

INTERVENTIONS TO IMPROVE MUSCLE PROTEIN METABOLISM DURING STRESS

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INTRODUCTION

Muscular inactivity results in a decrease in muscle protein synthesis, and in turn, a loss of lean body mass (LBM). LBM is lost during bed rest alone, but is accelerated when accompanied by stress or trauma. The loss of LBM with space flight may be the result of both muscular inactivity and stress-induced affects on muscle protein. With stress or injury, the hormonal profile is altered such that muscle protein maintenance is impaired. We have investigated nutritional and hormonal interventions which maintain muscle protein during metabolic stress.

CURRENT STATUS OF RESEARCH

Methods and Results

During stress or injury, an elevated cortisol secretion is sustained, while testosterone (T) production is severely reduced. Since cortisol remains elevated throughout space flight, we investigated its interaction with muscular inactivity. Six healthy subjects were made hypercortisolemic before and after 14 days of bed rest. Before bed rest, hypercortisolemia (made to mimic severe stress) had no greater effect on muscle protein metabolism than fasting. However, after 14 d of bed rest, muscle protein breakdown increased 2-fold, resulting in a 3-fold elevation of amino acid efflux/loss from muscle.

We then investigated the effects of T restoration during severe stress. Six severely burned men were studied before and after 2 weeks of T administration to restore concentrations to normal levels. Before T administration, normal feedings were unable to ameliorate muscle catabolism, as net muscle protein balance was greatly negative. After restoration of blood T concentrations, muscle protein balance was achieved with feedings. The improvement was due to a 2-fold decrease in muscle protein breakdown, which was accompanied by a doubling in the efficiency of muscle protein synthetic efficiency.

CONCLUSION

This research indicates that inactivity may sensitize skeletal muscle to the catabolic effects of hypercortisolemia. However, the detrimental effects of this combination can be ameliorated by restoring the anabolic influence of T. Like trauma or injury on Earth, space flight elevates cortisol while decreasing T production. These results provide insight into the maintenance of LBM during space flight.

FUTURE PLANS

The effect of space flight and muscular inactivity is primarily the reduction of muscle protein synthesis. Our current efforts focus on the stimulation of protein synthesis during hypercortisolemia with amino acid administration.

INDEX TERMS

Protein synthesis, testosterone, cortisol, bed rest, inactivity