

Treatment of Post Cardiac Catherization Femoral Artery False Aneurysms using Ultrasound Guided Compression Therapy, Experience at King Hussein Medical Center

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ABSTRACT

Objectives: To evaluate the ultrasound guided compression therapy as a modality of treating femoral false aneurysm in patients post cardiac catheterization and identify factors that affect its technical success.

Methods: This is a retrospective study conducted at the vascular surgery department at King Hussein Medical Center in Amman -Jordan during the period of December 2012 and March 2015. Eighty five patients were enrolled in the study, being referred from cardiology clinic at Queen Alia Heart Institute in Amman with femoral false aneurysms post cardiac catheterization. Using duplex ultrasound system transducer arrays, Ultrasound guided compression therapy in our vascular surgery laboratory was used to treat these patients femoral false aneurysms.

We have collected and analyzed the specific data regarding false aneurysms anatomic and morphologic characteristics and patients related factors, and evaluate their effect on the success of treatment.

Results: Over 28 month time period, 85 patients with femoral false aneurysms were treated using ultrasound guided compression therapy. Successful compression of the false aneurysm and complete thrombosis of the sac was achieved in 65 patients (76.47%). While in 20 patients (34.48 %) ,the procedure was unsuccessful after three attempted trials. Failed compression was reported in 6 patients (7 %) in the first session of compression, who succeeded compression in the second session trial of compression therapy. Among the patient group who failed compression after three trials, 65 % of patients had false aneurysm originated from superficial femoral artery and 3 % had false aneurysm raised from the profunda femoris artery, While 91 % of the patients who succeeded compression had false aneurysm raised from the main common femoral artery. The size of the false aneurysm also affected ultrasound compression sequel, with 40 % of the failed group had size of false aneurysm more than 3.5cm. We had experience one patient with complicated rupture of false aneurysm during the procedure and no patient who succeeded compression had recurrence in the follow up period.

Conclusion: Among the therapeutic modalities of treating femoral false aneurysm post cardiac catheterization, ultrasound guided compression therapy is considered an effective and safe modality; it has a high success rate with few complications. Several factors decreased the efficacy of the procedure including large size of the false aneurysm and site of origin being not in the common femoral artery.

Key words: False aneurysm, ultrasound guided compression, cardiac catheterization

JRMS June 2016; 23(2):39-46/DOI: 10.12816/0027104

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Manuscript received Agust 12, 2015. Accepted November 24, 2015.

Introduction

False aneurysm is a major complication of arterial puncture of the common femoral artery, being used as the access site for cardiac catheterization either for diagnostic or therapeutic purposes. ^(1,2)

These are increasingly encountered recently, due to the tremendous advances in the role of the coronary angiography and angioplasty, with increasing number of patients enrolled in such treatment modalities in the past 20 years.

The reported incidence of femoral artery false aneurysm ranges between 0.6% to 6% .Their incidences after diagnostic catheterization ranges from 0.05% to 2%, which rises to 2% to 6% if therapeutic interventions are performed. ⁽³⁻⁶⁾ It is defined as contained bleeding in the tissue that surrounds the arterial puncture site due to failure of sealing of the arterial puncture forming a sac, that is connected to the CFA with a neck. ^(3,4,6)

Duplex arterial ultrasonography is used to confirm diagnosis of femoral false aneurysm. The duplex ultrasound will show the aneurysm with the characteristic jet of blood flow running through the neck of the aneurysm and into the sac. ⁽⁷⁾ In the past, femoral false aneurysm used to be treated by open surgical repair. However, several recent less invasive therapies were introduced later including ultrasound guided compression and ultrasound guided thrombin injection. ^(1,8,9-13)

In this study, we have evaluated the efficacy of ultrasound guided compression on a number of patients referred to our vascular surgery clinic at King Hussein Medical Center with femoral false aneurysm post cardiac catheterization.

Methods

This is a retrospective analysis held in the period between December 2012 and March 2015 in the vascular surgery department at King Hussein Medical Center in Amman.

In this study, 85 patients were referred to our department from the cardiology clinic at Queen Alia Heart Institute during that period; these were 55 males and 30 females, age ranging between 35 years and 70 years old.

These patients were evaluated by the cardiology team post cardiac catheterization clinically and using duplex ultrasonography, and found to have femoral false aneurysms of varying sizes .The cardiac catheterization was for diagnostic purposes in 18 (21.2%) patients and therapeutic purposes in 67 (78.8%) patients . However, 80 (94.1%) patients were referred to us with right femoral false aneurysms and only 5 (5.9%) patients referred to us with left femoral false aneurysms. All of them were on antiplatelet therapy [baby aspirin 100mg (85 patients) and colpidogril 75mg 69 (81.2%) patients] once daily and 8 (9.4%) patients were on warfarin 5mg once daily.

Among the study group, 5 (9.4%) patients had renal failure and were on dialysis and 14 (16.5%) patients had Body mass index more than 30. Once referred to our clinic, these patients were reevaluated again using duplex ultrasound, and a 3-12 MHz linear array transducer was being used to evaluate the presence of the false aneurysm including the characteristic jet of blood through the neck and into the aneurysm sac.

The size, shape and site of the false aneurysm were determined, as well as the neck characteristics and the status of the surrounding structures.

Among the 85 patients, 63 (74.1%) patients had false aneurysm arising from the Common Femoral Artery (CFA), 19 (22.4%) patients had false aneurysm arising from the Superficial Femoral Artery (SFA) and 3 (3.5%) patients had their false aneurysm arising from the profunda femoris artery (PFA) (Diagram 1).

The size of the false aneurysm was divided into three groups which are shown in (Table I) Ultrasound guided compression therapy in our vascular surgery laboratory was used to treat these patients by manually compressing the false aneurysm to induce thrombosis in the lumen. ^(8,10,13-15) This modality of treatment was first introduced by Fellmeth *et al* , in 1991⁽⁸⁾ . In our vascular surgery laboratory, the ultrasound system device (Philips HD11XE) has a 3-12 MHz linear transducer array and curved linear transducer array. Using the 3-12 MHz linear transducer array , the false

aneurysm and its neck and surrounding structures were identified (fig. 1) , and suitable manual pressure is applied with the transducer in order to stop flow within the aneurysm cavity for 15 to 20 minutes ,mean while maintaining flow in the adjacent femoral artery (fig. 2) , after which time the flow in the false aneurysm is reassessed again , if flow is found to persist in the cavity , the procedure is repeated again for one more time in the same session for 15 to 20 minutes again and the flow in the false aneurysm is reassessed again. Procedural success was defined as absence of arterial flow in the false aneurysm post compression while maintaining flow in adjacent femoral vessels.

After a successful procedure, patients were advised to be kept in bed rest, with strict observation for about 6 hours .Evaluation of the distal pulses and ABI of the limb involved is done, and if patients experienced pain, 50 mg intravenous Tramadol was given to decrease pain and patients were discharged home. All patients were asked to come again after three days, in order to reassess their false aneurysm status, including all patients who failed the first attempt despite two consecutive trials during the first session.

Patients who did not have thrombosis of the false aneurysm in the first session received a third trial of ultrasound guided compression therapy in the second visit. Procedural failure was defined as persistence of arterial flow in the false aneurysm despite three trials of ultrasound guided compression therapy, or if they have faced any complications during or after the procedure.

These patients were sent for open surgical repair by our vascular surgery team either immediately if complications issue, or within the same week after the procedure.

All patients who succeeded ultrasound compression therapy were reevaluated three weeks later using duplex ultrasound scan to detect recurrence and fortunately none of the patients experienced recurrence.

Results

In our study, among 85 patients, ultrasound guided compression of the false aneurysm was successful in 65 patients (76.47%), while failed to compress the cavity and induce thrombosis of the false aneurysm in 20 patients (34.48 %) after three trials.

However, in 6/85 patients (7%) , the compression using ultrasound guidance was unsuccessful in the first session and required a second session of ultrasound guided compression during the follow up visit with successful results . The remaining 20 patients, who failed compression using ultrasound guidance despite two separate sessions, were referred to surgical repair by our vascular surgery team.

In regard to false aneurysm characteristics in these patients; 13/20 (65%) originated from the SFA, 3/20 (15%) false aneurysms originated from the PFA and the remaining 4/20 (20%) originated from the CFA.

The size of the false aneurysm was more than 3.5cm in diameter in 8/20 (40%) patients and between 2.5-3.5 cm in diameter in 10/20 (50 %) of patients and less than 2.5 cm in 2/20 (10%) of patients, p value 0.000 among variables (Table II).

Discussion

Femoral false aneurysm has been increasingly encountered recently during our medical practice mainly due to the increasing use of catheter based interventions for cardiac angiography either for diagnostic or therapeutic purposes. It has numerous other etiologies, including traumatic, infectious false aneurysms and anastomotic false aneurysms.⁽¹⁶⁾

It is considered the most common complication in patients post cardiac catheterization following arterial puncture using groin Common Femoral Artery (CFA) arterial access.

It has been estimated to occur in about 0.6 to 6 % in patients post femoral arterial access procedures. ^(4,5,6)

Regarding risk factor, they include:

1) Local factors, like site of vascular entry (not in the common femoral artery), inadequate

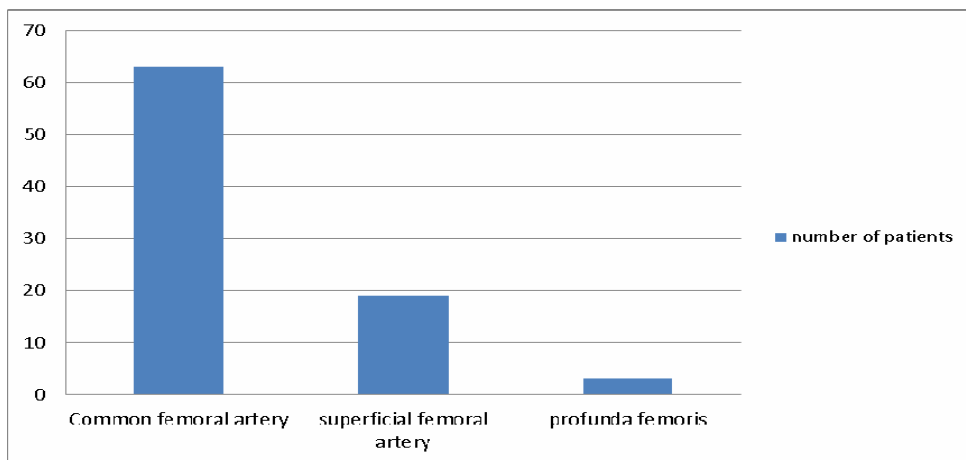


Diagram 1: The distribution of femoral false aneurysm among the related arteries: common femoral artery (CFA), profunda femoris artery (PFA), superficial femoral artery (SFA).

Table I: Number of patients with different sizes of femoral false aneurysm

Size of femoral false aneurysm	Patients	
	No.	%
< 2.5 c m	30	35.3
2.5 -3.5 cm	42	49.4
> 3.5 cm	13	15.3
Total	85	100

Table II: The distribution of patients with procedural success and procedural failure among different femoral false aneurysm characteristics.

Specific characteristic	Number of patients with procedural success		Number of patients with procedural failure		P-Value
	No. Patients	%	No. patients	%	
CFA origin	59	91	4	20	0.000
SFA origin	6	9	13	65	
PFA origin	0	0	3	15	
Size more than 3.5 cm	5	7	8	40	0.000
Size between 2.5 and 3.5 cm	32	49	10	50	
Size less than 2.5 cm	28	44	2	10	



Fig.1. False aneurysm arising from the common femoral artery with blood entering the aneurysm sac through the Neck of the aneurysm.



Fig.2. Absence of arterial flow in the sac of the false aneurysm following ultrasound guided compression with maintenance of flow in common femoral artery.

compression post sheath removal for hemostasis, use of large sheath size, diseased and severely calcified femoral vessels.

2) Systemic factors like patients on anticoagulation and antiplatelet, hypertensive patients, patients with coagulopathy and renal failure.

However females and obese patients are considered risk factors as well. (6,16-21)

The location of the access site used during catheterization plays a major role, as punctures into the profunda femoral arteries or superficial femoral arteries increase the risk of false aneurysm formation. (16, 21)

Patients usually present within 48 hours of the intervention and sometimes few days later, typically with pulsatile tender mass.

They frequently complain of pain and ecchymosis in the groin and thigh (22).

However, progressive enlargement of the false aneurysm may lead to skin edema and necrosis. Rupture may rarely occur and leads to life threatening bleeding.

Sometimes patients present with deep femoral venous thrombosis and limb arterial ischemia

and retroperitoneal bleeding in high puncture sites. (22)

Duplex ultrasonography is considered the diagnostic modality of choice, and in the world wide series it has 94% sensitivity and 97% specificity. (15) Using the B mode image, it shows an echo lucent mass connected to the feeding vessel through a channel through which arterial flow passes into the mass, when using the pulsed wave Doppler, the “to-and-fro” signal is obtained that is typical for false aneurysm. Duplex Ultrasonography also provides information regarding characteristics of the false aneurysm like diameter, shape and anatomy of the neck and site of the defect. (7,14-16) Other diagnostic modalities include Computed Tomography (CT) scan, magnetic resonance imaging (MRI) and conventional angiography. (23)

Femoral false aneurysm is treated using several modalities. Open surgical repair used to be the definitive treatment of choice.

However, less invasive therapeutic modalities were introduced recently, including ultrasound guided compression therapy, ultrasound guided

thrombin injection and endovascular therapeutic options like coiling and stenting. ^(1,10,11,12,13,24-29)

Decision regarding the best modality of treatment depends on several factors including size of the false aneurysm.

A prospective study done in 1992 by K. Craig Kent et al on 16 femoral false aneurysms post arterial puncture showed that false aneurysms less than 1.8cm can be observed safely and managed conservatively, as the majority of these femoral false aneurysms will eventually thrombose spontaneously. ⁽³⁰⁾ In another research article published by Matthew A. Corriere et al in December 2005 showed that femoral false aneurysms less than 3 cm in diameter can be observed safely in asymptomatic patients and followed up with serial duplex ultrasound examinations. However, they have excluded Symptomatic false aneurysms and patients on anticoagulation and referred them for open surgical repair. ⁽³¹⁾

Open surgical repair is considered the definitive modalities of treatment for false aneurysms presented with skin necrosis, overlying skin ulceration and those with associated arteriovenous fistulae as well as rapidly expanding and rupture femoral false aneurysms.

A retrospective study on 12, 261 patients done by S Huseyin *et al* in 2013 emphasized on the immediate surgical repair of femoral false aneurysms larger than 2 cm before rupture in order to minimize morbidity and mortality. ⁽³²⁾

Another therapeutic modality used to treat femoral false aneurysm is the ultrasound guided thrombin injection, and recently it has been proposed to be as one of the first lines of treatment of femoral false aneurysms .It was first described by Cope et al more than 20 years ago, ⁽⁹⁾ and kang et al modified the aneurysm puncture method into ultrasound guided direct puncture percutaneously. ⁽³³⁾

The procedure is considered as simple and safe and can be used in patients on anticoagulation, and has a high success reaching up to 98% .Its major drawbacks are distal embolization so it is contraindicated in patients with false aneurysms having wide and short necks. Patients with allergic reactions to bovine thrombin and

pregnant patients are considered contraindications for thrombin injection. ^(12,24-29)

In our retrospective study, we have used ultrasound guided compression therapy as a first line to treat all our patients presenting with varying sizes femoral false aneurysms. ultrasound guided compression therapy was first described in 1991 by Fellmeth *et al* as an alternative safe procedure to open surgical repair of femoral false aneurysm. ⁽⁸⁾ Among our 85 patients referred to our vascular surgery department with femoral false aneurysm post cardiac catheterization, we have achieved a success rate of 76.47%.It has been shown to be effective and safe, convenient, inexpensive and reliable treatment and cost effective, it has a worldwide success rate ranging 66% to 90 %. In a retrospective study published at the European journal of vascular and endovascular surgery in 2001by Lange P *et al* on 130 patients referred with post cardiac catheterization false aneurysms, they have achieved a success rate of 88 %.⁽¹¹⁾ In another study published in the Chinese journal of surgery in 2012 by Pan FS *et al*, and done on 42 patients, they have achieved a success rate of 81 %. ⁽³⁴⁾

In our study, the failure rate among patients was about 34.48%. However, several factors contribute to this failure rate including the diameter and size of false aneurysm, the site of origin, and the anticoagulation status of the patients. Practically, some patients did not tolerate pain during compression under ultrasound guidance despite pain killers and that have reduced the efficacy of the procedure.

Complications are still reported in this procedure, including false aneurysm rupture, limb ischemia, distal embolization, femoral vein thrombosis and vasovagal attacks. The incidence of such complication ranged between 2% to 4 % in several studies, ^(1,6,8,10-17)

In our experience, we have encountered one case of false aneurysm rupture in one of our patients who was referred to open surgical repair immediately.

Recurrence is considered one of the drawbacks in ultrasound guided compression therapy. In a study done by Coley BD *et al* on 130 patients having false aneurysms and treated using ultrasound guided compression therapy , and

published 1995, they have reported a recurrence rate of 4%.⁽¹⁰⁾

Recurrence is defined as persistence of arterial flow in the false aneurysm lumen, being detected in the follow up visit, despite successful thrombosis in the first session. In our study, none of our patients who achieved successful thrombosis during the first session experienced recurrence.^(1,10,17)

Despite these drawbacks, ultrasound guided compression therapy is still considered a safe and effective first line therapy of femoral false aneurysm.^(1,8,14,20,35)

Conclusion

Ultrasound guided compression therapy is considered one of the first line treatment modalities in selected patients with post cardiac catheterization femoral false aneurysms. It is a safe and effective procedure and has a high success rates with few reported complications.^(13,33)

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