Application of Branched-Chain Amino Acids in Healthy Humans: Discussion of Session 31,2

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Dr. Kurpad was asked to put the branched-chain amino acid requirement for normal humans, of about 80 mg per kg body wt per d, in the context of population nutrition and the use of food supplements. Dr. Kurpad responded that it is very hard to get a diet that is limiting in branched-chain amino acids, and that most normal diets easily meet the requirement. Even slum dwellers of the lowest socioeconomic strata in India, eating cereal-based diets, have leucine intakes in the range of 60–70 mg per kg body wt per d.

During his talk, Dr. Rennie mentioned that there is considerable oxidation of branched-chain amino acids during endurance exercise, but that this does not result in an increase in protein requirement. During the discussion, the point was raised that there seemed to be a disconnect between the large increase in branched-chain amino acid utilization and no increase in protein requirement. Dr. Rennie responded that there is really no disconnect. Most of the branched-chain amino acids that are oxidized appear to be released by depression of protein synthesis. So the total amount available is that made available by the fall in protein synthesis, and one can easily replace that by eating a normal diet. Since most diets contain 10% to 15% protein, as long as one replaces the energy stores one will replenish amino acid requirements. So the evidence that exercise increases protein requirements is very thin.

Dr. Blomstrand was asked which type of exercise she was talking about with regard to activation of mTOR and p70—endurance or heavy resistance. Dr. Blomstrand responded that it is heavy resistance exercise that results in increased muscle protein synthesis, and that endurance exercise does not activate p70 or S6 kinase. Dr. Rennie commented that there is some evidence that moderate endurance exercise can increase muscle protein synthesis, but that the effect is very much less than occurs with resistance exercise.

Dr. Volpi was asked to respond to the comment that endurance athletes and healthy calorie-restricted individuals who are extremely insulin sensitive generally have smaller muscles than overweight insulin-resistant individuals. Dr. Volpi responded that the insulin resistance that she talked about is different from the insulin resistance of muscle glucose uptake and hepatic glucose production. Her healthy older subjects had a normal glucose tolerance, yet, despite that, they did not respond to insulin infusion with increased thigh muscle protein synthesis, even though glucose uptake across the lower extremity was comparable to that of young controls. She observed that impairment of amino acid uptake and protein synthesis during hyperinsulinemia in older people was strictly correlated with impairment of the ability to increase muscle blood flow in response to insulin. This suggests that nutrient delivery to muscle may be playing a role. Dr. Rennie mentioned that his group had found increases in NF-κB and TNFα in muscles of healthy active 70 y-old men. He suggested that this chronic, subclinical inflammatory state likely also involved their vasculature.

Dr. Kalhan commented that the four conditions that he has studied, pregnancy, puberty, newborns and growth hormone therapy are all characterized by insulin resistance and are all associated with nitrogen accretion. He also made the point that the talks were all about the stimulation of protein synthesis, yet no mention was made of repressors of protein synthesis. There are exciting data regarding mutations that result in muscle hypertrophy (i.e., myostatin). So there must be a balance between stimulation and suppression of protein synthesis.

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