

ORIGINAL RESEARCH

EXTERNAL AGGRESSION TO THE LIMB AS A PREDICTIVE FACTOR IN THE EVOLUTION OF PATIENTS UNDERGOING ARTERIAL REVASCULARIZATION

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PURPOSE: A variety of predictive factors for the evolution of arterial grafts in patients with critical ischemia have been well defined in clinical studies, including diabetes mellitus, dialytic renal insufficiency, smoking, and distal arterial runoff. The goal of this study was to determine whether patients with critical ischemia undergoing arterial reconstruction in which ischemic lesions appeared spontaneously, compared to those in which the ischemic lesion appeared following an external aggression to the limb present different patterns of evolution.

METHODS: From February 2002 to January 2004, 100 patients undergoing infra-inguinal arterial reconstruction were followed. They were divided into 2 groups: 1) the spontaneous group (n = 52), comprising individuals presenting with ischemic lesions of spontaneous origin and 2) the external aggression to the limb group (n = 48), comprising individuals for which an external causal mechanism for the appearance of the ischemic lesion was identified. The variables analyzed were limb salvage and graft functioning rates.

RESULTS: Patients with spontaneous lesions had rates of limb salvage and graft functioning significantly lower than those for patients with lesions that were secondary to external aggression (42.3% versus 87.5%, respectively for both outcomes; P <.001).

CONCLUSIONS: The absence of an external aggression as a contributing factor to a critical ischemic lesion in the lower limb may result in a poorer evolution of both graft function and limb salvage following arterial revascularization. However, this factor is not expected to directly influence the case conduct, since almost half of the patients without evident external aggression had good graft functioning and limb salvage. This prognostic factor should be used just as all others are, i.e., to give patients and doctors a better idea of the possible evolution in such cases.

KEYWORDS: Intermittent claudication. Ischemic rest pain. Femoral artery. Natural history. Risk factor.

Revascularization is the procedure of choice for limb salvage in patients with critical ischemia in the lower limbs.^{1,2} The most commonly used methods are arterial bypasses and endovascular procedures.³⁻⁵

Results of the revascularization surgery have been improving lately, 10% to 32% of these patients do not achieve

the expectations for limb salvage,^{6,7} hemodynamic improvement at the affected extremity,⁸ or survival.⁹ To improve such results, we must be able to recognize all the factors that could influence on the favorable or unfavorable evolution of the bypasses, i.e., the predictive factors. Through knowledge of these factors, we may be able to prevent or correct what is undesirable and enhance what is desirable.

A variety of predictive factors¹⁰ have been well defined in clinical studies, including diabetes mellitus,¹¹ dialytic renal insufficiency,¹² smoking,⁶ and distal arterial runoff.^{1,3}

One factor that has not yet been correlated with the post-

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operative evolution of arterial grafts is the presence of external aggression to the limb (EAL). The external aggression could be trauma, infection, or interdigital mycosis that causes an ischemic lesion, thereby decompensating a stable condition of chronic ischemia and turning it into a critical ischemia.

The goal of this study was to ascertain whether patients with critical ischemia undergoing arterial reconstruction in which ischemic lesions appeared spontaneously present an evolution that differs from those in which the lesion appeared through EAL.

METHODS

One hundred patients undergoing arterial reconstruction for critical ischemia over a 2-year period were followed through a prospective, non-randomized, and uncontrolled study. The patients underwent similar treatment, following the same protocol. The study was approved by the Committee of Ethics for Analysis of Research Projects on Human Experimentation, and all subjects gave informed consent.

The patients were divided into 2 groups according to the clinical interview. In the first (spontaneous) group, 52 individuals presented ischemic lesions of spontaneous origin (without trauma, infection, or prior interdigital mycosis). The second (EAL) group consisted of 48 patients with ischemic lesions in whom a non-natural causal mechanism for the appearance of the ischemic lesion was identified. These traumas in the EAL group were: digital trauma in 22 patients, digital infection in 8, and interdigital mycosis in 18. The patients in the spontaneous group did not report any kind of trauma generating the digital lesions.

The average age of patients was 62.8 years; 80.2% were smokers, 50.5% were hypertensive, and 41.6% were diabetic. Baseline characteristics showed no significant differences between the groups as is shown in Table 1.

The indication for surgery was tissue loss (Rutherford III) for all patients. In every case, tissue loss was limited, with lesions of less than 5 cm in diameter or ischemic lesions caused by gangrene confined to the digits. Indication

Table 1 - Associated risk factors of the study subjects

Factors	Spontaneous group		EAL group	
	group	%	group	%
N° of patients	52		48	
Men/Women	36/16	69.2/30.8	33/15	68.8/31.3
Average age	62.9		62.8	
Diabetes mellitus	22	42.3	20	41.7
Coronary disease	13	25.0	13	27.1
Renal insufficiency	3	5.7	2	4.1
Smoking	42	80.7	39	81.3
Arterial hypertension	25	48.0	26	54.2
Preoperative Ankle braquial index	0.33		0.38	

for surgery was confirmed by the presence of an ankle-arm index of less than 0.40 or by no scar formation at the lesion after 4 weeks of appropriate local treatment.

Cultures of the ulcerated lesions were performed, and the appropriate perioperative antibiotic therapy was administered.

All patients underwent preoperative digital arteriography to determine the type of arterial revascularization to be used in each case as well as to evaluate the runoff. The arteriographic pattern is presented in Table 2 and shows that distal obstructions were more frequent in the spontaneous group.

Table 2 - Arteriographic pattern

Procedures	Spontaneous group		EAL group	
	group	%	group	%
Femoro-popliteal obstruction				
Segmental (<3cm)	1	1.9	1	2.1
Long obstruction (>6cm)	27	51.9	37	77.1
Superficial femoral and Popliteal Obstruction	20	38.4	9	18.6
Popliteal-distal obstruction	4	7.7	1	2.1
TOTAL	52		48	

The choice of bypass material and the site of the distal anastomosis was based on the arteriographic pattern and was at the discretion of the surgeon. Above-knee femoral-popliteal procedures were all performed using 8 mm bifurcated Dacron prostheses. In the other cases, the saphenous vein was used. Angioplasties were performed in 2 cases on segmental lesions of less than 3.0 cm in length.

The surgical procedures performed in both groups are listed in Table 3.

Table 3 - Revascularization procedures performed

Procedures	Spontaneous group		EAL group	
	group	%	group	%
Angioplasty	1	1.9	1	2.1
Femoral-popliteal	27	51.9	37	77.1
Femoral-distal	20	38.4	9	18.7
Popliteal-distal	4	7.7	1	2.1
TOTAL	52		48	

Postoperative anticoagulant or antiplatelet therapy was given based on the preference of the surgeon.

Debridement of necrotic tissue was performed either immediately after the arterial reconstructions, or at a later time (some days after the revascularization) according to the indications for each case.

The patients were followed up for 30 days after the operation. At that time, the functioning of the grafts was confirmed by means of color duplex ultrasonography.

The degree of salvage presented by the limb and the functioning of the graft 30 days after the operation were

analyzed for each of the groups.

The distribution of number of open runoff vessels obtained in the arteriographies in both groups was also studied.

The chi-square test was used to analyze the data. The significance level was set at $P < .05$.

RESULTS

The rate of graft functioning for the patient group with spontaneous lesions was significantly lower than the rate for patients with lesions that were secondary to EAL ($P < .001$). Rates for graft functioning in each group after 30 days are shown in Table 4.

Table 4 - Functioning of the grafts 30 days after revascularization surgery

	Spontaneous group	%	EAL group	%	Total
Functioning	22	42,3	42	87,5	64
Occluded	30	57,7	06	12,5	36
Total	52		48		100

$P < .001$

The rate of limb salvage for the patient group with spontaneous lesions was significantly lower than the rate for the patients with lesions that were secondary to EAL ($P < .001$). Rates for limb salvage in each group after 30 days are shown in Table 5.

Table 5 - Limb salvage following revascularization surgery

	Spontaneous group	%	EAL group	%	Total
Limb salvaged	22	42,3	42	87,5	64
Limb amputated	30	57,7	06	12,5	36
Total	52		48		100

$P < .001$

Twenty patients from the spontaneous group underwent below-knee amputation, and 10 underwent above-knee amputation. Four patients from EAL group underwent below knee-amputation, and 2 underwent above-knee amputation.

The patients in the spontaneous group presented worse runoff than those in the EAL group $P < .05$. The distribution of number of open runoff vessels obtained in the arteriographies is shown in Table 6.

Table 6 - Number of open run-off vessels

Run-off	Spontaneous group	%	EAL group	%
1	26	1.9	11	2.1
2	15	51.9	16	77.1
3	11	38.4	21	18.7
TOTAL	52		48	

$P < .05$

DISCUSSION

The search for better results in the treatment of patients with critical ischemia has stimulated us to seek predictive factors. One factor that would seem evident is the mechanism of the formation of the ischemic lesions. It appears, however, that this factor has never been studied. Therefore, we decided to perform a prospective evaluation of patients in our service who were undergoing revascularization of lower limbs.

The 2 groups studied were similar in terms of age, pre-existing diseases, incidence of a smoking habit, arterial hypertension, diabetes, ankle-arm index, and Rutherford classification of ischemia level.

The great majority of the patients in both groups presented with infections, thus necessitating both preoperative and postoperative antibiotic therapy.¹³ It is worth emphasizing that we did not observe any specific characteristics in the ischemic lesions that were correlated with the mechanism of lesion formation (i.e., spontaneous or secondary to external aggression).

The objective of defining the predictive factors in patients with critical ischemia is to give an idea of the prognosis for each case, even though such knowledge does not alter the medical conduct, since these are situations of imminent limb loss. The surgical treatment employed in all cases was based on and performed under the same assumption.

When the functioning of the grafts was analyzed after 30 days, it was noted that the patients with spontaneous lesions presented a higher occlusion rate than that of the EAL group (57.7% versus 12.5%). This was due to a worse runoff according to the arteriography (Table 6).

Similarly, the limb salvage rate was greater in the patient group with ischemic lesions secondary to external aggression, than for patients who presented with spontaneous lesions (87.5% vs. 42.3%). This parallelism was probably due to the fact that the patients with spontaneous lesions presented worse runoff.

Spontaneous lesions are a consequence of a more morbid situation in the arterial tree. Blood support in this situation is insufficient to cover the basal metabolism of the tissue, which translates into lesion formation. In contrast, with ischemic lesions secondary to external aggression, there may be greater blood support, and the arterial tree is presumably in better condition.

The conclusion is that patients with critical ischemic lesions of spontaneous origin have worse runoff and a poorer evolution following revascularization procedures than do patients who have ischemic lesions caused by EAL.

Absence of EAL can be considered to be a factor for poorer runoff and poorer evolution of both graft function and limb salvage. However, as with all the other prognostic fac-

tors, this must not directly influence the case conduct, since almost half of the patients without evident external aggression had good graft functioning and limb salvage following

the revascularization procedure. This prognostic factor should be used as all others are, i.e., to give patients and doctors a better idea of the possible evolution in such cases.

RESUMO

Wolosker N, Muraco Neto B, Munia MA, Rosoky RA, Ramos RS, Puech-Leão P. Agressão externa aos membros inferiores como fator preditivo na evolução dos pacientes submetidos a revascularização arterial. *Clinics*. 2005; 60(6):451-4.

OBJETIVO: Diversos fatores preditivos de evolução de enxertos arteriais em pacientes com isquemia grave foram definidos em estudos clínicos como diabetes mellitus, insuficiência renal, fumo e vasão distal. O objetivo deste estudo foi verificar se pacientes com isquemia grave submetidos a revascularização nos quais as lesões apareceram espontaneamente apresentam evolução diferente daquela em que as lesões apareceram após uma agressão externa ao membro.

MÉTODOS: De fevereiro de 2002 a janeiro de 2004, 100 pacientes submetidos a revascularizações infra-inguinais foram seguidos. Eles foram divididos em 2 grupos: 1) Grupo com lesão espontânea (52 pacientes), que compreendia pacientes apresentando lesões isquêmicas de origem espontânea e 2) Grupo de lesão por agressão externa (48 pacientes) que compreendia pacientes em que um mecanismo externo era identificado como causa do aparecimento da lesão

isquêmica. As variáveis analisadas foram salvamento de membro e índices de perviedade dos enxertos.

RESULTADOS: Pacientes com lesão espontânea apresentaram índices de salvamento de membro e perviedade do enxerto significativamente menores que pacientes com lesões secundárias a agressão externa (42,3% x 87,5%, respectivamente para ambos itens de estudo; $p < 0,01$).

CONCLUSÕES: A ausência de agressão externa para o aparecimento de lesões tróficas em membros inferiores isquêmicos é fator prognóstico de pior evolução tanto para o funcionamento dos enxertos como para o salvamento do membro nos pacientes submetidos a revascularizações infra-inguinais. No entanto esse fator não é suficiente para definir uma conduta médica, visto que metade dos pacientes que apresentaram lesão espontânea também tiveram boa evolução. O fator prognóstico deve ser usado como todos os outros - para oferecer aos pacientes e aos médicos uma idéia melhor sobre a possível evolução do caso.

PALAVRAS-CHAVE: Claudicação intermitente. Dor isquêmica de repouso. Artéria femoral. História natural. Fator de risco.

REFERENCES

1. Gupta SK, Girishkumar H. Lower extremity revascularization. *J Cardiovasc Surg (Torino)*. 1993;34(3):229-36.
2. Ferrari FB, Wolosker N, Rosoky RA, D'Ippolito G, Wolosker AM, Puech-Leao P. Natural history of stenosis in the iliac arteries in patients with intermittent claudication undergoing clinical treatment. *Rev Hosp Clin Fac Med Sao Paulo*. 2004;59(6):341-8.
3. Jansen T, Tulla H, Manninen H, Raisanen H, Lahtinen S, Aittola V, Jaakkola P. Results of infrainguinal bypass surgery: an analysis of 263 consecutive operations. *Ann Chir Gynaecol*. 2001;90(2):92-9.
4. Wolosker N, Nakano L, Anacleto MM, Puech-Leão P. Primary utilization of stents in angioplasty of superficial femoral artery. *Vasc Endovascular Surg*. 2003;37(4):271-7.
5. Wolosker N, Nakano L, Rosoky RA, Munia MA, Netto BM, Puech-Leao P. Endovascular treatment for intermittent claudication in patients who do not improve with clinical treatment. *Clinics*. 2005;60(3):193-200.
6. Seeger JM, Pretus HA, Carlton LC, Flynn TC, Ozaki CK, Huber TS. Potential predictors of outcome in patients with tissue loss who undergo infrainguinal vein bypass grafting. *J Vasc Surg*. 1999;30(3):427-35.
7. Abou-Zamzam AM Jr, Lee RW, Moneta GL, Taylor LM Jr, Porter JM. Functional outcome after infrainguinal bypass for limb salvage. *J Vasc Surg*. 1997;25:287-97.
8. Carsten CG 3rd, Taylor SM, Langan EM 3rd, Crane MM. Factors associated with limb loss despite a patent infrainguinal bypass graft. *Ann Surg*. 1998;64(1):33-7; discussion 37-8.
9. Conte MS, Belkin M, Upchurch GR, Mannick JA, Whittemore AD, Donaldson MC. Impact of increasing comorbidity on infrainguinal reconstruction: a 20-year perspective. *Ann Surg*. 2001;233(3):445-52.
10. Wolosker N, Rosoky RA, Nakano L, Basyches M, Puech-Leao P. Predictive value of the ankle-brachial index in the evaluation of intermittent claudication. *Rev Hosp Clin Fac Med Sao Paulo*. 2000;55(2):61-4.
11. Toursarkissian B, D'Ayala M, Shireman PK, Schoolfield J, Sykes MT. Lower extremity bypass graft revision in diabetics. *Vasc Surg*. 2001;(5):369-77.
12. Lantis JC 2nd, Conte MS, Belkin M, Whittemore AD, Mannick JA, Donaldson MC. Infrainguinal bypass grafting in patients with end-stage renal disease: improving outcomes? *J Vasc Surg*. 2001;33(6):1171-8.
13. Treiman GS, Oderich GS, Ashrafi A, Schneider PA. Management of ischemic heel ulceration and gangrene: an evaluation of factors associated with successful healing. *J Vasc Surg*. 2000;(6):1110-8.