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CIVILIAN BLUNT POPLITEAL ARTERY INJURIES

By

M. H. El. Dessouky. (M.D., FRCSI.)

Department Of Surgery, Faculty of Medicine, Cairo University.

In this study, 125 patients with blunt popliteal artery injury during the 15 years period (1984-1999) had been classified into 2 groups, group A (50 patients) during the 7 years period (1984-1991) and group B (75 patients) during the 8 years period (1992-1999). The amputation rate in the 2 groups had been compared against different variables as type of trauma, associated injuries, clinical presentations, type and site of popliteal artery injury, ischaemic time, pre-operative systemic anticoagulation, the use of intravascular shunts, use of fasciotomy and the timing of reconstructive procedures, in order to find out the causes of improved results.

Keywords: Arterial injuries, popliteal, civilian&Blunt.

INTRODUCTION

Although the management of vascular trauma has undergone considerable refinement during the past 20 years, popliteal artery injury continues to challenge surgeons and still results in extremely high rates of amputation or functional limb deficit. Popliteal artey ligations, practiced during World War Two, resulted in a 73% amputation rate. Arterial repair, begun during the Korean conflict, reduced incidence of amputation to 32%, a rate which persisted through Vietnam War. In civilian practice, limb loss is highest when the vascular injury is associated with blunt trauma about the knee joint. As recently as 1986, an amputation rate of 30% was reported with such injuries. (1)

PATIENTS AND METHODS

125 patients admitted to the casualty department in Kasr ElAini school of Medicine during the period from 1984 to 1999 (15 years) with blunt popliteal injury, had been divided into 2 groups: - group A included *50* patients (in the period from 1984 till 1991=7 years) and group B which included *75* patients (in the period from 1992 till 1999 = 8 years).

Both group have been compared concerning, age, sex, type of trauma, clinical presentation, associated injuries, type of arterial injury, site of arterial injury, type of arterial repair, ischaemic time, use of intravascular shunts, systemic anticoagulation, timing of fasciotomy and the timing and method of reconstructive procedure to cover any soft tissue defect, and the impact of these variables on the amputation rate.

RESULTS

The data were analysed using IBM computer and SPSS - PC 4-1 statistical package. Student's "t" test and the analysis of variance (ANOVA) to detect differences in the means between group A and group B have been used.

The level of significance was set at $P<0.05$.
N.B: -S=significant
NS=Non significant

Table (1): ***Age***

Group A		*Group B*		*Significance*
Age	Mean	Age	Mean	NS
15-68 y	41.5 y±5.35	11-70	40.5 y±7.59	
t=0.807		P=0.421		

Table (2): ***Sex***

Sex	*Group A*		*Group B*		*Significance*
	No.	%	No.	%	NS
Males	49	98.00	71	94.67	
Females	21	2.00	4	5.33	

t=0.87 P=0.351

Table (3): ***Type of trauma***

	Group A				*Group B*				*Significance*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%	
Vehicular accidents	45	90	8	17.78	68	90.67	5	7.35	S.
Falls	4	8	2	50	7	9.33	2	28.57	S.
Forcible knee hyperextension	1	2	1	100	0	0	0	0	S.

N.B: The total number of amputations in the group A was 11 cases (out of 50 cases=22%) and was 7 cases in the group B (out of 75 cases=9.33%).
*amp.=amputations.

Table (4): ***Associated injuries:***

	Group A				*Group B*				*Significance*	*P-value*	*T*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%			
Orthopaedic injuries (fractures and/or dislocation)	42	84	9	21.43	74	98.67	5	6.76	S	0.0197	5.43
Soft tissue injuries	19	38	7	36.84	30	40	2	6.67	NS	0.823	0.05
Vein injuries	33	66	2	6.06	41	54.67	2	4.88	NS	0.206	1.6
Nerve injuries	6	12	5	86.33	12	16	3	25	S	0.0189	5.51
Abdominal-chest-brain injuries	2	4	1	50	5	6.67	3	60	NS	0.809	0.06

N.B.: Although the associated injuries have become more severe, yet the amputation rate have been significantly decreased.
The amputation rate in group B was higher than group A in the group of associated abdominal, chest and/or brain injuries, as amputation was attempted on admission (primary amputation) in 2 out of the 3 cases (66.67%) of the amputated limbs.

Table (5): ***Clinical presentations***

	Group A				*Group B*				*Significance*	*t*	*P-value*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%			
Absent or diminished pedal pulses	5	10	2	40	2	2.67	0	0	Ns	1.12	0.289
*Clinical ischaemia	42	84	9	21.43	70	93.33	7	10	Ns	2.80	0.0943
Bleeding	3	6	0	0	3	4	0	0	Ns	0	0

- Clinical ischaemia is defined by neurological deficit, cyanosis, profound temperature differential relative to the contralateral limb paralysis.
- N.B.: The mental status of the patients made it difficult to precisely separate traumatic nerve injury from ischaemic neuropathy.

Table (6): ***Type of arterial injury:***

	Group A				*Group B*				*Significance*	*t*	*P-value*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%.			
Complete transection	8	16	3	37.5	6	8	1	16.67	Ns	1.03	0.3104
Partial tear	3	6	0	0	3	4	0	0	Ns	0	0
Contusion thrombosis	39	78	8	20.51	66	88	6	9.09	Ns	2.77	0.0962

Table (7): ***Site of arterial injury:***

	Group A				*Group B*				*Significance*	*t*	*P-value*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%			
Upper popliteal artery	15	30	2	13.33	18	24	1	5.65	NS	0.60	0.439
Lower popliteal artery	33	66	8	24.24	52	69.33	4	7.69	S	4.56	0.0327
Popliteal trifurcation	2	4	1	50	5	6.67	2	40	NS	0.06	0.8092

Table (8): ***Type of arterial repair***

	Group A				*Group B*				*Significance*	*t*	*P-value*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%			
End-to-end anastomosis	7	14	2	28.57	5	6.67	1	20	NS	0.11	0.7353
Saphenous vein interposition	41	82	9	21.95	68	90.67	6	8.82	S	3.71	0.0540
Vein patch	2	4	0	0	2	2.66	0	0	NS	0.01	0.9293

Table (9): ***Ischaemic time***

	Group A				*Group B*				*Significance*	*t*	*P-value*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%			
Less than hours	8	16	1	12.5	9	12	1	11.11	NS	1.32	
6-24 hours	30	60	4	13.33	64	85.33	4	6.25	NS	1.75	0.2513
More than 24 hours	12	24	6	50	2	2.67	2	100	NS		0.1859

Table (10): ***Use of intravascular shunts and intraoperative systemic anti-coagulation***

	Group A				*Group B*				*Significance*	*t*	*P-value*
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%			
Intravascular shunts	3	6	0	0	25	33.33	1	4	NS	0.12	0.724
Intraoperative systemic anticoagulation	10	20	1	10	69	92	2	2.89	NS	1.21	0.2722

Table (11): ***Fasciotomy and reconstructive procedure***

	Group A				*Group B*			
	No.	%	No. Of amp.	%	No.	%	No. Of amp.	%
Intraoperative fasciotomy	1	2	0	0.0	31	41.33	1	3.26
Delayed postoperative fasciotomy	25	50	2	8	5	6.67	1	20
Immediate reconstructive procedure	4	8	0	0.0	27	36	1	3.70
Delayed (post-operative.) reconstructive procedure	20	40	7	35	12	16	1	8.33

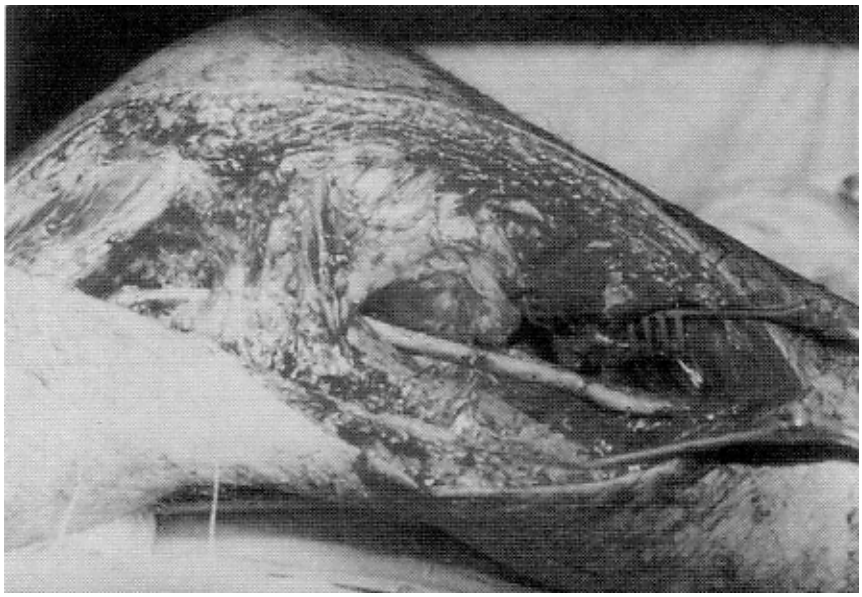

Fig. (1): Saphenous vein graft popliteo-tibioperoneal by pass in lower popliteal artery contusion thrombosis.

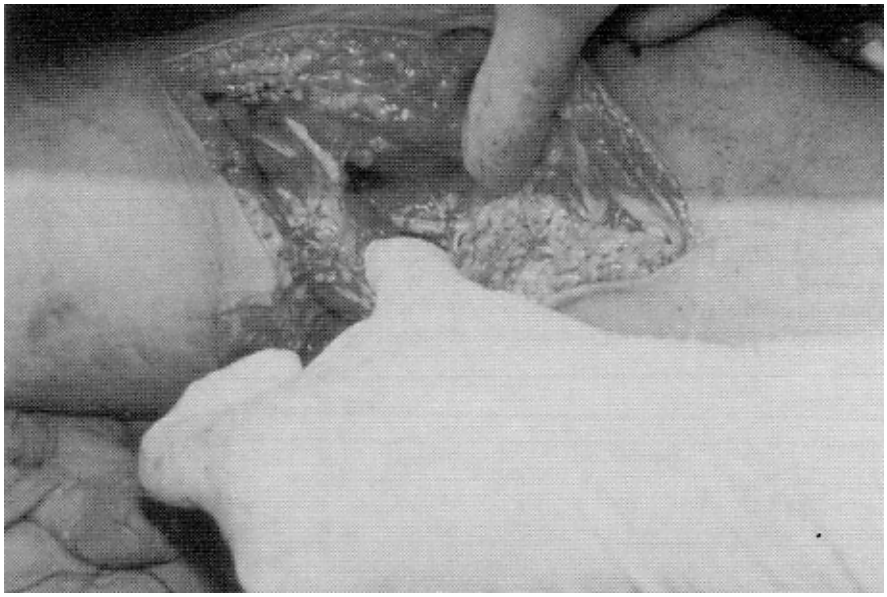

Fig. (2): Popliteal artery injury repair by vein patch graft.

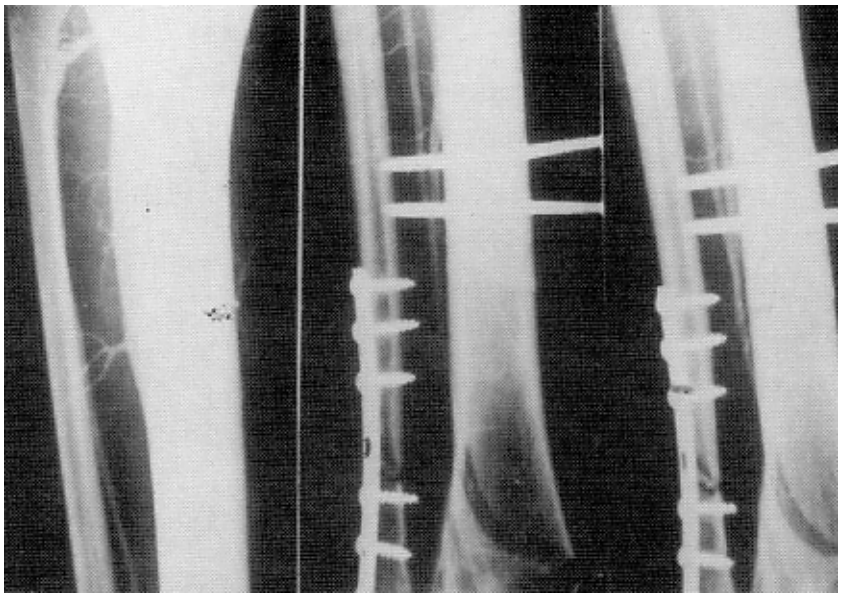

Fig. (3): Angiography of the tibial arteries, note the attenuated vessels due to unrelieved compartment syndrome.

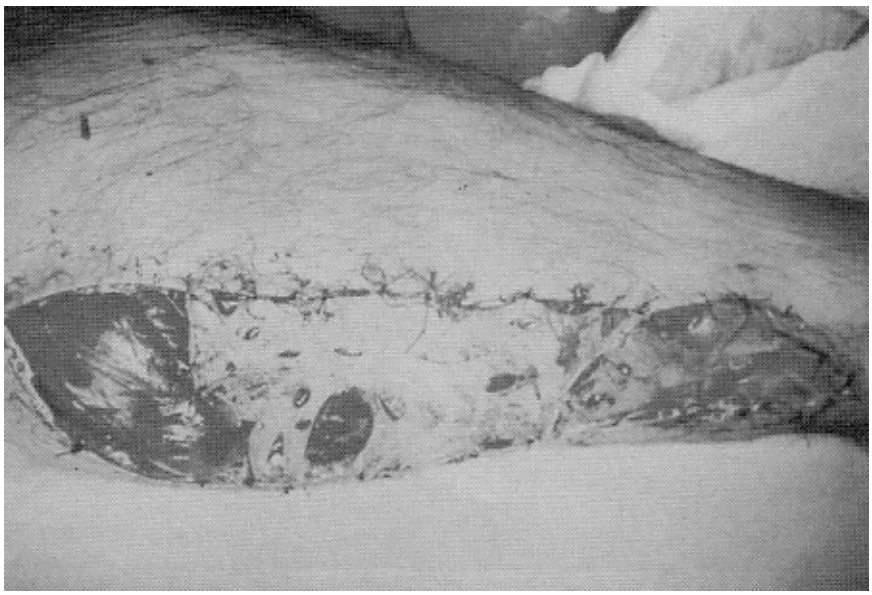

Fig. (4): Fasciotomy wound closed primarily by split thickness skin graft

Fig. (5): Ligated popliteal vein in combined popliteal artery and vein injury. Note the venous congestion in spite of limb viability

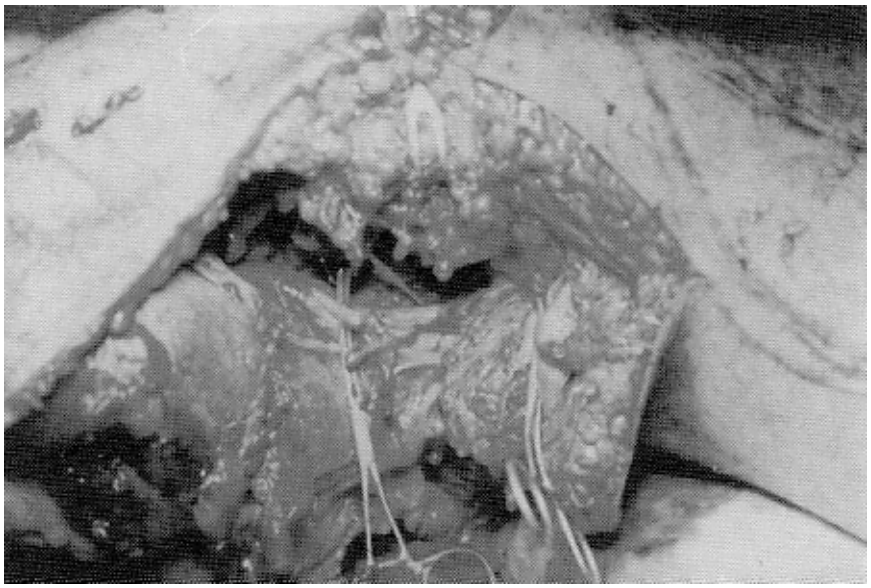

Fig. (6): Skin loss of the popliteal fossa. Note the designed fasciocutaneous flap (black circle).

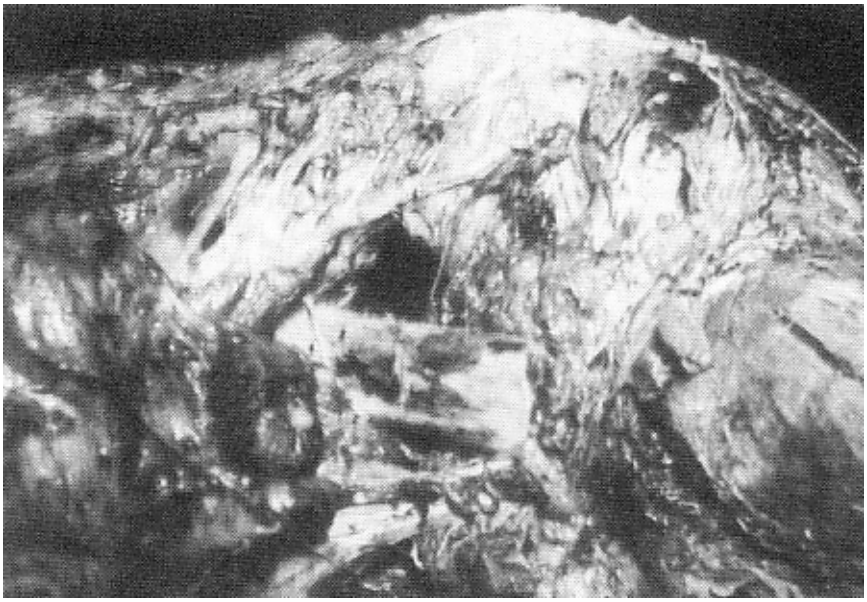

Fig. (7): Blunt trauma to the lower limb with severe skeletal and soft tissue injury.

DISCUSSION

Popliteal artery trauma comprises from 5% to 19% of all civilian arterial injuries.[2]. Knee dislocations are most often associated with popliteal trauma because arterial injuries occur in at least one third of anterior or posterior dislocations.[3]. However, because complete Knee disruptions are rare, most arterial injuries are caused by fractures.[1]. In this series, fractures were the cause of popliteal artery injuries in 90% of the cases in group A and 94.67% of the cases in group B.

Considering the extremely morbid and medicolegal consequences of a missed injury, a high index of suspicion of popliteal arterial trauma is warranted for all patients with knee dislocations or fractures about the knee, particularly proximal tibial fractures. [4]

The initial evaluation of the injured leg is of critical importance. In this series, there was an amputation rate of 40% in patients presented with only diminished or absent pedal pulses in-group A while it was 0.0% in group B. This is because in group B, we immediately explore any patient with absent or diminished pedal pulses, even though, there was no other evidences of ischaemia and we did not wait for duplex scanning nor angiography and thus, the ischaemic time was reduced.

In patients presented with clinical ischaemia, there was amputation rate of 2l .43% in group A and 10.0% in group B. This is due to the improved technique of vascular repair and the immediated and improved technique of dealing with orthopaedic and soft tissue injuries.

These results coincide with Snyder who in 1982 stated that 23% of limbs that were clinically ischsemic required amputation.[5]

Reynolds, et al, in their series in 1979 were unable to confirm the relationship between time delay and Jimb loss[6]

In this series, the amputation rate had dropped from 13.33% in-group A to 6.25% in-group B if revascularization had been accomplished in less than 24 hours. This is possibly because expeditious revascularization is crucial in limiting soft tissue necrosis, infection and distal arterial and venous thrombosis.

The early pre-use of systemic anticoagulation in Lim and Michuda series in 1980 had resulted in a significant drop in the amputation rate (from 31% to 8%). Local infusion of heparin or delayed systemic administration of

heparin may not prevent distal arteriolar or venous thrombosis. [7]

This coincides with the result of this series, in which the amputation rate was 10% in-group A and 2.89% in group B in patients who had been anticoagulated systemically.

So, in the absence of absolute contraindication such as pelvic or intra-abdominal bleeding or head trauma, early routine systemic anticoagulation is recommended and should be started as soon as popliteal occlusion is diagnosed.

In this series, there was a drop in, the amputation rate in patients with popliteal artery injuries associated with orthopedic injuries from 21.43% in group A to 6.76% in group B. This is probably because of the improvement in methods of orthopaedic stabilization with the frequent and efficient use of internal and external fixation and the more frequent use of intravascular shunts.

Vascular repair in patients with blunt popliteal artery injury takes precedence over skeletal fixation in most cases. When preoperative ischaemia is present, skeletal fixation is always done after revascularization. If the magnitude of skeletal instability is substantial and the manipulation needed to effect fixation will probably disrupt anastomoses, the skeletal fixation should be performed before definitive vascular repair. In such patients, an indwelling vascular shunt should be used during the skeletal repair. [8,9].

Repair of major venous injuries remains a controversial issue, but we agree with the openion of several authors who have shown that ligation rather than repair of popliteal venous injures, when combined with a popliteal artery injury, not only substantially increases the incidence and severity of pos~operative leg oedema but also is associated with higher rates of amputation. [10,11].

In this series, repair of popliteal vein injury was almost always attempted and the amputation rate in combined arterial and venous injuries was 6.06% in group A and 4.88% in group B.

Muscle flaps are being used increasingly for coverage of soft tissue defects (12), and the amputation rate had dropped from 36.84% in group A to 6.67 % in group B in cases of arterial injuries associated with soft tissue injuries.

The amputation rate had dropped in group A from 35% in patients who had been subjected to delayed (post-operative) reconstructive procedure to 0.0% in patients who had been subjected to immediate reconstructive procedure. This was also observed in group B in which the amputation rate had dropped from 8.33% to 3.70%.

Myonecrosis and permanent ischaemic nerve injury may result from a successful arterial repair if compartmental hypertension is unappreciated. The most commonly encountered cause of a compartment syndrome of the lower extremity is intrafascial bleeding and edema from direct musculo-skeletal trauma. In addition, revascularization of an acutely ischaemic limb produces compartmental hypertension. Therefore, patients with blunt popliteal artery injuries are particularly prone to the development of this syndrome. So, fasciotomy has to be done when there is evidence of established hypertension, or empirically, on the basis of severe soft tissue trauma, prolonged ischaemia or combined popliteal artey and vein injury. [13]

Open incisions in the dermis or fascia have frequently been associated with superficial infection, which may extend to deep infection and subsequent limb loss, thus it is preferable to graft the skin immediately to the fasciotomy site if the underlying muscle is clinically viable, If the muscle viability is questionable, delayed skin grafting should be done after repeated and aggressive debridement[14]

In this series, the amputation rate in patients who had been subjected to fasciotamy (intra-operative or delayed) was 7.69% in-group A and 5.56% in group B.

The following recommendations can be stated in order to improve the results of revascularization in patients with blunt artery injury.

1 - Immediate exploration of any patient with absent or diminished pedal pulses, even though, there is no evidences of ischaemia.

2 - Expeditious revascularization is crucial in limiting soft tissue necrosis, infection and distal arterial and venous thrombosis.

3 - In the absence of absolute contraindication, early routine systemic anticoagulation is recommended and should be started as soon as popliteal occlusion is diagnosed.

4 -Skeletal fixation is always done after revascularization. If the magnitude of skeletal instability is substantial and the manipulation needed to effect fixation will disrupt anastomoses, the skeletal fixation should be done first and in these cases an indwelling vascular shunt should be used during the skeletal repair.

5 - Ligation of popliteal vein, if injured, is associated with higher rate of amputation, thus, it is preferable to repair rather than to ligate popliteal vein injury.

6 - Muscle flaps should be used for coverage of soft tissue defects.

7 - Fasciotomy has to be done when there is evidence of established compartmental hypertension, or empirically, on the basis of severe soft tissue trauma, prolonged ischaemia or combined popliteal artery and vein injury, and it is preferable to graft the skin immediately to the fasciotomy site if the underlying muscle is clinically viable

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