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Comparative Morphological Characteristics of Skeletal Muscle Changes Under Local and General Anesthesia in Mechanical Injury of the Lower Limb

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RELEVANCE OF THE STUDY

Currently, many modern types of analgesics and anesthetic drugs have been developed, which significantly facilitate invasive procedures in surgery, dentistry, and traumatology. The systemic effects of anesthetic techniques and agents on different organs have been studied for many years; however, the impact of anesthetics on skeletal muscle myocytes of the musculoskeletal system remains insufficiently investigated. Neuromuscular transmission monitoring is widely used in anesthetic practice, especially during administration of muscle relaxants and in regional or local anesthesia to determine the level of sensory block. The method is based on recording muscle contraction following electrical stimulation of peripheral nerves. In anesthesiology, the ulnar nerve is most often stimulated, and the contraction strength of the adductor pollicis muscle is evaluated. Muscle tissue damage during infiltration anesthesia is associated with an increase in extracellular Ca^{2+} concentration. Among local anesthetics, bupivacaine demonstrates the most pronounced myotoxic effect, followed by ropivacaine, lidocaine, and tetracaine. Anesthetics may also affect mitochondrial ATP morphology and influence sodium channel function, leading to delayed ion dissociation. Some anesthetics reduce muscle tone, improve microcirculation, and relax muscle tissue.

Aim of the Study

To comparatively characterize morphofunctional changes in skeletal muscle of white outbred rats under local and general anesthesia after mechanical injury of the lower limb, and to investigate anesthetic-induced alterations in myocytes.

Materials and Methods

The study included 100 male and female white outbred rats aged 3, 6, 9, and 12 months. Experimental mechanical injury of the lower limb was performed. Skeletal muscle tissue samples were studied under local anesthesia and general anesthesia using immunohistochemical (IHC), histochemical, and cytomorphological methods. Morphological changes in muscle fibers, inflammatory response, and cellular damage were evaluated microscopically.

Scientific Novelty

1. Morphological changes in injured skeletal muscle under local anesthesia in rats aged 3, 6, 9, and 12 months were studied using immunohistochemical and histochemical methods.

2. Morphological changes in injured skeletal muscle under general anesthesia in rats of the same age groups were analyzed using identical morphological techniques.

Practical Significance

Age-related changes in skeletal muscle tissue after lower limb mechanical injury were studied using immunohistochemical and histochemical methods. The obtained results allow comparison of anesthetic-induced morphological changes in skeletal muscle under different anesthesia techniques. The findings contribute to selecting the least traumatic anesthesia strategy in clinical management of musculoskeletal injuries.

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