The Treatment of Iatrogenic Femoral Artery Pseudoaneurysms Seen After Coronary Angiography with Ultrasonography Guided-Mechanic Compression

Koroner Anjiyografi Sonrası Görülen İatrojenik Femoral Arter Anevrizmasının Ultrasonografi Eşliğinde Mekanik Kompresyon ile Tedavi Edilmesi

Mert DUMANTEPE, MD,[a]
Koray AK, MD,[b]
Yücesin ARSLAN, MD,[a]
Ufuk MUNGAN, MD,[a]
İlhan YURDAKUL, MD[a]

[a]Cardiovascular Surgery Clinic, Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Research and Training Hospital, [b]Department of Cardiovascular Surgery, Marmara University Faculty of Medicine, Istanbul

Geliş Tarihi/*Received:* 10.10.2008
Kabul Tarihi/*Accepted:* 16.03.2009

Yazışma Adresi/*Correspondence:*
Mert DUMANTEPE, MD
Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Research and Training Hospital, Cardiovascular Surgery Clinic, İstanbul, TÜRKİYE/TURKEY
mdumantepe@gmail.com

ABSTRACT Objective: Femoral artery pseudoaneurysm (FAP) is a significant complication in patients undergoing diagnostic or therapeutic catheterization. Doppler ultrasonography (USG) guided mechanical compression is an alternative method for the treatment of iatrogenic FAP. In this paper, we aimed to present our initial experience in the treatment of iatrogenic FAP with using USG guided mechanical compression method. **Material and Methods:** In this research, we analyzed a cohort of 13 consecutive patients with iatrogenic FAP treated with USG guided mechanical compression. The present study included 5 men and 8 women who were between 53 to 67 years old (mean age, 62 ± 8 years). Nine patients revealed a right sided and 4 revealed left sided FAP. The mean size of FAP was 4.3 ± 1.1 cm (3.5-5.7 cm). Patients were followed up for recurrence 7 days and 30 days after procedure. In the end of the following period the patients were still uneventful. **Results:** Our mean compression time was 45 ± 5.3 minutes .The immediate success rate in this research was 92.3% (12 of the 13 patients). Compression time was exceeded to 63 minutes in one patient and it was terminated due to the fatigue and discomfort of the patient. Early and late successful rates were the same. There was no significant complication in this patient collective. **Conclusions:** Our study shows that USG guided compression has been shown to be safe, easy to perform and cost effective approach for the treatment of femoral artery pseudoaneurysms.

Key Words: Femoral artery; aneurysm, false; ultrasonography, doppler; coronary angiography

ÖZET Amaç: Femoral arter psödoanevrizması (FAP) tanısal ve tedavi amaçlı kateterizasyon yapılan hastalarda gelişebilen önemli bir komplikasyondur. Doppler ultrasonografi (USG) probu ile mekanik kompresyon iatrojenik FAP tedavisi için alternatif bir tedavi yöntemidir. Bu çalışmada, iatrojenik FAP olgularında USG probu ile mekanik kompresyon tedavisi deneyimimizi sunmayı amaçladık. **Gereç ve Yöntemler:** Bu çalışmada, iatrojenik FAP gelişen ve USG probu ile mekanik kompresyon yöntemiyle tedavi edilen 13 hastadan oluşan bir grubu inceledik. Yapılan çalışma 53 ile 67 yaşları arasında (ortalama 62 ± 8), 5 erkek 8 kadın olguyu içermektedir. Hastalarda FAP'larının 4 ü sağ tarafta görülürken, 9'u sol taraftaydı. FAP'ın ortalama büyüklüğü 4.3 ± 1.1 cm idi (3.5-5.7). Hastalar rekürrens açısından tedavi sonrası 7. ve 30. günlerde kontrol edildi. İzlem süresi sonunda hastalar komplikasyonsuzdu. **Bulgular:** Ortalama kompresyon zamanımız 45 ± 5.3 dakika idi. Çalışmadaki erken başarı oranı %92.3 (13 hastanın 12'si) idi. Kompresyon süresi bir hastada 63 dakikayı geçti, hastanın yorgunluk ve huzursuzluk görülmesine bağlı olarak sonlandırıldı. Erken ve geç dönem başarı oranlarının aynı olduğu görüldü. Bu hasta grubu içerisinde işlem sırasında herhangi bir ciddi komplikasyon ile karşılaşılmadı. **Sonuç:** Çalışmamız, iatrojenik FAP olgularının tedavisinde kullanılan USG eşliğinde mekanik kompresyon yönteminin güvenli, uygulaması kolay ve düşük maaliyetli bir tedavi yöntemi olduğunu göstermiştir.

Anahtar Kelimeler: Femoral arter; psödoanevrizma; doppler ultrasonografi; koroner anjiyografi

Turkiye Klinikleri J Cardiovasc Sci 2009;21(2):216-20

Femoral artery pseudoaneurysms (FAP) may appear as a complication of arterial catheterization and currently become more common with the introduction of larger arterial introducer sheaths, aggressive anticoagulation protocols, and more complex percutaneous interventions.[1-3] Incidence of iatrogenic FAP in patients undergoing coronary angiography has been reported to be as high as 6%.[4] Surgical repair has been traditionally adopted to be the first choice in the management of these patients. However, several complications like infection, lymphorrea, bleeding are reported to occur in a considerable number of patients after surgery and, thereby, surgery may unfavorably alter postoperative outcome[5]. Therapeutic options have evolved from the traditional surgical options toward less invasive approaches such as ultrasonography (USG)-guided mechanical compression, percutaneous thrombin injection or endovascular management (embolization and stentgraft placement). In this paper, we aimed to present our initial experience in the treatment of iatrogenic FAP with the use of US-guided mechanical compression method.

MATERIAL AND METHODS

We analyzed a cohort of 13 consecutive patients with iatrogenic FAP who were treated with USG guided mechanical compression from January 2006 to December 2007. Patients' characteristics were given in Table 1. Patients who had clinical evidence of a puncture site complication, such as a new thrill or bruit, pulsatile hematoma, or marked pain or tenderness after coronary angiography were referred for color doppler USG assessment of the puncture site. Those patients who had a diagnosis of FAP were initially considered for USG-guided compression method. Educational Planning Board of our hospital approved the study. A written informed consent was obtained from all the patients who accepted to participate to the study and agreed the treatments. All sonographic examinations and mechanical compressions were performed with using a high-frequency (8 MHz) linear array transducer (Toshiba Xario Version V, HDI 5000 Scanner). Technically the transducer was positioned to show neck of the pseudoaneurysm (Figure 1a). Mechanical compression, increasing in intensity with time, to the region of the neck was applied until it was obliterated (Figure 1b). When the colour signal from the artery into the false aneurysm cavity ceased, the pressure of the compression reached to a plateau level that was sustained until the end of the procedure. Femoral artery flow distal to the compression was monitored during the procedure. After 25 minutes of compression, the probe was released to check the flow within the FAP in all cases. When the pseudoaneurysm sac was not obliterated completely, manual pressure was applied for a further period of 5-10 minutes. A progressive increase in the amount of thrombus within the sac of FAP was shown in Figure 1c. Compression continued until the pseudoaneurysm was completely thrombosed (Figure 1d). A nurse monitored vital signs and oxygen saturation continuously throughout the procedure.

The immediate early and late outcomes were recorded. Immediately definition, early and late outcome was made when the sac of the aneurysm was completely obliterated immediately after the first attempt, 7 days and 30 days after procedure, respectively. After successful thrombosis, patients were kept supine for 6 hours with the affected leg slightly elevated. All cases were discharged on the day of procedure. Patients were followed up for recurrence 7 days and 30 days after procedure.

TABLE 1: Characteristics of patient.

Age (year)	62 ± 8
Gender (male/female)	5/8
BMI (kg/m^2)	25 ± 2.2
Systolic BP (mmHg)	136 ± 14
Localization (right/left)	9/4
Catheterization type	
Cardiac catheterization and percutaneus coronary intervention	7
Peripheral angiography and intervention	4
Other (aortic stent greft, IABP)	2

FAP: Femoral arter pseudoaneurysm, BP: Blood pressure, BMI: Body mass index, IABP: Intra-aortic balloon pump.

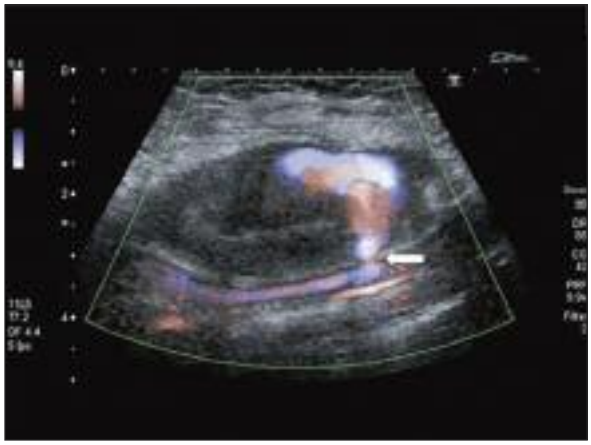

FIGURE 1a: Color doppler sonogram shows typical Swirling pattern of flow within pseudoaneurysm (54.8 x 24.7 mm in diameter). Arrow indicates the neck of pseudoaneurysm.

FIGURE 1b: After application of suprasystolic pressure to the neck of pseudoaneurysm and cessation of flow into pseudoaneurysm.

FIGURE 1c: During maintaining pressure on neck, the pseudoaneurysm sac is started to fill up with progresively increasing thrombus as arrow indicates.

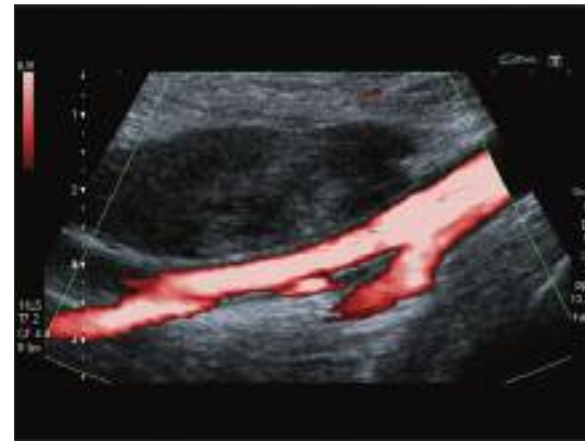

FIGURE 1d: After removal of compression, no residual flow detected in pseudoaneurysm or along neck.

RESULTS

The present study included 5 men and 8 women who were between 53 to 67 years old (mean age, 62 ± 8 years). Nine patients revealed a right sided and 4 revealed left sided FAP. The mean size of FAP was 4.3 ± 1.1 cm (3.5-5.7 cm). We had a mean compression time of 45 ± 5.3 minutes. The successful immediate outcome was achieved in all patients except for one patient in whom surgical repair was performed. The procedure was prolonged up to 63 minutes in one patient and it was terminated due to the fatigue and discomfort of the patient. The immediate successful rate was 92.3% (12 of the 13 patients). Pseudoaneurysm characteristics were given in Table 2.

All of the pseudoaneurysms were on superficial femoral artery in patient's group. One patient experienced hypotension (75/40 mmHg) related to vasovagal reaction during the procedure and it was responded to intravenous fluid resuscitation. Otherwise, there was no important complication in this patient. Control doppler USG revealed complete obliteration in the neck of FAP and thrombosis of the pesudoaenurysm sac (early and late

TABLE 2: Characteristics of pseudoaeurysm.

Characteristics	Succes (n=12)	Failure (n= 1)
Pseudoaneurysm		
Size (cm)	4.3 ± 1.1	5.8
Length of neck (cm)	1.2 ± 0.9	1.3
Width of neck (mm)	3.3 ± 1.5	3.4
Duration of compression time (min)	45 ± 5.3	63
Sheath size (French)	7.3 ± 1.1	7.0
Anticoagulation status		
None	7	-
Heparin	1	2
Warfarin	-	1

FAP: Femoral arter pseudoaneurysm.

success rate were 92.3%) after one week and one month.

DISCUSSION

Arterial pseudoaneurysms carry high risks of morbidity and mortality rates and, unfortunately, the development of lethal complications like rupture and massive bleeding is unpredictable. Thromboembolism, extrinsic compression of nearby neurovascular structures and necrosis of overlying skin and subcutaneous tissue have been all associated with postcatheterization pseudoaneurysms. Although it is still controversial in asymptomatic cases, symptomatic pseudoaneurysms should be treated immediately.[6] Some investigators have advocated observation for asymptomatic patients not on anticoagulation therapy with a pseudoaneurysm less than 3.5 cm in diameter.[7]

Surgery is a conventional and gold standard treatment of choice in these patients. However, it is associated with several complications including anesthesia-related risks (in patients having general anesthesia), bleeding, wound infection and lymphocele formation.[8] Lumsden et al, demonstrated that postoperative complication rate was seen as high as 21% and mortality rate was 2.1% in patients undergoing surgical repair of FAP.[9] Moreover, patients with groin hematoma had higher risks of poor wound healing of the surgical site, leading to prolonged hospitalization and delayed ambulation. San Roberto Garcia and colleagues analyzed the postoperative complications of patients who had undergone surgical repair of femoral pseudoaneurysm after cardiac catheterization. Infection and dehiscence of the surgical wound were the other two most common complications. The mortality observed in their study reached 3.8% of the patients. The mean hospital stay was 32.5 days. They reported that patients who undergo surgical treatment of femoral pseudoaneurysm post-cardiac catheterization experienced a high postoperative morbidity and hospital stay.[10] The morbidities were published in prior studies range from 7.4 to 31.7%.[11-13] This large disparity was explained by the lack of unanimity in criteria for the registration of any complications.

Liau and colleagues described the ultrasound guided percutaneous injection of thrombin into the FAP in 1997.[14] Patient selection and technical aspects of this technique have been still evolving and safety data, particularly after coronary intervention, remains limited. Careful attention to patient selection and thrombin injection technique is necessary to prevent complications. Most centres avoid this technique in patients with severe peripheral vascular disease or with previous exposure to thrombin products, which may predispose to immune reactions. Cavity size and neck length should be assessed by USG examination before thrombin injection. Care should be taken with small pseudoaneurysms (< 15 mm in diameter) to prevent relatively large volumes of thrombin being injected too quickly, thus spilling into the artery and causing luminal thrombus formation.[15]

Since firstly been described by Fellmeth et al, in 1991, non-invasive treatment of FAP via USG-guided compression has substantially replaced surgery in the management of these patients.[16] With introduction of this new treatment modality into clinical practice, morbidity and mortality rates of the disease have been decreased dramatically when compared to conventional surgical repair. USG guided compression seems to be a useful, well tolerated, easy to perform on outpatient settings and highly cost effective. In our cohort, one patient experienced vasovagal reaction as a complication of the procedure. Rare complications of USG-guided

mechanical compression such as venous thrombosis, skin necrosis, and pseudoaneurysmal rupture have been reported.[6]

The immediate failure rate of this technique has been reported to be as high as 15-38% in patients who have received anticoagulants; therefore, anticoagulants should be discontinued prior to the procedure.[17] Other factors affecting the success of this method were pseudoaneurysm size, whether the pseudoaneurysm is simple or complex, age of the pseudoaneurysm.[1,16] In our patients, anticoagulant therapy was discontinued before procedure in all cases and the only obvious risk for immediate failure was the size of the aneurysm sac. Our study showed an inverse relationship between pseudoaneurysm size and likelihood of success: smaller lesions were easier to treat. This result is intuitively appealing considering that the flow through smaller pseudoaneurysms tends to be less than the flow through larger pseudoaneurysms, and is therefore easier to completely arrest.

CONCLUSIONS

In our study patients referred for a FAP often carrying high comorbid conditions (suspected coronary or peripheral arterial disease). With this regard preference of non-invasive methods in such a patient population seems to be more crucial to improve the outcome and the quality of life. We believe that USG-guided compression may be regarded as an alternative method in the treatment of these patients. However data questioning the benefit of this method in the long-term should be clarified.

REFERENCES

1. 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(4):425-30.
2. Okcun B, Gurmen T. [Complications and the management strategies of coronary angiography]. Turkiye Klinikleri J Int Med Sci 2007; 3(42): 48-72.
3. Ercan E, Tengiz I, Akilli A, Nalbantgil I. [Vascular access routes and their complications.] T Klin J Cardiol 2003;16(5): 419-24.
4. Chatterjee T, Do DD, Mahler F, Meier B. Pseudoaneurysm of femoral artery after catheterisation: treatment by a mechanical compression device guided by colour Doppler ultrasound. Heart 1998;79(5):502-4.
5. Saad NE, Saad WE, Davies MG, Waldman DL, Fultz PJ, Rubens DJ. Pseudoaneurysms and the role of minimally invasive techniques in their management. Radiographics 2005;25 Suppl 1:S173-89.
6. La Perna L, Olin JW, Goines D, Childs MB, Ouriel K. Ultrasound-guided thrombin injection for the treatment of postcatheterization pseudoaneurysms. Circulation 2000;102(19):2391-5.
7. Toursarkissian B, Allen BT, Petrinec D, Thompson RW, Rubin BG, Reilly JM, et al. Spontaneous closure of selected iatrogenic pseudoaneurysms and arteriovenous fistulae. J Vasc Surg 1997;25(5):803-9.
8. Ricci MA, Trevisani GT, Pilcher DB. Vascular complications of cardiac catheterization. Am J Surg 1994;167(4):375-8.
9. Lumsden AB, Miller JM, Kosinski AS, Allen RC, Dodson TF, Salam AA, et al. A prospective evaluation of surgically treated groin complications following percutaneous cardiac procedures. Am Surg 1994;60(2):132-7.
10. San Norberto García EM, González-Fajardo JA, Gutiérrez V, Carrera S, Vaquero C. Femoral pseudoaneurysms post-cardiac catheterization surgically treated: evolution and prognosis. Interact Cardiovasc Thorac Surg 2009;8(3):357-8.
11. Oweida SW, Roubin GS, Smith RB 3rd, Salam AA. Postcatheterization vascular complications associated with percutaneous transluminal coronary angioplasty. J Vasc Surg 1990;12(3):310-5.
12. Messina LM, Brothers TE, Wakefield TW, Zelenock GB, Lindenauer SM, Greenfield LJ, et al. Clinical characteristics and surgical management of vascular complications in patients undergoing cardiac catheterization: interventional versus diagnostic procedures. J Vasc Surg 1991;13(5):593-600.
13. Ricci MA, Trevisani GT, Pilcher DB. Vascular complications of cardiac catheterization. Am J Surg 1994;167(4):375-8.
14. Liau CS, Ho FM, Chen MF, Lee YT. Treatment of iatrogenic femoral artery pseudoaneurysm with percutaneous thrombin injection. J Vasc Surg 1997;26(1):18-23.
15. Ferguson JD, Whatling PJ, Martin V, Walton J, Banning AP. Ultrasound guided percutaneous thrombin injection of iatrogenic femoral artery pseudoaneurysms after coronary angiography and intervention. Heart 2001;85(4):E5
16. Fellmeth BD, Roberts AC, Bookstein JJ, Freischlag JA, Forsythe JR, Buckner NK, et al. Postangiographic femoral artery injuries: nonsurgical repair with US-guided compression. Radiology 1991;178(3):671-5.
17. Dean SM, Olin JW, Piedmonte M, Grubb M, Young JR. Ultrasound-guided compression closure of postcatheterization pseudoaneurysms during concurrent anticoagulation: a review of seventy-seven patients. J Vasc Surg 1996;23(1):28-35.