

# Weight Supported Treadmill Ambulation in a Patient with Severe Congestive Heart Failure: A Case Report



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## Abstract

We describe a 43-year old man with congestive heart failure (CHF) with markedly reduced ejection fraction and New York Heart Association Class 3 to 4 symptoms. After a 6-minute walk test showed a 140 m distance, he performed 6 weeks of walking sessions on a weight-supporting lower body positive pressure treadmill (LBPP). Unloading 40% of his body weight he was able to progressively increase the duration of the walking sessions, exhibited a post-session diuretic effect and dramatically increased his exercise capacity on a 6-minute walk test. He rated his satisfaction with the sessions as maximal. His functional class improved to class 2, remaining stable at 1-year follow-up. We conclude that repeated sessions of ambulation on a weight-supporting LBPP treadmill may benefit patients with CHF with reduced ejection fraction and poor functional capacity.

**Keywords:** Weight Supported Treadmill; Heart Failure; Lower Body Positive Pressure; Six Minute Walk Test

**Abbreviations:** CHF: Congestive Heart Failure; LBPP: Lower Body Positive Pressure

## Introduction

We describe a 43-year old man with congestive heart failure (CHF) with very low functional capacity who demonstrated a marked improvement in 6-minute walk distance and functional class after 6 weeks of walking sessions on a weight support treadmill.

## Case

The patient is a 43-year old African American overweight man with a long history of hypertension who presented 3 years ago with signs and symptoms of congestive heart failure (CHF). Echocardiography revealed a left ventricular ejection fraction of 25% and coronary angiography exhibited normal coronary anatomy. He received an implantable cardio-defibrillator and was treated with carvedilol 25mg bid, enalapril 20mg qd, furosemide 40mg qd, spironolactone 25mg qd and fixed-dose hydralazine 37.5 mg-isosorbide dinitrate 20 mg tid. However, symptoms of shortness of breath and fatigue progressed to occur on minimal exertion and occasionally at rest. On physical exam, body mass index was 29.2kg/m<sup>2</sup>, blood pressure was 120/60mmHg. Pulse was 68 beats per min. Jugular venous pressure was 5cm and heart sounds were normal. A summation gallop was audible and there were no murmurs. Lung fields were clear. There was trace bilateral lower extremity edema, but no hepatomegaly.

Chest radiography showed cardiomegaly and clear lung fields. Repeat echocardiography showed a mildly dilated left ventricle (5.8cm) with severe diffuse hypokinesis and an ejection fraction of 25%. The left atrium was mildly dilated. Right ventricular size and wall motion were normal. There was mild-moderate mitral regurgitation, and pulmonary artery systolic pressure was 30mmHg. The transmitral filling pattern was pseudonormal. He walked a distance of 140m on a 6-minute walk test.

## Intervention

The patient participated in supervised 30-minute sessions 2-3 times per week for 6 weeks of ambulation training on an anti-gravity treadmill (AlterG) (AlterG, Inc., Fremont, CA). Lower body positive pressure (LBPP) was set to 40% of body weight support. The patient started at a comfortable speed, increasing as tolerated. During his first session, he started and remained at 1 mph for 6.5 minutes and gradually increased to 30 minutes at the end of the 6 weeks. During several of the sessions, the patient reported sudden urgency to urinate, but he tolerated the exercise well without fatigue.

## Outcome

Repeat 6-minute walk test showed an improvement to 540 meters. The patient reported his highest ratings of satisfaction

and gratitude with the ambulation sessions. His functional class improved to class 2 and he began a walking program. He has remained stable without deterioration at 1-year follow-up.

## Discussion

Congestive heart failure with reduced ejection fraction is a progressive disorder that poses significant morbidity and mortality [1]. In addition to advances in medical and device therapy leading to improved outcomes, exercise remains an overlooked but effective treatment modality shown to reduce hospital admissions and to improve health-related quality of life [2]. However, the unfortunate dilemma is that patients who could potentially derive the most benefit are the least able to be active and engage in exercise. Lower body positive pressure (LBPP) treadmills have recently become widely available to the recreational community. In general, such systems consist of a computer-controlled treadmill equipped with a pressurized air chamber that generates a vertical upward force directly opposing the force of gravity and effectively decreasing body weight [3]. The airtight chamber is formed by the user wearing neoprene shorts that zip around the waist, creating a kayak type skirt from the waist down.

Variable degrees of weight support can be achieved by pumping greater air pressure as WS is proportional to the level of LBPP. In addition, the air-filled chamber improves balance and the frame of the treadmill stabilizes patients with imbalance. Accordingly, anti-gravity treadmills are used to rehabilitate patients with orthopedic and neuromuscular conditions [4]. A single case report showed improvement in exercise capacity in a patient with morbid obesity following ambulation on an Alter-G treadmill [5]. However, studies evaluating the utility of weight support treadmills in patients with other medical conditions such as CHF are lacking. Accordingly, we report the first case we are aware of in the literature showing improvement of exercise capacity in a patient with severe congestive heart failure. This patient was able to increase 6-minute walk distance by 400m, which markedly exceeded the 30 m increase considered significant [6].

He crossed the 300m threshold that has prognostic importance [7]. Longer 6-minute walk distance is associated with lower hospitalization rates and higher health related quality of life [2]. The exact mechanism(s) responsible for clinical improvement are unknown but may be related to enhanced oxygen extraction within skeletal muscle microcirculation and better coordinated muscle metabolic control [8]. Also, whereas cardiac autonomic imbalance is deranged during the progression of CHF and dysautonomia improved by exercise, LBPP might portend beneficial effects owing to increased parasympathetic tone. Of note, weight support evokes a number of cardio-respiratory changes as a consequence of increased intra-thoracic blood volume and lower extremity

compression, including augmenting venous return, increasing stroke volume and baroreceptor activation [3,9]. The patient remained stable and was able to begin a conventional walking program suggesting that weight supported treadmill ambulation may be useful as a bridge to unsupported exercise.

Our patient's situational urinary urgency might be attributable to increased parasympathetic tone as well as hemodynamic and/or hydrostatic changes affecting diuresis, analogous to sitting or standing in water [10]. Further studies are required to examine the association of lower body positive pressure and diuresis. Furthermore, he enjoyed the sessions immensely, demonstrating a potential for strong patient satisfaction. In summary, this case report suggests great potential of repeated sessions of ambulation on weight support treadmill to improve functional capacity in patients with medical illnesses such as congestive heart failure by offloading patients' body weight.

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