Ultrasound-guided compression repair of femoral pseudoaneurysms complicating cardiac catheterization

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Catheterization; Peripheral vessels; Pseudoaneurysm; Ultrasonography.

Background. **Femoral pseudoaneurysms complicate cardiac catheterizations in up to 3.2% of cases. Ultrasound-guided compression repair (UGCR) is a known valid alternative therapy to surgical and percutaneous repair. We evaluated its safety and efficacy in a series of patients.**

Methods. **Patients with clinical findings suggesting pseudoaneurysm after cardiac catheterization, underwent echo-color and duplex studies. When a pseudoaneurysm was diagnosed, the patient underwent UGCR until closure or for 50 min. A groin compression bandage was applied after the procedure and patients were put on bed rest for 12-18 hours; a new ultrasound study was performed the day after the procedure: when the UGCR procedure failed, patients were referred to a vascular surgeon or interventional radiologist. When possible, a third ultrasound study was performed 1 month after the procedure.**

Results. **Between January 2001 and June 2003, 15 pseudoaneurysms were diagnosed and treated by means of UGCR. The UGCR procedure (UGCR followed by groin bandage) was successful in 13 cases (87%); 1 patient underwent surgical repair and 1 patient underwent percutaneous repair. No local or systemic complications were observed following UGCR.**

Conclusions. **Pseudoaneurysm UGCR constitutes a safe and valid procedure; it is less invasive and easier to perform than percutaneous and surgical repair.**

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Introduction

The incidence of pseudoaneurysms of the femoral artery after cardiac catheterization is reported to reach 1% in diagnostic studies[1] and 3.2% when a percutaneous cardiac intervention is performed[2].

Although small pseudoaneurysms often close spontaneously, when untreated femoral pseudoaneurysms may lead to significant morbidity including groin pain, pseudoaneurysm infection, enlargement and rupture, blood loss, and compression neuropathy[3].

Surgical repair is safe and effective but the risk of wound infection and blood loss and the delayed recovery necessitating prolonged hospitalization (with significant expenses) are well-known drawbacks. Percutaneous closure (with endovascular covered stents or embolization techniques)[4] represents a valid and effective alternative to surgery. However, it requires another femoral site access and is expensive. Since the first experiences, ultrasound-guided compression repair (UGCR) has become the first-line therapy for pseudoaneurysms[3,5]; the recently introduced direct ultrasound-guided thrombin injection[6,7] seems to offer greater rates of success without significant additional risks.

We report our experience with UGCR for the treatment of post-cardiac catheterization pseudoaneurysms.

Methods

Between January 2001 and June 2003 every patient with clinical findings suggesting a femoral pseudoaneurysm after cardiac catheterization procedures (a new groin bruit, a pulsating groin mass, an enlarging hematoma with groin pain) underwent ultrasound evaluation including echo-color and duplex sonography (Acuson Sequoia 512, Mountain View, CA, USA, equipped with a 5 MHz linear array transducer, or a Sonos 4500 Agilent instrument, Andover, MA, USA, equipped with an 11-3 MHz linear array transducer).

Pseudoaneurysms were diagnosed in the presence of an extravascular hypoechogenic cavity characterized by a swirling color flow and communicating via a tract

(or neck) usually directly visible on the color flow image (Fig. 1) and characterized by a pulsed Doppler "to and fro" signal (Fig. 2) due to blood motion between the cavity and the arterial lumen[8].

Contraindications to UGCR included a localization above the inguinal ligament, critical limb ischemia, impending compartment syndrome, infection, and severe pain in the groin. Anticoagulant therapy was not a contraindication.

Sedative medication was not used routinely before the procedure but only if the initial compressions were not tolerated; an attempt was made to distract the patients and to verbally reassure them.

Having obtained the patients' informed consent, the procedure was started by means of an increasing downward force applied with the transducer over the neck of the pseudoaneurysm until there no longer was any flow, as evaluated at real-time color flow monitoring; when the neck was too short or not visible, the force was directly applied onto the pseudoaneurysm until the flow inside stopped. Sometimes, the minimum force necessary to arrest flow in the tract and in the pseudoaneurysm also occluded the artery: this was not considered to be a contraindication to UGCR but a careful examination of femoral arterial and venous flows before and after each compression period was requested.

Cycles of 10 min compressions were repeated until the pseudoaneurysm flow ceased (as evaluated at color and duplex scanning) (Fig. 3) or, in any case, after 50 min of compression.

After the procedure all patients immediately received a groin compression bandage targeted on the lesion zone and were put on bed rest for 12-18 hours. Then they underwent a new color Doppler examination 1 day after the procedure; in case of failure of the UGCR procedure, patients were referred to the interventional radiologist or to a vascular surgeon for invasive therapy. Whenever possible, patients with successful pseudoaneurysm UGCR underwent an additional ultrasound study 1 month after the procedure.

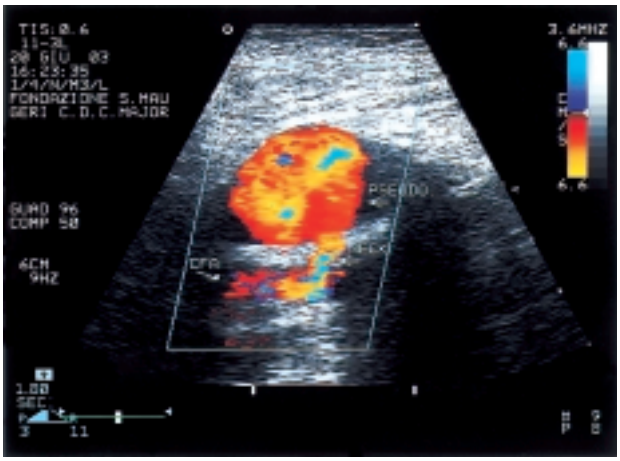

Figure 1. *CFA = common femoral artery; NECK = pseudoaneurysm communicating tract; PSEUDO = pseudoaneurysm.*

Results

We studied 25 patients with clinical findings suggesting femoral pseudoaneurysm after cardiac catheterization procedures: a femoral pseudoaneurysm was diagnosed in 15 patients, a femoral arteriovenous fistula in 4 patients, and only a large groin hematoma in 6 patients.

The 15 patients (7 males, 8 females, average age 62 years, range 35-79 years) with a diagnosis of femoral pseudoaneurysm were included in our study: in 12 patients, the pseudoaneurysm was diagnosed after a first cardiac catheterization (in 5 patients after diagnostic coronary catheterization and in 7 after coronary angiography plus coronary angioplasty) while in 3 pa-

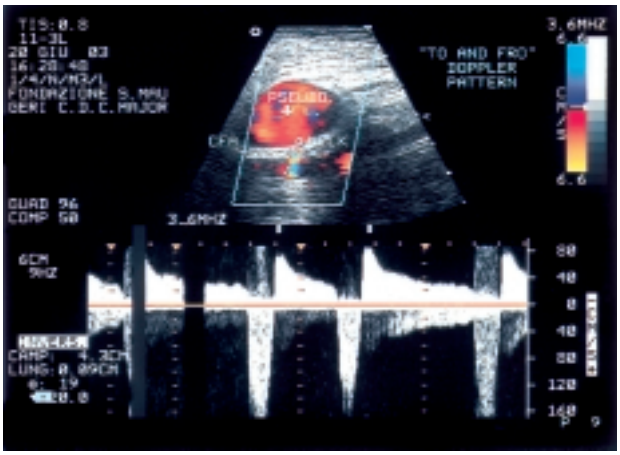

Figure 2. *CFA = common femoral artery; NECK = pseudoaneurysm communicating tract; PSEUDO = pseudoaneurysm; TO AND FRO = pulsed Doppler pattern registered in the neck leading to the pseudoaneurysm.*

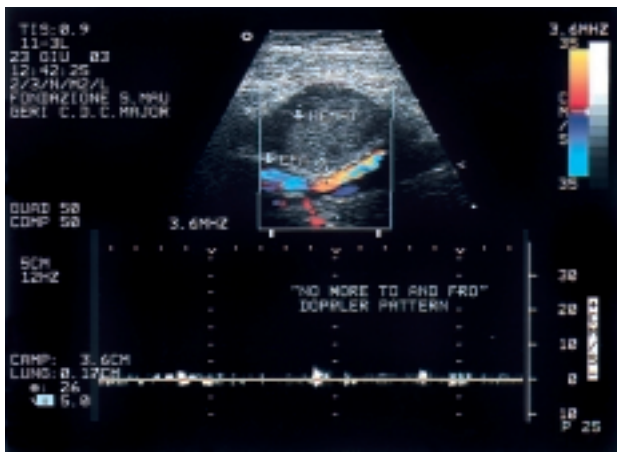

Figure 3. *CFA = common femoral artery; HEMAT = hematoma substituting the pseudoaneurysm cavity in case of successful ultrasound-guided compression repair; TO AND FRO = pulsed Doppler pattern registered in the neck leading to the pseudoaneurysm.*

tients it was diagnosed after repeated cardiac catheterization (a planned coronary angioplasty in all cases). One patient necessitated an intra-aortic balloon pump following shock during cardiac catheterization; another one developed ventricular fibrillation immediately after coronary angioplasty because of an acute stent thrombosis, and was successfully treated with electric defibrillation. Twelve patients were on subcutaneous anticoagulant therapy (enoxaparin), 12 patients were taking aspirin, 11 patients were taking clopidogrel or ticlopidine, and 1 patient was on glycoprotein IIb/IIIa antagonist therapy (abciximab) (Table I).

A new groin bruit was the main clinical feature suggesting pseudoaneurysm while groin pain, a pulsating groin mass and an enlarging groin hematoma were less frequent. In 13 patients, the pseudoaneurysm was clinically suspected within 24 hours of cardiac catheterization, while in 2 patients symptoms manifested 5 days after cardiac catheterization (new increasing groin pain during evacuation) (Table I).

Hypertension was the main coronary artery disease risk factor in patients who developed a pseudoaneurysm, followed by overweight and high blood lipid levels (Table I). Only 2 patients had well defined peripheral artery disease.

The mean size of the pseudoaneurysm was 45 × 27 × 24 mm; the largest pseudoaneurysm measured 80 × 50 × 30 mm (Table I).

Thirteen pseudoaneurysms (87%) were successfully treated by means of UGCR and targeted groin bandaging (Table II): 11 (73%) were closed at the end of the compression cycles, while 2, still partially open after 50 min of compression, closed after 16 hours of bandage compression. Two pseudoaneurysms (one occurring in a patient whose cardiac catheterization was complicated by ventricular fibrillation and stent thrombosis and the other in a patient on oral anticoagulant therapy switched to low molecular weight heparin some days before cardiac catheterization) were not amenable to treatment by UGCR: these were treated by percutaneous therapy and surgical repair respectively.

Only 2 patients required sedative medication during the procedure; the mean compression time was 27 min; the procedures were performed without complications.

Seven patients underwent ultrasound evaluation 1 month after the procedure: no signs of the previous lesion were detectable in 4 patients and a small hematoma was still present in 3 patients; in all cases, the femoral arterial and venous flows were found to be normal at color Doppler.

Table II. Results.

No. diagnosed pseudoaneurysms	15
UGCR success (%)	13 (87%)
Mean compression time (min)	27
Success after 50 min compression	11 (73%)
Need for surgery or percutaneous repair	2 (13%)
Complications	0

UGCR = ultrasound-guided compression repair.

Table I. Clinical features.

No. patients	15
Sex (M/F)	7/8
Age (years)	62.8 ± 11 (range 35-79)
Pseudoaneurysm origin	9 CFA, 6 SFA
Mean pseudoaneurysm size (mm)	45 × 27 × 24
Maximum pseudoaneurysm size (mm)	80 × 50 × 30
Pseudoaneurysms diagnosed after a first cardiac catheterization	12 (5 after coronary angiography alone, 7 after coronary angiography and PTCA)
Pseudoaneurysm diagnosed after repeated cardiac catheterization	3 patients (all underwent planned PTCA)
Time from cardiac catheterization to the clinical suspicion of pseudoaneurysm	24 hours in 13 patients 5 days in 2 patients
Low molecular weight heparin therapy	12 patients
Aspirin therapy	12 patients
Ticlopidine or clopidogrel therapy	11 patients
Glycoprotein IIb/IIIa antagonist therapy	1 patient
Clinical features suggesting pseudoaneurysm	
Groin pain	5 patients (33%)
New groin bruit	14 patients (93%)
Pulsating groin mass	5 patients (33%)
Enlarging groin hematoma	6 patients (40%)
Coronary artery disease risk factor	
Diabetes mellitus	5 patients (33%)
Hypertension	14 patients (93%)
Smoking	3 patients (20%)
Overweight	8 patients (53%)
Hyperlipidemia	6 patients (40%)

CFA = common femoral artery; PTCA = percutaneous transluminal coronary angioplasty; SFA = superficial femoral artery.

Discussion

Femoral pseudoaneurysms represent an infrequent but possible complication after cardiac catheterization performed both for diagnostic[1] and interventional[2] purposes.

Risk factors include older age, low femoral arterial puncture, a large arterial sheath size, the use of anticoagulation therapy, fibrinolytic therapy[9] and probably the use of glycoprotein IIb/IIIa antagonists.

Pseudoaneurysm UGCR, since the first reports[3,10], has been considered as a valid alternative to surgical repair. The mechanism of pseudoaneurysm closure by ultrasound-guided compression follows the basic Virchow thrombosis principles: the compression on the tract connecting the arterial lumen to the pseudoaneurysm results in stasis within the cavity itself and, if sufficiently prolonged, induces therapeutic thrombosis. The resulting hematoma may take days to many weeks to resolve[10].

In our experience of 15 patients with a post-cardiac catheterization pseudoaneurysm, UGCR procedure was successful in 87% of cases, even in patients on subcutaneous anticoagulants; the compression time, though not short, was well tolerated by the patients. No local or systemic complications were observed.

Despite the higher success rates and the shorter procedure times reported for percutaneous pseudoaneurysm repair[4] and for ultrasound-guided direct thrombin injection[7], these techniques are invasive, more expensive, with a small but relevant risk of infection, and are not easily available in the rehabilitation setting; the delayed recovery and the consequent prolonged hospitalization are the additional drawbacks of surgical repair.

In conclusion, we believe that UGCR still constitutes the first-line therapeutic approach for femoral pseudoaneurysms since (when performed by skilled operators) it is cost-effective, sufficiently safe, well tolerated and easily available.

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