

Exercise Oxymetry in the Diagnosis of a Clinically Challenging Bilateral Socket Intolerance and Follow-up of An Apparently Inefficient Revascularisation

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Abstract

Socket intolerance is a cause of walking impairment in amputees. Exercise transcutaneous oxygen pressure (Ex-tcpO₂) is proposed to monitor exercise-induced ischemia. A man with bilateral tibial amputation was referred for left thigh pain and socket intolerance. Ex-tcpO₂ showed an ischemia on the left thigh and on buttocks. After vascular surgery, the patient complains from walking limitation with left buttock pain. A new Ex-tcpO₂ showed a normalization of the thighs ischemia but a worsening on the left buttock, due to the circumflex artery occlusion during surgery. This case illustrates questions that physician may face, Ex-tcpO₂ confirms vascular origin of the pain.

Keywords: Vascular claudication; Amputee; Socket Intolerance; Walking

Introduction

Peripheral artery disease (PAD) is a frequent cause of walking impairment due to pain induced by walking (intermittent claudication) [1] and can lead to lower limb amputation. Vascular claudication affects mainly calves, but other localizations such as buttocks or thighs may be reported. Socket intolerance is a frequent cause of walking impairment due to pain in lower limb amputees. Transcutaneous oxygen pressure during exercise (Ex-tcpO₂) can be used to monitor exercise-induced regional blood flow impairment (RBFi) throughout walking treadmill tests on both lower limbs and different areas. This method was demonstrated to be accurate to detect arteriographically proved lesions [2]. Thereby Ex-tcpO₂ is a unique tool to determine the concordance between symptoms and arterial lesions shown by imaging. Indeed, PAD symptoms can be improved by collateral artery development whereas symptoms may worsen by accidental occlusion of collateral arteries in case of unsuccessful revascularization.

We describe an amazing case of claudication in a patient with bilateral trans-tibial amputation, showing the interest of Ex-tcpO₂ both as a diagnostic tool and as a unique method of following and explaining the results of an apparently unsuccessful revascularization.

Case Description

On March 2012, a 72-year-old man with moderate renal failure and an ancient bilateral traumatic proximal trans-tibial amputation at the age of 17 was referred to our laboratory for evaluation of a severe left thigh pain while walking associated with moderate bilateral buttocks and right thigh walking aching. Until the age of 71 he was perfectly able to walk and was physically active with his two prostheses. The maximal walking distance (MWD) was estimated at 100 meters. The patient was referred for Ex-tcpO₂ to confirm the ischemic origin of thigh pain because of renal failure, we were reluctant to perform contrast agent injection. The patient was evaluated using a standard

treadmill procedure. For tcpO₂ measurements, we used six tcpO₂ devices (TCM3 Radiometer, Copenhagen, Denmark) with probes heated to 44.5°C. TcpO₂ values were automatically transferred to a computer (Acknowledge BIOPAC MP150, Cerom, Paris, France) on a sample rate of 0.5 Hz. Probes were positioned on the chest, on the lower back, on the upper external quarter of each buttock and on both thighs. TcpO₂ was recorded for two minutes at rest, during exercise and throughout recovery. From tcpO₂ recorded values, we automatically calculated the decrease from rest of oxygen pressure (DROP) at each limb site. The DROP index had been described and validated [2,3]. The DROP index consists in the subtraction of limb-tcpO₂ changes from chest tcpO₂-changes. A significant ischemia is a minimal DROP value below minus 15 mmHg.

Standard Procedure

A two-minute reference period at rest while the patient was standing still on the treadmill. Thereafter the walking period was performed at 10% grade and 3.2 km/h. Patient was blinded to the distance and time throughout the test. When exercise was stopped, the speed and slope rapidly returned to zero. During the recovery phase after walking, the patient was asked to remain stable in the standing position. Recovery lasted 10 minutes (Figure 1).

Ex-tcpO₂ was stopped because of a severe left thigh pain after a 101-metre-long walking distance. The ex-tcpO₂ curves showed a severe ischemia on the left thigh (DROP tcpO₂=-36 mmHg) and significant ischemia on the right one (-15 mmHg) and both buttocks (-15 at the right one and -21 mmHg at the left one) (Figure 1B). Previous ultrasound imaging and an angio-scan performed after Ex-tcpO₂ showed bilateral ilio-femoral stenosis and a severe stenosis on the left common femoral artery (Figures 2A and 2B). Surgical management consisted in a technically successful end arteriectomy of the left femoral tripod associated with an angioplasty of the right external and common iliac arteries. Three months after surgery, the patient complains from walking limitation with severe left buttock pain, whereas thigh pain has disappeared.

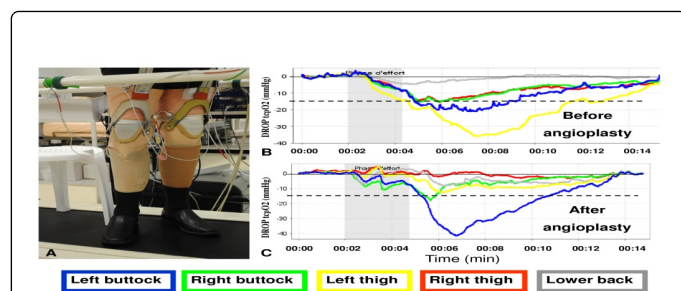


Figure 1: Left panel: (A) Installation of the patient on the treadmill. Two probes are placed on each buttocks and each thighs. The lower back and chest reference probes are not visible. Right panels: The period between 0 and 2 minutes is the resting period. The walking period is shown in grey. Post exercise recovery allows for the normalisation of DROp values within 10 minutes. Dotted line is the threshold of ischemia (DROp \leq 15 mmHg). (B) Results of the Ex-tcpO₂ before angioplasty show a severe ischemia on the left thigh and a significant ischemia on the right thigh and both buttocks. (C) Results of the Ex-tcpO₂ after angioplasty shows a complete normalization of the right and left thigh ischemia but a worsening of left buttock ischemia.

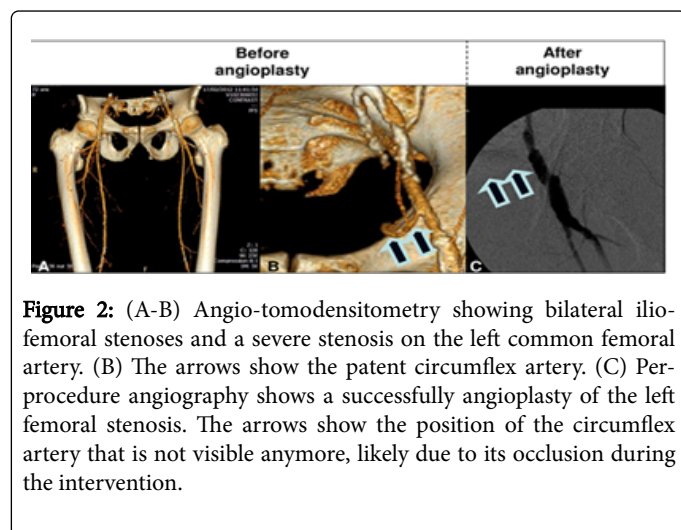


Figure 2: (A-B) Angio-tomodensitometry showing bilateral ilio-femoral stenoses and a severe stenosis on the left common femoral artery. (B) The arrows show the patent circumflex artery. (C) Per-procedure angiography shows a successfully angioplasty of the left femoral stenosis. The arrows show the position of the circumflex artery that is not visible anymore, likely due to its occlusion during the intervention.

A new Ex-tcpO₂ test was performed, stopped at 125 m for left buttock pain. The ex-tcpO₂ curves showed a complete normalization of the right and left thigh ischemia but a particularly severe worsening of left buttock ischemia (DROp tcpO₂ = -41 mmHg), consistent with the symptoms described by the patient (Figure 1C). As shown in Figures 2B and 2C, buttock ischemia was probably due to the occlusion of the circumflex artery during the initial procedure (Figure 2C). No surgical solution was found to re-vascularise the hypogastric circulation. On a 2.5 year follow-up, no improvement of walking ability was observed.

Discussion

Claudication [4,5] and socket intolerance [6] sometimes remain challenging diagnostic situations. In the present case, due to renal failure, we were reluctant to perform contrast agent injection as a

primary tool of proximal ischemia [7]. The initial Ex-tcpO₂ helped confirm the vascular origin of the pain and argued for the injected imaging with revascularization of arterial lesions. Bilateral amputation of our patient did not allow ankle to arm pressure recording and almost precluded the use of post exercise thigh pressure measurements for technical reasons. Amputation in the present patient was of traumatic origin while with age the patient had developed atherosclerosis, but the problems observed in the present case are illustrative of the questions that physician may face in either arterial or ageing traumatic amputees. In our case, buttock claudication might be due to the relief of thigh pain unmasking buttock pain. Ex-tcpO₂ results confirm that it is not the case and the buttock pain clearly results from a worsening of buttock ischemia during exercise. Since 2003, the analysis of Ex-tcpO₂ results with the DROp index has allowed to get rid of the reliability issue of absolute tcpO₂ values and has attained highly reliable exercise results in claudicants [2]. As shown in the figure, Ex-tcpO₂ provides objective evidence that angioplasties have normalized the perfusion both on the right and left thigh as a result of technically successful angioplasties, while right buttock ischemia is almost unchanged. It cannot be excluded that the decrease in DROp at the left buttock level is due to a slightly longer walking period during the second test. We assume that this is not the explanation since no worsening was observed on the right buttock. The role of circumflex iliac arteries is clearly not dominant in models of the pelvic circulation [8]. Nevertheless, when dominant pathways (lumbar or ipsilateral and contra hypogastric arteries) are occluded, such arteries may become essential to cover muscle blood flow requirements at exercise. The very interest of the present case is that we have objective evidence to support this hypothesis. Ex-tcpO₂ appears as an original tool to help physicians argue for the vascular origin of walking induced pain in clinically challenging situations such as socket intolerance in limb amputees.

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