Comparison between antegrade common femoral artery access and superficial femoral artery access in infrainguinal endovascular interventions

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ABSTRACT

Background: Antegrade access for infrainguinal endovascular intervention can be achieved through the common femoral artery (CFA) or superficial femoral artery (SFA). A few studies with small sample sizes have shown similar efficacy and safety for antegrade puncture of the CFA and SFA. In the present study, we analyzed the feasibility of SFA access and the occurrence of complications between SFA and CFA ipsilateral access in a broader cohort.

Methods: In the present retrospective study, we analyzed data from 462 patients with peripheral arterial disease (PAD) who had undergone peripheral angioplasty from 2009 to 2016. The inclusion criteria were PAD at Rutherford stage 3 to 6 and use of an endovascular approach. Patients with coagulation disorders, those receiving anticoagulant therapy, cases with deployment of closure devices, cases with more than one access on the same limb, and patients with inadequate bed rest after the procedure were excluded. A systematic analysis of all patients' electronic medical records was performed to evaluate the demographic aspects and technical success and identify the possible complications associated with CFA and SFA access.

Results: Of the 462 patients, 290 had undergone SFA puncture and 172, CFA puncture. The demographic evaluation of both groups revealed no differences between the two groups, except that more patients with diabetes were in the CFA group and more patients with dyslipidemia and an advanced clinical presentation were in the SFA group. First puncture access was successful in 99.7% of the SFA group and 96.5% of the CFA group ($P = .01$). The hematoma rate in the SFA and CFA groups was 20.3% and 11%, respectively ($P = .01$). The incidence of major bleeding and clinically relevant nonmajor bleeding was not significantly different between the two groups ($P = .215$). Only three patients had developed a pseudoaneurysm, two of whom were in the SFA group. Female sex (odds ratio [OR], 2.572; 95% confidence interval [CI], 1.520-4.354; $P < .001$] and older age (OR, 1.034; 95% CI, 1.009-1.059; $P = .007$) were associated with an increased hematoma rate.

Conclusions: SFA access was associated with a higher overall rate of hematoma compared with CFA access. However, no significant difference was found in the incidence of major bleeding between the two access sites. Planned SFA access should be considered as an alternative to CFA access. (J Vasc Surg 2021;74:763-70.)

Keywords: Access; Angioplasty; Common femoral artery; Infrainguinal; Introducer sheath; Peripheral endovascular intervention; Superficial femoral artery

When endovascular revascularization is indicated for patients with infrainguinal peripheral arterial disease (PAD), ipsilateral or contralateral femoral arterial percutaneous vascular access is usually performed.[1] The common femoral artery (CFA) has been the most frequently used access point because of many factors. It has a suitable caliber for the usual introductory profile, the anatomic and radiologic parameters increase procedure safety, it is fixed and has a superficial path that facilitates the puncture, and compression against the femoral head is possible for hemostasis.[2,3]

Antegrade puncture of the superficial femoral artery (SFA) was first described by Berman et al[4] in 1986 using a guidewire positioned in the artery's proximal segment as a puncture parameter for access to the contralateral CFA. The first study evaluating antegrade puncture of the SFA was reported by Blais[5] in 1993 and included 25 patients. Since then, antegrade puncture of the SFA with ultrasound guidance has been used as an alternative access procedure when a high risk of using CFA puncture exists (eg, obesity, high femoral bifurcation, heavily diseased arteries, or groin scarring from previous surgery or angioplasty).[2,6-8]

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Author conflict of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

0741-5214

https://doi.org/10.1016/j.jvs.2021.02.029

During the past 10 years, based on these results, SFA access was used more frequently in routine procedures and, in particular, represented an alternative to contralateral access in patients with a hostile groin. In the present study, we have described our experience using SFA access for 10 years. We compared antegrade puncture of the SFA with that of the CFA in a large sample of 462 patients.

METHODS

The local research ethics committee approved the present retrospective, single-center study, which waived the requirement for patient written informed consent. The inclusion criteria were infrainguinal PAD disease, Rutherford classification 3 to 6, use of an endovascular approach, and access performed through the ipsilateral antegrade CFA or SFA. The exclusion criteria were the use of a vascular puncture sealing device, double access in the treated limb, failure of anticoagulant interruption before the procedure, the use of thrombolytic agents, an international normalized ratio >1.5, a platelet count <100,000/μL, inadequate external compression (<15 minutes) for hemostasis (manual), and inadequate bed rest after the procedure (<6 hours).

Two vascular surgeons performed a systematic analysis of the electronic medical records. Thus, all the procedures had been reviewed twice, and the analysis was performed in five phases. The first phase consisted of screening the infrainguinal procedures to confirm the indication and the absence of the exclusion criteria. In the second phase, the blood test results were checked before and after the procedure until discharge. In the third phase, we evaluated the medical reports, specifically the nurse and physician notes during the procedure and immediately after introducer sheath retrieval. In the fourth phase, we analyzed the daily notes from the physicians and nurses until discharge. The regular medical prescriptions, blood transfusion records, and duplex ultrasound scan records were also systematically reviewed in the fourth phase. Finally, in the fifth phase, we analyzed the data from the first medical outpatient visit. Most patients (n = 404) were followed up at our outpatient clinic after discharge. Of these patients, 90.6% had returned within 30 days and 9.4% after 30 days (mean, 19 ± 20 days). We also examined the bleeding history and the physical examination findings.

As a part of the hospital protocol, all the patients received 200 mg of acetylsalicylic acid (ASA) and a clopidogrel loading dose of 300 mg 1 hour before the procedure. After the procedure, the patients received dual antiplatelet therapy (200 mg of ASA and 75 mg of clopidogrel daily for 3 months and, subsequently, 200 mg of ASA continuously).

Procedure technique. All the procedures were performed in an endovascular suite. The surgeon chose the preferred puncture site. Using the Seldinger technique, both punctures were performed using a 19-guage needle and a femoral kit of 11-cm introducer sheaths. Small sheath profiles were preferred, especially for antegrade puncture of the SFA. However, if necessary, the surgeon switched to a larger sheath. The anatomic parameters, fluoroscopic findings, and pulsation guided the antegrade CFA punctures. At the discretion of the vascular surgeon in charge, a duplex ultrasound scan for vessel puncture was used in selected cases. SFA antegrade puncture was performed in the proximal thigh segment, usually under the inguinal crease, guided by duplex ultrasound scans and parietal calcifications observed using fluoroscopy. From 2012 onward, ultrasound guidance was used for all SFA punctures. The short-axis out-of-plane technique was used for duplex ultrasound-guided punctures. The largest size of the introducer sheath used was considered for analysis. After confirmation of the adequate position of the introducer sheath, most of the patients had received a heparin solution (100-150 UI/kg of unfractionated heparin) via venous access infusion.[11]

After the procedure, the patients remained in the recovery room after access retrieval for ≥1 hour before returning to the room. The introducer sheath was removed 60 to 90 minutes after the end of treatment. Manual compression was performed above the puncture site for ≥15 minutes by a vascular surgeon on the team. If hematoma formation or active bleeding was identified after compression, the time was extended for 15 additional minutes until resolution. After the end of compression, the patient was kept at rest for 6 hours in the supine position.[12]

Definitions. The International Society on Thrombosis and Hemostasis bleeding criteria were used when bleeding had occurred.[13,14] This classification stratifies bleeding events into three levels: major, not major but

ARTICLE HIGHLIGHTS

- **Type of Research:** A single-center, retrospective cohort study
- **Key Findings:** Of 462 patients, 290 had undergone superficial femoral artery (SFA) access and 172 had undergone common femoral artery access. The success rate was higher for SFA access (99.7% vs 96.5%; $P = .01$). The hematoma rate was greater for SFA access (20.3% vs 11%). However, the incidence of major bleeding was not different between the two groups. The hematoma rate was also higher in women and older patients for both groups.
- **Take Home Message:** Antegrade SFA access is an option for endovascular treatment of peripheral arterial disease. However bleeding events were more frequent in women and elderly patients.

Table I. International Society of Thrombosis and Hemostasis bleeding definition[a]

Major bleeding (presence of one or more criteria)
Decrease in hemoglobin level ≥2 mg/dL
Need for transfusion of ≥2 red blood cell concentrates
Bleeding in critical sites (ie, intracranial, intraspinal, intraocular, pericardial, intra-articular, intramuscular with compartmental syndrome, retroperitoneal syndrome)
Bleeding contributing to death
Nonmajor clinically relevant bleeding
Bleeding not meeting previous criteria but requiring medical intervention, emergency consultations, temporary suspension of research, associated with pain or limitation of daily activities
Any bleeding with hemodynamic repercussions
Any bleeding requiring hospitalization
Hematoma caused by subcutaneous cell tissue >100 cm^2
Any bleeding with clinical repercussions for the patient
Minor bleeding
Any other bleeding not meeting criteria for previous categories

[a]Criteria secondary to bleeding caused by anticoagulant use and not related to complications of arterial puncture were excluded. Adapted from Tangelder et al.[14]

clinically relevant, and minor (Table I). Access was considered successful if the puncture and introducer sheath had been placed in the first artery chosen at the first attempt. Access was considered partially successful if the first puncture had failed but access was achieved after other attempts. Access was considered unsuccessful if the previously chosen access had to be changed. Technical success after endovascular intervention was considered present when vessel patency was established with residual stenosis <30%.[11]

Statistical analysis. SPSS software, version 20.0 for Windows (IBM Corp, Armonk, NY), was used for analysis. Regarding the descriptive statistics, categorical variables are presented as the absolute and relative frequencies, and continuous or numerical variables using measures of the central tendency (mean and median) and variability (variation and standard deviation). The Student *t* test, Fisher exact test, χ^2 test, and Mann-Whitney *U* test were used to compare the CFA and SFA puncture results.

The propensity score method was used to calculate the inverse probability of treatment weighting and then incorporated into a logistic regression model to estimate the odds of hematoma stratified by the type of puncture (SFA or CFA). The following factors were considered: hypertension, diabetes, smoking, dyslipidemia, coronary artery disease, sex, age, dyslipidemia, ultrasound-guided access, introducer sheath calipers, the use of drugs (ie, clopidogrel, ticlopidine, heparin, ASA), and Rutherford class. The propensity model presented an area under the curve of 0.816. A considerable proportion of data were missing for dyslipidemia, ASA, highest systolic and diastolic arterial pressure during the procedure, and the use of antiplatelet agents before the procedure (44.8%, 23.2%, 19%, and 12.8%, respectively). To avoid the loss of information, we performed a simple data imputation using the regression method. $P < .05$ was considered statistically significant.

RESULTS

A total of 530 electronic medical records of patients who had undergone infrainguinal endovascular therapy were evaluated from January 2009 to October 2016. After the first analysis, 68 procedures were excluded, leaving 462 available for evaluation. Of the 462 patients, CFA access was used for 172 and SFA access for 290.

The demographics, indications, and procedures details comparing the SFA and CFA groups are listed in Table II. Hypertension, active smoking, and dyslipidemia were more frequent in the SFA group; however, only the difference for the latter was statistically significant. Additionally, in the SFA group, more advanced PAD (Rutherford class 5 and 6) was observed, with a statistically significant difference.[15] In the CFA group, the frequency of diabetes was greater (35.3% vs 24.5%; $P = .013$). Most patients in the SFA and CFA groups had used ASA (87.9% vs 83.6%; $P = .247$) and clopidogrel or ticlopidine (73.6% vs 66%; $P = .267$) at antiaggregating doses in the preoperative period. No significant difference was found in the medications used between the two groups.

The success rate for completing the endovascular angioplasty procedure was similar between the two groups (SFA, 96.2%; vs CFA, 94.8%; $P = .462$). The proximal arteries (mid- and distal SFA and popliteal arteries) had been more often treated in the CFA group (41.9% vs 22.4%; $P = .001$). The use of stents was greater during angioplasty in the CFA puncture group ($P < .006$; Table III). The number of treated arteries was similar between the two groups ($P = .394$). The higher blood pressure values during the procedure were similar between the two groups for systolic (167.0 vs 167.7 mm Hg; $P = .789$) and diastolic (86 mm Hg in both groups; $P = .636$) blood pressure.

Concerning the access, the use of ultrasound guidance for the puncture was more frequent in the SFA group (41.1% vs 11.2%; $P < .001$). Additionally, in the SFA group, a lower profile of introducer sheaths was used ($P < .001$), with the 4F introducer used more frequently (43.6% vs 12.9%) in the SFA group and the 5F sheath used more frequently in the CFA group (47.4% vs 70.6%). Introducer sheath calipers were not protective against hematoma formation; 88% of the SFA hematomas were associated with a 4F or 5F introducer ($P = .566$) and 73.7% of the CFA hematomas were associated with 5F introducer access ($P = .742$). The puncture

Table II. Characterization of sample stratified by access

Factor	SFA group	CFA group	*P* value
Age, years	69 ± 11	68 ± 11	.192
Male sex, %	45.5	52.3	.157
Hypertension, %	32	17.6	.050
Diabetes, %	24.5	35.3	.013
Active smoking, %	29.2	12.1	.101
Dyslipidemia, %	20.2	12.9	.008
Coronary artery disease, %	8.8	12.9	.184
Renal impairment, %	6.4	7.4	.686
Stroke, %	10.3	9.8	.865
Procedure duration, hours	1.28 ± 0.63	1.18 ± 0.62	.092
Left side treated, No. (%)	147 (50.7)	96 (55.8)	.286
Rutherford classification, No. (%)			.003
III	6 (2.1)	7 (4.1)	
IV	20 (7)	28 (16.3)	
V	230 (80.4)	128 (74.4)	
VI	30 (10.5)	9 (5.2)	

CFA, Common femoral artery; *SFA*, superficial femoral artery.
Data presented as mean ± standard deviation, unless noted otherwise.

Table III. Treated arteries and stent deployment

Endovascular treatment	SFA group	CFA group	*P* value[a]
SFA	109 (37.6)	105 (61.0)	<.001
Popliteal artery	124 (42.8)	65 (37.8)	.294
Tibioperoneal trunk	14 (4.8)	9 (5.2)	.847
Anterior tibial artery	120 (41.4)	45 (26.2)	.001
Posterior tibial artery	55 (19.0)	26 (15.1)	.293
Peroneal artery	75 (25.9)	34 (19.8)	.136
Stent deployment	105 (36.5)	85 (49.4)	.006

CFA, Common femoral artery; *SFA*, superficial femoral artery.
Data presented as number (%).
[a]Computed using the χ^2 test.

success rate was greater in the SFA group than in the CFA group (99.7% vs 96.5%; $P = .010$; Table IV). Furthermore, the rate of adequate catheterization of the artery chosen in the first puncture was similar between the two groups. Nevertheless, the frequency of failure was greater with the need to change the puncture site in the CFA group (3.5% vs 0.3%; $P = .010$). The only failure in the SFA group had been resolved with a second attempt. In the CFA group, two patients had required a second puncture, and four had required a change in the artery to continue the procedure.

The complications at the puncture sites in both groups are listed in Table V. A total of 78 hematomas were identified and were more frequent in the SFA group ($P = .027$). Major bleeding had occurred in a few cases, and the incidence was not different between the CFA and SFA groups (1.2% and 2.4%, respectively). Pseudoaneurysms had developed in two patients (<1% of both groups), requiring a surgical approach in only one patient and percutaneous treatment with thrombin injection in one patient. Blood product transfusion was more frequent in the SFA group than in the CFA group ($P = .017$; Table IV).

During hospitalization, 12 of the patients had died (7 in the CFA group and 5 in the SFA group), with no significant differences between the two groups. Bleeding had contributed to death for two of the five patients in the SFA group. One of these patients had had PAD Rutherford class 5 and had undergone SFA angioplasty without complications. On the same day, the patient had experienced cardiac arrest without a response to standard resuscitation maneuvers. The nurse and medical records had described an access site hematoma. The second patient had had PAD Rutherford class 6 and had

Table IV. Rate of failure of arterial puncture (n = 462)[a]

Technical access success at first attempt[a]	SFA group (n = 290)	CFA group (n = 172)
Success	289 (99.7)	166 (96.5)
Partial failure	1 (0.3)	2 (1.2)
Complete failure	0 (0)	4 (2.3)

CFA, Common femoral artery; *Complete failure*, chosen artery had required changing; *Partial failure*, second puncture successful using artery previously chosen; *SFA*, superficial femoral artery.
Data presented as number (%).
[a] $P = .010$ (Fisher exact test).

Table V. Access complications after SFA and CFA puncture

Complication	SFA group	CFA group	*P* value
Hematoma (total)	59 (20.3)	19 (11)	.010[a]
Minor bleeding (ISTH grade I)	45 (15.5)	17 (9.9)	.085[a]
Nonmajor clinically relevant bleeding (ISTH grade II)	7 (2.4)	0 (0)	
Major bleeding (ISTH grade III)	7 (2.4)	2 (1.2)	
ISTH grades II and III	14 (4.8)	2 (1.2)	.215[a]
Other			
Pseudoaneurysm	2 (0.6)	1 (0.5)	.999[b]
Blood transfusion	19 (6.5)	3 (1.7)	.017[a]

CFS, common femoral artery; *ISTH*, International Society on Thrombosis and Hemostasis; *SFA*, superficial femoral artery.
Data presented as number (%).
[a]Computed using the χ^2 test.
[b]Computed using the Fisher exact test.

undergone peripheral angioplasty. A large thigh hematoma was observed shortly after introducer sheath retrieval. The patient had received a red blood cell transfusion and critical care support. The patient had remained stable for 24 hours, underwent surgical debridement of the leg ulcer, and developed hypotension after the hemodialysis session, leading to cardiac arrest despite hemodynamic support. In the CFA puncture group, none of the seven fatalities had been attributed to hematoma formation.

The results of the analysis of possible causes of the complications are presented in Table VI. The prevalence of complications was greater among older individuals, women, and individuals in whom the puncture was guided by Doppler ultrasound examination. The introducer caliber and systolic and diastolic blood pressure values during the procedure and the use of antiplatelet drugs or heparin did not show any associations with hematoma formation.

When the SFA was punctured, the likelihood of a complication had increased by 144%. The difference was statistically significant (odds ratio, 2.444; 95% confidence interval, 1.864-3.203; $P = .001$).

DISCUSSION

The ideal access will allow for technically easy artery puncture, high recanalization success, and a low incidence of complications.[2,16,17] However, none of these techniques could be considered an ideal access. For CFA retrograde access, the use of specific materials, such as introducers and long catheters, is necessary. In addition, complications in the limb might not be affected by ischemic injury.[16] In antegrade CFA access, even when using fluoroscopic and ultrasound guidance as parameters for puncture, inadvertent assessment of the depth of the SFA can occur, especially in obese patients and those with anatomic variations.[18-21]

Therefore, SFAs could be considered an alternative for access in infrainguinal procedures. It has been estimated that the SFA puncture has a longer learning curve, with the likely need to perform 60 procedures to master the technique.[22,23] In our hospital, an increase occurred in the frequency of antegrade punctures owing to the unavailability of specific material for the crossover, and a progressive increase in obese patients and those with previous inguinal incisions (hostile groin) was observed. This technique had been performed more frequently at the origin or proximal segment of the thigh after evaluating the artery's position and caliber via ultrasound guidance. Multiple studies of large samples have shown antegrade access to be as safe as retrograde access[16,21]

To date, three important studies in the literature have compared antegrade puncture of the SFA and CFA. All three studies had demonstrated that SFA puncture is effective and safe; however, the number of cases studied was small, especially relative to the number of patients undergoing SFA puncture. In 2007, Marcus et al[9] had retrospectively analyzed 30 patients with a hostile groin

Table VI. Evaluation of demographic and technical aspects related to access complications (SFA and CFA)

Variable	Complication		*P* value
	No	Yes	
Age, years	69 ± 16.5	73 ± 13	.006[a]
Sex			<.001[b]
Female	185 (77.1)	55 (22.9)	
Male	199 (89.6)	23 (10.4)	
Doppler ultrasound-guided puncture			.007[b]
No	262 (86.5)	41 (13.5)	
Yes	102 (76.1)	32 (23.9)	
Introducer sheath, F			.665[b]
4	115 (83.9)	22 (16.1)	
5	202 (83.8)	39 (16.2)	
6	39 (86.7)	6 (13.3)	
7	4 (66.7)	2 (33.3)	
ASA			.434[b]
No	43 (87.8)	6 (12.2)	
Yes	255 (83.3)	51 (16.7)	
Clopidogrel or ticlopidine (n = 403)			.871[b]
No	20 (80)	5 (20)	
Yes, unknown dose	77 (82.8)	16 (17.2)	
Yes, antiaggregant dose	239 (83.9)	46 (16.1)	
Blood pressure, mm Hg			
Systolic	166.8 ± 26.6	170.4 ± 24.8	.331[c]
Diastolic	86 ± 19	86 ± 23	.633[a]

ASA, Acetylsalicylic acid; *CFS*, common femoral artery; *SFA*, superficial femoral artery.
Data presented as mean ± standard deviation or number (%).
[a]Computed using the Mann-Whitney *U* test.
[b]Computed using the χ^2 test.
[c]Computed using the *t* test.

who had undergone 44 angioplasties by antegrade puncture using the CFA pathway in 15 and the SFA in 23. They found that ultrasound-guided SFA punctures were more effective and safer compared with CFA access.[9] In 2010, Gutzeit et al[10] prospectively studied 100 patients and ultrasound-guided procedures. Of the 100 patients, 50 had undergone SFA puncture with greater technical success, a shorter procedure duration, and a lower rate of hematoma after antegrade puncture of the SFA compared with CFA puncture but with a greater rate of pseudoaneurysm formation.[10] In 2012, Kweon et al[8] studied 199 patients who had undergone antegrade puncture, and the 28 punctures of the SFA showed similar safety and efficacy.[8]

We found a greater incidence of hematoma complications in the SFA group in our series, and the incidence of blood transfusion was also higher. Many factors could explain the greater frequency of complications in the SFA group. Hematoma was likely more easily perceived in the SFA group than in the CFA group owing to the position of the access and difficulty with compression. Another possibility was a greater incidence of more severe cases of arterial disease in the SFA group. Higher wall calcification in the SFA group could have led to a greater incidence of bleeding because of difficulty with manual compression.

Antegrade puncture with ultrasound guidance can reduce the number of attempts and incidence of major complications.[6,24] A randomized trial had evaluated retrograde puncture of the CFA and showed the benefit of using ultrasound guidance only for obese patients with a weak or absent femoral pulse.[17] As stated previously, ultrasound-guided CFA puncture was performed only in a few patients, and almost one half of the patients had undergone SFA puncture. In contrast to previous studies, we found a greater incidence of hematoma in the patients who had received ultrasound-guided punctures in both groups. This observation had likely resulted from selection bias because the use of ultrasound guidance was at surgeon's discretion, and the most challenging cases were likely designated for the use of ultrasound-guided access.

The use of lower profile introducers increases the safety of the puncture.[25] However, it could also limit the use of stents that require higher profiles and other specific materials such as atherectomy and reentry devices. The patients who had undergone SFA puncture had received

introducers with a lower profile, with 4F used for 43.6% and 5F for 47.4%. Of those who had undergone CFA puncture, 4F had been used for 12.9% and 5F for 70.6%, with similar proportions reported in previous studies.[6,8] The higher failure rate in the CFA group, which had required a new puncture or change in the chosen artery, was compatible with previously reported results.[8,10] The overall risk factors for complications, such as female sex and older age, were also reported in other studies.[16,26]

Considering these aspects, it seems that SFA access is relatively safe and results in high technical success. SFA access could likely be considered for patients with certain CFA technical problems, such as obesity, early femoral bifurcation (proximal), and a hostile groin, especially for men and younger patients. If considered, the use of a low-profile introducer sheath might be a better option. SFA access could also be used instead of contralateral CFA access, especially in cases of disease not involving the first portion of the SFA.

Study limitations. The first limitation was that our study was a retrospective, nonrandomized study. Thus, weight and height data were missing for most of the patients, and we could not evaluate the association of bleeding with obesity. However, the systematic electronic medical record analysis and double-checking of the records showed that the incidence of hematoma was high in both groups and comparable to that observed in prospective studies. Another possible bias was the nonroutine use of ultrasound guidance for puncture and the unavailability of percutaneous closure devices. The use of these devices might decrease the incidence of hematoma. The possibility of conducting a prospective, randomized study might be considered to reduce the risk of selection bias.

CONCLUSIONS

SFA access was associated with a higher overall rate of bleeding than was CFA access. However, no significant difference was found in the incidence of major bleeding between the two access sites. The success rate was similar between the two groups; however, failure of the puncture attempts were more frequent for CFA access. Female sex and older age were associated with increased hematoma incidence.

AUTHOR CONTRIBUTIONS

Conception and design: LB, FN, RB, NW
Analysis and interpretation: LB, FN, RB, MB, NW
Data collection: LB, LP
Writing the article: LB, FN, RB, NW
Critical revision of the article: LB, LP, FN, RB, MB, NW
Final approval of the article: LB, LP, FN, RB, MB, NW
Statistical analysis: LB, RB
Obtained funding: Not applicable
Overall responsibility: LB

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Submitted May 11, 2020; accepted Feb 12, 2021.

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