ORIGINAL ARTICLE

Evaluation of great saphenous vein occlusion rate and clinical outcome in patients undergoing laser thermal ablation with a 1470-nm bare fiber laser with low linear endovenous energy density

Avaliação da taxa de obliteração da veia safena magna e da evolução clínica de pacientes submetidos a termoablação com lase 1470 nm, fibra linear e baixa densidade de energia endovenosa linear
Título traduzido 2

Walter Junior Boim Araujo [1] , Jorge Rufino Ribas Timi [1] , Carlos Seme Nejm Júnior [1] , Filipe Carlos CaronCronos

[1] Universidade Federal do Paraná –UFPR, Department of Surgery, Curitiba, PR, Brazil.
Financial support: None.
Conflicts of interest: No conflicts of interest declared concerning the publication of this article.
Submitted: June 05, 2015. Accepted: June 26, 2015.

The clinical importance of air plethysmography in the assessment of chronic venous disease

13 de julho de 2017

Jornal Vascular BrasileiroJ. Vasc. Bras.1677-54491677-7301Sociedade Brasileira de Angiologia e de Cirurgia Vascular (SBACV)jvbAR2016002110.1590/1677-5449.00211601101ArticlesImportância clínica da pletismografia a ar na avaliação da doença venosa crônica Conflicts of interest: No conflicts of interest declared concerning the publication of this article. *Correspondence Marcelo Bellini Dalio Departamento de Cirurgia e Anatomia HCRP, Campus Universitário Av. Bandeirantes, 3900, 9º andar CEP 14049-900 - Ribeirão Preto (SP), Brazil Tel.: +55 (11) 8111-7424 E-mail: mbdalio@usp.br Author information NRAD and MBD - MD, PhD, and assistant physician at Divisão de Cirurgia Vascular e Endovascular, Departamento de Cirurgia e Anatomia, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo (USP). MSR - MD, PhD, and associate professor at Divisão de Cirurgia Vascular e Endovascular, Departamento de Cirurgia e Anatomia, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo (USP). CEP - MD, PhD, and full professor at Divisão de Cirurgia Vascular e Endovascular, Departamento de Cirurgia e Anatomia, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo (USP). EEJ - MD, PhD, and associate professor and head of Divisão de Cirurgia Vascular e Endovascular, Departamento de Cirurgia e Anatomia, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo (USP).

Author contributions Conception and design: NRAD Analysis and interpretation: NRAD, MBD, MSR Data collection: NRAD Writing the article: NRAD, MBD Critical revision of the article: CEP, EEJ Final approval of the article*: NRAD, MBD, MSR, CEP, EEJ Statistical analysis: NRAD Overall responsibility: NRAD *All authors have read and approved of the final version of the article submitted to J Vasc Bras. 0105 00 2804201624082016

Resumo

Abstract Air plethysmography is a non-invasive test that can quantify venous reflux and obstruction by measuring volume changes in the leg. Its findings correlate with clinical and hemodynamic measures. It can quantitatively assess several components of venous hemodynamics: valvular reflux, calf muscle pump function, and venous obstruction. Although clinical uses of air plethysmography have been validated, it is used almost exclusively for medical research. Air plethysmography can be used to assess chronic venous disease, to evaluate improvement after venous surgery, to diagnose acute and past episodes of deep venous thrombosis, to evaluate compression stocking therapy, to study the physiological implications of high-heeled shoes in healthy women, and even to evaluate the probability of ulcer healing. Resumo A pletismografia a ar é um método não invasivo que pode quantificar refluxo e obstrução venosa medindo alterações no volume das pernas. Seus achados se correlacionam com parâmetros clínicos e hemodinâmicos. Ela pode fornecer informações quantitativas dos diferentes componentes da hemodinâmica venosa: refluxo valvular, função de bomba muscular da panturrilha e obstrução venosa. Apesar de ter seu uso clínico validado, a pletismografia a ar é usada quase que exclusivamente para pesquisa. Ela pode ser usada para avaliar a doença venosa crônica, mensurar o ganho hemodinâmico após cirurgia venosa, diagnosticar trombose venosa profunda atual ou prévia, avaliar os efeitos da elastocompressão, estudar as implicações fisiológicas do uso de salto alto em mulheres e também avaliar a probabilidade de cura de uma úlcera venosa. Keywords: ***air plethysmography chronic venous disease varicose veins***

venous thrombosis leg ulcer Palavras-chave: ***pletismografia a ar doença venosa crônica varizes trombose venosa úlcera de perna***

INTRODUCTION

Chronic venous disease (CVD) includes a spectrum of clinical presentations ranging from uncomplicated telangiectasis and varicose veins to venous ulceration.[th] It represents an important public health problem with economic and social consequences.[th th th] Prevalence is about 20 to 73% in females and 15 to 56% in males.[th] The combination of skin abnormalities and sustained venous hypertension is referred to as chronic venous insufficiency (CVI). Manifestations of CVD are the result of outflow reflux, obstruction, or a combination of both. These processes may be primary or secondary to other conditions, such as deep venous thrombosis (DVT).[th]

Duplex scanning and venography can provide the anatomic and physiologic information necessary to diagnose and treat venous reflux and/or obstruction in the superficial, deep, and perforator systems.[th]

Air plethysmography (APG) has been introduced as an additional tool for the evaluation of venous hemodynamics.[th th th] APG is a non-invasive test that can quantify venous reflux and obstruction by measuring volume changes in the leg.[th] Its findings correlate with clinical and hemodynamic measures.[th]

Although clinical uses of APG have been validated, it is almost exclusively used for medical research. The purpose of this review is to discuss the applications of APG for clinical assessment of chronic venous disease.

STANDARD AIR PLETHYSMOGRAPHY TECHNIQUE

Christopoulos et al.[th] have described validation and the reproducibility and results of APG in detail, both in normal volunteers and in patients with superficial or deep venous disease. In order to evaluate venous reflux, APG is performed with a 35 cm-long polyvinyl chloride air chamber (5 L capacity) that surrounds the leg from knee to ankle and is connected to a pressure transducer and chart recorder. The pressure transducer is calibrated with 100 mL of air after the air chamber is fitted around the leg, with the patient supine. The leg is elevated to 45 degrees to empty the veins and a baseline reading is obtained (Figure 1A). The patient is then asked to stand, putting body weight on the opposite leg. The increase in leg volume is observed until a plateau is reached, indicating that the veins are full (Figure 1B). This plateau corresponds to the functional venous volume (VV). The time taken to achieve 90 percent of venous volume has been defined as venous filling time 90 (VFT 90). The venous filling index (VFI) is calculated by dividing 90% of VV by VFT90. The patient is then asked to perform a single heel-raise maneuver. The resultant decrease recorded is the ejected volume (EV), caused by contraction of the calf muscle (Figure 1C). The ejection fraction (EF) is calculated by dividing the ejection volume by the venous volume and multiplying by 100. After a new plateau is reached, 10 heel-raise maneuvers are performed to reach another plateau, representing residual volume (Figure 1D). The residual volume (RV) is the volume at the end of exercise. Finally, the patient is asked to remain standing (Figure 1E). The residual volume fraction (RVF) is calculated by dividing the RV by the VV and multiplying by 100. The VFI is an index of global venous reflux, the EF is a reflection of calf muscle pump function, and the RVF is a reflection of ambulatory venous pressure.[th th th]

In order to evaluate venous obstruction, APG is performed using an 11 cm pneumatic cuff with a 40 cm long bladder placed around the proximal thigh to act as a partially occluding tourniquet. After calibration, with the patient in supine position, the tourniquet is inflated to 70 mmHg and maintained until a maximal venous volume is reached and the chart recorder traces a plateau. Upon rapid deflation of the tourniquet, venous outflow is recorded. The outflow fraction (OF) is obtained by dividing the amount of venous volume emptied in 1 second by the venous volume and multiplying by 100. OF values lower than 38% suggest venous obstruction.[th]

APPLICATIONS OF AIR PLETHYSMOGRAPHY IN THE CLINICAL ASSESSMENT OF CHRONIC VENOUS DISEASE

Some important applications of APG in evaluation of lower extremity chronic venous disease and venous function are discussed below:

DIFFICULTIES WITH USING AIR PLETHYSMOGRAPHY IN CLINICAL SETTINGS

Although it is a noninvasive and relatively inexpensive method, APG can be technically difficult. It is highly dependent on accurate calibration and because of this it can be considered an examiner-dependent test. Minimal technical errors during measurements invalidate the test and make it obligatory to repeat the test from the start. Calibration and frequent restarting mean that APG

is often a time-consuming procedure. Obesity can also influence results, making APG parameters inappropriate.

As stated above, APG is currently almost exclusively used for medical research. Despite its low cost and non-invasive nature, APG is rarely found in clinical vascular laboratories. In Brazil, this fact could be partly explained by the absence of a domestic APG device manufacturer. Until recently, there was an APG device produced in Brazil that was available at a reasonable cost. Nowadays, all APG devices in Brazil must be imported, which makes costs considerably higher.

CONCLUSION

Air plethysmography is a non-invasive test that can be used to quantitatively assess several different components of venous hemodynamics: valvular reflux, calf muscle pump function, and venous obstruction. It can be used to assess chronic venous disease, to evaluate improvement after venous surgery, to diagnose acute and past episodes of deep venous thrombosis, to evaluate compression stocking therapy, to study the physiological implications of high-heeled shoes in healthy women, and even to evaluate the probability of ulcer healing.