

Outline the differences between the excitation-contraction coupling mechanism bet...



Outline the differences between the excitation-contraction coupling mechanism between skeletal and cardiac muscles. Excitation-contraction coupling is the combination of the electrical and mechanical events in the muscle fibres and is related by the release of calcium from the sarcoplasmic reticulum. (Silverthorn, 2007) In the skeletal muscle, action potential in the nerves is generated when the somatic motor neurons releases the neurotransmitter acetylcholine (ACh), at the neuromuscular junction. This initiates muscle action potential which is then transmitted to the t-tubules.

Action potential in the t-tubules leads to the release of calcium in the sarcoplasmic reticulum triggering muscle contraction. In the cardiac muscles, the initial depolarisation in sino-atrial node initiates the action potential in the muscles. This is then transmitted to T-Tubule which leads to calcium influx from extracellular space. This leads to the sarcoplasmic reticulum releasing calcium which causes the muscle contraction. The skeletal muscles need ACh from the somatic motor neuron, in order for skeletal muscle action potential to initiate excitation- contraction coupling.

In cardiac muscles, the action potential also initiates EC coupling, but it originates impulsively in the hearts pace maker cells and spreads via gap junctions. (Richard and Pocock, 2006) The skeletal muscles and cardiac muscles differ mainly in mechanisms by which the depolarisation in the membrane leads to the release of Ca^{2+} . In the skeletal muscle, the T-tubule membrane is coupled closely to the sarcoplasmic reticulum via the L-type calcium channel and the ryanodine receptor.

However, in the cardiac muscle the Ca^{2+} enters via voltage-gated calcium channels which initiate a regenerative release, through activation of the <https://assignbuster.com/outline-the-differences-between-the-excitation-contraction-coupling-mechanism-between-skeletal-and-cardiac-muscles/>

Ca²⁺ sensitive ryanodine receptor and this initial entry triggers further release from the sarcoplasmic reticulum. (Rang and Dale, 2003) The mechanism of excitation- contraction coupling in the skeletal muscle relies on the ryanodine receptor being activated to produce the Ca²⁺ from the sarcoplasmic reticulum that is responsible for allowing muscle contraction. This is evident of direct coupling between the calcium channels of the T-tubule and the ryanodine receptors of the sarcoplasmic reticulum.

The cardiac muscles lack T-tubules and therefore, there is no direct coupling between the plasma membrane and the sarcoplasmic reticulum. In cardiac muscles, the mechanism relies on a calcium-induced calcium release, which includes the conduction of calcium ions into the cell, causing the further release of ions. (Rang and Dale, 2003) The duration of action potential also differs for the skeletal and cardiac muscles. In the skeletal muscles, the action potential short and ends as the related twitch contraction begins.

The twitch contraction is short and ends as the sarcoplasmic reticulum recovers the Ca²⁺ that it released. In the cardiac muscle cells, the action potential is long-lasting, and Ca²⁺ carries on entering the cell throughout the plateau period. As a result, the muscle cell contraction continues until the plateau ends. Therefore, the cardiac muscle contractions are nearly 10 times as long as those of skeletal muscles fibres. (Silverthorn, 2007) The cardiac muscle tissue can contract without neural stimulation, via automaticity and the specialized cardiac muscle cells called pacemaker cells control the timing of contractions.

However, the skeletal muscle requires ACh from the motor neurons for contractions. (Mader, 2006) Mader, S, S,. (2006) Human Biology (9th ed.). <https://assignbuster.com/outline-the-differences-between-the-excitation-contraction-coupling-mechanism-between-skeletal-and-cardiac-muscles/>

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