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Summary of the Evidence – Blood Flow Restriction Therapy in the Geriatric Population

Blood flow restriction (BFR) therapy consists of external pressure applied to the proximal aspect of an extremity via an inflated cuff to occlude venous flow distal to the cuff site.[1] This technique is used in combination with low-load resistance training purportedly, as an effective method for increasing strength without placing a heavy load on a joint.[1] The process of skeletal muscle adaptation to the stress is thought to occur through the mechanism of anaerobic metabolism and the more selective recruitment of type 2 muscle fibers.[1] Additionally, the cellular swelling that occurs from blood pooling during the venous occlusion promotes protein synthesis in the muscle fibers.[1] Specifically, the increased intracellular fluid triggers the anabolic signaling pathway which promotes increased anabolic hormone release, leading to increased production of protein in the muscle fibers and thus cell hypertrophy.[1] As muscle weakness is common in patients presenting to physical therapy, this intervention approach may be successful for increasing strength and physical function in patients that are unable to place heavy loads on their joints due to pain or other precautions.[1] Therefore, this treatment approach could be very beneficial for the geriatric population, specifically those with osteoarthritis and are limited in their strength and function secondary to pain. The summary of evidence from ten articles presented in this overview will focus on the outcomes of elderly patients who participated in BFR with low-load training compared to high-load training alone.[2-

Studies included in this review include high-level evidence from systematic reviews, meta-analyses, and randomized control trials.[2-11] Ages included in these studies ranged from 50 to 75 years old.[2-11] Interventions lasted from 4 to 12 weeks depending on the study.[2-11] The outcome measure typically used to assess strength was a specific 1 repetition maximum (1RM) according to which muscle group the study was assessing, with interventions focused on that muscle group.[2-11] Several studies also used various measures assessing overall level of function such as the Short Form Health Survey (SF-36), Timed Up and Go, Late Life Function and Disability Instrument (LLFDI), and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).[2-11] Specific parameters for the the 1RM percentage used varied with each study, but high load training was largely defined as 60-80% 1RM and low-load training was 10-40% 1RM.[2-11] The most widely used equation for determining the cuff pressure was: pressure mm Hg = 0.5 (SBP) + 2(thigh circumference) + 5.[2-11]

The results of randomized control trials and conclusions from the systematic reviews demonstrated agreement in conclusions about the strength effects of BFR in the geriatric population.[2-11] Use of BFR with low-load training leads to similar strength and function gains compared to high-load training without BFR while simultaneously placing less mechanical stress placed on the joints.[2-11] For example, one RCT implemented intervention 3x/week that included exercises (leg press, let extension, calf flexion, and leg curl) performed at 60% 1RM for the high intensity training group and 20% 1RM for the low intensity with BFR group.[3] Differences in post-training changes in 1RM between groups were as follows (BFR with low intensity relative to high intensity): leg press −50.81 (−117.22, 15.60) lbs, leg extension −26.60 (−54.94, 1.74) lbs, calf flexion −30.66 (−91.05, 29.73) lbs, and leg curl −16.46 (−36.05, 3.13) lbs.[3] These results

demonstrate the ability of BFR with low-load training producing comparable strength gains to high-load training. The increase in strength with high-load training is consistently higher compared to low-load training with BFR, but the BFR with low-load training option still creates statistically significant increases in strength and size compared to low-load training alone.[2-11] BFR used with low-load training also produces significantly greater increases in muscle hypertrophy when compared to use of low-load training alone.[2-11] Additionally, using BFR while walking demonstrates increases in muscle size and strength in older adults as well.[10]

Due to BFR with low-load training producing responses comparable to high-load training for muscle strength, muscle volume, pain, and function, it is recommended for use in the geriatric population.[2-11] Specifically, it is recommended for those with osteoarthritis that are limited in therapy secondary to their pain in order to reduce the likelihood of muscle atrophy secondary to inactivity.[2-11] Due to the oftentimes challenging and/or contraindicated exercises associated with high load training, BFR appears to be a safer, effective, and less painful alternative by placing less mechanical stress on the joints when administered by a trained professional and individualized appropriately.[2-11] The high prevalence of contraindications in the clinical population may prevent participation in high load training (joint instability, joint degeneration, pain, surgical restrictions), however, BFR with low-load training appears to lead to similar strength improvements while keeping the patient safe. [2-11] This would be pertinent when considering the increased risk of muscle atrophy in the geriatric post-surgical and arthralgia populations. Improving strength in the elderly population is expected to lead to improved function necessary for maintaining a healthy quality of life. [2-11]

As with any intervention, it is important to consider safety with each individual patient. Systematic reviews assessing the safety of using BFR have concluded that it is not associated with additional cardiovascular stress compared to traditional resistance training.[12] Furthermore, patients that participated in BFR training after having undergone cardiac surgery did not demonstrate any adverse side effects or increase in creatine phosphokinase levels compared to those participating in traditional resistance training.[13] Potential adverse effects noted during or after BFR treatment include increased rate of exertion, dizziness, delayed onset of muscle soreness, and numbness.[14] However, none of these side effects have been proven to be directly causal from BFR and may be preventable with adjustments in cuff size, pressure, and duration of treatment.[14] Possible contraindications may include unstable hypertension, hemophilia, open fracture, pregnancy, dehydration, clotting disorder, cancer, medication that increases blood clotting risk, or an unstable cardiopulmonary condition.[14] As with any treatment, the PT should evaluate the patient's medical history and express any concerns with their physician prior to initiating BFR training. Further research with larger sample sizes is needed to determine the most adequate and appropriate BFR parameters and intervention parameters specific to the geriatric population that will produce the most effective results.

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