

Cold and menthol receptor activation TRPM8 improves post-traumatic recovery of rat *muscle soleus* in C₆₀ fullerene therapy

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Introduction

The biomechanical parameters of *muscle soleus* of rats during the first 3 days of development of the posttraumatic syndrome caused by destruction of muscle cells by means of the mechanical compression are studied. Injections of both C₆₀ fullerene antioxidant and menthol, which is the selective agonist of TRPM8 cold receptors, are used as therapeutic agents. Injections of an aqueous colloidal solution of C60 fullerene (at concentration of 1 mg/kg) into the damaged muscle improve its contractile function by 25–30%.

Methods

The experiments were carried out on 30 male Wistar line rats in age of 3 months, weighing 170±5 g. All surgical procedures and modeling of Crush Syndrome were performed by standard protocol. To cause muscle fatigue, 10 min series of 1 Hz electrical stimulation was performed at 1.3-1.4 thresholds [1].

To produce C₆₀FAS a method based on the transfer of these carbonsn from

Application of combined injections of C₆₀ fullerene and menthol (at concentration of 1 mkg/kg) improve this indicator by an extra 17–19%, while stabilizing the decrease in muscle strength observed throughout all experiments. The revealed synergy effect of menthol and aqueous solution of C₆₀ fullerene on posttraumatic process of restitution of skeletal muscle function opens up new prospects for the clinical application of such a combined therapy.

toluene to water with subsequent ultrasound treatment has been used. [2, 3].

The statistical processing of the results was performed by the methods of variation statistics using software Origin 9.4. Performed at least 5-6 repetitions of every dimension.

Results

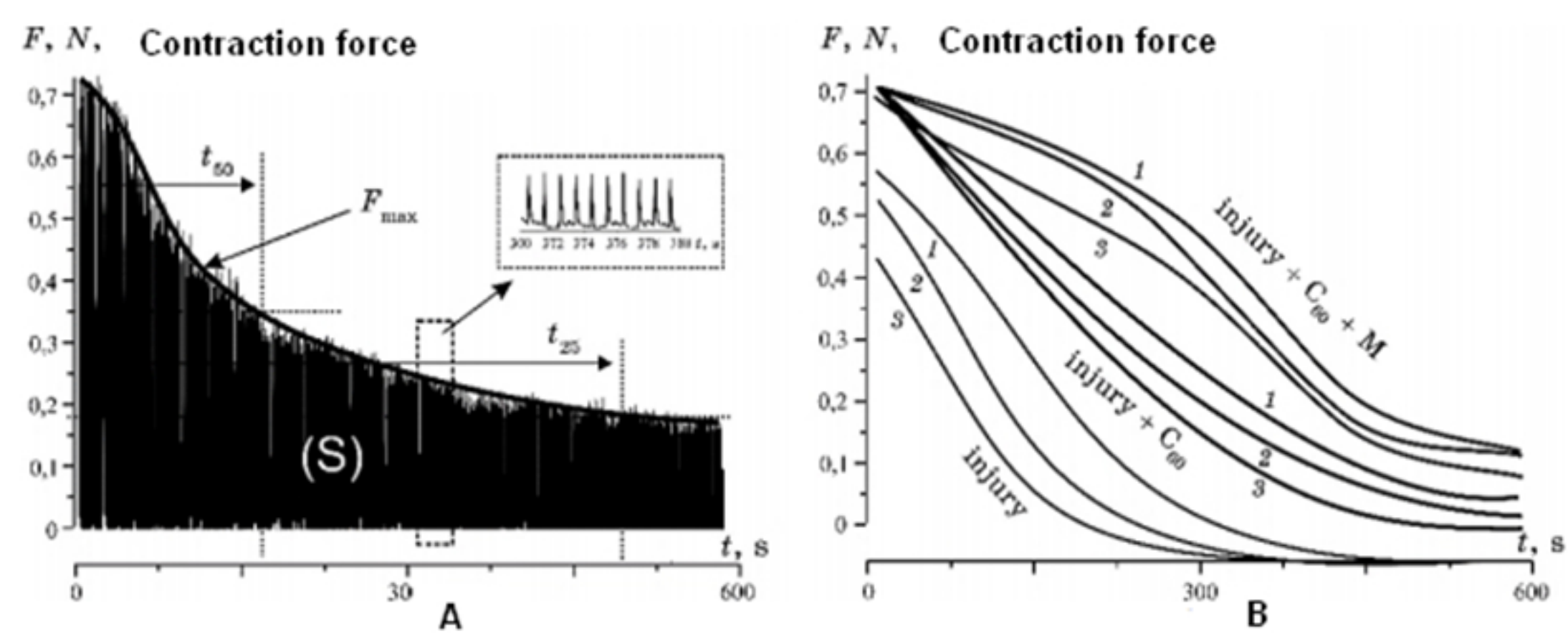


Fig 1. Force generation curves of *muscle soleus* contraction caused by stimulative irritation frequent 1 Hz and duration of 600 s: A- analyzed fatigue development markers; B - curves of maximum muscle power response when using therapeutic agents (C₆₀-fullerene (C₆₀) and menthol (M)); F_{max} - maximum muscle power response; (S) - integrated muscle contraction power; t₅₀ and t₂₅ - time to reach 50% and 25% of the initial amplitude of muscle power; 1, 2, 3 - curves of maximum muscle power; power responses on the 1st, 2nd and 3rd day after muscle injury; injury, C₆₀, injury C₆₀ M - injury, injury against the background of injections C₆₀ and C₆₀ with M respectively.

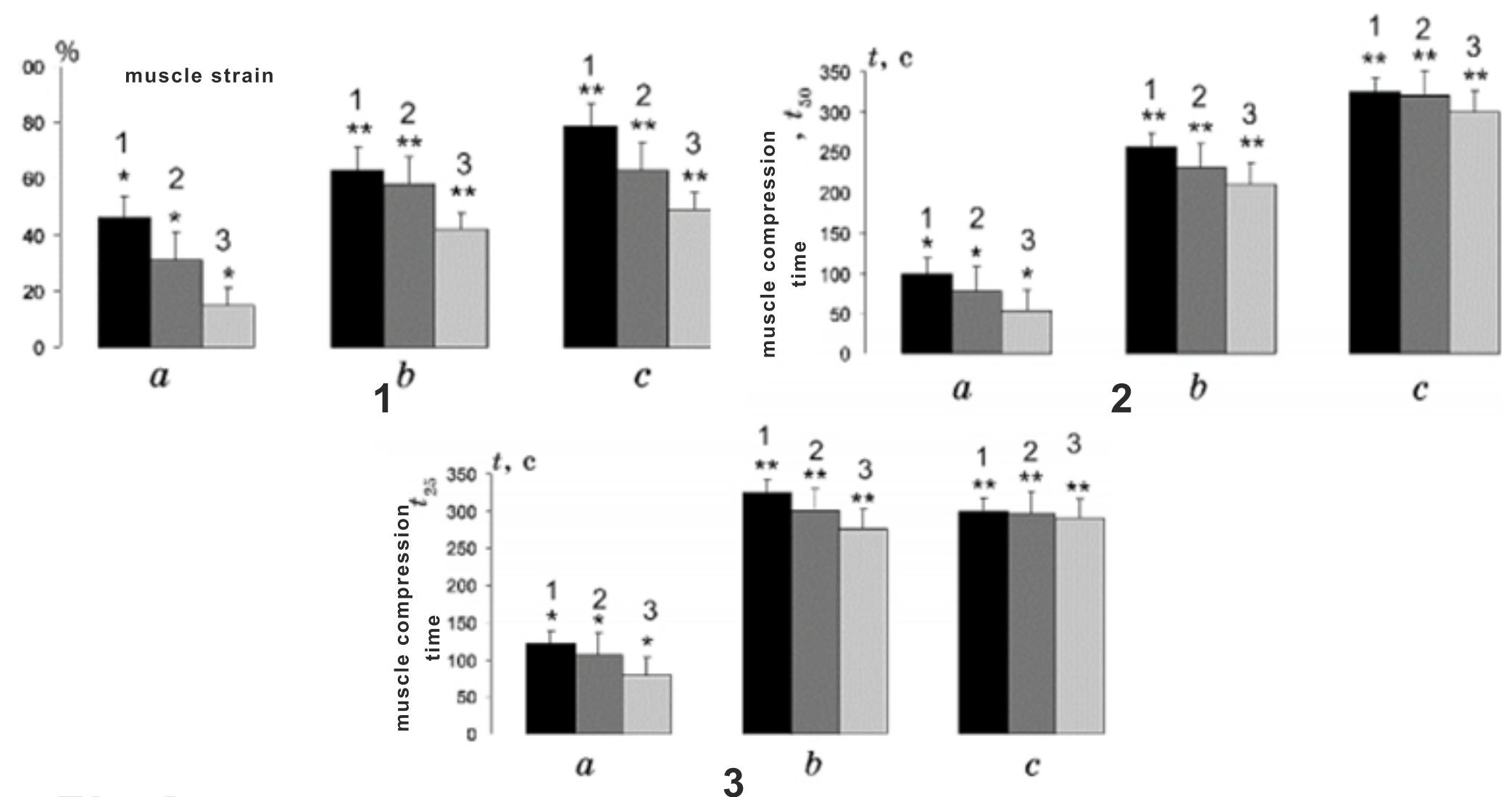


Fig 2. Biomechanical parameters of post-traumatic muscle fatigue in the use of therapeutic agents: a, b and c -injury, injury with C₆₀- fullerene and C₆₀- fullerene menthol injections, respectively. *p<0,05; **p<0,05 relative to group a.

Conclusion

Crush Syndrome is a systemic manifestation of the destruction of muscle cells caused by compression, provoking the release of cellular components (CK, lactic acid and myoglobin etc.) in extracellular fluid as a muscle injury factor, revealed a significant reduction in the power reaction of muscles with progressive temporal symptomatology (Fig. 1). The use of C₆₀- fullerene injection significantly improved the contractile process dynamics of the damaged muscle. These data indicate a significant positive trend in the therapeutic use of C₆₀FAS. The ability of C₆₀- fullerene to effectively neutralize free radicals is, in our opinion, the main reason for the positive results obtained.

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The specific action of menthol affects the effects we have obtained, namely, the reduction of pain symptoms, inflammatory reactions, improvement of metabolic reactions and changes in vascular tone. The identified synergy of the therapeutic action of menthol and C₆₀FAS to post-traumatic skeletal muscle repair requires its further detailed examination with to conduct clinical trials.

References

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