Outcome of Popliteal Artery Injury in Ibn Al Nafees Hospital

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ABSTRACT

Background: Popliteal artery injury is the most common cause of amputation in extremities. Blunt trauma was the most frequent cause of injury, however penetrating trauma injuries are considerable.

Objectives: To focus on the way of presentation, modes of management and sequel of repair popliteal artery injury.

Methods: This is a retrospective study of 80 patients, presented with popliteal artery injury admitted to Ibn-Al-nafees teaching hospital from January 2015 to December 2015. Patients were classified into 4 groups depending on their hemodynamic state, group A 18 75%, group B 16.25%, group C 46 25% and group D 18.75% and their diagnosis depended on clinical presentations mainly hard signs and soft signs without using duplex or angiography because of their unavailability at time of reception.

Results: Resection and graft interposition using saphenous vein was done in the majority of cases with the use of heparin locally and/or systemically in most of the cases. Associated popliteal vein injury constituted 70% of associated injuries, which must be repaired when feasible to avoid amputation because ligation was an aggravating factor for amputation. Fracture of femur represent 40% of associated injuries and represents a dilemma in the management in which fracture stabilization performed before arterial repair unless limb-threatening ischemia was found and the procedure must not encroach on the viability of the limb. Fasciotomy was indicated and it was performed in most of the cases.

Conclusion: Lifesaving, which is the primary goal of surgery of popliteal artery injury followed by limb salvage still can be achieved if repair done within 9 hours of injury.

Keywords: Popliteal injury, Amputation, Associated injuries, Fasciotomy, Heparin.

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Popliteal artery injury (PAI) is considered to be rare, with a reported incidence of 0.2%. It is the second most common vessel injury in the lower extremity and is associated with significant amputation rates when compared to other lower-extremity artery injuries[1,2]. The majority of PAIs are due to blunt trauma, which is also associated with a worse outcome when compared to PAI due to penetrating injury[1,3,4]. Management of patients with PAI requires expeditious recognition and diagnosis of arterial trauma, open surgical repair, repair of associated venous injury, and early fasciotomy[1,5,6].

Fasciotomy was recommended with injuries which might be associated with combined arterial and venous injuries, massive soft damage, delay between wounding definitive repair and swelling of extremity[6]. Endovascular repair is a relatively new alternative treatment for traumatic PAI[7]. When compared to open repair, the potential advantages of the use of an endovascular approach is less invasive, associated with decreased blood loss, shorter operative time, faster recovery, and shorter inpatient stay[7,8]. Additionally, use of endovascular treatment involves accessing the injury from a remote site, which eliminates the risk of iatrogenic trauma to nearby structures while avoiding major dissection of an already traumatized region[9,10] .

The aim of this study done to focus on the way of presentation, modes of management and sequel of repair.

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Methods

This is a retrospective study of 80 cases presented with popliteal artery injuries admitted to Ibn-Al nafees teaching hospital from January 2015 to December 2015. Fifty-three patients were referred from other hospitals and the remaining 27 were directly received. Their age ranged from 17 to 46 years, (20-30 years) was common age group. Seventy-two (90%) males and 8 (10%) females. The mechanism of injury was penetrating in 69 cases (86.25%). In addition, blunt injury in 11 cases (31.75%). Penetrating injuries included bullet injuries in 45 cases(56.25%) and stab 4 cases (5%), shell or blast in 19 cases (23.75%) and iatrogenic (bone fixation). Data were collected from victims or their relatives and additional information were obtained from their referral sheets regarding the details of injuries and the initial resuscitation measures. Vital signs routinely checked in the casualty department at the time of arrival, patients were classified into four groups depending on their hemodynamic state. All patients were admitted and resuscitated in the causality department.

Evaluation of the injured patients was immediately established by taking the history and performing physical examination and preliminary investigations when are required. Any active bleeding was controlled by tight bandaging and wounds were examined to determine the location and mechanism of injury. The physical signs considered to be associated with possible significant injury were shock, active bleeding, hematoma (pulsating or expanding), and extensive tissue loss, absent pulses of the lower limbs or neurological deficit. Attending surgeon made the decision for exploration or observation, at the end all patients were explored. Heparin was given as single dose intraoperative either systemically in a dose of 5000 IU intravenously or locally in a solution of 100 IU/ml. Heparin was continued for 2-3 days in most patients in dose of 5000 IU 2-4 times daily. Fifty-sex patients with popliteal artery injury have associated venous injuries.

Results

The patients whom presented with in first 6 hours after injury was 49 patients 61.25%, all had good result (100%), while patients whom presented in > 9 hours after injury was 13 patients 16.25%, 11 patients of them had bad results (84.62%), (Table 1). Absent pulses was most common sigh of popliteal artery injury presented with 91.25%.Popliteal veins were common associated injuries 70%, (Table 2). Majority of injured popliteal veins 75% were repaired, in 25% the popliteal vein was ligated. Surgical treatment of patients with popliteal artery injury which were divided according to the surgical approach into the supragenicular, and genicular, and infragenicular part, involved many types of operative techniques in which 32 patients 40% had resection and end to end anastomosis, 43 patients 53.75% had graft interposition, three patients 3.75% had lateral suturing and two patients 2.5% had ligation, (Table 3). Seventy-one patients 88.75% with fasciotomy and only 9 patients 11.25% without fasciotomy. It was done in 40 patients of 43 patients whom underwent interposition graft (93.02%) versus no any patients whom underwent ligation (0%), (Table 3). Heparin was used 74 patients 92.5%. It was used in all patients whom underwent interposition graft (100%) versus no any patients whom underwent ligation (0%), (Table 3). Postoperative oedema was common early post-operative complications (which occur within 1st 24 hours) where it was founded in 68 patients 85% versus wound infection was common late postoperative complications (which occur after 24 hours) which was seen in 46 patients 57.5%, (Table 4). There were four operative deaths and the mortality was (5%), three patients due to penetration trauma versus one patient in blunt trauma, (Table 5). Inevitable amputation was present in 14 patients (17.5%), 12 patients in penetration trauma (85.72%) versus 2 patients in blunt trauma (14.28%). Delay of referral was common cause of amputation which was notice in 9 patients 64.29%, (Table 5).

Table 1: Hemodynamic state of patient at time of arrival and the time from accident to vascular repair with its relation to the results.

Patients groups	No.	%	PR	Systolic BP	Pulse pressure	Capillary refilling
Group A	15	18.75	<100	Normal	Normal	Normal
Group B	13	16.25	>100	Normal	Normal	Delayed
Group C	37	46.25	>120	Decline	Decline	Delayed
Group D	15	18.75	>140 palpable	Marked decline	Mark decline	Absent
Total	80	100				
Time prior to repair (hr.)			Poor result	Good result		
<6	49	61.25%	0(0%)	49(100%)		
6-9	18	22.5%	7(38.89%)	11(61.11%)		
>9	13	16.25	11(84.62%)	2(15.38%)		
Total	80	100	18(22.5%)	62(77.5%)		

Table 2: General and local associated injuries in popliteal artery injuries.

General injuries			Local injuries		
Type	No.	%	Type	No.	%
Head & neck	1	1.25	Venous	56	70
Chest	5	6.25	Nerve	7	8.75
Abdomen	1	1.25	Soft tissue	63	78.75
Bone (apart from lower 1/3 of femur and upper tibia)	23	28.75	Bone (lower 1/3 of femur and upper tibia)	32	40

Table 3: Types of surgical repair according to surgical sites and heparin usage and fasciotomy in relation to these types of surgical repair.

Variable	Resection and end to end anastomosis	Lateral suturing	Graft interposition	Ligation	Total
Supragenicular	28(35%)	3 (3.75%)	33 (41.25%)	0(0%)	64(80%)
Genicular	2 (2.5 %)	0(0%)	7 (8.75%)	1 (1.25%)	10(12.5%)
Infragenicular	2 (2.5 %)	0(0%)	3 (3.75%)	1 (1.25 %)	6(7.5%)
Total	32 (40%)	3 (3.75%)	43 (53.75%)	2 (2.5%)	80(100%)
Heparin	29(36.25%)	2(2.5%)	43(53.75%)	0(0%)	74(92.5%)
Fasciotomy	29(36.25%)	2(2.5%)	40(50%)	2(2.5 %)	71(88.75%)

Table 4: Early and late postoperative complications in popliteal artery injury.

Early complications	No.	%
Edema	68	85
Ischemia	9	11.25
Paralysis	2	2.5
Renal failure	1	1.25
Bleeding	7	8.75
Late complications		
Edema	21	26.25
Stiffness	32	40
Wound infection	46	57.5
Bleeding	2	2.5
Gangrene	4	5
A-V fistula	2	2.5
Aneurysm	1	1.255
Claudicating	1	1.25
DVT	22	27.5
Perforated D.U	1	1.25
Renal failure	1	1.25

Table 5: Causes of death and amputation in popliteal artery injuries.

Causes of amputation	No.	%	Penetration trauma	Blunt trauma
Delay of referral	9	64.29	7(77.78%)	2(22.22%)
Fracture femur (unfixated)	3	21.43	3(100%)	0(0%)
Multiple injuries	2	14.28	2(100%)	0(0%)
Total	14	100	12(85.72%)	2(14.28%)
Causes of death				
Head injury	1	25	0(0%)	1(25%)
Acute renal failure	1	25	1(25%)	0(0%)
Chest injury	1	25	1(25%)	0(0%)
Multiple injuries	1	25	1(25%)	0(0%)
Total	4	100	3(75%)	1(25%)

Discussion

Vascular injuries account for 2% of total causalities. In our series, penetrating injury constituted 86.25% while blunt injury constituted 31.75% of popliteal artery injury and this is different from other series in the references. This may be due to more civilian injuries and road traffic injuries[3]. Most studies are parallel with our study in that younger age group, mostly males 20-30 years, are the commonest age group due to their activity and more liability to violence and road terrific accident[6]. 65.5% of our patients presented with shock state (C, D group). The rest 35% patients presented with normal hemodynamics or compensated shock stat (A and B groups), in other study 1.29% presented with shock state[11]. This is because of the proximity of hospital to the scene, improved emergency and quick transport systems in other countries, in contradiction to remote hospital and delayed referral to specialized centers in our country[11]. The commonest associated injuries in our series were venous injuries, bone fractures that are consistent with other studies in the references[5].

Local presentation of popliteal artery injuries in this study were more than 90% with hard signs, absent distal pulses being the

commonest hard sign detected, followed by distal tissue ischemia (coldness) and the third sign was pallor. Much less patients presented with soft sign which may be explained by un awareness of our hospital and centers, and delay in referral of cases with arterial injuries manifested with soft signs until development of distal ischemia or false aneurysm or arteriovenous fistula. Popliteal artery injury is diagnosed in our wards mainly by physical examination, while in other series predicted mainly by preoperative angiogram 84%[9].

The decisions to take patients to the theater in this study depended on the presence of hard signs or soft signs. Those patients with hard signs were immediately resuscitated and taken to the theater and explored while those with soft signs were delayed somewhat (few hours) until full resuscitation and evaluation were performed. And eventually explored without angiography or another local investigations (duplex) to ensure arterial injury as other series[9,12]. This is because of unavailability of duplex and angiography, so we depended on clinical judgment only. At surgery, the supragenicular part of popliteal artery was the commonest part exposed to injury and this is because this part of the artery passing deep in its course and at risk of injury by fracture femur bone 80%.

These results were similar to other study in which the supragenicular part of the popliteal artery is 33.3% are injured[13]. The important goals in treatment of lower extremity popliteal artery injury are lifesaving followed by limb salvage, success of treatment is measured in rate of limb salvage. We found that the time between arterial injury and surgical intervention is one of the most important priorities that must be taken into consideration when dealing with arterial injury, as good result manifested (normal limb function) when repair is done within the first 6 hours of injury and also still within 9 hours but poor result manifested as permanent disability in the affected limb if repair takes place after 9 hours after time of injury[14]. 70% of popliteal artery injury had associated popliteal vein injury which need special care as vein ligation should be avoided unless life -threatening situation demands priority[15].

In present study, the majority of injured popliteal veins 70% were repaired, in 25 % the popliteal vein was ligated and unfortunately 9% associated with gross limb ischemia in spite of satisfactory arterial repair and ended with above knee amputation, this is supported by a local study which emphasized popliteal vein repair rather than venous ligation[l5]. Other study showed ligation of popliteal vein is reliably associated with amputation and it was an aggravating factor in the setting of severe arterial injury and delay to surgery. A major point of controversy in the management of peripheral vascular trauma is the time and method of fixation of associated bone injuries. Fractures and orthopedic surgery may cause soft tissue damage including vascular injury to vital collateral vessels and also increase risk of infection[16].

Stabilization of associated fractures may be performed before arterial repair if the procedure does not encroach on the viability of the limb and unless limb threatening ischemia was found, so vascular repair must always, if possible be repaired first[16]. In the present study, vascular repair primarily was performed in most of the patients because of limb threating ischemia, but in three patients combined teams of vascular and orthopedic surgeons operated on at the same time with external fixation for the fracture with vascular reconstruction**.** In the present series, we noticed that fasciotomy performed more in those who needed graft interposition, mostly because associated arterial and venous injuries and delay presentation and relatively more time expended in graft interposition, 85% of patients needed fasciotomy especially those with combined arterial and venous injuries. Systemically hepranization was a matter of controversy, some study accepted single dose of systemic hepranization at the time of vascular repair especially if there is vascular thrombosis and need thromboctomy[17].

In the present study, systemic heparin was mostly used in those with graft interposition although it was also used in other techniques of repair and we omitted its use in those with multiple injuries to avoid heamatomas, we extended the use of heparin to two days for graft interposition and fasciotomy was not a contraindication to heparin use. Regional heparin was the technique of choice (solution containing 5000 IU heparin / 500ml saline) 20 ml being instilled in to the vessel proximally and distally during vascular repair in our eligible patients. Although successful repair was not a

prognostic factor for the limb salvage, amputation has been done in 14 patients (17 .5%) of our series often due to the type of injury where two of them had crush injury and may be due to delay in referral, other series have less incidence of amputation (11%) due the more sophisticated situation and facilities. Morbidity, the commonest early and late one was oedema due to associated injury (venous) or delay referral and limb ischemia, those patients need close follow-up during hospitalization as they need re-exploration, fasciotomy or they may need amputation. Joint stiffness manifested in those associated with fracture femur because of delay of referral of our patients to physiotherapy in some of them or because we lost them in the early follow-up interval, also nerve injury may be another etiological factor. Although with successful repair was an important factor for post-operative result, morbidity happened in our patients and mortality took place in 4 patients 5% due to severe type of injury or other associated injuries.

In conclusions; Popliteal artery injuries mostly due to penetrating injuries and afflict young age group due to violence. 65% presented with shock state, which is more than other studies because of remote hospital and delay referral. Popliteal artery injury presented with hard signs in > 90% of cases which is more than other study, because of negligibility of popliteal artery injury with soft signs by our hospital. Although all patients explored were positive whether hard or soft sign there is need of angiogram and duplex at night. Lifesaving is the primary goal of surgery of popliteal artery injury followed by limb salvage which still can be achieved if repair done within 9 hours of injury. Associated popliteal vein injury should be repaired if feasible and ligation should be avoided unless life-threatening situation appears. Associated fracture femur may be stabilized before vascular repair unless limb threatening ischemia so arterial repair should be done first. Fasciotomy may be indicated in patients with combined arterial and venous injuries or those with delayed referral and swollen limb and should be done immediately at time of vascular repair. Systemic heparin may be extended two days after vascular repair mainly for those with graft interposition and local heparin at time of arterial repair.

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