

## Choosing the individual rehabilitation program for patients with intermittent claudication

A. ORSINI<sup>1</sup>, S. IZZO<sup>3</sup>, G. SAGGIO<sup>2</sup>, G. SINAIMERI<sup>3</sup>, L. IZZO<sup>3</sup>, F. RAZIONALE<sup>3</sup>,  
S. VALABREGA<sup>4</sup>, A. D'ALESSANDRO<sup>3</sup>, S. MANDOLESI<sup>3</sup>, P. DI CELLO<sup>3</sup>, P. IZZO<sup>3</sup>

**SUMMARY: Choosing the individual rehabilitation program for patients with intermittent claudication.**

A. ORSINI, S. IZZO, G. SAGGIO, G. SINAIMERI, L. IZZO,  
F. RAZIONALE, S. VALABREGA, A. D'ALESSANDRO, S. MANDOLESI,  
P. DI CELLO, P. IZZO

*This study is aimed at identifying the collateral circulation in case of femoral-aorta-iliac axis obstruction, with the purpose of a more correct therapeutic indication being either medical or surgical or physiotherapeutic or combined.*

KEY WORDS: Rehabilitation - Collateral circulation - Physiotherapy.

### Introduction

An examination of the literature clearly shows that arterial disease of the lower limbs of the 2nd stage are liable to medical and physical treatment (1, 2) with a considerable increase in the autonomy of travelling.

The explanation for this lies in improving the quality of the collateral circulation.

In later stages of medical treatment, results are often ineffective, in fact, "... the critical ischemia of the lower limbs is the main indication for femoral-distal reconstructions" (3).

Even in studies that consider best cases (4, 5) it is clear that a significant number of revascularizations gives rise even in a short time, to the loss of luminal patency. Hence, the limb fate will depend on the development and functionality of the collateral circulation.

The importance of collateral circulation in the arterial diseases of lower limbs, is not a discovery of our day, but it dates back to two centuries ago.

Luigi Porta in 1845 (6) described the collateral circulation as follows:

- newly formed anastomosis;
- anastomosis preformed;
- anastomosis reformed (intramuscular, periosteal, subcutaneous).

These last two ones are fundamental, because they can occur at any moment and may also grow considerably with the time.

"Whatever the cause, the importance of ischemic disorders depends on the quality of the collateral circulation". This quality concept is reported by Fontane in 1957 (7) "... these studies show major discrepancies between gravity 'of arteriographic symptoms and ischemic present signs, and vice-versa".

And still Milone (8) states: "to highlight the anastomosis angiography is not enough to speak of collateral circulation."

The collateral circle is not only an anatomical entity but a "functional anatomical entity" ... therefore is ... "hemodynamics."

Strandness in 1969 (9) states that the gradient tension that develops in arterial stenosis blockages is the sum of the resistances of collateral circulation. "Those arteries distal to the area of occlusion have been termed the "run-

<sup>1</sup> "San Raffaele" Telematic University, Rome, Italy

<sup>2</sup> Department of Electronic Engineering, "Tor Vergata" University of Rome, Rome, Italy

<sup>3</sup> Department of Surgery "Pietro Valdoni", "Sapienza" University of Rome, Rome, Italy

<sup>4</sup> Division of General Surgery, "St. Andrea" Hospital, Rome, Italy

Corresponding author: Luciano Izzo, e-mail: luciano.izzo@uniroma1.it

© Copyright 2017, CIC Edizioni Internazionali, Roma

off” vessels and are considered the critical area in determining the immediate and long-term patency rate.”

These data are still at the base of the studies about the predictability of the patency of bypass proposed by the SVS / ISCVS.

There must however be pointed that even the most accurate arteriographic study, absolutely necessary to establish the values of out-flow and peripheral resistance, proposed and recommended by the SVS / ISCVS, where are based on the outcome standards on patency of bypass, it can not provide hemodynamic information and even less in real time.

In an attempt to overcome this difficulty, some authors (10, 11) have identified a critical value of the peripheral resistance to flow equal to 1.2 mmHg / ml / min, values equal to or greater are at risk of closure. As regards the flow values lower than 60-100 ml / min are critical, according to other authors (12, 13). The data about the specificity and sensitivity of the various methods are discordant.

CW Doppler (Figure 1) is an important method for the purpose of anatomical-topographic detection and for the hemo-dynamics quantization (14). Normally these collateral vessels are not detectable and are activated only in the event of downstream obstacle.

It is therefore important to be familiar with these possible anastomosis to identify them. Their search is performed with CW Doppler according to the technique, albeit modified, and proposed aims by Claude Franceschi: “...The interest of this analysis lies in the valuable information it can provide not only to the lesion diagnosis but also and especially to prognostic and therapeutic medical or surgical revascularization”.

## Methodology

The patients are studied by ultra-sonographic exa-

minations performed with the Franceschi technique that represent an important technique for purposes of identifying anatomical-topographic and for quantizing hemo-dynamics.

Through the direct study or through appropriate compression maneuvers it is possible to identify and map collaterals by assessing the hemodynamic importance.

Our study of 134 arteriopathies highlighted the activation of collateral circulation (as shown in the table) in 24 cases out of 35 aorto-iliac lesions; 25 cases out of 29 lesions of the external iliac artery, 62 cases out of 69 lesions of the superficial femoral artery (Figure 2).

So a good knowledge of collateral circulation allows:

- 1) noting their presence and consistency;
- 2) assessing the functional importance;
- 3) realizing a therapeutic strategy;
- 4) finalizing the development.

A good collateral circulation, as often happens for the great anastomotic net, can be a real anatomic bypass.

This finding leads us to think that it is possible to intervene in a targeted manner on the development of collateral circulation, pain relief and to prevent necrosis, but also to develop, through the development of computerized data, those collaterals that will ensure the survival of limb even after the closing of the bypass.

It also aims through a statistical and mathematical formula to derive an early predictor that addresses to the best therapeutic solution.

## Final considerations

The authors have developed a computer program that will analyze, based on the activation data of collateral circulation and obstruction levels the anastomotic possibilities between districts arterial pre and post stenosis-obstruction, linking them to the relevant muscles sprayed from those arteries.

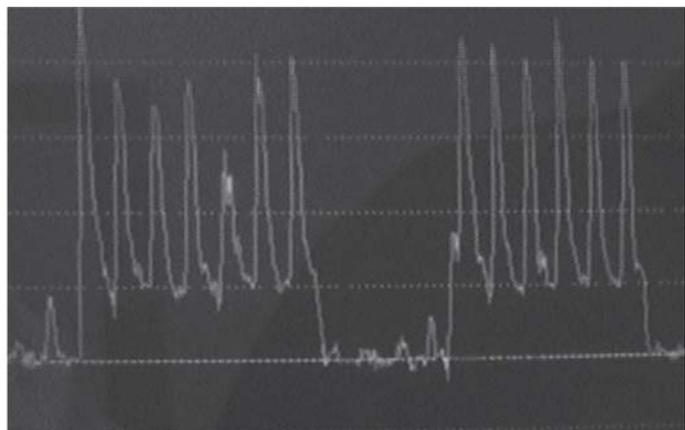


Figure 1 - CW Doppler method.

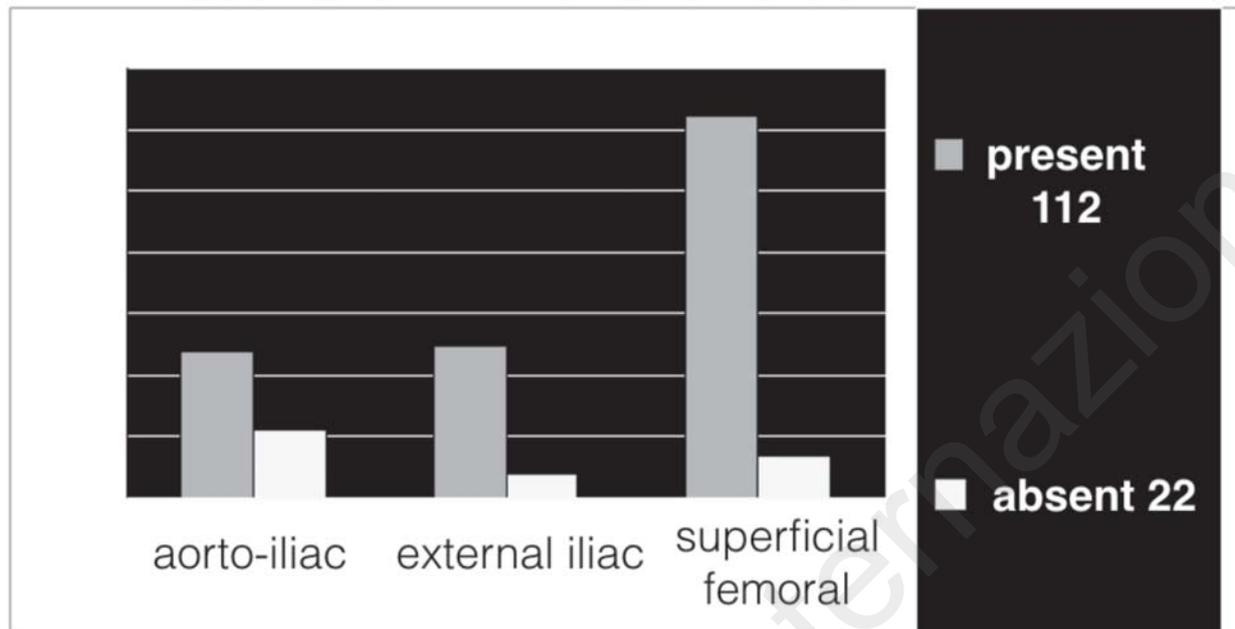


Figure 2 - The results of 134 arteriopathic cases.

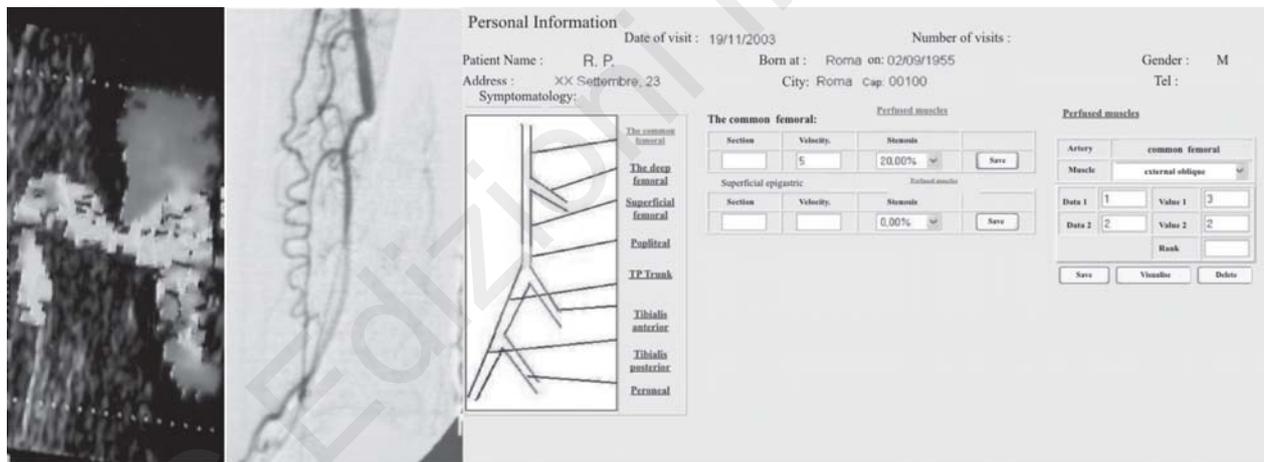


Figure 3 - Screenshot of the program run for the patient R.P.

The computer shows the groups of preferential muscles to be developed with the targeted physical therapy and medical therapy in order to hypertrophy the ana-

stomotic, collateral and afferent circulation and finally it will allow to quantify the scope of hemodynamics making it possible thus to test the therapeutic efficacy.

## References

1. Gardner AW, Poehlman ET. Exercise rehabilitation programs for the treatment of claudication pain. A meta-analysis. *JAMA*. 1995;274(12):975-80.
2. Regensteiner JG. Exercise in the treatment of claudication: assessment and treatment of functional impairment. *Vasc Med*. 1997;2(3):238-42.
3. Rutherford RB, Flanigan DP, Gupta SK, Johnston KW, Karmody A, Whittemore AD, et al. Suggested standards for reports dealing with lower extremity ischemia. *J Vasc Surg*. 1986;4:80-94.
4. Branchereau A, Colonna MA, Magnapan PE. Risultats des pon-

- tages artériels après dix ans. Chirurgie Spécialités (Chigot JP, et al, eds) Paris: Expansion Scientifique. 1990:62-65.
5. Malone JM, Moore WS. The natural history of bilateral aorto-femoral by-pass grafts for ischemia of lower extremities. Arch Surg. 1975;110:1300-1305.
  6. Porta L. Delle alterazioni patologiche delle arterie per la legatura e la torsione, esperienze ed osservazioni. Milano, Bernardoni, 1845.
  7. Fontaine R, Kim M, Wagner R, Loritke JG, Levy JC. Physiopatologie des oblitérations de la bifurcation aortique. Minerva. Cardioangiologica Europea. 1957;1:1-39.
  8. Milone F, Barone G, Angelillo R, Di Filippo B, Lombardi D. Studio radio anatomico del circolo collaterale nelle ostruzioni arteriose aorto-iliache. Min Cardioangiologica. 1982;30:737-42.
  9. Strandness DE. Jr. Pathological alterations in blood flow. Ann Rev Med. 1969;20:1-14.
  10. Ascer E, et al. Components of outflow resistance and their correlation with graft patency in lower extremity arterial reconstructions. J Vasc Surg. 1984;1(6):817-28.
  11. Ascer E, et al. Quantitative assessment of outflow resistance in lower extremity arterial reconstructions. J Surg Res. 1984;37(1):8-15.
  12. Lundell A, Bergquist D. Prediction of early graft occlusion in femoropopliteal and femorodistal reconstruction by measurement of volume flow with a transit time flowmeter and calculation of peripheral resistance. Eur J Vasc Surg. 1993;7(6):704-8.
  13. Terry HJ. The electromagnetic measurement of blood flow during arterial surgery. Biomed Eng. 1972;7(10):466-74.
  14. Franceschi C. Le Doppler (I): l'étage aorto-iliaque. Le Doppler (II): l'étage fémoro-poplité. Le Doppler (III): les artères de la jambe et du pied. Le Quotidien du Médecin (Med. Cardio-Vasculaire);1982:55-64.
-