Peripheral Arterial Pseudoaneurysms—a 10-Year Clinical Study

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Received: 11 October 2012 / Accepted: 17 June 2013 / Published online: 29 June 2013
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Abstract Peripheral arterial pseudoaneurysms are quite common in Northern India (Punjab Province) and thus a common presenting complaint of varied etiology. The objective of this study was to evaluate the clinical outcome of patients presenting with peripheral arterial pseudoaneurysms of varied etiology. Retrospective analysis of medical records of patients with diagnosis of peripheral arterial pseudoaneurysm from 1 May 2001 to 30 October 2009 was done. In the prospective period from 1 November 2009 to 30 April 2011, the patients were personally examined by the authors and followed up till discharge from the hospital and subsequently at 2 weeks, 1 month, 3 months, and 6 months postdischarge from the hospital. We studied 50 patients (13 in the prospective group and 37 in the retrospective study group). Intravenous drug abuse (26 cases) followed by trauma (nine cases) was the commonest etiology. Femoral artery was the commonest artery involved (37 cases). A pulsatile mass with localized tenderness was the commonest presentation. All patients underwent surgical treatment with 36 (72 %) patients undergoing ligation and excision of the pseudoaneurysm. Six (12 %) patients underwent revascularization with reverse saphenous vein graft. Five (10 %) patients underwent primary repair, and three (6 %) patients were managed by putting a synthetic ePTFE graft. Postoperative wound infection was seen in 18 (36 %) patients, and 33 (66 %) patients had an uneventful recovery. In pseudoaneurysms, surgical repair at the early instance carries a favorable prognosis. If feasible, reverse saphenous vein grafting is the best conduit for repair. Synthetic vascular graft (ePTFE) can be used in case autologous saphenous vein is not available. Excision and ligation is safe,

and we recommend it as the treatment of choice for infected arterial pseudoaneurysms.

Keywords Pseudoaneurysm · IV drug abuse · Ligation

Introduction

Pseudoaneurysms are localized arterial disruptions or pulsatile hematomas that communicate with an artery through a disruption in the arterial wall. The usual causes are trauma, vascular interventions, anastomotic disruptions, and intravenous (IV) drug abuse. The characteristic findings are those of a pulsatile mass, palpable thrill, and an audible to-and-fro murmur. Various imaging techniques can be used for diagnosis [1]. Pathologically, the wall of the artery has been breached, and external wall of the aneurysmal sac consists of outer arterial layers, perivascular tissue, blood clot, or a layer of reactive fibrosis [2].

Peripheral pseudoaneurysm is a common complication of both diagnostic and therapeutic vascular interventions commonly performed by interventional radiologists or cardiologists [3].

Intravenous drug abuse is an increasing social- and health-related problem. Repeated venipunctures, injection of some types of insoluble substances, and needle sharing habits among drug abusers of poor socioeconomic background frequently result in various complications [4].

Approximately 75 % of all admissions for accidental intra-arterial drug injections involve the lower limb; hence, the most common site for infected pseudoaneurysm is the inguinal region. If left untreated, the infected pseudoaneurysm may be accompanied by systemic sepsis, life-threatening hemorrhage, loss of limb, or even death. Treatment options vary from excision and ligation of the involved vessels to ligation of the involved vessels and routine revascularization [5].

Vascular system complications are an ongoing hazard of intravenous drug abuse. Repeated failed attempts to inject

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preparations of heroin, cocaine, and cannabis into a major upper or lower limb deep vein are likely to cause arterial or vein injury. Among injuries, femoral and brachial artery false aneurysms are being reported with increasing frequency [6].

Iatrogenic pseudoaneurysms can be treated by noninvasive or invasive techniques. Noninvasive techniques comprise of observation, blind compression, and ultrasound-guided compression. Invasive techniques consist of percutaneous endovascular interventions and open surgical repair [7]. Despite the excellent results with thrombin injections, there still remains a role for surgical repair [8, 9]. The most common adverse events related to pseudoaneurysm repair include postoperative bleeding, neuralgia, and infection though mortality remains low [10].

We conducted an 8.5-year retrospective and 1.5-year prospective analysis of the patients presenting with pseudoaneurysms in our department to evaluate the etiology and clinical outcome in these patients.

Materials and Methods

The study included 50 patients. The retrospective period was 8.5 years from 1 May 2001 to 30 October 2009, and the prospective period was 1.5 years from 1 November 2009 to 30 April 2011. All patients above 12 years of age presenting in our institution with a diagnosis of peripheral arterial pseudoaneurysm were included in the study.

In the retrospective group, medical records of the patients with diagnosis of peripheral arterial pseudoaneurysm were analyzed and data were recorded as per protocol. In the prospective group, the patients were personally examined by the authors and followed up till discharge from the hospital. They were subsequently followed up at 2 weeks, 1 month, 3 months, and 6 months postdischarge from the hospital. During follow up, the vascularity of the affected limb was assessed clinically and by Doppler ultrasound study.

Results

The study included a total of 50 patients with 13 (26 %) patients in the prospective study group. The majority of the patients were middle-aged (mean age 29.5 years), with the youngest subject being a 13-year-old boy and the eldest was a 66-year-old male. The study group is comprised of 44 (88 %) males and six (12 %) females. The longest history of presenting symptoms recorded in our study was 150 days. The duration of symptoms ranged from 5 to 31 days with a median of 14 days. The commonest etiology was intravenous drug abuse followed by trauma as in Table 1.

Femoral artery was the commonest artery involved with 37 cases (74 %) as in Table 2.

Table 1 Etiology of pseudoaneurysms

No.	Causes	No. of cases	Percentage
1	IV drug abuse	26	52
2	Traumatic	9	18
3	Iatrogenic	8	16
4	Anastomotic	3	6
5	Mycotic	4	8
	Total	50	100

A pulsatile mass ($n=36$, 72 %) with localized tenderness ($n=38$, 76 %) was the most common presenting complaints as in Table 3.

The most common cause of pseudoaneurysm in our study was intravenous drug abuse with femoral and brachial arteries being the most commonly involved vessels. On admission, investigatory work-up revealed anemia ($Hb < 10$ g%) in 34 (68 %) patients and raised total leukocyte counts ($>10,000/\text{mm}^3$) in 36 (72 %) and 1 (2 %) patient has a platelet count of $<100,000/\text{mm}^3$. Doppler ultrasonography was the most commonly used investigation. *Staphylococcus aureus* was the commonest isolated organism from wound cultures as in Table 4.

In our study, all 50 (100 %) patients underwent surgical treatment for peripheral arterial aneurysm. The patients underwent different surgical procedures: majority of the patients ($n=36$, 72 %) underwent excision of the pseudoaneurysm with ligation of the involved artery and debridement of the aneurysmal sac without any revascularization procedure (26 cases of femoral artery pseudoaneurysms, 5 cases each of brachial artery and radial artery pseudoaneurysms). Revascularization with reverse saphenous vein graft was carried out in six (12 %) patients with femoral artery pseudoaneurysms. Five (10 %) patients (two cases of femoral artery pseudoaneurysms and three of brachial artery pseudoaneurysms) underwent a primary repair, and three (6 %) patients with femoral artery pseudoaneurysms were managed by using a synthetic vascular (ePTFE) graft as in Table 5.

A total of 26 complications were seen in 19 (38 %) patients, ranging from wound infection to amputation. Postoperative wound infection was seen in 18 (36 %) patients with the commonest organism being methicillin-sensitive *S. aureus*. Ligation of the femoral artery led to amputation of the lower

Table 2 Artery involved

No.	Artery involved	No of cases	Percentage
1	Femoral artery	37	74
2	Brachial artery	8	16
3	Radial artery	5	10
	Total	50	100

Table 3 Presenting symptoms

No.	Symptom	No. of cases	Percentage
1	Pulsatile mass	36	72
2	Localized tenderness	38	76
3	Ecchymosis	28	56
4	Claudication	12	24
5	Pulse distal to aneurysm	24	48
6	Palpable thrill	20	40
7	Cyanosis of involved limb	1	02
8	Edema of involved limb	12	24
9	Cold limb at admission	14	28

limb in four (8 %) cases. Brachial artery ligation in five patients did not lead to any amputation of the forearm because of collateral circulation. Postop sepsis was seen in one (2 %) patient. Lower limb ischemia was seen in two (4 %) cases (Table 6).

Postoperative Doppler ultrasound showed monophasic arterial flow in the peripheral arteries of the affected limb in two (4 %) patients and biphasic flow in the peripheral arteries of the affected limb in 44 (88 %) patients. In four (8 %) patients, Doppler ultrasound could not be done as they underwent amputation of the affected limb.

Thirty-three (66 %) patients had an uneventful recovery on follow-up, and 17 (34 %) patients were symptomatic during follow-up. There was no intra- or postoperative mortality.

Discussion

In our study, most of the patients were males aged between the second and fourth decade, which is in coherence with the results found by Darbari et al. and Mohammadzadeh et al. [1, 4]. The mean duration of presenting symptoms ranged between 5 and 31 days (median 14 days). Concurrent study by Klonaris also showed the range of symptoms from 5 to 50 days [13]. A pulsatile mass with localized tenderness was the

Table 4 Wound culture isolation on admission

No.	Organism	No. of cases	Percentage
1	<i>Staphylococcus aureus</i> (SA)	9	18
2	<i>E. coli</i> (EC)	4	8
3	<i>Pseudomonas</i> (PSE)	4	8
4	<i>Enterococcus</i> (ENT)	2	4
5	<i>Acinetobacter</i> (ACB)	1	2
6	<i>Proteus</i> (PRO)	1	2
7	<i>Klebsiella</i> KLE+PSE	2	4
8	ACB+PSE+KEL+PRO	1	2
9	PSE+EC	1	2

Table 5 Management measures

No.	Management	No. of cases	Percentage
1	Ligation and excision		
	Femoral artery pseudoaneurysm	26	52
	Brachial artery pseudoaneurysm	5	10
	Radial artery pseudoaneurysm	5	10
	Total	36	72
2	Venous grafting		
	Femoral artery pseudoaneurysm	6	12
	Total	6	12
3	Primary repair		
	Femoral artery pseudoaneurysm	2	4
	Brachial artery pseudoaneurysm	3	6
	Total	5	10
4	PTFE graft		
	Femoral artery pseudoaneurysm	3	6
	Total	3	6
5	Ultrasound-guided compression	0	0
6	Duplex-directed thrombin injection	0	0
7	Endovascular stenting	0	0
	Grand total	50	100

commonest presentation in our study, which was observed in a study by Darbari but also patients can present with limb edema, gangrene, or even sepsis [1].

Table 6 Outcome during follow-up

No.	Complications	No. of cases and percentage, <i>n</i> (%)		
		At 2 weeks	At 3 months	At 6 months
1	No complication	17 (34)	37 (74)	39 (78)
2	Persistence of primary wound	28 (56)	4 (8)	2 (4)
3	Claudication	3 (6)	2 (4)	2 (4)
4	Wound infection	17 (34)	0 (0)	1 (2)
5	Wound reexploration	2 (4)	1 (2)	3 (6)
6	Anastomotic blow out	0 (0)	0 (0)	0 (0)
7	Amputation (lower limb)	2 (4)	1 (2)	1 (2)
8	Ischemia	2 (4)	1 (2)	0 (0)
9	Distal embolization	0 (0)	0 (0)	0 (0)
10	Gangrene of toes	0 (0)	2 (4)	0 (0)
11	Hematoma	0 (0)	0 (0)	0 (0)
12	Numbness in lower limb	1 (2)	1 (2)	2 (4)
13	Wound debridement	2 (4)	0 (0)	1 (2)
14	Bleeding	0 (0)	0 (0)	0 (0)
15	Skin necrosis	1 (2)	0 (0)	0 (0)
16	Loss of power in lower limb	1 (2)	0 (0)	0 (0)

The most common cause of infected pseudoaneurysm is IV drug abuse. Penetrating trauma in the form of stab, industrial injury, firearm discharge, and sometimes manipulation during orthopedic surgery are the other frequent causes [1, 4]. The femoral artery is seen to be the commonest artery affected followed by brachial artery as studied by Georgiadis and in our study as well [6].

Most patients presenting thus are usually infected, with *S. aureus* being the commonest organism. This has been proved by Klonaris who found positive *Staphylococcus* cultures in 11 (76 %) patients [13]. Bell et al. have stated that almost all pseudoaneurysms are usually infected at presentation to hospital [12]. In our study, 25 (50 %) patients had positive wound cultures on admission with *S. aureus* being the commonest organism infecting nine (18 %) patients.

Although a variety of imaging modalities vary from duplex ultrasonography, contrast-enhanced multislice CT angiography to digital subtraction angiography, duplex ultrasonography still remains a cheap, widely available, and easily reproducible measure. It still remains the initial investigation of choice as in the studies by Arora and Klonaris [11, 13]. In our study, duplex ultrasonography was the commonest investigation employed.

Surgical vascular repair is the management of choice for pseudoaneurysms; however, the type of surgery and reconstruction vary with the etiology and the presentation of the patient. Controversy lies as to attempt to reconstruct the vascular continuity in case of the pseudoaneurysm-involved vessel or to simply ligate and excise the involved segment along with the perianeurysmal necrotic tissue. Mohammadzadeh et al. have already stated that if reconstruction involves the employment of a prosthetic graft, then graft infection is a serious complication [4]. The solution lies in the fact that in cases where the pseudoaneurysmal segment is not infected, a vascular reconstruction should be carried out either with autologous reversed saphenous vein or a prosthetic graft. The decision for reconstruction is based on the segment of the artery involved and the presence of any infection. The presence of infection precludes any reconstruction, and then, ligation and excision of the involved segment is the treatment of choice. The vascularity of the involved limb is at stake, but then, collateral flow which usually develops is mostly sufficient enough to maintain the viability of the limb. In our study, all 50 (100 %) patients underwent surgical treatment for peripheral arterial aneurysm. The majority of the patients ($n=36$, 72 %) underwent excision of the pseudoaneurysm with ligation of the involved artery and debridement of the aneurysmal sac without any revascularization procedure. Revascularization with reversed saphenous vein graft was carried out in six (12 %) patients. Five (10 %) patients underwent a primary repair, three (6 %) patients were managed by putting a synthetic vascular (ePTFE) graft, and only four (8 %) patients required amputation.

This has been shown by various authors like Arora et al. who performed simple arterial ligation for all patients with no reported amputation after the operation. Development of mild claudication at 18 months was the only reported adverse effect [11]. Reddy et al. carried out arterial ligation in 39 patients with only two (5 %) amputations performed because the patients had inadequate collateral supply because of a previous common femoral artery ligation [14].

Although most of the patients ($n=33$, 66 %) in our study had an uneventful recovery which is the normal course, there are a variety of dreaded postoperative complications. The most common postoperative complication in our study was wound infection seen in 15 (30 %) patients, but then, this was the subset of patients with positive wound cultures preoperatively to begin with. Anastomotic blowout is a devastating but rare complication with reported rates being less than 3.3 % [1], and in our study, we did not come across with this complication; however, there was no reported mortality. Extra anatomic bypass through the obturator foramen is another useful technique for placing the graft as it avoids the infected tissues, but it was not employed in our study.

Conclusion

Pseudoaneurysms managed by surgical vascular repair do well; in fact, vascular repair should be done at the first instance. If feasible, reverse saphenous vein graft is the best conduit for repair. When autologous venous graft is not available, synthetic vascular graft (ePTFE) should be used.

In cases where repair is impossible and as a life-saving measure, ligation may be done. However, this can lead to serious complications like severe limb ischemia or limb loss and it should not be practiced with the assumption of good collaterals.

Excision and ligation is safe, and we recommend it as the treatment of choice for infected arterial pseudoaneurysms.

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