TOPICS IN EXERCISE SCIENCE AND KINESIOLOGY

Understanding Orthostatic Intolerance and Exercise Programming for the Health and Fitness Practitioner

Implementation Strategies

Deni Roller, **Carley A Shannon**, **Andrew T. Del Pozzi**

Ball State University, Muncie, Indiana, USA; Integrative Exercise Physiology Laboratory.

Abstract

- The purpose of this manuscript is to briefly review Orthostatic Intolerance (OI) and discuss proper exercise programming and progression guidelines for working with those affected by OI; a disorder associated with autonomic nervous system dysfunction, characterized by a difficulty standing upright.
- In order to do this, we performed a review of the published literature using google scholar and PubMed search engines.
- Evidence indicated that a light to moderate intensity aerobic exercise program would aid in improving orthostatic tolerance.
- Previous studies have indicated that progressive resistance training aids in mechanisms that are dysfunctional in OI such as blood volume increases and a decrease in baroreceptor responses.
- Preparticipation physical exams and initial value assessments are an integral part of the OI exercise prescription as many individuals will have unhealthy vital capacities due to OI symptomology and accompanying deconditioning.
- Many Individuals with OI have responded positively to aerobic and resistance training. Using informed judgment when prescribing exercise and careful progression of frequency, intensity, and duration should be considered.

- Key Words: Postural Tachycardia Syndrome, Hypotension, Training

Introduction

Sufficient blood volume, skeletal muscle pump activation, and autonomic reflexes are vital mechanisms required for the response to the rapid cardiovascular changes that occur during the change from supine to upright posture (orthostasis) (10). When deficient in one or more of these areas, orthostatic intolerance (OI) can occur. Symptoms may include, but are not limited to, vision changes (11-14), lightheadedness (12-14), headache (12-14, 19), fatigue (12-14), weakness (12, 14), nausea (13, 14), heat intolerance (13), impending loss of consciousness (11, 14), and reported signs of pallor (13, 14), diaphoresis (13, 14), tachycardia (12, 14), bradycardia (14), or hypotension (11, 12, 14). While OI is commonly described in pediatric patients, it can occur throughout all stages of life (10, 11, 14, 19). OI is often categorized as either acute or chronic. Approximately 40% of people will experience a syncopal (simple faint) event in their lives, (14) and chronic OI affects 500,000 to 3,000,000 Americans (24). Chronic OI is commonly misunderstood because diagnosis is uncommon (25). Most Chronic OI patients have to wait longer than four years to receive the correct diagnosis (25). This makes treatment plans very difficult to complete as well as increases the specialty needed to assist in the use of nonpharmacological methods to manage the disorder. While, most patients will be told by their physician to start an exercise program; most physicians are ill equipped to advise further than the recommendation to start exercise and to seek the help of a Health and Fitness Practitioner (HFP) (26). The HFP should be able to accommodate this special population if they are encountered. Aerobic exercise has been shown to aid in the management of OI symptoms by increasing peak oxygen utilization by ~8%, increasing cardiac volume by ~12% as well as overall cardiac mass by ~8%, as well, total blood volume has been shown to increase by ~6% in chronic OI patients (6, 11, 14, 19). Additionally, It has been noted that one of the best defenses for OI is a well-developed skeletal muscle pump (27). One way to increase skeletal muscle pump in through resistance training. Whole-body resistance training programs have resulted in increased orthostatic tolerance as assessed by LBNP (8, 9). A complete exercise training program should include resistance training, flexibility, and aerobic training. Exercise programing becomes difficult when working with an individual who has debilitating symptoms from standing, however, keeping the individual's needs and limitations in mind and progressing slowly to overcome them should be the focus for the Health and Fitness Practitioner (HFP). Because of the rarity of OI many HFPs are ill-prepared to fully understand the OI patients individualized symptomology it is for these reasons we have provided this background and exercise programming recommendations.

Methods and Results

In order to determine the appropriate exercise prescription for individuals that experience OI we conducted a review of the published literature using Google Scholar and PubMed search engines with the search terms: "Orthostatic Intolerance", "Hypotension" and "Exercise Training". In doing so we found that, inactivity, as well as increased time sitting or lying down, have been found to lead to deconditioning of the peripheral skeletal muscles, cardiac atrophy, and reduced blood volume, and can result in OI (5, 22, 28). It is important to understand that chronic OI is not deconditioning. However, deconditioning does exacerbate the symptoms of chronic OI (29, 30). Those diagnosed with OI are at an increased risk of inactivity and increased deconditioning (1, 5, 19). An individualized exercise program should incorporate goals that are specific to improving fitness, peripheral muscles mass, and cardiovascular function, along with decreasing the negative effects of OI (14).The HFP must be knowledgeable in physiology in order to understand the consequences of upright posture for each individual client that experiences the symptoms of OI. HFPs involved need to understand the specific signs and symptoms that their client may experience and do their best to avoid, or at a minimum, lessen these in order to reduce the risk of injury or the exacerbation of OI symptomology.

POA1: Aerobic Training in OI

Because those affected by OI experience their symptoms upon standing, individuals with OI are more likely to avoid physical activity; it has been found that OI symptoms improve, as well as quality of life following exercise training {Fu, 2018 #248;Fu, 2015 #249}. This was attributed to the aerobic adaptations associated with improved aerobic capacity {Wieling, 2002 #3681}; an increase in plasma volume {Saltin, 1968 #3693;Convertino, 2007 #301}, increased cardiac size and mass {Dorfman, 2007 #3710}, and stroke volume {Convertino, 2007 #301;Dorfman, 2007 #3710}. It was previously found that aerobic exercise training was superior to propranolol (a pharmaceutical) in enhancing upright hemodynamics, normalizing renal-adrenal responsiveness, and improving overall quality of life in patients with OI (14). Others found similar results implementing a 3-month aerobic exercise program. Significantly improving quality of life for those with OI, with 71% no longer met OI criteria (17). A subset of these patients continued aerobic exercise for 6 and 12 months. They found that their OI symptoms continued to stay in remission (17). See table 1 for a sample aerobic exercise program.

Table 1. Aerobic Exercise programming for Orthostatic intolerance with sample progressions following 16 weeks of training.

Mode	Intensity	Duration	Frequency
Recumbent Cycle Rower Swimming	RPE of 8-11	3 min On 2 min Recovery 3 min On 2 min Recovery	3 days per week
Initial Progression Following 8 weeks of Training			
Recumbent Cycle Rower Swimming	RPE 8-11	15 min	3 days per week
Second Progression Following 16 weeks of Training			
Recumbent Cycle Rower Swimming walking/jogging (as tolerated)	RPE 12-16	30 min (walking/jogging Duration may vary)	3+ days per week

POA2: Resistance Training with OI

Resistance training aids in improving muscular strength and endurance, bone density, and body composition {Coelho-Junior, 2017 #279;Valkeinen, 2006 #285;Kizilbash, 2014 #247}. Several studies have shown that resistance training can lead to increased blood volume {Fu, 2018 #248;Fu, 2015 #249;Kizilbash, 2014 #247;McCarthy, 1997 #264} and LBNP tolerance {McCarthy, 1997 #264;Lightfoot, 1994 #269}, decreased sensitivity of the carotid baroreceptor cardiac reflex response (BARO) {Fu, 2015 #249;Lightfoot, 1994 #269;McCarthy, 1997 #264}, and decreased venous pooling {Fu, 2018 #248;Fu, 2015 #249;Kizilbash, 2014 #247;Lightfoot, 1994 #269;McCarthy, 1997 #264}. When investigating the effects of a moderate intensity

Table 2 Resistance training programming for Orthostatic Intolerance with sample progressions following 16 weeks of training.

Mode	Intensity	Duration	Frequency	Notes
Should be whole body workout. Sample: Seated Leg Press Leg Curl Leg Extension Calf Raises Chest Press Seated Row Back Extensions Crunches Glute Bridges Wall Sits	A resistance that can be done 8 times but no more than 10 times	3 sets 8-10 repetitions 3 to 5 min rest between sets	2 days per week minimum 48 hours recovery in between	Can be done same days as Aerobic. Resistance machines would be the safest in this population however individualized programming is most important. Once client can perform 12 repetitions increase resistance
Initial Progression Following 8 weeks of Training				
Whole Body Resistance	A resistance that can be done 8 times but no more than 10 times	3 sets 8-10 repetitions 3 to 5 min rest between sets	2 days per week minimum 48 hours recovery in between	
Second Progression Following additional 8 weeks of training				
Whole Body Resistance	A resistance that can be done 8 times but no more than 10 times	3 sets 8-10 repetitions 3 to 5 min rest between sets	2 days per week minimum 48 hours recovery in between	If Client tolerates you can add a day of training

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POA3: The Exercise Prescription

A thorough pre-participation physical exam (PPE) should be conducted by the HFP prior to any participation in fitness activities. The PPE should include assessment of the patients baseline orthostatic tolerance and fitness levels. As with any exercise prescription, initial assessment is essential in devising and implementing a proper individual exercise program. Principles of interindividual variability, initial values, overload, and progression when developing a personalized exercise program for OI patients should be taken into consideration by the HFP, along with principles of diminishing returns and reversibility as the efficiency of the program should be frequently reassessed. No "one-size-fits-all" exercise prescription exists for any population, let alone patients with OI.

POA4: Summary and Practical Application

Exercise training, both short and long-term, have exhibited a positive influence on disorders of OI {George, 2016 #253;Sugawara, 2012 #305}. Prescribing safe and individualized exercises should be considered an important therapeutic modality for treating patients with OI. Pre-participation evaluations should be conducted prior to any engagement in physical activity to establish baseline fitness, and orthostatic tolerance measurements. Evidence suggests that light to moderate aerobic exercise coupled with the slow integration of progressive resistance training is most effective {Fu, 2011 #3113;Fu, 2010 #3689;Fu, 2018 #248;Fu, 2015 #249;Grubb, 2005 #3337;Mtinangi, 1998 #3686}. Decisions should be evidenced based when prescribing exercise and should be accompanied by a careful progression of frequency, intensity, and duration in order to assist the OI patient achieve their orthostatic and fitness goals.

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