Incidence and Risk Factors of Complications following Antegrade Common Femoral Artery Access

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Abstract

Background: Bleeding and vascular complications following retrograde common femoral artery access are studied. Access site complications, their incidence, and risk factors following antegrade access remain unclear. Materials and Methods: We retrospectively analyzed 189 patients from our prospectively collected database at Jain Institute of Vascular Sciences, Bengaluru, India. All patients had antegrade femoral access and underwent femoral and popliteal artery interventions from January 2013 to December 2014. We aimed to study incidence, risk factors, length of postintervention hospital stay, and early morbidity following antegrade femoral access. Antegrade direct arterial punctures resulted in a complication rate of 14.28%, which comprised 20 ecchymosis (74.07%), 5 groin hematoma (18.51%), and 2 pseudoaneurysm (0.07%). Two patients required blood transfusion. Groin hematoma was common in females (3 vs. 2 patients) than males but had less ecchymosis (7 vs. 13 patients). Age more than 69 years, female sex, 7 Fr sheath size, direct arterial puncture by palpation, and manual compression were associated with higher incidence of complications. Complicated patients had longer hospital stay (3.52 ± 1.19 days vs 1.34 ± 0.59; range 1–7 days; $P = 0.0001$). Conclusion: Several factors predict access site-related complications following antegrade femoral access, notably gender, age, ultrasound guidance, sheath size, and closure device. Knowledge of these findings could be useful to determine strategies to reduce access site vascular and bleeding risk and improve outcomes.

Keywords: Access site complications, antegrade access, femoral access

INTRODUCTION

In recent years, there has been a substantial increase in peripheral vascular interventions for treating patients with peripheral vascular diseases.\(^1\) Recent endovascular advancement in guidewires, catheters, low-profile angioplasty balloons, and stents has improved safety and vessel patency, increasing the popularity of percutaneous interventions for peripheral artery disease over traditional open surgery.\(^2\) Since 1995, there has been a 10-fold increase in the rate of percutaneous vascular interventions and simultaneous decline in surgical interventions.\(^3\) Relative to patients with coronary artery disease, patients with peripheral vascular disease are more likely to have atherosclerosis affecting the common femoral artery (CFA).\(^4\) Complications related to retrograde femoral access are described in literature. Data specifically for antegrade access are relatively sparse. However, they are not necessarily sparse, rather just less documented than retrograde access. Antegrade access was exclusively used for diagnostic and therapeutic interventions of infrainguinal disease. An increasing number of infrainguinal interventions along with perioperative anticoagulation and antiplatelets necessitates the need to identify risk factors for complications to minimize risks. The objectives of our study are to identify incidence and risk factors of complications following antegrade CFA access.

MATERIALS AND METHODS

We analyzed 189 patients, who underwent elective vascular intervention at Jain Institute of Vascular Sciences, Bengaluru, India, from January 2013 to December 2014. All included patients were evaluated clinically and investigated preoperatively with pulse volume recordings, arterial duplex, and computed tomography/magnetic resonance angiography. Patients who...
diagnosed to have suprainguinal disease or CFA disease on preoperative evaluation and patients who underwent infrainguinal intervention from contralateral retrograde or brachial access were excluded from the study. Patients demographics recorded were age, gender, comorbidities, and investigations preoperatively; intraoperative details included operative procedure, type of access, use of ultrasonography (USG), sheath size, and procedure performed. Postoperatively, closure method (manual/closure device), access site, and systemic complications were recorded. Patients were evaluated in immediate postoperative period, within 24 h (early) and at 30 days (delayed period) for any access site complications.

Details of all patients were collected and entered into database. All patients preoperatively were on antiplatelets, preferably ecosprin. All procedures were carried out under local anesthesia and sedation; general anesthesia was rarely needed. Vascular sheaths were used in every patient after gaining access; sheath sizes ranged from 5 to 7 Fr. A modified Seldinger technique was used to cannulate the CFA after palpation directly (manual method); USG was required especially in obese patients. Postintervention arterial closure was achieved with the help of manual compression or closure device (Perclose Proglide Suture-Mediated Closure System; Abbott vascular, USA). The use of closure technique was at surgeon’s discretion. All patients received 80 IU/kg of unfractionated heparin just after insertion of sheath. Intraoperatively, activated clotting time (ACT) was targeted between 250 and 300 s. The femoral sheaths were removed immediately after interventions in patients where closure device was used. In patients who had manual compression, sheath was removed after ACT dropped below 180 s. Sheaths were removed by vascular surgery trainees in vascular interventional unit. Compression pressure is moderate enough to compress not to occlude vessel which confirmed by palpating distal pulse. No definitive rules govern how long to hold pressure for various sheath sizes, but a general guideline of 3 min per French size has been used. Manual compression was applied for 15 min or till bleeding stopped following above-mentioned principle. Manual compression patients were on bed rest till 6 h and closure device for 2 h postoperatively. Patients without any perioperative adverse events were discharged the next day. Patients were followed up for complications such as pseudoaneurysm, groin hematoma, ecchymosis, retroperitoneal hematoma, arterial thrombosis, laceration, arteriovenous (AV) fistula, arterial dissection, and need for blood transfusion at intervals mentioned above.

Statistical analysis
The Chi-square and Fisher’s exact tests were used for analysis of categorical variables when appropriate and the Student’s t-test for analysis of continuous variables. Statistical significance was defined as $P < 0.05$.

Results
Detailed demographic data for those patients included in the study are shown in Table 1. A total of 189 patients underwent antegrade femoral access for infrainguinal interventions which included femoral angioplasty/stenting and below the knee angioplasty. Of 189 patients, 148 (78%) were male (range 27–87 years with median age of 65 years) and 41 (22%) were female (range 45–87 years with median age of 66 years). Diabetes, hypertension, previous history of coronary artery disease, and chronic kidney disease were seen in 88%, 72%, 28%, and 11% of patients, respectively. Access was gained by palpation alone in 172 (91%) patients and USG was used in 17 (9%) patients. Sheath sizes varied from 5, 6, and 7 Fr. Access site closure was achieved by manual compression in 176 (93%) patients and closure device was deployed in only 13 (7%) patients.

Twenty-seven (14%) patients had access site complications [Figure 1]. The mean age for patients who had complications

![Access site complications](image)

**Table 1: Demographics of patients**

|                      | No ASCs $(n=162)$ | ASCs $(n=27)$ | $P$ value |
|----------------------|------------------|--------------|-----------|
| Age (years)          |                  |              |           |
| Mean±SD              | 65±11            | 70±10.0      | 0.02      |
| Sex, n (%)           |                  |              |           |
| Male                 | 131 (81)         | 17 (63)      | 0.04      |
| Female               | 31 (9)           | 10 (37)      |           |
| Comorbidities, n (%) |                  |              |           |
| Diabetes mellitus    | 141 (87)         | 25 (93)      | 0.53      |
| Hypertension         | 118 (73)         | 19 (70)      | 0.81      |
| Coronary artery disease | 46 (28)   | 7 (26)       | 1         |
| Chronic kidney disease | 16 (10)  | 4 (4)        | 0.49      |
| Chronic pulmonary disease | 6 (4)    | 2 (7)        | 0.32      |
| Antegrade access, n (%) |              |              |           |
| Manual               | 150 (93)         | 22 (81.50)   | 0.07      |
| Ultrasoundography     | 12 (7)           | 5 (18.50)    |           |
| Sheath size (Fr), n (%) |              |              |           |
| Five                 | 7 (4.50)         | 0            | 0.24      |
| Six                  | 78 (48)          | 10 (37)      |           |
| Seven                | 77 (47.50)       | 17 (63)      |           |
| Closure technique, n (%) |              |              |           |
| Manual compression   | 152 (94)         | 24 (89)      | 0.40      |
| Closure device (suture based) | 10 (6)  | 3 (11)       |           |
| Postintervention stay |                |              |           |
| Postintervention stay (mean±SD days) | 1±1     | 4±1          | 0.0001    |

ASC: Access site-related complication, SD: Standard deviation
was higher than without complications and was statistically significant (70 ± 10 vs. 65 ± 11 years; \(P = 0.02\)). Complications were significantly common in females (17 vs. 10; \(P = 0.04\)). Ecchymosis was most common complications and occurred in 20 patients (74%), most commonly in males (13/20). Five (18.51%) patients had groin hematoma, of them 2 required blood transfusion and all were managed conservatively and no surgical intervention was required. Females had higher incidence of groin hematoma compared to males (3 vs. 2 patients) but less ecchymosis (7 vs. 13 patients). Two patients had access site pseudoaneurysm, one underwent USG-guided thrombin injection, and one expired on 3rd postoperative day because of cardiac cause. Complications such as arterial dissection, thrombosis, laceration, AV fistula, and retroperitoneal hematoma were not seen in any of the patients till 30th postoperative day. Patients who had USG-guided access complications were less (\(P = 0.07\)) but not statistically significant; methods such as direct arterial puncture by palpation or USG guidance do not influence complications. Sheath size of more than 6 Fr was associated with higher complications although was not statistically significant (\(P = 0.24\)).

Access site complications were seen in 24/172 (13.96%) of manual compression and 3/17 (17.65%) of closure device used patients. The mean hospitalization stay was longer in complication group and ranged from 1 to 7 days (4 ± 1 vs. 1 ± 1 day; \(P = 0.0001\)).

Access site-related complications following antegrade femoral access were influenced by age and gender. Although sheath size more than 6 Fr, direct access by palpation, and manual compression increase complications, these data are too small to interpret its significance.

**DISCUSSION**

Data regarding antegrade femoral access are underreported in available literature. Access techniques had evolved from direct arterial puncture to use of USG and fluoroscopy over the years. There is also a change in techniques of access closure from manual to closure devices (suture, collagen based, etc.). In case of antegrade access, pulsations in CFA are normal; hence, direct puncture is comparatively easy in thin patients but might require USG for obese patients, especially with pendulous abdomen. Previously published literature focuses mainly on the use of closure device in antegrade access closure but very less literature is available about manual compression for access closure. Hackl et al.\(^9\) in their study showed that of 168 patients, 12 had complications including three pseudoaneurysm (1.8%) and nine hematomas (5.4%). They also reported that sheath size does not influence complications and platelet count influences it (\(P = 0.05\)). In a study of 55 patients with antegrade access (6 Fr sheath), Maxien et al.\(^7\) reported 1 (1.7%) pseudoaneurysm, 2 (3.4%) minor hematomas, and 1 (1.7%) minor secondary bleeding. Schmelter\(^8\) in their study of antegrade puncture of 93 patients found only minor vascular complications in seven cases (7.0%), with four cases of pseudoaneurysm (4.0%) and three cases of significant late bleeding (3.0%). Minko et al.\(^9\) proved that obesity is an independent risk factor for access site complication in antegrade punctures. Dariushnia et al.\(^10\) in society of intervention radiology (SIR) guidelines have reported pseudoaneurysm rate of 0.04%–0.1% and major hematoma requiring evacuation or blood transfusion of 0.5%–1.7%; in the present study, this incidence is 1% and 2.6% (only 1% required blood transfusion), respectively. In comparison with SIR guidelines, this study also included therapeutic interventions, which increases duration of the procedure. In our study, body mass index (BMI) was not available for all patients and hence not included as variable. Most of the available data had described use of closure device in antegrade access closure and these data have not been compared to manual compression. Techniques for gaining femoral access have not been compared in available literature; in our study, we tried to compare these data for access and closure device but the number of patients is less.

In our study of 189 patients, 27 had complications which included pseudoaneurysm (1.06%), groin hematoma (2.65%), and ecchymosis (10.59%) and these are comparable to other studies which included mainly closure device. One patient received reintervention in the form of thrombin injection and two received blood transfusion.

This is a single-center study and data were collected retrospectively. In a number of patients undergoing USG-guided access, use of closure device is very few. Females have higher incidence of groin hematoma, but numbers are few. Ecchymosis is most common complication. There is no general consensus about manual compression pressure and duration. Furthermore, variables such as BMI, number of punctures to get access, surgeon’s expertise, and duration of procedure and technical failure of closure device can also influence access site complications and need to be considered as variables. Larger and equally distributed population with large sample size can help answer these questions.

**CONCLUSION**

Complications following antegrade femoral access are largely influenced by age, gender, use of USG guidance, sheath size, and use of closure device. Patients with access site complication have significantly increased hospital stay and invariably increased the cost of therapy.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Wheatley BJ, Mansour MA, Grossman PM, Munir K, Cali RF, Gorsuch JM, et al. Complication rates for percutaneous lower extremity arterial antegrade access. Arch Surg 2011;146:432-5.
2. White CJ, Gray WA. Endovascular therapies for peripheral arterial disease: An evidence-based review. Circulation 2007;116:2203-15.
3. Anderson PL, Gelijns A, Moskowitz A, Arons R, Gupta L, Weinberg A, et al. Understanding trends in inpatient surgical volume: Vascular interventions, 1980-2000. J Vasc Surg 2004;39:1200-8.
4. Lo RC, Fokkema MT, Curran T, Darling J, Hamdan AD, Wyers M, et al. Routine use of ultrasound-guided access reduces access site-related complications after lower extremity percutaneous revascularization. J Vasc Surg 2015;61:405-12.
5. Turney EJ, Lyden SP. Technique: Endovascular diagnostic. In: Cronenwett JL, Johnston KW, editors. Rutherford’s Vascular Surgery. 8th ed. Philadelphia: Elsevier; 2014. p. 1381.
6. Hackl G, Gary T, Belaj K, Hafner F, Rief P, Deutschmann H, et al. Exoseal for puncture site closure after antegrade procedures in peripheral arterial disease patients. Diagn Interv Radiol 2014;20:426-31.
7. Maxien D, Behrends B, Eberhardt KM, Saam T, Thieme SF, Reiser MF, et al. Evaluation of the 6-F ExoSeal vascular closure device in antegrade femoral artery punctures. J Endovasc Ther 2012;19:836-43.
8. Schmelter C, Liebl A, Poullos N, Ruppert V, Vorwerk D. Suitability of Exoseal vascular closure device for antegrade femoral artery puncture site closure. Cardiovasc Intervent Radiol 2012;36:659-68.
9. Minko P, Katoh M, Gräber S, Buecker A. Obesity: An independent risk factor for insufficient hemostasis using the AngioSeal vascular closure device after antegrade puncture. Cardiovasc Intervent Radiol 2012;35:775-8.
10. Dariushnia SR, Gill AE, Martin LG, Saad WE, Baskin KM, Caplin DM, et al. Quality improvement guidelines for diagnostic arteriography. J Vasc Interv Radiol 2014;25:1873-81.