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Dietary supplementation for reduction of muscle soreness during physical therapy: Case report

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Abstract

Objective: The current literature offers ample evidence to support the use of amino acid therapy to prevent muscle soreness following overuse and to help maintain and restore muscle tissue following prolonged periods of inactivity. The purpose of this case report is to demonstrate that a carbohydrate-amino acid supplement can safely be used during physical therapy to prevent muscle soreness.

Methods: A 74-year old female underwent elective hip replacement surgery followed by a week of rehabilitative physical therapy. The patient elected to use a carbohydrate-amino acid supplement as a means to prevent muscle soreness following physical therapy and consented to observation.

Results: During the course of physical therapy the patient reported no muscle soreness on the days following therapy while using the carbohydrate-amino acid supplement. The one occasion where the supplement was not used following physical therapy, noticeable discomfort due to muscle soreness was reported.

Conclusions: This case report supports the use of carbohydrate-amino acid supplementation to prevent muscle soreness while restoring lean muscle and strength following physical therapy, even though definite conclusions cannot be drawn from a single case report design. Current literature in conjunction with this case report supports the need for properly designed studies to further investigate the therapeutic benefits of a carbohydrate-amino acid supplement as an adjunct to physical therapy and rehabilitation.

Key Words: Dietary Supplements, Physical Therapy Modalities, Inflammation, Muscles, and Amino Acids.

Introduction

Following any unaccustomed or prolonged use of the muscles that leads to overuse will inevitably result in muscle soreness. This muscle soreness is referred to as delayed onset muscle soreness or DOMS.[1,2] Because DOMS is not a direct manifestation of the resulting disruption of the contractile component of the muscle tissue and muscle membranes, the soreness is not felt immediately. DOMS is a symptom of the damage that occurs when soluble muscle proteins leak into the extra cellular space resulting in local inflammation and the muscle swelling that ensues. Peak levels of DOMS have been shown to coincide with peak levels of edema.[3, 4] For this reason, the soreness begins to develop gradually following exercise and can last for several days. Although this muscle soreness is most often associated with athletic training, it can affect anyone, especially persons undergoing physical therapy. Because DOMS can have a negative impact on muscle function and reduce one's ability to perform physical activities, it can curtail further physical activities for days. For the patient requiring physical therapy following surgery or an injury, the muscles can be weakened and/or atrophied from physical inactivity. Such a scenario makes the patient an ideal candidate for experiencing DOMS during physical therapy, even though physical therapists strive to manage therapy intensity to maintain a balance between strength gains and muscle soreness. For this reason, finding an effective intervention to prevent or reduce DOMS while helping to rebuild atrophied muscles would facilitate a patient's physical therapy and recovery.

The role of oral supplementation of amino acids in the prevention of DOMS is a field of interest for nutritional science that has a direct and practical application in the field of sports medicine. Oral supplementation with 77 mg/kg branched chain amino acids (BCAA) before exercise has been reported to suppress endogenous muscle protein breakdown.[5] This finding was corroborated in another study whereby giving 100 mg/kg of BCAA before, during and after exercise showed a protein sparing effect on muscle proteins.[6] Supplementation with 12-g/day BCAA for 2 weeks plus 20 g before and after exercise reduced serum creatine phosphokinase (CPK) for several days following exercise.[7] A recent study that investigated administering 5 g BCAA before exercise noted a reduction on DOMS for several days following exercise.[8] Previous studies have shown that administering 40 g EAA after exercise results in a change from net protein degradation to net protein synthesis.[9]

Carbohydrate-amino acid mixtures have also recently been shown to help reduce muscle soreness. When a liquid carbohydrate beverage was consumed 10-minutes before and immediately after exercise, it resulted in a more favorable anabolic response, although it did not alter the catabolic response.[10] When a solution of 8% carbohydrate + 2% protein was consumed immediately following exercise, there was a perceived reduction in soreness among athletes.[11] Administration of a 6% carbohydrate solution containing 6 g EAA during weight resistance exercise

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suppressed cortisol release, stimulated insulin release and reduced myofibrillar protein degradation[12,13] and increased the anabolic response.[14]

Mixtures of amino acids have also been reported to reduce DOMS. Mixes of amino acids have been shown to reduce serum CPK activity following exercise.[15,16] When an amino acid mixture containing 60% essential amino acids was given at a total daily dose of 7.2 g twice daily on the day of exercise and for 4 days following exercise, there was a statistically significant reduction in both serum CPK levels and DOMS in the days following exercise.[17]

A recent study has described the use of beta-hydroxy-beta-methylbutyrte (HMB) in the prevention of DOMS. In this study administration of 3g HMB/0.3g KIC for 14 days prior to a single bout of eccentric resistance training determined that CPK and DOMS were significantly reduced after 14 days supplementation with HMB/KIC compared to controls.[18] One previous study looked at the effects of short term HMB supplementation on eccentric resistance training found that six days supplementation with 40 mg/kg HMB did not reduce DOMS after a single bout of exercise.[19]

This case report examines the role for using a carbohydrate-amino acid supplement containing HMB in the prevention of muscle soreness during post-operative physical therapy.

Patient and methods

The patient was a 74-year old Caucasian female who had undergone elective left hip replacement. She was 5 feet 8 inches tall, weighed 175 lbs.

The patient had become progressively immobile over a period of approximately 2-years due to the degenerative left hip. At the time of surgery, the patient was barely able to walk across the room without having to stop to sit and rest. Because a great deal of her time was sedimentary, she had become weak and lost muscle strength.

The patient requested to be provided with a sample of a patent-pending carbohydrate-amino acid dietary supplement that was designed to prevent or significantly reduce muscle soreness following muscle overuse. Her intention was to use the product during her physical therapy to aid in reducing muscle soreness and to help regain muscle strength. Her request was granted and in return permission was obtained from the patient to observe and interview her during the physical therapy.

The patient used a pre-production sample of a carbohydrate-amino acid dietary supplement. A single serving of the supplement contained 44 g of a proprietary blend which consisted of sucrose, maltodextrin, calcium beta-hydroxy-beta-methylbutyrate, L-leucine, L-phenylalanine, L-lysine, L-threonine, L-valine, L-histidine, L-isoleucine, L-methionine). Among the eight essential amino acids, 40% was made up of the branched chain amino acids. The recommended serving of approximately 50 g was mixed with 500 ml of water and consumed immediately following physical therapy.

Results

Following a successful hip replacement and recovery, the patient was moved from the hospital on the fifth day to a local rehabilitation center in the Southwest United States. On the seventh post-operative day, physical therapy was started and consisted of hip abductions, hip extensions, knee raises, knee flexions, ankle pumps, bed supported knee bends and straight leg raises. As therapy progressed, rubber bands were added to add resistance to the exercise routine.

Immediately following each physical therapy session, the patient consumed one dose of the carbohydrate-amino acid supplement. Each day prior to physical therapy the patient was asked to rate the level of muscle soreness in her legs from the previous day's therapy using a visual analog scale (VAS) of 1 to 10 with one being no soreness and ten being the most severe soreness. Following six of her daily physical therapy sessions, the patient reported no muscle pain, as indicated with a VAS soreness value of 1, when the carbohydrate-amino acid supplement had been used immediately post-therapy the preceding day. Other hip replacement patients in her therapy group were interviewed to determine if they were experiencing muscle soreness in conjunction with the physical therapy regimen. The other patients who were not using any type of supplementation reported that they did experience muscle soreness and discomfort, especially in their thighs. Although physical therapy sessions are not typically conducted on the weekends, her assigned physical therapist was on weekend duty and gave the patients an unscheduled session of physical therapy. Following this session, the patient did not have the carbohydrate-amino acid supplement, which was routinely prepared and brought in daily by a family member. In this one instance where the patient did not receive post-therapy nutritional supplementation, she did report a noticeable amount of discomfort from muscle soreness the following day and reported a VAS soreness value of 4. The patient commented that her thighs were sore and felt some tightness in her muscles. This VAS soreness value when not using the supplement was a noticeable increase over previous values when the supplement was used and the degree of muscle soreness noted is a reasonable value for what one would expect for the level of muscle exertion employed during physical therapy. No further soreness was noted on subsequent therapy sessions when the supplement was used.

Discussion

The present case report observes that a post-surgical patient who used a carbohydrate-amino acid supplement containing HMB immediately following each therapy session perceived no muscle soreness. The support for her perception of having no muscle soreness while using the supplement is bolstered by her experiencing muscle soreness on the one occasion when the supplement was not used following physical therapy.

Although the patient chose to use the carbohydrate-amino acid supplement to prevent muscle soreness during physical therapy, there are several other potential benefits that may have assisted in her post-surgical recovery. Previous studies have shown that when essential amino acids are consumed along with a high glycemic

carbohydrate following exercise, there is a greater gain in muscle protein synthesis over that induced by exercise or nutritional supplementation alone.[20] This increase in muscle protein synthesis in conjunction with physical therapy would lead to muscle hypertrophy and aid the patient in regaining strength and rebuilding atrophied muscles. As many elderly patients may also suffer from some degree of malnutrition, an anabolic nutritional supplement may also provide basic nutritional benefits.

Manninen[21] has described the optimal recovery drink as composed of high glycemic carbohydrates, protein hyrdrolysate and supplemental L-leucine. The purpose of these ingredients is to provide carbohydrate/protein to induce an optimum insulin response, provide protein hydrolysate as a source of amino acids for protein synthesis and L-leucine as an insulintrophic amino acid. The present composition provides a high glycemic mix of simple and complex carbohydrates to make the drink isotonic so it empties quickly out of the stomach and is absorbed rapidly. It preferably utilizes free-form essential amino acids as they can be absorbed rapidly and because the non-essential amino acids can be made by the body and are not rate limited in protein synthesis.[9] The essential amino acids serve as a protein source to potentiate the induction of insulin. Furthermore, the essential amino acids contains L-lysine, one the most potent insulinotrophic amino acids, in addition to L-leucine and L-phenyalanine, which are somewhat less potent and L-methionine and L-valine which are moderately potent. L-leucine's effect on muscle is though to be due largely to it being metabolized into ketoisocaproate, which is metabolized into HMB and ultimately the end product HMG-CoA, which supports muscle membrane repair through increased intramuscular cholesterol synthesis. Therefore, the downstream metabolite HMB is included in this composition to bypass other metabolic pathways and promote greater conversion into HMG-CoA. For these reasons, this composition offers several advantages over Manninen's proposed optimal recovery drink.

A recent study investigated the benefits of using an anabolic nutritional supplement on malnourished rats that were recovering from a bone fracture. Those rats receiving an anabolic supplement consisting of 30% protein with conditionally essential amino acids showed greater improvements in bone mineralization, body mass and muscle mass than those receiving protein alone.[22] Essential amino acid supplementation has been shown to have a similar effect on muscle and bone in osteoporotic rats.[23] Therefore, nutritional supplementation of orthopedic patients with anabolic supplements may augment musculoskeletal recovery following corrective surgery for bone fractures and other orthopedic procedures.

Injuries or disease that require long periods of immobility during recuperation can have a deleterious effect on muscles. The muscles enter a catabolic state and other tissues, such as the immune system and injured tissue, use the amino acids released from the degradation of muscle. This results in muscle atrophy and physical weakness. Once healed, the patient must be rehabilitated through physical therapy to regain muscle mass and strength. Previous studies have demonstrated that essential amino acid-carbohydrate supplements can help prevent and reverse the catabolic effects of prolonged inactivity and the resulting loss of muscle protein.[24-26]

A study on muscle recovery following six weeks of non-weight bearing inactivity demonstrated that after 12 weeks of physical therapy, muscle function had improved significantly, but was still less than weight bearing inactive normal controls.[27] This study also documented that therapy patients often do experience muscle soreness during physical therapy; and demonstrated a positive correlation between the degree of DOMS and the resulting progress in muscle recovery and strength. This study showed that the patients who experienced the most muscle soreness during the study were the ones who showed the greatest improvement in muscle strength at the end of the study. The reasoning for this was that those who worked the hardest and experienced the most DOMS gained the most benefit from therapy. Patients who did not experience a significant degree of DOMS had the least muscle strength at the end of the study. These latter patients may have intentionally performed their physical therapy at a lower intensity to avoid the discomfort of muscle soreness.

Based on published studies and the observed results in this case report, it is fair to speculate that orthopedic patients, as well as other ambulatory patients, could benefit from an amino acid-carbohydrate supplement that was able to provide both anabolic properties and prevent muscle soreness during physical therapy. Such post surgical supplementation should allow both the bone and surrounding muscle tissue to experience improved post-operative healing. Additionally, supplementation should also allow the therapist to increase the intensity of the therapy without limiting subsequent activities due to DOMS. This would allow the patient to perform better during physical therapy due to lack of muscle soreness resulting from reloading muscles, and atrophied muscles should respond to the exercise by showing increased hypertrophy and gains in strength.

Further studies need be carried out using the present carbohydrate-amino acid supplement to determine if bone and tissue repair can be improved following surgery. Also, if patients can undergo more intense physical therapy without the undesirable discomfort from DOMS, they will be able to recoup more muscle strength at a faster rate during rehabilitation. Such nutritional therapy would be very beneficial to patients with injuries as it could help maintain muscle mass during convalesce and enhance musculoskeletal repair. This could enable the patient to be in better physical condition upon entering rehabilitation and perform both qualitatively and quantitatively better when undergoing physical therapy.

Additionally, as the population grows older and life spans increase, orthopedic injuries will increase proportionately. Any adjunct nutritional therapy that results in a more successful outcome following surgery and faster return to normal activities would be of enormous benefit to both the healthcare system and patients.

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