Movement of isolated segment of mammalian small intestine

[Purpose]
1. Learn how to make a preparation of isolated segment of mammalian small intestine.
2. Learn the technique of isolated small intestine perfusion.
3. Investigate the effects of temperature, HCl, NaOH, acetylcholine (ACh) and norepinephrine (NE) on movements of the small intestine.

[Principle]
General properties of gastrointestinal smooth muscle:
1) Low excitability
2) High distensibility
3) Tonic contraction
4) Autorhythmicity
5) High sensitivity to temperature, stretch and chemical stimulation

Effects of low temperature, HCl, CaCl₂, NaOH, ACh and NE on movements of the small intestine will be investigated in this experiment.

[Experimental object]
Rabbit.

[Experimental apparatus]
Mammal surgical instruments, modified organ bath, isometric transducer, thread, RM6240 multi-channel physiological recording and processing system, pipettes. 1 mol/L HCl, 1 mol/L NaOH, 1:10000 ACh, 1:10000 NE and Tyrode’s solution (mM: NaCl 136.8; KCl 2.69; CaCl₂ 1.79; MgCl₂•6H₂O 0.06; NaHCO₃ 11.9; NaH₂PO₄•H₂O 0.43; glucose 5.55).

[Experimental method & procedure]
1. Rabbit is anaesthetized and bled.
2. Remove segments of duodenum near the stomach and make up preparations approximately 2 cm in length.
3. 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 (Fig. 6-1). Allow preparation to equilibrate for 20 min; during this period, change the solution at 10 min intervals.
4. Record movements with RM6240 multi-channel physiological recording and processing system. Measure the amplitude and frequency of the spontaneous contractions.
5. Experiments items

(1) Measure the changes in amplitude and frequency of spontaneous contractions under normal conditions.

(2) 25°C Tyrode’s solution: Change the 37°C Tyrode’s solution to 25°C Tyrode’s solution. Measure the changes in amplitude and frequency of spontaneous contractions. After a significant effect is observed, wash the preparation immediately with 37°C Tyrode’s solution at least three times until the movements return to normal.

(3) 1:10000 ACh: Add 0.3 ml 1:10000 ACh into the perfusion solution. Measure the changes in amplitude and frequency of spontaneous contractions. Wash the preparation immediately after a significant effect is observed.

(4) 1:10000 NE: Add 0.3 ml 1:10000 NE into the perfusion solution. Measure the changes in amplitude and frequency of spontaneous contractions. Wash the preparation immediately after a significant effect is observed.

(5) 1% CaCl₂: Add 0.3 ml 1% CaCl₂ into the perfusion solution. Measure the changes in amplitude and frequency of spontaneous contractions. Wash the preparation immediately after a significant effect is observed.

(6) 1 mol/L HCl: Add 0.3 ml 1 mol/L HCl into the perfusion solution. Measure the changes in amplitude and frequency of spontaneous contractions. Wash the preparation immediately after a significant effect is observed.

(7) 1 mol/L NaOH: Add 0.3 ml 1 mol/L NaOH into the perfusion solution. Measure the changes in amplitude and frequency of spontaneous contractions. Wash the preparation immediately after a significant effect is observed.

(8) Complete table 6-1 after all the above experiments have been done.

Tips:

- Drug volume is for your reference. Please modify the volume of drugs according to
the response of the intestine to get satisfactory effects.

- 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.

[Virtual Experiment Procedure]

1. Open the virtual experiment window of movement of small intestine (Fig. 6-2)

![Virtual experiment window of movement of small intestine](image.png)

Fig.6-2. Virtual experiment window of movement of small intestine.

2. Move the mouse to the red burette icon. Click the left mouse key to move the burette to the burette image area on the top of the organ bath to start the experiment items one by one (Fig. 6-2). As shown in the recorder, the amplitude and frequency of the spontaneous contractions can be recorded with marks. Mimic the action of wash immediately after a significant effect is observed by clicking the clamp image.

3. Experiment items as above (NO item of CaCl₂).
4. Click the “measure” button to review the whole results of experiment items. Measure the amplitude and frequency of the spontaneous contractions. Edit or print the data.

Table 6-1: Effects of temperature, HCl, NaOH, CaCl₂, ACh and NE 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>25°C Tyrode’s solution</td>
<td>1:10000 ACh</td>
</tr>
<tr>
<td></td>
<td>1% CaCl₂</td>
<td>1 mol/L HCl</td>
</tr>
</tbody>
</table>

[Discussion]

1. Why is the upper part of small intestine used (duodenum near stomach)?
2. What are the effects and mechanisms of action of 25°C Tyrode’s solution on the movements of gastrointestinal smooth muscle?
3. What are the effects and mechanisms of action of ACh on the movements of gastrointestinal smooth muscle?
4. What are the effects and mechanisms of action of NE on the movements of gastrointestinal smooth muscle?
5. What are the effects and mechanisms of action of 1% CaCl₂ on the movements of gastrointestinal smooth muscle?
6. What are the effects and mechanisms of action of 1 mol/L HCl on the movements of gastrointestinal smooth muscle?

7. What are the effects and mechanisms of action of 1 mol/L NaOH on the movements of gastrointestinal smooth muscle?