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## The Efficacy of Ultrasound-guided Compression of Iatrogenic Femoral Pseudo-aneurysms

P. Lange, T. Houe and U. J. V. Helgstrand\*

Department of Vascular Surgery, Rigshospitalet, Copenhagen, Denmark

**Objective:** to evaluate ultrasound guided compression (UGC) for the treatment of iatrogenic femoral pseudoaneurysms (PA).

**Design:** retrospective follow-up of 130 patients with suspected PA referred from the cardiac catheterisation laboratory over a 36-month period.

**Results:** the overall incidence of PA was 0.5% and was significantly higher after therapeutic (1.5%) than diagnostic (0.3%) procedures ( $p < 0.000001$ ). Forty-eight patients with a PA were treated with UGC with an 88% success rate. Success did not appear to be related to PA diameter.

**Conclusion:** the efficacy of UGC as treatment of PAs is confirmed.

**Key Words:** Pseudo-aneurysm; Doppler ultrasound compression.

### Introduction

The incidence of iatrogenic femoral pseudo-aneurysm (PA) varies from 0.1–0.7% after diagnostic to 3.2% after interventional procedures.<sup>4,10</sup> For almost a decade<sup>1–3</sup> ultrasound-guided compression (UGC) has been used to treat this complication and many authors have described their experience.<sup>4–19</sup> Our first reported response with UGC dates back to 1995, at which time compression was successful in nine out of the 10 patients treated.<sup>20</sup> More recently, PA has been treated by means of thrombin injection.<sup>21–27</sup> The aim of this study is to denote our experience with UGC.

### Materials and Methods

A retrospective review of patients referred with a suspected PA between 1996 to 1998 was carried out. All cardiac catheterisations had been done through the right femoral artery (6F diagnostic, 8F angioplasty) and all patients had received heparin ((4000–10 000 IU). In addition, three received warfarin and nine acetylsalicylic acid (in two cases of CAG a 5 French catheter and in one case the diameter was 4 French). Diagnosis

and compression was achieved using a duplex ultrasound. Compression was applied for three periods of 10 min, and the result of compression was evaluated after each period. When no flow could be visualised in the cavity of the PA the patient was returned to the ward. The following day the compressed artery was scanned again to verify thrombosis. If not, compression was done again. When 3 consecutive days of UGC treatment had proved ineffective the patient was operated on. Chi-squared test and Chi-squared test for trend was used for statistical analysis.

### Results

One hundred and thirty patients were referred with suspected PA after diagnostic ( $n = 7813$ ) or interventional ( $n = 1823$ ) cardiac catheterisations. Forty-eight had a duplex confirmed PA (20 angiography, 14 angioplasty, 14 stent placement). The overall incidence of PA was therefore 0.5% (angiography [0.3%] vs intervention [1.5%],  $p < 0.000001$ ). The mean (range) PA diameter was 30 (10–70) mm. UGC was successful in 88% cases (18/20, 90%, angiography; 24/28, 86%, intervention). UGC was more successful with increasing experience (Table 1).

In all patients who received warfarin ( $n = 3$ ) and acetylsalicylic acid ( $n = 9$ ) UGC was successful. In five patients UGC failed after three consecutive 10 min

\* Please address all correspondence to: U. J. V. Helgstrand, Department of Vascular Surgery RK, Rigshospitalet 3111, DK 2100 Copenhagen Ø, Denmark.

**Table 1. Total numbers of compressions and the numbers of successful compressions during each of three consecutive 12 month periods from 1996 to 1998. The tendency towards increasing efficacy of UGC was not significant.**

	0–12 months (1996)	13–24 months (1997)	25–36 months (1998)
<i>n</i> = No. of compressions in period	<i>n</i> = 13	<i>n</i> = 16	<i>n</i> = 19
<i>n</i> = No. of successful compressions in period	<i>n</i> = 10	<i>n</i> = 13	<i>n</i> = 19
Successful compressions (%)	77%	81%	100%

(*p* = 0.07). (Chi-squared test for trend).

periods of compression, and in one case compression was not attempted because of the presence of an arteriovenous fistula. These six patients were operated on. Operated PAs were not significantly larger than those treated successfully with UGC. No peripheral thrombo-embolic complications were recorded. One patient died after surgical treatment of PA.

### Discussion

The incidence of PA varies, and probably lies somewhere in the vicinity of 0.2 % after simple angiography and 2.3–3.2% following intervention.<sup>4</sup>

Larger sheath size, procedure duration, the use of heparin, warfarin and aspirin and inadequate compression are important risk factors for PA.

Success rates for UGC vary from 68% to 95%.<sup>4–19</sup> Several authors have found PA size and anticoagulation to be associated with failure of UGC,<sup>4,6,7,9,14,17</sup> but we have not been able to confirm this.

Our own overall success rate of 88% was achieved after a maximum of 30 min of compression Day 1 or Day 2 after cardiac catheterisation. This is in accordance with reports by Agrawal *et al.* and Cox *et al.*, in which occlusion of PAs was noted after an average of 30 and 33 min of compression, respectively.<sup>3,19</sup> Cox and others<sup>4</sup> have also stated that the “age” of PA correlates negatively with the success of UGC. As UGC, in our investigation, was attempted only hours to a few (1–2) days after catheterisation, we have no experience in using UGC in older aneurysms. In addition it has been stated by Schaub *et al.*<sup>9</sup> that if UGC fails, a conservative solution can be chosen in the majority of cases. Over a period of 180 days (median 40 days), 50 cases out of 54 “stable” PA lesions thrombosed spontaneously. They concluded that operation should be reserved for progressive and complicated cases of PA.

Unfortunately, so far it seems difficult to predict the likelihood of spontaneous PA closure on the basis of colour Doppler sonographic characteristics<sup>29</sup> except for certain obvious patho-anatomical features, like arteriovenous fistulas, multilobulated PAs or rupture.<sup>30</sup>

We have no consistent long-term follow-up data in our material, but Kumins *et al.* found no recurrences of PA at late scanings performed after a mean of 264 days,<sup>7</sup> which further confirms the efficacy of UGC. Interestingly, this group found associated arteriovenous fistulas AVF to be the main predictor of early compression failure. The presence of femoral AVF after cardiac catheterisations poses a special but limited problem. In our study we found one PA with an AVF, and in that particular case UGC was not attempted. Schaub *et al.*<sup>28</sup> has described the successful compression of three out of nine AVFs, whilst Krumme *et al.* only succeeded in one out of five such cases.<sup>15</sup> The latter concludes that AVFs should be repaired surgically.

From literature peripheral thrombo-embolic complications to UGC seems to be rare.<sup>12,14</sup> We also found no peripheral thrombo-embolic events after UGC in our study.

Although UGC seems to be effective, thrombin injection may be even more promising with success rates of 94–100% in relatively large series.<sup>21–23</sup> In three non-randomised studies UGC (60–74%<sup>22,24,25</sup>) was inferior to thrombin (94–96%).

Thrombin may cause less pain and discomfort in the patients compared to UGC.<sup>21,24–27</sup>

### References

- 1 FELLMETH BD, ROBERTS AC, BOOKSTEIN JJ *et al.* Postangiographic femoral artery injuries: nonsurgical repair with US-guided compression. *Radiology* 1991; **178**: 671–675.
- 2 FELD R, PATTON GM, CARABASI RA *et al.* Treatment of iatrogenic femoral artery injuries with ultrasound guided compression. *J Vasc Surg* 1992; **16**: 832–840.
- 3 AGRAWAL SK, PINHEIRO L, ROUBIN GS *et al.* Non-surgical closure of femoral pseudoaneurysms complicating cardiac catheterization and percutaneous transluminal coronary angioplasty. *J Am Coll Cardiol* 1992; **20**: 610–615.
- 4 CHATTERJEE T, DO DD, KAUFMAN U, MAHLER F, MEIER B. Ultrasound-guided compression repair for treatment of femoral artery pseudoaneurysms: acute and follow-up results. *Cathet Cardiovasc Diagn* 1996; **38**: 335–340.
- 5 CHATTERJEE T, DO DD, MAHLER F, MEIER B. A prospective, randomised evaluation of non-surgical closure of femoral pseudoaneurysm by compression device with or without ultrasound guidance. *Cathet Cardiovasc Interv* 1999; **47**: 304–309.
- 6 EISENBERG L, PAULSON EK, KLIEWER MA *et al.* Sonographically guided compression repair of pseudoaneurysms: further experience from a single institution. *AJR Am J Roentgenol* 1999; **173**: 1567–1573.

- 7 KUMINS NH, LANDAU DS, MONTALVO J *et al.* Expanded indications for the treatment of postcatheterization femoral pseudoaneurysms with ultrasound guided compression. *Am J Surg* 1998; **176**: 131–136.
- 8 CHUA TP, HOWLING SJ, WRIGHT C, FOX KM. Ultrasound guided compression of femoral pseudoaneurysm: an audit of practice. *Int J Cardiol* 1998; **63**: 245–250.
- 9 SCHAUB F, THEISS W, BUSCH R *et al.* Management of 219 consecutive cases of postcatheterization pseudoaneurysm. *J Am Coll Cardiol* 1997; **30**: 670–675.
- 10 RATH J, MARX R, GANSCHOW US *et al.* Formation, therapy and prevention of false aneurysm of the femoral artery following diagnostic and interventional heart catheterization. (Article in German). *Dtsch Med Wochenschr* 1997; **122** : 771–777.
- 11 WEATHERFORD DA, TAYLOR SM, LANGAN EM, COFFEY CB, ALFIERI MA. Ultrasound-guided compression for the treatment of iatrogenic femoral pseudoaneurysms. *South Med J* 1997; **90**: 223–226.
- 12 HOOD DB, MATTOS MA, DOUGLAS MG *et al.* Determinants of success of color-flow duplex-guided compression repair of femoral pseudoaneurysms. *Surgery* 1996; **120**: 585–588; discussion 588–590.
- 13 LANGELLA RL, SCHNEIDER JR, GOLAN JF. Color duplex-guided compression therapy for postcatheterization pseudoaneurysms in a community hospital. *Ann Vasc Surg* 1996; **10**: 27–35.
- 14 HAJARIZADEH H, LAROSA CR, CARDULLO P, ROHRER MJ, CUTLER BS. Ultrasound-guided compression of iatrogenic femoral pseudoaneurysm: failure, recurrence, and long-term results. *J Vasc Surg* 1995; **22**: 425–430; discussion 430–433.
- 15 KRUMME B, LEHNERT T, WOLLSCHLAGER H, KELLER E. Possibilities and limitations of color duplex guided compression therapy of puncture-induced blood vessel lesions in the groin. (Article in German). *Rofo Fortschr Geb Rontgenstr Neuen Bildgeb Verfahr* 1995; **163**: 158–162.
- 16 SEITZ C, KADDATZ J, KESTER M, KOBER G. Color Doppler-guided compression of pseudoaneurysms after arterial puncture. (Article in German). *Dtsch Med Wochenschr* 1995; **120**: 205–208.
- 17 COLEY BD, ROBERTS AC, FELLMETH BD *et al.* Postangiographic femoral artery pseudoaneurysms: further experience with US-guided compression repair. *Radiology* 1995; **194**: 307–311.
- 18 MOOTE DJ, HILBORN MD, HARRIS KA *et al.* Postangiographic femoral pseudoaneurysms: treatment with ultrasound-guided compression. *Ann Vasc Surg* 1994; **8**: 325–331.
- 19 COX GS, YOUNG JR, GRAY BR, GRUBB MW, HERTZER NR. Ultrasound-guided compression repair of postcatheterization pseudoaneurysms: results of treatment in one hundred cases. *J Vasc Surg* 1994; **19**: 683–686.
- 20 SILLESEN HH, NIELSEN TG, VOGT KC. Pseudoaneurysm of the femoral artery treated with color Doppler ultrasonography-guided compression. (Article in Danish). *Ugeskr Laeger* 1995; **157**: 5101–5103.
- 21 LA PERNA L, OLIN JW, GOINES D, CHILDS MB, OURIEL K. Ultrasound-guided thrombin injection for the treatment of post-catheterization pseudoaneurysms. *Cirkulation* 2000; **102**: 2391–2395.
- 22 PEZULLO JA, DUPUY DE, CRONAN JJ. Percutaneous injection of thrombin for the treatment of pseudoaneurysms after catheterization: an alternative to sonographically guided compression. *Am J Roentgenol* 2000; **175**: 1035–1040.
- 23 LENNOX AF, DELIS KT, SZENDRO G *et al.* Duplex-guided thrombin injection for iatrogenic femoral artery pseudoaneurysm is effective even in anti coagulated patients. *Br J Surg* 2000; **87**: 796–801.
- 24 PAULSON EK, SHEAFOR DH, KLIEWER MA *et al.* Treatment of iatrogenic femoral arterial pseudoaneurysms: comparison of US-guided thrombin injection with compression repair. *Radiology* 2000; **215**: 403–408.
- 25 TAYLOR BS, RHEE RY, MULUK S *et al.* Thrombin injection versus compression of femoral artery pseudoaneurysms. *J Vasc Surg* 1999; **30**: 1052–1059.
- 26 BROPHY DP, SHEIMAN RG, AMATULLE P, AKBARI CM. Iatrogenic femoral pseudoaneurysms: thrombin injection after failed US-guided compression. *Radiology* 2000; **214**: 278–282.
- 27 FELD RS. Stop compressing, start injecting. *Am J Roentgenol* 2000; **174**: 1788–1789.
- 28 SCHAUB F, THEISS W, HEINZ M, ZAGEL M, SCHOMIG A. New aspects in ultrasound-guided compression repair of post-catheterization femoral artery injuries. *Circulation* 1994; **90**: 1861–1865.
- 29 PAULSON EK, HERTZBERG BS, PAINE SS, CARROLL BA. Femoral artery pseudoaneurysms: value of color Doppler sonography in predicting which ones will thrombose without treatment. *AJR Am J Roentgenol* 1992; **159**: 1077–1081.
- 30 PAULSON EK, KLIEWER MA, HERTZBERG BS *et al.* Color Doppler sonography of groin complications following femoral artery catheterization. *AJR Am J Roentgenol* 1995; **165**: 439–444.

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