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Dynamic study of venous blood pressure in the lower extremities during walking and exercising using a stationary bicycle

José Maria Pereira de Godoy, MD, PhD[1], Domingo Marcolino Braile, MD, PhD[1], Stela Marys Barufi, PhT[2] Maria de Fátima Guerreiro Godoy, OT, PhD[2]

Adress: [1]Department Cardiology and Cardiovascular Surgery in Medicine School of São Jose do Rio Preto-FAMERP Av. Brigadeiro Faria Lima, 5416 Zipe code: 15090-000-São Jose do Rio Preto-SP-Brazil [2]Private Clinic Godoy Av. Constituição, 1306 Zipe code:15025-120 São Jose do Rio Preto-SP-Brazil
E-mail:godoyjmp@riopreto.com.br *corresponding author

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Abstract

The purpose of this study was to evaluate changes in venous pressure gradient in the lower limb, in the dynamic study, during activities of walking and bicycle ergometer. Was punctured the vein with the left medial hallux 0.9 mm x 25 mm angiocath and connected, via a DTX Plus sensor ™, to a portable apparatus which collected and stored venous pressures at half-second intervals in the form of numbers. After calibration of the apparatus was held the march, then exercises on a bicycle ergometer. Five evaluations were performed with an average of 290 measurements for evaluation. We compared the pressures of walking with the bicycle ergometer. Statistical analysis was performed using the unpaired t test for each assessment. Was detected in the five evaluations that the pressures of walking were significantly greater than the bicycle, unpaired t test $p < 0.05$. The minimum and maximum limits were 8mmHg and 41 mmHg and 26 mmHg to more than 100mmHg for walking. We conclude that the march creates more work pressure in the venous system than the bicycle ergometer in the dynamic study.

Key words: Venous pressure ambulatory, Dynamic study, Bicycle ergometer, Walk.

Introduction

Exercising and physical activities are important in the rehabilitation of patients and interfere in the circulation system. Several exercises and activities have been employed both in the prevention and treatment of diseases (1-3).

However the development of exercising apparatuses has transformed physical activities into a method of preventing, evaluating and treating several diseases. Apparatuses such as the stationary bicycle have been utilized for clinical evaluation and as a method of controlling exercising (1-3).

Moreover, walking is a part of everyday life and has been utilized as a form of preventing and treating some diseases (4-6). Although both activities involve the lower limbs which play an important role in venolymphatic return, there are few published evaluations of venous pressure using the different types of exercises utilized in rehabilitation clinics. No studies have focused on evaluations of the ambulatory venous pressure during exercising using a stationary bicycle.

The aim of the current study is to report on the variations in the venous (ambulatory) pressure gradient of the lower limbs in a dynamic study comparing walking and exercising using a stationary bicycle.

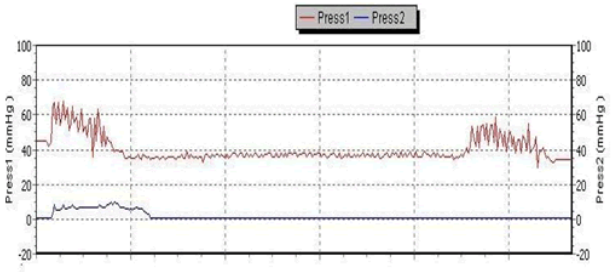
Method

The medial vein of the left big toe was punctured using a 0.9 x 25 mm angiocath which was subsequently connected to a DTXTM plus sensor connected to a portable apparatus developed by Braile Biomedica in São José do Rio Preto, Brazil that collects and stores data at half-second intervals. The volunteer in this study was a 46-year-old man with normal superficial and deep

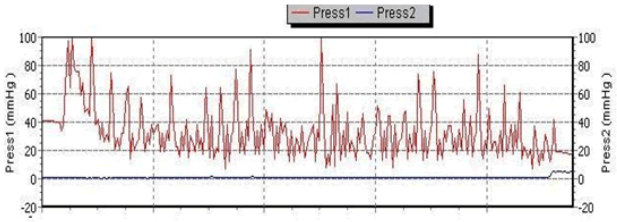
venous systems as evaluated by duplex. After calibration of the apparatus, the volunteer performed exercises on a stationary bicycle and walked. A total of five evaluations, each with an average of 290 measurements, were made for the two types of exercises. The blood pressures were compared between walking and exercising on the stationary bicycle. The non-paired t-test was employed for statistical analysis with an alpha error of 5% (p-value ≤ 0.05) being considered significant.

Results

On comparing the five evaluations of each type of exercise it was observed that walking produces significantly higher changes in pressure (working pressures) than the stationary bicycle (non-paired t-test – $p < 0.05$). Graph 1 illustrates one of the evaluations using the bicycle and Graph 2 during walking. The minimum pressure was 8 mmHg for walking and 26 mmHg for the stationary bicycle. The maximum limits were 100 mmHg for walking (the maximum limit of calibration for the apparatus) and 41 for the bicycle.



Graph 1: In red, changes in venous pressure of the dorsal vein of the left big toe during one evaluation of exercising using a stationary bicycle. The blood pressure was measured at half-second intervals



Graph 2: In red, changes in venous pressure of the dorsal vein of the left big toe during one of the evaluations of walking. The blood pressure was measured at half-second intervals

Discussion

The current study shows that walking produces higher muscle working pressures in the venous system than exercising on stationary bicycles. No studies were found indexed to the PubMed, Scopus or ISI electronic libraries comparing the working blood pressures produced by these two forms of exercising.

It is well known that there is a greater influence of gravitational pressure when the patient is in the erect position during walking than in the seated position when utilizing a stationary bicycle. On the other hand, walking demands greater joint mobility of the toes and sole than exercising using a bicycle. The joint mobility of the knee is greater when exercising using a bicycle than when walking; it is important to remember that both types of exercises use different muscle groups.

The changes in pressure observed both during exercising using the bicycle and walking show that pulsating blood flows are produced due to interference of the muscle groups involved. These data are important to understand the response of the venous system during the stress of exercising and even during daily physiological situations such as walking. Dynamic studies of different venous system diseases, particularly those of the lower extremities, evaluated in the physiological conditions of walking or exercising may contribute to design better therapeutic approaches to these diseases.

These data warn about the indication of exercising, in particular, for patients with venous diseases where walking exerts the most physiological ambulatory venous pressures. However, during exercising using the stationary bicycle, the musculature of the calf has less mobility and does not produce the same efficiency in creating pulsating pressures as walking.

Studies evaluating the effect of elastic compression stockings on the blood pressure demonstrate that the type of joint involved and gravitational pressure interfere in the working pressures [7,8]. Thus this pilot study serves as a warning about recommending exercising to patients with chronic venous insufficiency.

Conclusion

As measured in this dynamic study, walking produces higher working pressures in the venous system than exercising using a stationary bicycle..

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