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# Atenolol Ameliorates Skeletal Muscle Atrophy and Oxidative Stress Induced by Cast Immobilization in Rats

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**Abstract:** (1) Background: Skeletal muscle atrophy is a common and debilitating condition associated with disease, bed rest, and inactivity. We aimed to investigate the effect of atenolol (ATN) on cast immobilization (IM)-induced skeletal muscle loss. (2) Methods: Eighteen male albino Wistar rats were divided into three groups: a control group, an IM group (14 days), and an IM+ATN group (10 mg/kg, orally for 14 days). After the last dose of atenolol, forced swimming test, rotarod test, and footprint analysis were performed, and skeletal muscle loss was determined. Animals were then sacrificed. Serum and gastrocnemius (GN) muscles were then collected, serum creatinine, GN muscle antioxidant, and oxidative stress levels were determined, and histopathology and $^{1}$H NMR profiling of serum metabolites were performed. (3) Results: Atenolol significantly prevented immobilization-induced changes in creatinine, antioxidant, and oxidative stress levels. Furthermore, GN muscle histology results showed that atenolol significantly increased cross-sectional muscle area and Feret's diameter. Metabolomics profiling showed that glutamine-to-glucose ratio and pyruvate, succinate, valine, citrate, leucine, isoleucine, phenylalanine, acetone, serine, and 3-hydroxybutyrate levels were significantly higher, that alanine and proline levels were significantly lower in the IM group than in the control group, and that atenolol administration suppressed these metabolite changes. (4) Conclusions: Atenolol reduced immobilization-induced skeletal muscle wasting and might protect against the deleterious effects of prolonged bed rest.

**Keywords:** cast immobilization; atenolol; oxidative stress; metabolomics; skeletal muscle atrophy



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## 1. Introduction

Skeletal muscle atrophy is defined as a loss of skeletal muscle mass and may occur as a consequence of diseases such as cancer, acquired immunodeficiency syndrome, sepsis, burn injury, organ failure, or respiratory or metabolic disease [1]. Disuse atrophy (also called immobilization) is defined as a loss of skeletal muscle mass due to inactivity or lower activity than normal and usually affects a single group of muscles. This condition usually occurs after prolonged bed rest, spinal cord injury, exposure to microgravity, or intensive care unit (ICU) stay and is commonly encountered after cast application for fracture management or permanent bed rest [2]. On the other hand, neuronal muscle atrophy occurs after denervation or spinal cord injury. Studies have shown that astronauts exposed to microgravity suffer considerable bone strength and cross-sectional muscle area