane potential were recorded in current-clamp conditions by single microelectrode inserted in a smooth muscle cell. As previously observed (2) in mechanical experiments, colonic preparations exhibited spontaneous contractile activity consisting of rhythmic changes in isometric tension. Relaxin caused a decay of the basal tension, that persisted for the whole time of exposure, coupled by a stable and long-lasting increase in amplitude of the spontaneous contractions. The nitric oxide synthesis inhibitor L-NNA (200 μM) or tetrodotoxin (1 μM) only abolished the basal tension decay. In the presence of the guanylate cyclase inhibitor ODQ (1 μM) relaxin had no longer effect.

Electrophysiological records, achieved by a single microelectrode inserted in a single smooth muscle cell in current-clamp condition, showed rhythmic changes in the resting membrane potential. Relaxin induced the following changes: an early slow hyperpolarisation and a late increase of the rhythmic rate of potential waves with, occasionally, some spikes superimposed.

* Corresponding Author: Department of Physiological Sciences, University of Florence, Viale G.B. Morgagni 63, I-50134 Florence, Italy. mcaterina.baccari@unifi.it; Phone: +055-423733.

http://www.fupress.com/ijae

Scheme 1



The increase in PKG and PKA activity enhances BK_{Ca} channel causing hyperpolarization. This condition increases the driving force that enhances the Ca^{2+} influx through VGCC and SACs, and consequently the cell depolarizes. The greater $[Ca^{2+}]_i$ potentiates IK_{Ca} and BK_{Ca} currents so the cell repolarizes again. This results in rhythmic voltage waves and parallel increase in size of spontaneous contractions.

Adding ODQ in presence of relaxin, induced an increased rate of the rhythmic waves in the resting membrane potential after about 1 min.

The direct mechanical and electrophysiological effects of relaxin on muscle modulation could be explained by the increase of cGMP and cAMP synthesis, by Gs-NOS-GC-cGMP and Gs-AC-cAMP pathways. Our results may be explained by scheme 1.

In conclusion, the results of the present study indicate that relaxin, other than directly modulating muscular colonic motility, also affects membrane potential of colon smooth muscle.

References

1) Baccari M.C. (2008) Relaxin and nitric oxide signalling. Curr. Prot. Pept. Sci. 9: 638-645.
2) Baccari M.C. et al. (2012) Relaxin exerts two opposite effects on mechanical activity and nitric oxide synthase expression in the mouse colon. Am J Physiol Endocrinol Metab, 303:E1142-E1150.
3) Baccari, M.C.et al. (2004) Depression by relaxin of neurally induced contractile responses in the mouse gastric fundus. Biol. Reprod. 70: 222-228.
4) Bani, D., et al. (2002) Relaxin depresses small bowel motility through a nitric oxide-mediated mechanism. Studies in mice. Biol. Reprod. 66: 778-784.