Brachial artery injury in AL-Diwaniya teaching Hospital

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الخلاصة

ان اصابة الشريان العضدي من اكثر اصابات الشرايين شيوعا . والتي يمكن ان تنتج عن الجروح النافذه او الراضة او حتى التداخل الجراحي . لقد تم دراسة 80 حالة في مستشفى الديوانية التعليمي من تاريخ 1 نيسان 2004 ولغاية 30 نيسان 2007 وذلك لتسليط الضوء على علاجها ونتائجه .

كانت الاصابات الناتجة من الطلق الناري تمثل نسبة 50% من الاصابات .والجروح الراضة تمثل نسبة 27,5% والجروح الطعنية تمثل نسبة 16,25% اما التداخل الجراحي يمثل نسبة 5% من الاصابات .

لقد تم معالجة 60% من الاصابات باستخدام الترقيع الوريدي و 22,5% باستخدام الترقيع الشرياني و15% بخياطة الشريان مباشرة و 2,5% بعقد الشريان .

نسبة الوفيات كانت 5% نتيجة الاصابات المرافقة لاصابة الشريان العضدي .

وكان تصلب المفاصل من اكثر المشاكل التي يعاني منها المريض بسبب قلة الحركة وعدم التزام المريض بالعلاج الطبيعي .

Abstract

Aim: to focus on the management of brachial artery injury and it's sequelae .Methods: This is a prospective study of 80 patients admitted at Al-Diwaniya Teaching Hospital from 1st April , 2004 to 30th April, 2007 . All patients were prepared for surgical intervention under general anesthesia and proceed for arterial repair. Results: The most common mechanism of injury was bullet injury (50%) , followed by blunt (27.5%) , stab wounds (16.25%) , iatrogenic factors (5%) and rarely by thermal injury .The technique of repair was by venous graft in the majority of cases (60%) and we needed arteriorraphy in (22.5%) , end to end anastomosis in (15%) and ligation in (2.5%) .Conclusion: Brachial artery injury occurs more in young male group and commonest cause is bullet. Diagnosis of brachial artery injury is done by physical examination. Commonest postoperative complications (late sequelae) due to nerve injuries and joint stiffness.

Introduction

The development of surgical control of the arterial system represents one of the most important achievements in the field of surgery.

Vascular repair techniques were improved during Korean & Vietnam's war, combined with advances in resuscitated , anesthesia & preoperative care, resulted in similar low amputation rate .

Vascular injury caused by penetrating wounds are related to the velocity of projectile . A high velocity projectile causes injuries several centimeters beyond the path of penetration requiring extensive debridment of devitalized tissues .

Arterial injuries from blunt trauma are caused by direct compression or by rapid deceleration which leads to intimal tear , since the intima is the least elastic layer of the arterial wall .

Blood dissects under the flap frequently causing thrombosis of the vessels [1].

Iatrogenic arterial injury may be caused during coronary arteriography or accidental injection of pharmacological agents which leads to ischemia & gangrene of extremity .

The presence of distal cutaneaus gangrene or stony heard musculature makes the benefits of revascularization questionable , but successful repair may

preserve the viable tissue and permit amputation at a lower level .

Re-establishment of arterial flow within 4-6 hours after arterial injury minimizes the possibility of permanents ischemia .

Although every hour of delay may diminish success , there is no absolute period beyond which repair is contraindicated .

Failure to recognize the existence of a vascular injury may cause acute or chronic ischemia .

In some patients , amputation is avoided but chronic ischemia causes intermittent claudication , ischemic rest pain or Raynaud's phenomena [2].

Patients and methods

This is a prospective study of 80 consecutive patients presented with brachial artery injury admitted at Al-Diwaniya Teaching Hospital from 1st April , 2004 to 30th April, 2007 . All patients were admitted and proceed for surgical management by graft, arteiorraphy, end to end anastemosis or ligation. Data were collected directly from the patients or from their relatives as well as all additional information were obtained from their referral sheets regarding the details of injuries and the initial resuscitative measures.

Seventy-two patients were males and 8 were females, (Figure 1)

Age distribution of the patients in this study ranged from 10 months to 60 years with an average of 26.4 years (Figure 2).

The mechanisms of injury was a bullet in 40 (50%), blunt in 22 (27.5%), stab in 13 (16.25%), iatrogenic in 4 (5%), and thermal injury in 1 patient (1.25%) (Figure 3).

Injuries were evaluated and classified according to the anatomic location. Sixty-four (80%) were located below profunda (deep brachial artery), and sixteen (20%) above profunda.

Evaluation of the injured patients was immediately established by examination and routine radiological examination, unavailability of angiographic tests at the time of the study precluded its use as an emergency diagnostic tool.

Any active bleeding was controlled by direct pressure and the wounds were examined to determine the location. The physical signs considered to be associated with probable or possible significant injury were pulselessness, pallor, paraesthesia, coldness, paralysis and hematoma (pulsatile or expanding).

The decision for exploration was made by the attending surgeon. Management of those patients was carried throughout their hospitalization and clinical follow-up was conducted for most of them.

Brachial artery injuries are associated with many local and general injuries as shown in table (1). Follow up was conducted for seventy one patients (88,75%) for 1 month post surgery , only nine of them (11,25%), their follow up has been lost.

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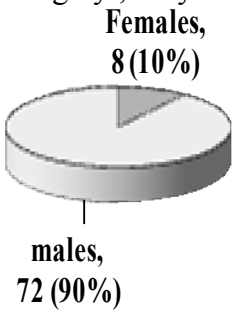

Figure (1): Distribution of patients according to gender

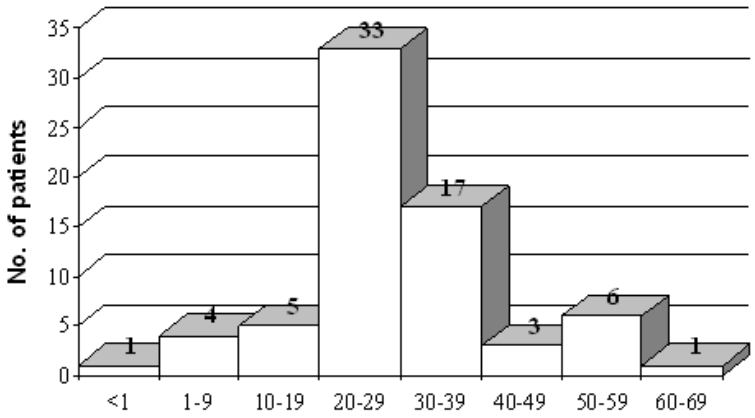

Figure (2): Histogram showing distribution of patients according to age.

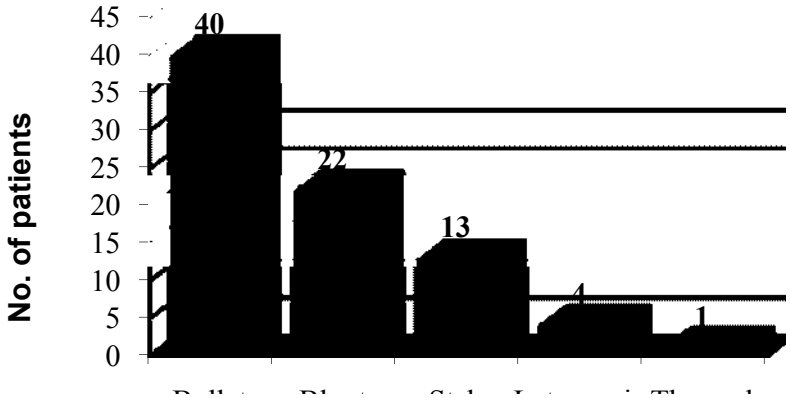

Figure (3): Distribution of patients according to type of injury

Table (1): Associated injuries with brachial artery injuries

Associated injury		No.	%
General	Chest injury	16	72.72%
	Head injury	2	9.09%
	Abdominal injury	2	9.09%
	Burn	1	4.54%
	Fracture femur	1	4.54%
Total		22	100%
Local*	Venous injury	54	77.14%
	Median nerve	30	42.85%
	Fracture humerus	15	21.14%
	Radial nerve	2	2.85%
	Ulnar nerve	2	2.85%
Total		70*	100%

* seventy patient with brachial artery injury have local associated injuries some were mixed injuries.

Results

Analysis of data defined 2 separate patient groups based on location of injury. Table NO. 2 shows these groups with present

Bleeding from brachial artery injuries was controlled by direct pressure in most patients while tourniquet was used in 18 patients ten of those patients were presented with edema, sixteen patients presented with pain, all of those with paraesthesia and pulseless limb, 15 patients with coldness and 14 patients presented with cyanosis (Table 3).

Seventy one patients were surgically treated within the fist 6 hours of injury. Nine patients were delayed more than 6 hours, as shown in (table 4), in those with delayed repair, 2 of them developed thrombosis, 2 patients developed claudication and 1 patient developed gangrene.

Type of surgical treatment depended on the pathology of brachial artery injury and symptoms. Patients with injury above profunda presented mostly with hard signs of vascular injury.

the length of injured segment, (Table 5).

Venous grafts were used in 48 patients, in 33 of them saphenous vein was used while cephalic vein was used in 15 patients because it was sizable and available in operative field (Table 6).

Ligation was performed in 2 patients with sever crushed limb and loss of tissue

Systemic heparin was used in 32 cases (5000 IU 6 hourly i.v as shown in (Table 7), only 1 patient developed thrombosis while other patients' heparin was contraindicated because of associated injuries.

An uneventful course was noticed in 38 (47,5%) patient this series, 38 (47.5%) patients were morbid and 4 (5%) patients were mortal, (Table 8 & 9).

Table (2): Relation between sign & symptom and location of injury

Groups	No	Pulscless limb	Pallor	Coldness	Paralysis	Paresthcsia	Pain	Hematoma	Odema
I. Above Profounda	16 (20%)	14 (87.5%)	12 (75%)	8 (50%)	9 (56.25%)	8 (50%)	5 (31.25%)	8 (50%)	10 (62.5)
II. Below Profounda	64 (80%)	58 (90.6%)	48 (75%)	48 (75%)	6 (9.3%)	12 (18.75%)	8 (1.25%)	5 (7.81%)	11 (17.18%)
Total	80 (100%)	72 (90%)	60 (75%)	56 (70%)	15 (18.75%)	20 (25%)	13 (16.25%)	13 (16.25%)	21 (26.25%)

Table (3): Relation of the presentation & the preoperative use of tourniquet

Symptoms	Pluseless limb	Paresthesia	Cyanosis	Coldness	Odema	Pain
No. (n=18)	18	18	14	15	10	16
%	100%	100%	77.7%	83.3%	55.5%	88.8%

Table (4): Time between injury and surgical intervention

Time	Number	%
During first 6 hours	71	88.75"/0
After 6 hours	9	11.25%
Total	80	100%

Table (5): Pathology of injury

Type of injury	No.	%
Completely severed	51	63.75%
Partially severed	19	23,75%
Non-severed	10	12.5%
Total	80	100%

Table (6): Type of operative treatment

Surgical technique	No.	%
Graft	48	60%
Arteriorraphy	18	22.5%
End to end	12	15%
Ligation	2	2 5%,
Total	80	100%

Table (7): Duration of heparin use

Heparin time	No.	%
Single dose	9	28.12%
I day	15	46.87%
2 days	4	12.5%
2-4days	4	12.5%
Total	32	100%

Table (8): Morbidity post-surgery

Complication		No.	%	Treatment
Early (< 24 hours)	Oedema	11	64.70%	Elevation
	Thrombosis	4	23 .52%	Re-open
	Bleeding	2	11.76%	Re-open
Total		17	100%	
Late (> 24 hours)	Paralysis	32	51.6%	Conservative
	Joint stiffness	18	29.03%	Conservative
	Ischemia (claudication)	4	6.45%	Conservative
	Gangrene	4	6.45%	Amputation
	False aneurysm	2	3.22%	Surgery
	Infection#	2	3.22%	Conservative
Total		62*	100%	

Antibiotics were given according to the culture and sensitivity with frequent dressing

* Many patients were share more than one complications.

Table (9): Cause of mortality

No.	Type of injury	Age in years	Time of death after injury in days	Cause of death
1	Bullet	25	2	Head injury
2	Cannulation	1	4	gastroenteritis
3	Burn	36	6	Septicemia
4	Stab wound	53	14	Renal failure

Table (10): Shows number of patients with amputation and causes.

No.	Age in years	Cause
1	2	Intra-arterial injection of antibiotic
2	23	Severe crush injury
3	30	Bullet, referral to us after 10 hours from injury
4	36	Severe burn with loss of muscle and soft tissue

Hospitalization ranged from 1-14 days with a mean of 4.3 days.

Discussion

Diagnosis and treatment of vascular injuries in the extremities can be challenging. Brachial artery injury is one of the most common vascular injuries at Al-Diwaniya Teaching Hospital. This figure goes with Perry and Feliciano studies[3]. In this thesis, males represent the bulk of the cases (90%) and this is because they are more exposed to violence than females.

The age of patients in our series ranged from 2 months to 60 years, with an average of 26, 4 years. In Perrault study, the patients' age ranged from 6 years to 92 years with an average of 52 years, this difference is because of the high average age in western countries[4].

In this study, bullet injury was the commonest cause of brachial artery injury followed by blunt and then stab wound, , this figure different from Schroeder study where vascular injury caused by fracture of humerus (RTA) in 57%, contusion in 33% and penetrating in 10%[5] because of civilian war in our country.

Our patients were categorized into two groups according to the location of injury, whether above or below the profunda brachii. Above the profunda injuries represent 20% of cases and 80% below profunda because of long course and anterior anatomic location. Those with above profunda injury presented with ischemia (pulseless, pallor, paralysis, paraesthesia and pain), this is because the profunda artery provides a lot of collatterals around the elbow joint ,this result goes with Perry's study[3].

Tourniquet was used in 18 patients (22.5%) to control bleeding as life saving measures.

The tourniquet causes more venous bleeding and more edema because of the venous obstruction and jeopardizing the arterial flow leading to limb ischemia.

Most of those patients presented with the following signs and symptoms of ischemic limb: pulseless (100%), paraesthesis (100%), cyanosis (77.7%) and pain (88.8%). So tourniquet is indicated only in severe crush injury with hopeless limb.

Time between injury and vascular repair is critical as every hour delay will affect the prognosis of limb post repair, most of our patients (71 patients, 88.75%) presented to our hospital within the first 6 hours after injury and repair was successful within this period, while 9 patients (11.25%) presented more than 6 hours because of referral from remote areas, even so we did not deny them the chance of repair because there is no absolute time for contraindication of vascular repair but their results were not like those who presented with the first six hours[6].

Because of the unavailability of angiography at the time of the study and urgency of the cases made the immediate exploration mandatory based on physical findings.

Surgical treatment was determined by pathophysiology of vascular injury whether repair, end-to-end anastomosis, or interposition grafts are needed. In general, 1-2 cm of arterial wall may be resected without graft replacement[1]. Saphenous vein graft was used in 33 patients while cephalic vein was used in 15 patients. Cephalic vein was used where it was sizable to be the graft of choice, however, synthetic conduit was avoided because of the high rate of thrombosis and infection and this goes with Malcolm's study [7].

Forty eight patients (60%) needed autogenous graft, while in Penkov study, 45%

of cases used autogenous grafts. End-to-end anastomosis represented 15% in this study whi1e presented 55% in Penkov study[8], as in our series bullet injury was the commonest injury with arterial loss while Penkov patients' were those with blunt trauma .

Systemic heparin was used m 32 patients (40%) especially in those patients who arrived late to hospital with manifestation of limb ischemia. Systemic heparinization usually was not employed in multiply injured patients. Local heparinization with diluted heparin solution (100 units/ ml) is enough to discourage local clot formation, this dose is recommended by Sabiston[1].

In this study, for patients with systemic heparinization 15 patients (46.82%) used heparin for 24 hours (5000 in 6 hourly i.v.) Mainly, heparin was given in patients with autogenous grafts to prevent thrombosis[1, 8]. Only one patient developed thrombosis and needed reoperation, so good results achieved with systemic heparinization for 24 hours only, Derrault has got the same result[9].

Deep vein injury represented the commonest associated injury in 54 patients (77.14%), (Table 1). Repair of venous injury in extremities is preferred to decrease ischemia[1, 2, 6], in contradiction to this study, in our series all associated venous injuries were ligated without significant morbidity which was comparable to local study done at IBN-AL Nafees Hospital[10].

Brachial artery injury associated with median nerve injury occurred in 30 patients (42.88%). This is because that the anatomical course of median nerve is closely related to the brachial artery[4] .

Total cut or particularly injured median nerve was repaired by approximation using prolene sutures at the same session.

Brachial artery injury was associated with fracture humerus in 15 patients (18.75%), (Table 1) which may be due to fractured segment not the direct trauma, so fixation of bone is mandatory and done before brachial artery repair to protect vascular anastomosis, but when ever signs of ischemia or fixation was delayed more than 6 hours, vascular repair should be done first[1].

In our study all of these cases, a vascular repair was done first but fixation by POP was performed to protect vascular anastomosis because there was no time to delay the fracture fixation.

Other associated injuries may cause death in some patients especially head and chest injuries. One death was caused by head injury. So these injuries have a priority in the management of the patient over brachial artery repair that made prognosis of vascular repair very poor.

Morbidity of brachial artery injury was present in 38 patients (47.5%). It commonly resulted from paralysis and joint stiffness. This result agreed with Penkov study[8].

Astonishingly, in many patients with joint stiffness there was no fracture to humerus while those with fractured humerus has no joint stiffness. This explained by early physiotherapy inpatients with fracture while our groups come late to establish physiotherapy.

So, physiotherapy was mandatory in those patients with brachial artery injury to prevent joint stiffness and this done as soon as possible after union of fracture or within 2 weeks if there was no fracture.

Comparing with Penkov and Hocken's study [8,11,12] ; our results were good with minimal morbidity (regarding vascular complications), however, four patients were mortal (5%) due to associated injuries or complication and not directly from brachial artery injury, (Table 10).

Conclusions

1. Brachial artery injury occurs more in young male group.
2. Bullet is the commonest cause of injury .
3. Diagnosis of brachial artery injury is done by physical examination.
4. Commonest postoperative complications (late sequelae) due to nerve injuries and joint stiffness.

Recommendations

1. Toumiquet is preferably avoided.
2. Systemic heparin is preferably used in patients without multiple injuries and those patients presented after 6 hours.
3. Injured deep veins can be ligated safely.
4. Physiotherapy should be started as soon as possible to prevent joint stiffness.

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