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Force Production Declines Without Effects On Mitochondrial Respiration In Rats Exposed To Consecutive Tetanus Contractions

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Skeletal muscle has an enormous dynamic range, and mitochondria are responsible for the aerobic production of ATP within muscle fibers. In the mitochondria, electrons are transferred across different protein complexes down their potential gradient to create a protonmotive force used to synthesize ATP. Recently, the organization of the protein complexes of the electron transport chain into supercomplexes (SC) (e.g. CI+CIII₂+CIV), which would theoretically aid in ATP synthesis, has been shown to increase with exercise training. It is unknown, however, if acute contraction can alter the organization of SC within skeletal muscle mitochondria. **PURPOSE:** The goal of the present study was to determine if performing fatiguing twitch contractions (Twitch - T) on Type I muscle (soleus) from male and female rats alters maximal mitochondrial respiration and/or SC formation compared to control (No-Twitch - NT). **METHODS:** Solei were dissected from 44 weeks old Sprague-Dawley rats following euthanasia. Suture loops were attached to the distal end of both solei and the excised muscles were transferred to the muscle force testing system incubated with the Ringer's-Solution bubbled with 100% O₂ at 37°C. Maximal twitch force was recorded with single twitches at 1Hz, followed by stretching of the passive tension by about 10mN. The muscle was then stimulated to tetanus at 100Hz. This procedure was repeated with 1min rest periods until maximal force was decreased to 50%. Mitochondria were then isolated from 0.1 g of T and NT muscles using differential centrifugation and O₂ consumption rate was determined in the presence of respiration media, fuels, and ADP. BN-PAGE was performed to examine the organization of complexes and SC in isolated mitochondria, after membranes were solubilized with digitonin. **RESULTS:** Repeated tetanus contractions resulted in reduction of force production in both male and female rats (1515±7 vs 776±12), however females were able to produce more force per mass compared to males (0.0013 vs 0.0009 mN/g, p< 0.05). No differences were observed in mitochondrial respiration rates between T and NT solei (0.17±0.01 vs 0.18±0.01 nmol/g/min), although qualitative analysis of BN-PAGE showed signs of severe protein degradation in muscles subjected to the tetanus protocol. **CONCLUSION:** Consecutive tetanus contractions lead to reduction in force production and are possibly causing intense protein damage. The optimization of tetanic contraction protocols is essential to determine if SC organization can be altered acutely following muscle exertion and how mitochondria respiration and ATP production can be affected by these events. **SIGNIFICANCE/ NOVELTY:** Assessing if acute changes in mitochondrial SC occur as a result of fatiguing contractions in skeletal muscle can provide novel insights into exercise prescription and adequate ways to promote optimal performance, avoiding muscle damage.

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