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Arterial embolectomy in lower limbs

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Arterial embolisms in the lower limbs occur frequently, and are of great interest to the vascular surgeon. The authors studied 159 cases of arterial embolisms in lower limbs from January 1991 to July 1993. Ages varied from 12 to 98, with a mean of 58. Eighty patients were male and 78 were female. In most cases, etiology of the embolus was well-established, and mainly caused (78 percent) by atrial fibrillation. Occlusion was most frequent in the femoral artery (53.4 percent). All patients presented severe lower limb ischemia, but not gangrene, on admission. The duration of ischemia, between the onset of symptoms and the liberation of arterial flow, was in most patients (67.9 percent) less than 24 hours. All patients were submitted to lower limb embolectomy with the Fogarty catheter, of which 70.9 percent were done through the femoral artery. Fasciotomy was performed on 48 patients due to a compartmental syndrome. Nineteen patients died immediately after operation; 68.4 percent due to heart failure. Twenty-three (16.4 percent) of the 140 surviving patients (150 operated limbs) were submitted to amputations after the occlusion of artery branches, which had undergone embolectomies. One hundred and twenty-seven limbs (84.6 percent) were preserved in 117 patients (83.5 percent). Eleven cases (7.3 percent) required repeated surgery with the Fogarty catheter. The patients with muscle tenderness, paralysis, or ischemia lasting longer than 24 hours had worse results in relation to the preservation of the limb ($p < 0.05$). We conclude that patients who present lower limb embolisms, are in good clinical condition, and who do not have any necrosis in the limbs, have good outcomes as to limb preservation, along with low complication rates, after embolectomy with the Fogarty catheter. Limb preservation was significantly higher in patients who did not present muscle tenderness, and who had normal motor activity and a ischemia duration of less than 24 hours.

UNITERMS: Femoral artery. Vascular surgery. Embolectomy.

INTRODUCTION

Arterial embolisms in the lower limbs occur frequently, and are of great interest to the vascular surgeon since the outcome may involve gangrene, death, or permanent impairment.¹⁻³ Our study was based on 159 patients with arterial embolisms in the lower limbs treated from January 1991 to June 1993 in the emergency room of the General Hospital of the College of Medicine of the University of São Paulo (UHCMUSP). Our goal was to

study the surgical treatment of lower limb embolisms, and to evaluate whether muscle tenderness and the degree of motor involvement are predictive factors for limb preservation and operative mortality.

METHODS AND PATIENTS

From January 1991 to July 1993, 175 cases of arterial embolism in the lower limbs of 159 patients were surgically treated in the emergency room of the UHCMUSP. The clinical presentations of the arterial embolisms included signs and symptoms of acute occlusion such as: pain in the affected limb; absence of pulse distal to the obstruction; poor tissue perfusion (which was characterized by pallor,

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cyanosis and/or the lowering of temperature in comparison to the other limb); paresis and paralysis (due to ischemic lesion of the nerves as well as of the muscle groups); paresthesia; hypoesthesia; or anesthesia of leg or foot. The diagnosis of a arterial embolism was determined by the absence of any previous symptoms in the limb with the acute condition, associated with an embolic source (usually cardiac), and was confirmed when the embolus was found and removed.

Eighty-one patients were female and 78 were male, with ages varying from 12 to 98 (mean age = 58). Seventy-three cases (41.7 percent) showed right impairment, 70 cases (40 percent) showed left impairment, and 16 cases (18.3 percent) showed bilateral impairment. The embolus origin was not well-defined in 26 percent of the cases; atrial fibrillation was the most common cause (Table 1).

Table 1
Distribution according to origin of emboli

Etiology of embolism	Patients TN=159	
	N	%
Atrial Fibrillation	78	49
Congestive Heart Failure	9	5.7
Ventricular Extrasystole	7	4.4
Valvular Disease	7	4.4
Conduction Alterations	7	4.4
Endocarditis	5	3.2
Antecedent MI	4	2.5
Pericarditis	1	0.6
Not Defined	41	25.8

The obstruction level demonstrated by absence of pulse is shown in Table 2.

Table 2
Distribution according to level of obstruction

Level of Obstruction	Patients TN=159	
	N	%
Bilateral Femoral	16	10.1
Unilateral Femoral	69	43.3
Popliteal	56	35.2
Below the Popliteal Artery	19	11.4

The duration of ischemia, from the onset of symptoms to the liberation of arterial flow, is shown in Table 3, ranged from 1 to 96 hours (mean duration = 31 hours).

Table 3
Distribution according to duration of ischemia

Question of Ischemia	Patients TN=159	
	N	%
0-6 hours	37	23.2
6-12 hours	39	24.5
12-24 hours	32	20.2
Above 24 hours	51	32.1

Statistical analyses were done using the Fisher test, with a critical value of 0.05

SURGICAL PROCEDURES

All cases were treated as emergencies due to severe ischemia. Anesthesia was administered by medullar blockage in all cases but 12, in which local anesthesia with lidocaine infiltration was used for femoral exploration, due to the patients' critical condition.

Revascularization was performed by a direct approach to the artery (most frequently at the femoral bifurcation - Table 4), followed by the removal of embolus and secondary thrombi with a Fogarty catheter.

Table 4
Distribution according to surgical access

Access	Surgeries TN=179	
	N	%
Bilateral Femoral	12	13.4
Unilateral Femoral	103	57.5
Popliteal Below the Knee	36	20.2
Combined	8	8.9

A fasciotomy of anterior and posterior muscle compartments was performed on 48 limbs (27.4 percent) by means of two extensive incisions which allowed for

the expansion of muscle volume without restriction by the fascia and skin.

RESULTS

Embolectomy results should be reviewed under three aspects: limb preservation and survival (PS); limb amputation and survival (LS); and the death of the patient (DP).

In this study, 19 patients (12.2 percent) died, most due to heart complications (Table 5).

Table 5
Distribution according to cause of death

Cause	Deaths n=19	
	N	%
Heart Failure	13	68.4
Sepsis	4	21.0
Intestinal Necrosis	1	5.3
Metabolic Disorders	1	5.3

Intestinal necrosis leading to death occurred after mesenteric embolism. Six of these patients showed bilateral embolisms.

After analyzing the time of ischemia, presence of muscle tenderness, and decrease in motor activity, we observed that none of these factors were significantly responsible for mortality ($p>0.05$).

Twenty-three of the 140 operated patients (150 limbs) were submitted to amputations after the occlusion of artery branches, which had previously undergone embolectomy. Three of these patients presented bilateral embolisms, and one limb was preserved in each case.

Out of 117 patients (83.5 percent), 127 limbs (84.6 percent) were preserved. Reoperation (with the Fogarty catheter) was necessary in eleven cases (7.3 percent). The results of patients with muscle tenderness were worse in relation to the preservation of the limb (Table 6) ($p<0.05$). In patients with paralysis due to ischemia, results were significantly worse ($p<0.05$), as shown in Table 7.

Patients with ischemia, that had lasted for more than 24 hours, had significantly worse outcomes than those whose ischemia had lasted for less than 24 hours. ($p<0.05$) (Table 8).

Table 6
Relation between limb preservation and muscle tenderness

Cause	M.T.	
	Present	Absent
Preserved Limb	29	98
Limb Amputation	11	12
Total	40	110

M.T. - Muscle Tenderness

Table 7
Relation between limb preservation and motor activity

	M.A. n=140		
	Normal	Paresis	Paralysis
Number of Patients	109	19	22
Limb Amputation	13	3	7

M.A.- Motor Activity

Table 8
Relation between limb preservation and duration of ischemia

Duration of Ischemia (hours)	Preserved Limb	Total
0-6	33	35
6-12	36	37
12-24	26	29
>24	32	49

DISCUSSION

Arterial embolisms are a very frequent clinical manifestation⁴⁻⁶ of complications from other diseases. A cardiac embolic source was confirmed in 74.2 percent of the cases in this study. The equal distribution of gender and age variation (12-98 years, mean = 58) were similar to what has been reported in foreign and national literature.^{7, 8}

The clinical diagnosis of an embolism is not usually difficult, especially when the causing factor is evident. In

all our cases, especially in the presence of heart disease, we discerned that the embolus origin was not in the arterial branches of the limb, which allowed the patient to undergo surgery without an arteriography, avoiding further delay and possible complications. When there is doubt as to the diagnosis, arteriography is necessary to ensure the appropriate surgical approach.

In most cases (74.2 percent), there was a heart condition which suggested the origin of the embolus. Other less frequent causes of lower limb embolisms, such as aneurysms, plaques, and tumor embolisms⁹ were not found among our patients. The 41 (25.8 percent) cases with unknown causes coincide with other statistics.⁵ Lower limb embolisms presented severe ischemia in all cases, and could have lead to irreversible damage if not treated in time.

Mortality rates vary from 10 to 30 percent,^{10,11} and are usually due to heart complications,^{9,12} mortality increases twofold in patients more than 60 years old. Our cases showed a mortality rate of 12.25 percent, of which 84 percent were more than 60 years old.

We noticed that muscle tenderness, motor impairment and duration of ischemia did not interfere significantly with surgically-related mortality. This reinforces that mortality is due to heart conditions (68.4 percent of deaths), as opposed to the severity of ischemia at admission. Thus, these were patients with severe heart disease and a poor prognosis who presented acute ischemia of the lower limb and were submitted to revascularization, which increased the risk of heart decompensation.

Clinical treatment with an appropriate anticoagulation should be administered to patients with mild ischemia who present severe clinical conditions in which there is no further risk of claudication of the lower limb.¹³

Surgical embolectomy has long been a the treatment of choice,^{4,6} even before 1963, when routine use of the Fogarty¹⁴ catheter began. The technical simplification introduced by this method, and the use of a local anesthetic for access to the femoral bifurcation, allowed this surgery to become more frequent.¹⁵

Due to poor collateral circulation, the degree of ischemia in lower limbs is always greaster than in upper limbs. In our patients, surgery was indicated when there was a presence of an embolism without any irreversible

trophic alteration; the duration and degree of ischemia were not considered.

Patients submitted to surgery showed good results. Limb amputation occurred in 16.4 percent of the surviving patients. We confirmed that the best results occurred in patients with a shorter duration of ischemia.^{10,14,16-18} We observed that patients with paralysis and tenderness showed poor results. This finding is probably related to the fact that tenderness is a clinical sign of severe tissue ischemia in the limb, thus indicating a poor prognosis due to a greater probability of irreversible tissue necrosis, which may lead to limb amputation in spite of revascularization.

Motor involvement depends only on perfusion and innervation. Therefore, finding this would indicate a better prognosis than tenderness, since there is only a neurologic alteration and no necrosis of the muscle; after revascularization the limb is preserved, although there might be neurologic sequelae.

The inverse correlation of duration of ischemia and limb preservation emphasizes the need to initiate a therapeutic approach immediately upon admission. Investigation of the embolic source should be conducted only by clinical observation and routine preoperative exams. Arteriography, as in our report, should be used only in selected cases with mild ischemia, so as to identify the etiology of the obstruction and allow for better preoperative programing. In any identified embolic source, long-term anticoagulation therapy is recommended to prevent any recurrence.^{10,19}

CONCLUSION

Embolectomy with the Fogarty catheter in lower limb embolisms has shown good rates of limb preservation and a low incidence of surgical complications in patients who are in good clinical condition and show no sign of necrosis in the limbs. Limb preservation is significantly higher in patients who present no muscle tenderness; normal motor activity; and ischemia that has lasted less than 24 hours.

RESUMO

As embolias arteriais de membros inferiores ocorrem com grande frequência na população em geral, correspondendo a importante área de interesse ao cirurgião vascular. Os autores analisaram 159 casos de embolia arterial em membros inferiores, atendidos de janeiro de 1991 a julho de 1993. A idade variou entre 12 a 98 anos (média de 58 anos), 81 pacientes eram do sexo masculino e 78 do sexo feminino. A etiologia da embolia foi na grande maioria dos casos bem definida, sendo que a principal causa foi a fibrilação atrial (78%). A oclusão da artéria femoral foi a mais frequente (53,4%). Todos os pacientes desta série apresentavam isquemia grave de membro. Nenhum paciente estava com gangrena à admissão. A maioria dos pacientes apresentava tempo de isquemia entre o início do quadro e da liberação do fluxo arterial menor que 24 horas (67,9%). Todos os pacientes foram submetidos a embolectomia de membro inferior com catéter de Fogarty, 70,9% por acesso femoral. Empregou-se a fasciotomia em 48 pacientes devido a presença de síndrome comportamental. Dezenove pacientes faleceram, no pós-operatório imediato, a maioria deles por insuficiência cardíaca (68,4%). Dos 140 pacientes (150 membros) operados que sobreviveram, 23 (16,4%) apresentaram perda de membro após oclusão da árvore arterial previamente desobstruída pela embolectomia. Houve preservação de 127 membros (84,6%) em 117 pacientes (83,5%). Foi necessária a reoperação (nova passagem do catéter de fogarty) em onze casos (7,3%). Os pacientes com empastamento muscular, plegia ou tempo de isquemia maior que 24 horas tiveram piores resultados quanto à preservação de membro ($p < 0,05$). Concluímos que em casos de embolia de membro inferior, apresentando-se o paciente em boas condições clínicas e com o membro sem necrose instalada, vale a pena a realização da embolectomia com catéter de Fogarty, devido aos bons resultados quanto à preservação do membro e baixos índices de complicações derivadas do procedimento cirúrgico. A preservação de membro foi significativamente maior nos pacientes sem empastamento muscular, com tempo de isquemia menor que 24 horas e atividade motora normal.

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