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Dynamic Evaluation of the Venous Pressure During Passive Plantar Flexion and Dorsiflexion Exercises with the RAGodoy® Apparatus

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Abstract

Objective: The objective of this case report was to dynamically evaluate pressure changes during passive exercises using a device that performs plantar flexion and dorsiflexion.

Design and setting: The medial vein of the left hallux was punctured using a 0.9 mm x 25 mm angiocat catheter and this was connected to a DTX Plus ™ sensor. With this portable apparatus, pressure variations are measured at half-second intervals and the data stored in a numerical form. The RAGodoy® apparatus was used to perform passive exercises that stretched and bent the ankle joint.

Six evaluations were made and the minimum and maximum pressures during each session were assessed. Main outcome measures and results: In all the sessions, variations in the pressures were obtained with a minimum pressure of 8 mmHg and a maximum of 77 mmHg.

Conclusion: The device, named the RAGodoy®, creates pressure variations in the venous system, which assist blood flow in the lower limbs and thus it can be used to avoid venous stasis.

Key words: Dynamic venous pressure, Lower limbs, Passive exercises, Device, RAGodoy®.

Introduction

The main purpose of venous circulation is to return the blood back to the heart where it is re-oxygenated and recirculated. When a person is motionless and seated, part of the venous system has to work against gravity. In combination with the anatomic characteristic of valves, the muscles and tendons that surround the deep veins, work as a pump that forces the blood from the legs back to the heart. The venous valves act to prevent reflux and thus this pumping mechanism compensates the effects of gravity and prevents venous hypertension converting the static condition into a dynamic flow [1,2].

Variations in the venous pressure gradient during walking exist between the veins in the thigh and lower leg as a consequence of the action of these muscle pumps [2].

Virchow's triad objectively defines the three major components that lead to thrombotic events: venous stasis, endothelial lesion and hypercoagulability.

The prevention of thrombosis is necessary in patients who are exposed to thrombotic risk, however they can

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not always receive the recommended treatment due to contra-indications such as in cases of active bleeding and immediately after suffering strokes. The main location affected by thrombosis is the lower limbs with the calf muscle region being the most common site.

Mechanisms that prevent venous stasis may be useful in patients who are contra-indicated for anticoagulation [3]. The use of an apparatus to perform plantar flexion and dorsiflexion exercises with continuous passive movements may improve the venous flow of the limb [4].

The objective of this report was to make a dynamic evaluation of pressure variations during exercising with an apparatus that performs plantar flexion and dorsiflexion exercises.

Method

The medial vein of the left hallux of a 46-year-old male volunteer, who presented with telangiectasia (CEAP 1) of the lower limbs at clinical examination, was punctured with a 0.9 mm x 25 mm angiocat catheter. The catheter was then connected to a DTX ™ Plus sensor, a portable device development by Godoy & Braile in Braile Biomédica in São José do Rio Preto, Brazil. This device is utilized for invasive pressure measurements, collecting the data at half-second intervals and storing them for future management.

The RAGodoy®, an apparatus that performs plantar flexion and dorsiflexion exercises, was utilized to dynamically evaluate venous pressure variations during passive exercising (Figure 1). Six evaluations were made, the data were stored as numbers and presented in the form of a graph.

Figure 1 shows the equipment and the positioning of the limbs during exercising

Results

In all evaluations, variations in the pressure gradient were detected as are illustrated in Table 1.

Table 1: Minimum, maximum and mean pressure variations (mmHg)

Evaluation	*Minimum Index (mmHg)*	*Maximum Index (mmHg)*	*Mean (mmHg)*
1	12	75	18
2	8	62	19
3	13	43	30.5
4	12	77	42
5	17	66	20
6	18	66	23

Discussion

The RAGodoy® is an apparatus that was developed with the primary objective of preventing deep vein thrombosis (DVT) in immobile individuals such as patients in the surgical center, intensive care units and on hospital wards. However, the first studies were on patients with lymphedema, where the objective was to perform mechanical lymph drainage [4]. The action of the apparatus is to reproduce some of the movements in structures experienced during walking that is, bending and stretching the ankle joint. One of factors in Virchow's triad is venous stasis; a dynamic study of venous return has already proven that this apparatus causes a pulsating blood flow. No studies discussing this issue were found in the Medline electronic database.

Conclusion

The RAGodoy® apparatus causes return pressures in the venous systems of lower limbs that may be utilized to prevent venous stasis.

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