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RESEARCH ARTICLE

TRAUMATIC ANEURYSMS AND ARTERIOVENOUS FISTULA.

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Abstract

Posttraumatic pseudoaneurysms and arteriovenous fistula are rarely observed⁽¹⁾ where time from trauma to diagnosis varies from hours to years. Because of the imminent clinical course, early operation is usually indicated to prevent very impressively the extensive consequences of an unrecognized traumatic AV malformation⁽²⁾. They occur most commonly in the extremities and are noted most often in military casualties.⁽³⁾

The trauma leading to the AVM may be penetrating, blunt, postsurgical or inflammatory. A swelling with or without pulsation, loss of function or peripheral claudication of the limb are the main presenting symptoms. A bruit and trill are usually present. Color Doppler USS and CT angiography will provide the essential diagnostic information. In our research there are 12 cases of traumatic AVM in different parts of the body which are angiographically documented.

The surgical procedures performed were proper identification of feeder vessels, surgical control of these vessels, total excision with arterial ligation or total excision with end to end arterial anastomosis or by grafting when segmental resection is required, either by reversed autogenous vein graft or by synthetic graft remain the basic principles of therapy. The end result of the surgical operations was considered good in most of patients with restoration of normal blood flow to the affected limb.

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Aim:-

To evaluate the treatment of late sequelae of penetrating arterial injuries such as false aneurysms and arteriovenous fistula (AVF) in different parts of the body which are an important cause of morbidity and loss of function of the affected limb.

Material and Methods:-

Retrospective clinical study was initiated in Vascular Surgery department in Misurata Central Hospital in the period of 2 years between November 2014 to October 2016. Data were collected from patients files and their previous radiological investigation including Duplex U/S, CT angiography.

Our research included 12 patients with false aneurysms, 10 of them in the extremity and two patients (1 in Superficial temporal artery & 1 in arch of aorta). Eleven patients were males and one patient was female, age range was 3 to 34 years with a mean of 21.3 years. The cause of the injury was broken glass 1, stab wound 3, Arterial blood gas (ABG) taken 1, post explosive injuries 4, post RTA 1 & post gunshot injury 2 cases.

Introduction:-

Arterial pseudoneurysm and arteriovenous (AV) fistula might occur as a result of trauma in different parts of the body. These two entities can form independently of one another, but even though it is rare they also could be observed simultaneously.⁽⁴⁾ The "classical" description of a traumatic AVM indicated that it was generally formed from single, direct communication between an artery and vein.

Clinical progress could get serious in this type of occurrences and because of the imminent clinical course early diagnosis and treatment are needed. But if symptoms occur, they vary from swelling to pain, even extending to heart failure due to high shunt volume. A thrill and bruit accompanying the AV shunt is characteristic, however, not always detectable. Many of the symptoms are reversible with surgery.⁽²⁾ Surgical treatment is difficult and involves different methods according to location and feeding artery.⁽⁵⁾ In this research, we present our approach to the diagnosis and treatment of a pseudoaneurysms, and arteriovenous fistula due to various type of injuries.

Pathophysiology:-

An arteriovenous malformation consists of endothelial-lined communication between an artery and vein with no interposed capillary bed. The communication may be single (secondary to trauma, most commonly penetrating) or consist of multiple channels and spaces admixing the blood and forming a complex vascular structure (congenital AVF).

There are two types of aneurysms: True arterial aneurysms involve all three layers of the artery wall (intima, media and adventitia), while False aneurysms Represent a collection of blood, held around the vessel by a wall of connective tissue. May occur following trauma or there may be a slow leak of blood which is confined by surrounding tissues, also can be arise following angiogram, angioplasty or at the join between a graft and the artery. Result in a slowly expanding blood-filled cavity, which will eventually rupture or lead to thrombosis.

Clinical presentation:-

The most common symptom of a traumatic AVM is pulsatile progressively enlarging mass and relate a history of a previous trauma. also most AVMs will have a palpable thrill even if a bruit is not present⁽²⁾ Attention to traumatic arteriovenous communications has been concentrated around wartime experiences as penetrating shrapnel wounds have accounted for the majority of vascular wartime injuries⁽³⁾. We have identified 12 cases of such vascular lesions documented by Duplex U/S & CTA from 11-2014 till 10-2016 (Table I).

The Superficial Femoral Artery was the most commonly involved feeder vessels. It is enlightening that the etiology of AVM was the majority of penetrating wounds leading to AVMs were a result of explosive in 4 of 11 cases, while the contusion injuries were usually automobile accidents.

Etiology	No. of cases
Broken glass	1
Stab wound	3
ABG taken	1
Post explosive injuries	4
Post RTA	1
Post gunshot inj.	2

The summary of clinical finding in our 12 patients in (Table I) indicates that 4 were due to explosive injuries, 1 due to RTA, 3 following stab wounds, 1 due to broken glass injury, 2 following gunshot and 1 case iatrogenic following ABG taken during neonatal ICU admission. The symptoms began 1 day to 3 years following the trauma, with 4 being greater than 6 months. Swelling or the presence of a mass were the predominate symptoms in 10 patient, while intermittent claudication were described as the presenting complaint by 3 patients each.

Case No.	age	sex	Trauma	Location	Time of onset after Trauma	Clinical presentation	Diagnostic image	Imaging Result	Therapy	Discharge in
1	8y	F	Post glass inj.	Rt. per auricular area	6 months	Pulsatile swelling	Duplex U/S	Post. division of Rt. Superficial temporal artery pseudoaneurysm	Aneurysmectomy with ligation of STA	3 rd day post OP
2	3y	M	Post ABG	Lt. wrist	Since neonatal period	Pulsatile swelling, bruit, trill & absent R.A. pulsation distal to site of inj.	Duplex U/S	Lt. R.A. pseudoaneurysm & AVF with cephalic vein	Aneurysmectomy with ligation of R.A. & Cephalic V.	6 th day post OP
3	18y	M	Post explosive inj.	Lt. upper Arm	20 days	Pulsatile swelling, bleeding & palpable distal Lt. upper limb upper limb pulsation	Duplex U/S & CTA	Muscular branch pseudoaneurysm from Lt. profunda humerus A.	Aneurysmectomy and ligation of muscular branch	4 th day post OP
4	33y	M	Post stab inj.	Rt. mid forearm	10 days	Pulsatile swelling, bleeding & absent R.A. pulsation distal to site of inj.	CTA	Rt. Radial A. pseudoaneurysm	Aneurysmectomy and ligation of R.A.	4 th day post OP
5	34y	M	Post explosive inj.	Rt. mid thigh	3 years	Pulsatile swelling, intermittent claudication & ischemic pain at night & no palpable distal pulsation	CTA	Pseudoaneurysm of SFA & AVF with SFV	Aneurysmectomy and vascular reconstruction by synthetic graft of both SFA & SFV	6 th day post OP
6	27y	M	Post stab inj.	Lt. Knee	4 months	Pulsatile swelling, intermittent claudication & no palpable distal pulsation	CTA	Pseudoaneurysm of Lt. inferior medial genicular artery & AVF with its V.	Aneurysmectomy and ligation of genicular vessels	4 th day post OP
7	13y	M	Post RTA	Aortic arch	Immediate after trauma	Pt. Initially shocked & vitally unstable	CTA after resuscitation	Pseudoaneurysm of Aorta descending aorta distal to original of Lt. Subclavian artery	Urgent Thoracotomy planned as no facility for endovascular	Died on table

Case No.	age	sex	Trauma	Location	Time of onset	Clinical presentation	Diagnostic image	Imaging Result	Therapy	Discharge in
8	34y	M	Post explosive inj.	Lt. Arm	4 Months	Painful pulsatile swelling of Lt. arm getting worse in last 4 days with palpable distal pulsation	Duplex U/S & CTA	Pseudoaneurysm of Lt. Brachial Artery	Aneurysmectomy and contralateral reverse interposition of LSV grafting	6 th day post OP
9	17y	M	Post gunshot inj.	Lt. thigh	1 Month	Pulsatile swelling at Lt. thigh with palpable distal pulsation	CTA	Pseudoaneurysm of SFA & AVF with SFV	Aneurysmectomy and contralateral reverse interposition LSV grafting for both SFA & SFV	6 th day post OP
10	25y	M	Post explosive inj.	Lt. Leg	1 day	Pain at Lt. leg with palpable distal pulsation	CTA	Pseudoaneurysm of Lt. Tibioperoneal trunk	Aneurysmectomy and end to end anastomosis of the artery	5 th day transferred to other department B/O other ass. injures
11	18y	M	Post stab inj.	Rt. thigh	1 Month & half	Pain at Rt. thigh extending distally till Rt. foot ass. with limitation of movement of Rt. lower limb	Duplex U/S & CTA	Pseudoaneurysm of Rt. lateral circumflex femoral A. branch from profunda femoris A. measuring 7x8 cm with filling contrast 3x4 cm	Aneurysmectomy and ligation of Rt. lateral circumflex femoral artery vessels	6 th day post OP
12	26y	M	Post gun shot	Lt. Knee	1 year	Pulsatile swelling, intermittent claudication, no palpable distal pulsation & limitation of movement of Lt. Knee	CTA	Pseudoaneurysm of Popliteal artery & AVF with Popliteal vein	Aneurysmectomy and contralateral reverse interposition LSV grafting for PA & ligation of PV	6 th day post OP

Table I:-Traumatic aneurysms & arteriovenous fistula (AVF)

Discussion:-

Pseudoaneurysms and arteriovenous fistulas are usually caused by traumas mostly by the penetrating ones also can be due to blunt trauma and iatrogenic injury. **(Figure I)**



Figure I:-preoperative picture for case No. 11 shows site of post stab scar and swelling at Rt. upper thigh

As a result of the arterial injury, periarterial hematoma occurs and the hematoma becomes surrounded by the fibrous tissue. Orifice of the pseudoaneurysm is rather small with respect to the aneurysmal diameter. Usually there is only one communication between the artery and vein. This type of cases could be observed in any part of the body and among the extremity vessels, the superficial femoral is the one, which is most frequently affected.^(6&7) The basis of proper therapy for traumatic AVMs rests with accurate radiological identification of the specific vessels involved, outlining the extent and determining the surgical approach for each patient. Diagnosis is not difficult in these cases. duplex ultrasound, computed tomography (CT), magnetic resonance angiography are the suggested methods of diagnosis.

Duplex ultrasound can determine the character of blood flow (ying-yang sign) and presence of intraluminal thrombus whereas postoperative duplex imaging can confirm the patency of vascular repair.⁽⁸⁾ **(Figure II)**

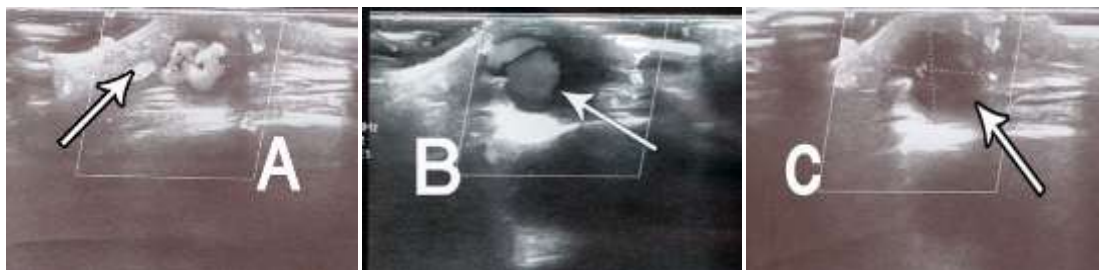


Figure II:-Duplex USS for case No.1 shows pseudoaneurysmal dilation of Superficial Temporal Artery

Arrow (A) shows feeder artery

Arrow (B) shows Ying-yang sign

Arrow (C) shows aneurysmal dilatation of superficial temporal artery

Although magnetic resonance angiography (MRA) is a noninvasive, radiation-free imaging modality, which can provide a high-resolution imaging, it was felt to be contraindicated in our patients due to the presence of residual metallic fragments from his previous injury.⁽⁸⁾ In addition MRA was not available in our hospital to be done in other cases where metallic sharpens are not visible by x-ray **(Figure III)**



Figure III:-Case 8 x-ray shows metallic shrapments and internal plate fixation of mid shaft of Lt. humerus

Computed tomography angiogram provides complete and accurate detection of the anatomical localization of the lesion and a good vision of the collaterals. This can be used in caution because of contrast use. On the other hand, shrapments and metallic bone fixation devices (internal & external) can cause some artifact affect quality of the image. (Figure IV)

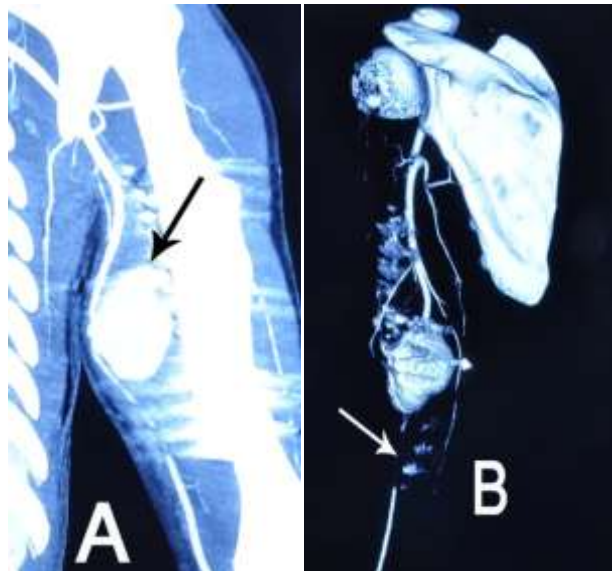


Figure IV:-CT angiography for case 8 reveal posttraumatic pseudoaneurysmal dilation of Lt. brachial artery

(A) Some artifact from internal plate fixation of mid shaft of Lt. humerus

(B) 3D imaging modality of CTA shows exact anatomy of pseudoaneurysm and artifact loss of distal Lt. brachial artery

Cases where post-traumatic arteriovenous fistula and pseudoaneurysm coexist are rare and these cases should get immediate treatment in the early phases when detected. Serious complications can frequently occur in such cases. These complication are repute, neuropathy, distal embolus, thrombosis⁽⁹⁾ and delayed wound healing because of passage of blood back through arteriovenous fistula(AVF)⁽²⁾. Therefore, many cases should undergo surgery as soon

as possible. Arteriovenous fistula affecting the cardiovascular system hemodynamically and damaging the structure of the vein. Besides, immediate surgical operation prevents the pressure upon the neighboring muscle and nerve tissues by the existing mass. Early surgery has many advantages; it is easier due to less sticking and vascularization, distal embolus and rupture can be avoided (**Figures V & VI**)

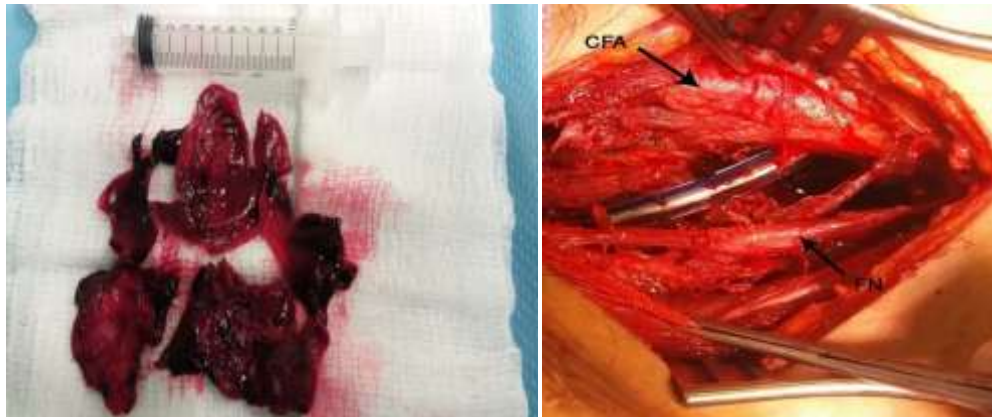


Figure V:-Intraoperative pictures for case No. 11 reveal post aneurysmectomy cavity where suction drain putted and relation with Femoral artery and nerve also intraoperative rupture of pseudoaneurysm because of surrounded by thick fibrose tissue.

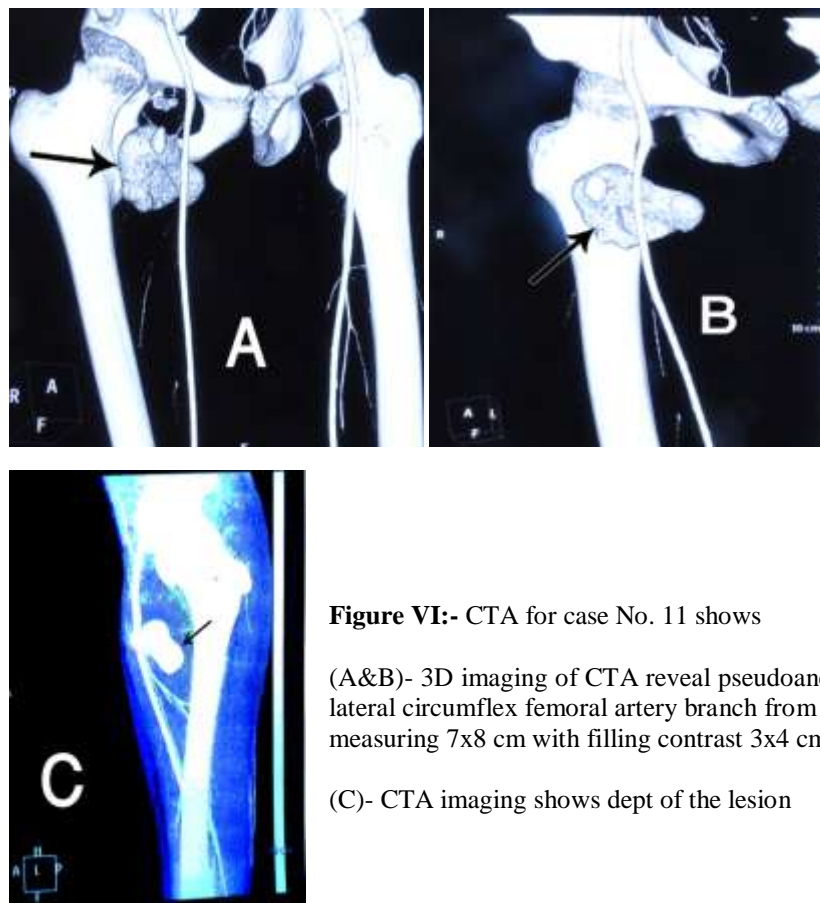


Figure VI:- CTA for case No. 11 shows

(A&B)- 3D imaging of CTA reveal pseudoaneurysmal dilation of lateral circumflex femoral artery branch from Profunda femoris A. measuring 7x8 cm with filling contrast 3x4 cm

(C)- CTA imaging shows dept of the lesion

Arterial pseudoaneurysm and arteriovenous (AV) fistula, these two entities can form independently of one another, but even though it is rare they also could be observed simultaneously.⁽⁴⁾

In our research 5 out of 12 cases arterial pseudoaneurysm simultaneously with arteriovenous fistula.

Because of the fast progress of the post-traumatic pseudoaneurysm and arteriovenous fistula cases and the resultant serious complications, it is recommended that surgical operation should be done as soon as possible. This point of view is supported by the fact that no problem is encountered in the follow-up period after the operation.⁽¹⁰⁾

In many cases, interventional therapy (stent implantation, coiling and thrombin injections) are possible options of treatment^(11&12) but unfortunately are not available in our hospital. In our study, we performed different methods of vascular surgical interventions according to location and feeder vessels either by resection of the aneurysm and applied saphenous interposition on the defective region in the artery and vein (which is preferred method) and less preferred surgical methods might be listed as ligation, synthetic graft use if autogenous venous graft was not sufficient. The critical issue in the surgical treatment is the resection of the vascular lesion with restoration of blood flow. The preferred method is the resection of the aneurysm and the primary repair of the pseudoaneurysm entrance. But, if the anastomosis cannot be performed without tension due to the loss of the tissues, then autogenous saphenous vein or synthetic graft can be used in vascular reconstruction. As for the arteriovenous fistula, artery and vein are separated from each other and the joint regions are repaired.

Complete surgical excision of the AVM remains the most successful therapy at this time. Ligation of the feeder vessels without excision of the AVM is not effective as it simply promotes preferential dilation of other collateral vessels reestablishing the blood flow pattern through the AVM. After being studied with CTA, the surgical plan is developed.⁽³⁾ Exposure of the AVM can usually be obtained by the use of a variety of incisions according to site of AVM. Total excision of the lesion including as much length of abnormal afferent and efferent vessels as possible will reduce the danger of reformation of the AVM.

Ligation	Repair by grafting	Repair by end to end anastomosis
6 cases	4 cases	1 case

6 cases (1, 2, 3, 4, 6 & 11) were treated by total aneurysmectomy and ligation of feeder artery. This includes case No. 4 where ligation of Radial A. was done after making sure of palmar arch patency. This procedure was done because the patient was infected at site of pseudoaneurysm which makes it high risk for anastomotic leak if repair is applied. After the operation, radial artery pulsation was detected at the level of Rt. wrist instead of radial artery ligation done at mid forearm. **(Figures VII & VIII)**

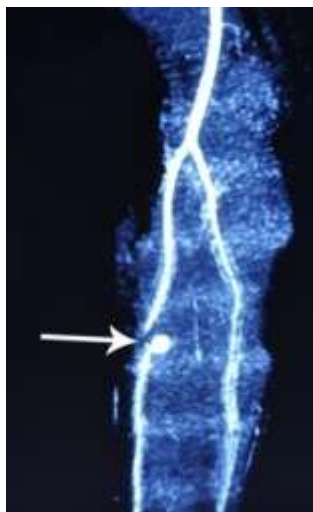


Figure VII:-CT angiography for case 4 shows pseudoaneurysmal dilation of Rt. Radial A.

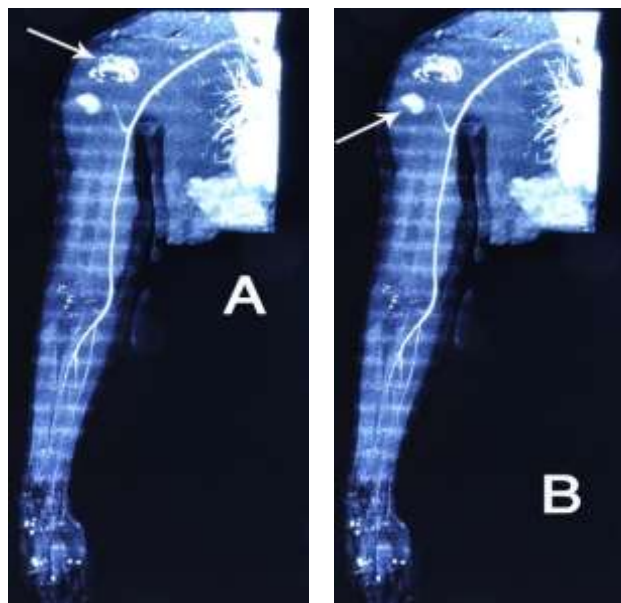


Figure VIII:-CT angiography for case 3 shows
 (A) Pseudoaneurysmal dilation of Muscular branch from Lt. profunda humerus A.
 (B) Shrapnel

cases (3, 4& 7) are presented with ruptured pseudoaneurysms case No. 7 rupture occurred on OT table with no time to control profuse bleeding with no facility for endovascular intervention and the patient consequently died. (**figure IX**)

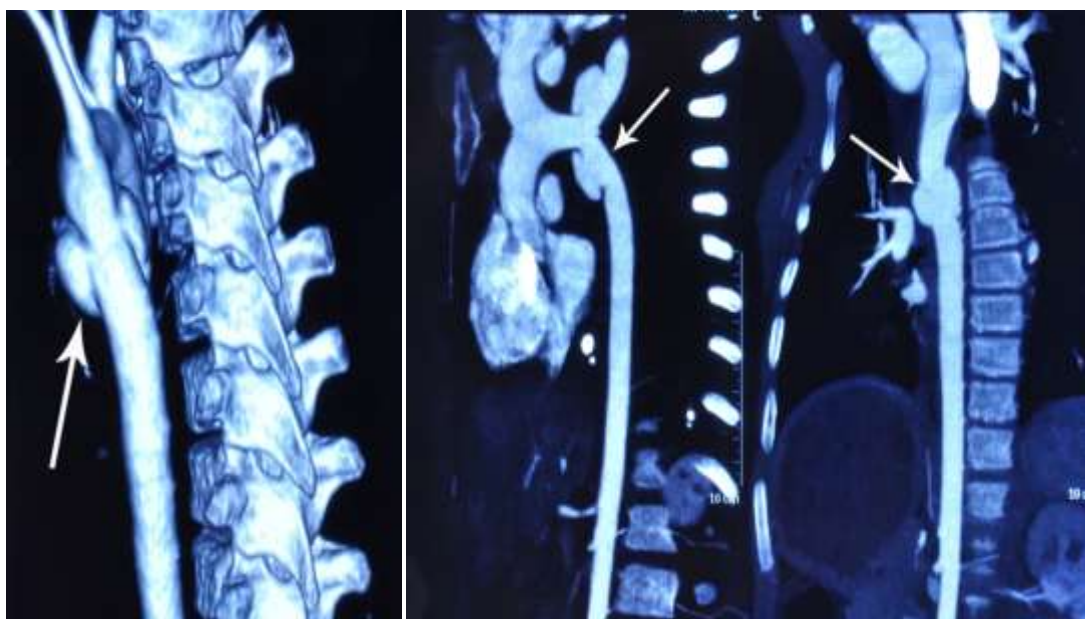




Figure IX:-CT angiography for case No. 7 reveal post traumatic pseudoaneurysm of arch of aorta distal to Lt. subclavian artery

3 cases (5,6 &12) are presented by intermittent claudication because of the passage of blood back through arteriovenous fistula (AVF) which decrease blood supply to distal limb, after OT all symptoms disappeared and good exercise tolerance. (**Figures X, XI & XII**)



Figure X:-CT angiography for case No. 6 reveal post stab pseudoaneurysmal dilation with arteriovenous fistula formation In between Lt. inferior medial genicular vessels

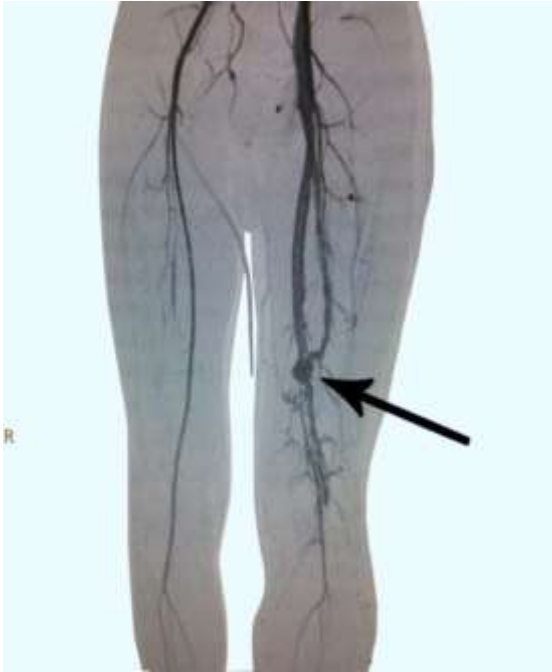
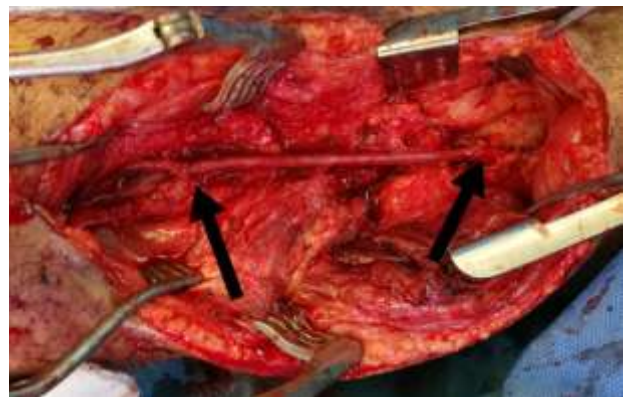


Figure XI:-CT angiography for case No. 9 reveal post gunshot pseudoaneurysmal dilation with arteriovenous fistula formation In between Rt. SFA, SFV & vena commitant

Figure XII:-CT angiography for case No. 12 reveal post gunshot pseudoaneurysmal dilation with arteriovenous fistula formation In between Lt. PA& PV with some artifact because of Lt. lateral femoral condyle fixation by cancellous screw (White arrow) while (Black arrows) reveal intraoperative aneurysmectomy and contralateral reverse interposition LSV grafting for PA & ligation of PV through posterior approach and arrows reveal both ends of popliteal artery.



So early detection of AVM can decrease the chance of segmental excision and graft repair. In our study 4 cases No. (5, 8, 9 & 12) graft repair was done and they were diagnosed late after more than 1 month. On the other hand, 1 case was detected early within 1 day where end to end anastomosis were done because when late diagnosis wall of the artery become part of wall of pseudoaneurysm. This leads to more resection to prevent pseudoaneurysm reformation and both ends distance become more wide which need graft repair. **(Figure XIII)**



Figure XIII:-CT angiography for case 10 reveal
(A) pseudoaneurysmal dilation of Lt. Tibioperoneal trunk
(B) Shrapments

Conclusion:-

Posttraumatic pseudoaneurysms and arteriovenous fistulas are the vascular complication resulting from local traumas. for this reason, early angiography should be considered in penetrating injuries near major limb vessels, as the initial symptoms and signs of vascular injury may be minimal.⁽¹³⁾ This procedure aims to avoid late sequelae which may need segmental excision of the injured vessels.⁽¹⁴⁾ Also early intervention is needed to avoid rupture because of direct trauma or infection which make the repair difficult and increase risk of anastomotic failure because of infection more. Early surgery has many advantages; it is easier due to less sticking and vascularization, distal embolus and rupture can be avoided. Moreover, incidence of direct repair or end to end anastomosis are more applied in case of early rather than late diagnosis.

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