Virtual Experiment

Movement of isolated segment of mammalian small intestine

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[Purpose]

• To learn how to make a preparation of isolated segment of mammalian small intestine.
• To measure contractions of the segment of small intestine in an organ bath with a force transducer.
• To investigate the effects of temperature, hydrogen chloride (HCl), sodium hydroxide (NaOH), acetylcholine (ACh) and norepinephrine (NE) on movements (contraction strength and rate) of the small intestine.
General properties of gastrointestinal smooth muscle:

- Low excitability
- High distensibility
- Tonic contraction
- Autorhythmicity
- High sensitivity to temperature, stretch and chemical stimulation

• **Slow wave potential**
  - a membrane potential that cycles between depolarizations and repolarizations in the gastrointestinal smooth muscle
  - originates in the cells of Cajal as the basic electrical rhythm
• **Features of slow wave potential**
  - always present but do not always cause contraction
  - dictate frequency of contractions
  - **amplitude** and **frequency** modulated by
    - body temp & metabolic activity
    - intrinsic (Auerbach's plexus & Meissner's plexus) or extrinsic (Sympathetic nervous system & Parasympathetic nervous system) innervation
  - circulating hormones

• The important feature of the BER is that it regulates the frequency of contractile waves in different parts of the gastrointestinal tract.
[Experimental object]

[Experimental method & procedure]

- Anaesthesia.
- Remove segments of duodenum near the stomach and make up preparations approximately 2 cm in length.
- Mount preparations longitudinally on tissue holders. Connect preparations to an isometric transducer under 2 g tension in a 20-ml organ bath containing Tyrode’s solution, oxygenated with 95%O₂±5%CO₂ at 37°C.
- Equilibrate for 20 min, solution is changed at 15 min intervals.
- Record movements. Measure the amplitude and frequency of the spontaneous contractions.
[Procedure]
Effect of low temperature on movements of the small intestine.
Effect of acetylcholine (ACh) on movements of the small intestine.
Effect of adrenaline (Adr) on movements of the small intestine.

Effect of sodium hydroxide (NaOH) on movements of the small intestine.
Effect of hydrogen chloride (HCl) on movements of the small intestine.
Experiment items

1) Measure the changes in amplitude and frequency of spontaneous contractions under normal conditions
2) 25°C Tyrode’s solution  20ml
3) 1:10000 ACh  100ul
4) 1:10000 Adr  100ul
5) 1 mol/L HCl  100ul
6) 1 mol/L NaOH  100ul

Design and complete a table after all the above experiments have been done
Effects of temperature, HCl, NaOH, ACh and Adr on movements of the small intestine in rabbit.

<table>
<thead>
<tr>
<th></th>
<th>Frequency (contractions/min)</th>
<th>Amplitude (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before treatment</td>
<td>During treatment</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
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<tr>
<td>25°C Tyrode’s solution</td>
<td></td>
<td></td>
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<tr>
<td>1:10000 ACh</td>
<td></td>
<td></td>
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<tr>
<td>1:10000 Adr</td>
<td></td>
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<tr>
<td>1 mol/L HCl</td>
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<tr>
<td>1 mol/L NaOH</td>
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</tbody>
</table>

**Tips**

- Be sure to **wash** the preparation immediately after a significant effect is observed to avoid an irreversible change in resposiveness.
- Be sure the preparation has **returned** to **normal conditions** before the next drug is added.
DISCUSSION

• Why is the upper part of small intestine used (duodenum near stomach)?
• What are the effects and mechanisms of action of ACh on the movements of gastrointestinal smooth muscle?
• What are the effects and mechanisms of action of HCl on the movements of gastrointestinal smooth muscle?

The End.