Experiment 2.3

Demonstrate the following on gastrocnemius muscle and sciatic nerve preparation of frog

- I. Effect of two successive stimuli applied at different time intervals.
- II. Genesis of tetanus.

I. EFFECT OF TWO SUCCESSIVE STIMULI APPLIED AT DIFFERENT TIME INTERVALS

OBJECTIVES

At the end of practical class student should be able to-

- 1. Analyze, interpret and explain the graphs related to this experiment.
- 2. Explain the beneficial effect.
- 3. Explain summation of effect.
- 4. Explain summation of stimuli.

APPARATUS

Same as in simple muscle twitch.

Procedure

- 1. Record a simple muscle twitch as described in Experiment 2.2.
- 2. Separate the contact arm (strikers) in such a way that second stimulus will fall in early part of latent period of first stimulus and record the simple muscle twitch.
- 3. Repeat the same procedure in such a way that second stimulus falls.
 - i. In second fall of latent period.
 - ii. In contraction period.
 - iii. In relaxation period.
 - iv. Immediately after relaxation period of first twitch.

RESULT AND DISCUSSION (Fig. 2.3.1)

Precautions

Same as in simple muscle twitch.

QUESTIONS AND ANSWERS

- Q.1. What is beneficial effect?
- *Ans.* There is a gradual rise in the height of first three or four contractions when stimulated successively just after relaxation of muscle each time. The important reasons underlying the phenomenon are:
 - i. Available of more Ca⁺⁺ at actin-myosin site because of incomplete withdrawal of these ions during relaxation.
 - ii. Increase in the temperature of muscle.
 - iii. Decrease in internal viscosity of muscle.

Q.2. What is summation of effect?

Ans. When the second stimulus is given to the tissue after the refractory period of the first is over, it leads to further development of tension.

Q.3. What is summation of stimuli?

Ans. When preparation is stimulated repeatedly with subthreshold stimuli it produces response. This is called summation of stimuli.

II. GENESIS OF TETANUS

OBJECTIVES

At the end of practical class student should be able to-

- 1. Analyze, interpret and explain the graphs related to this experiment.
- 2. Tell what do you understand by incomplete and complete tetanus.
- 3. Tell the type of activity involved in maintenance of posture.
- 4. Tell what is clonus.
- 5. Calculate tetanizable frequency for a given simple muscle twitch.
- 6. Tell how does tetanus differ from tetany.
- 7. Tell what is pathological tetanus.
- 8. Tell what is physiological contracture.
- 9. Tell what is rigor.
- 10. Explain, why the cardiac muscle cannot be tetanized.



Fig. 2.3.1: Simple muscle twitch with two successive stimuli.

Amphibian Experiments





Physiology Practical Manual

APPARATUS

Same as in simple muscle twitch except variable interrupter and signal marker.

Procedure

- 1. Arrange the muscle nerve preparation as for simple muscle twitch.
- 2. Remove kymograph from the primary circuit and add variable interrupter in the circuit.
- 3. Now record simple muscle twitches at slow speed (12.5 mm/sec) with frequency of stimuli above 5/sec.
- 4. Increase the frequency of stimuli 10 and 20 per second and take the record.
- 5. Now remove the variable interrupter from primary circuit and include Neef's hammer of induction coil in the primary circuit and adjust frequency of stimuli 30 and 50/sec. and take the recording again. Nerve can be stimulated with the help of student stimulation (electronic stimulation) with different frequency of stimuli (variable interrupter gives low frequency of stimuli up to 25–30/sec and Neef's gives higher frequency of stimuli 40–100/sec).

Result and Discussion (Fig. 2.3.2)

Precautions

- 1. Prevent drying of preparation.
- 2. Avoid unnecessary stimulation of the preparation.

QUESTIONS AND ANSWERS

Q.1. What is beneficial effect?

- *Ans.* There is a gradual rise in the height of first three or four contractions when stimulated successively just after relaxation of muscle each time.
- Q.2. What do you understand by incomplete and complete tetanus?
- *Ans.* In incomplete tetanus there is slight relaxation in between the contractions. In complete tetanus there is no relaxation at all.
- Q.3. What type of activity is involved in maintenance of posture?
- *Ans.* Incomplete tetanus type of contractions are present in maintaining the posture. The asynchronous discharge of nerve fibers causes smooth muscle contractions.
- Q.4. What is clonus?
- *Ans.* It is a state of incomplete tetanus.
- Q.5. Can you calculate tetanizable frequency for a given simple muscle twitch?
- *Ans.* Yes. It can be calculated by dividing one second by contraction period of that muscle. For example, contraction period of a muscle = 0.04 sec. or 40 m sec. Tetanizable frequency for that muscle = $1 \div 0.04 = (1000 \div 40) = 25$ per sec.
- Q.6. How does tetanus differ from tetany?
- *Ans.* Tetanus is a state of sustain contraction because of repeated stimulation and tetany is because of deficiency of calcium ions in the body which causes hyperexcitability of neural tissue.
- Q.7. What is pathological tetanus?
- *Ans.* It is produced because of toxins of certain anaerobic bacteria.
- Q.8. What is physiological contracture?
- *Ans.* When fatigue sets in, the muscle is unable to relax fully and remains in a state of partial contraction called physiological contracture or contraction remainder.
- Q.9. What is rigor?
- *Ans.* Removal of calcium ions from actin-myosin site is an active process, a decrease in ATP during fatigue not allowing the muscle to relax and there is state of muscle contraction called rigor. When it occurs after death, it is called rigor mortis.

Q.10. Why the cardiac muscle cannot be tetanized?

Ans. Cardiac muscle is having a long refractory period this is why it cannot be tetanised.

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