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Femoral Arteriographic Abnormalities and Puncture Site Complications in Patients Treated with Carotid Artery Stenting

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Abstract

Purpose: Percutaneous carotid artery stenting (CAS) is associated with the risk of complications at the puncture site of the femoral artery. The objective of this study was to determine the frequency of femoral arteriographic abnormalities and puncture site complications assessed immediately after arterial puncture in patients treated with CAS and examine the associations between these factors.

Patients and Methods: A total of 124 consecutive patients who underwent CAS via femoral artery puncture between July 2010 and June 2013 were included in this study. In each case, an arteriographic evaluation of the puncture site was performed by injecting contrast media through an 8-Fr sheath introducer immediately after insertion into the femoral artery. If any extravasation or arteriovenous fistula formation was detected, the lesion was manually compressed in order to achieve hemostasis and/or the disappearance of the fistula before inducing systemic heparinization for the CAS procedure. The clinical and neuroradiological records of each patient were reviewed.

Results: Puncture-related complications occurred in seven of the 124 (5.6%) patients, including arteriovenous fistula formation in one patient and extravasation in six patients. All lesions were resolved by local compression, after which CAS was performed successfully in all cases. Puncture site complications were observed after CAS in six patients (4.8%), all of whom developed subcutaneous hematomas that did not either require additional treatment or affect the postoperative course.

Conclusions: Performing femoral arteriography immediately after sheath placement for CAS may reduce the incidence of puncture site complications.

Key words: **Femoral artery**, **Carotid artery stenting**, **Arterial puncture**, **Subcutaneous hematoma, Arteriovenous fistula**

Introduction

The most common approach for carotid artery stenting (CAS) for the treatment of carotid artery stenosis is via the femoral artery. Puncture site complications associated with this route include arterial occlusion and the formation of hematomas, false aneurysms or arteriovenous fistulas [1)–6)] occasionally requiring surgical intervention. In order to detect early complications, we routinely perform femoral arteriography immediately after placing the sheath introducer into the artery to certify adequate arterial access during the CAS procedure. In this report, the frequency of and associations between femoral arteriographic abnormalities and puncture site complications in patients treated with CAS were analyzed.

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Table 1 Baseline characteristics of the 124 patients

Mean age, years	73.4 ± 9.2
Male	99 (80%)
Cardiovascular risk factors	
Diabetes mellitus	38 (31%)
Hypertension	94 (75%)
Hyperlipidemia	60 (48%)
Atrial fibrillation	13 (10%)
History of cardiovascular disease	24 (19%)
Presenting symptom	
Cerebral infarction	54 (44%)
TIA or amaurosis fugax	10 (8.1%)
Asymptomatic	60 (48%)
Degree of carotid artery stenosis	77.8 ± 13.2
Antiplatelet agents	
Cilostazol + aspirin	104 (83%)
Clopidogrel + aspirin	12 (9.7%)
Cilostazol + clopidogrel	8 (6.5%)

Materials and Methods

This study involved 124 consecutive patients who underwent CAS percutaneously via femoral artery puncture at our hospital between July 2010 and June 2013 (Table 1). Data regarding age, sex, cardiovascular disease risk factors, presenting symptoms and the degree of stenosis were evaluated as patient background factors, and femoral arteriographic abnormalities assessed immediately after arterial puncture as well as puncture site complications of CAS were assessed as outcomes. The patients were considered eligible for CAS if they had symptomatic carotid stenosis of ≥50% or asymptomatic carotid stenosis of ≥80%, according to the criteria proposed by the North American Symptomatic Carotid Endarterectomy Trial (NASCET).[7] All patients were treated with two of three oral antiplatelet agents (aspirin: 100 mg daily, clopidogrel: 75 mg daily or cilostazol: 200 mg daily). Following the induction of general anesthesia, the femoral artery was punctured with an 18-G double bevel needle, after which an 8-Fr sheath (Medikit Supersheath™, Medikit, Tokyo, Japan) was placed according to Seldinger's method. Femoral arteriography was immediately performed through the sheath to examine the condition of the puncture site. In the event of a hemorrhagic finding at the puncture site, manual compression of the punctured groin region was applied for five minutes to ensure resolution of the extravasation of the contrast media. Heparin (80 IU/kg) was infused intravenously to achieve an activated clotting time of ≥250 seconds. The CAS procedure was then started.

After completing the CAS procedure, heparin neutralization was not performed, although the puncture site was treated with a hemostatic device (Angio-Seal, St. Jude Medical. Inc., St. Paul, MN). The puncture site was examined visually or on CT angiography or ultrasonography when deemed necessary over the first three days after the CAS procedure.

Results

Abnormal findings at the puncture sites were observed on femoral arteriography performed immediately after sheath placement in seven of the 124 (5.6%) patients (Table 2). These findings included arteriovenous fistula formation in one (0.8%) case and extravasation of the contrast media in six (4.8%) cases. In these seven patients, local compression was performed for five

Table 2 Data for the six patients with complications at the femoral artery puncture site

Case	Age (years)	Sex	Past history	Complication	Antiplatelet agents
1	76	M	HT,DM	Arteriovenous fistula	Cilostazol + aspirin
2	70	M	HT	Extravasation	Clopidogrel + aspirin
3	82	M	HT,DM	Extravasation	Cilostazol + aspirin
4	80	M	HT,DM,HL	Extravasation	Cilostazol + aspirin
5	73	M	HT,DM	Extravasation	Cilostazol + aspirin
6	60	M	HT	Extravasation	Cilostazol + aspirin

HT, hypertension; DM, diabetes mellitus; HL, hyperlipidemia

minutes, and resolution of the abnormal findings was confirmed on a sequential femoral arteriogram in all cases.

Puncture site complications were observed in six (4.8%) patients between 30 minutes and three hours after the completion of CAS. No abnormal findings were observed on femoral arteriography performed at the time of sheath placement in any of these six patients. All six patients underwent ultrasonography of the femoral artery, which revealed neither false aneurysms nor arteriovenous fistulas, resulting in a diagnosis of subcutaneous hematoma. All subcutaneous hematomas were ≤5 cm in size and treated using local compression. In all cases, the symptoms included only local pain that disappeared within two to four days. No growth of the hematomas was subsequently observed, and no patients suffered from negative consequences, such as prolonged hospitalization.

Presentation of representative cases

A 70-year-old male underwent CAS for right internal carotid artery stenosis (NASCET: 83%) detected on neck ultrasonography. Femoral arteriography performed after puncture of the right femoral artery revealed extravasation (Fig. 1). After performing local compression for five minutes, a sequential femoral arteriogram confirmed resolution of the hemorrhage (Fig. 2). Systemic heparinization was then induced during the CAS procedure. The patient exhibited a favorable postoperative course, with no hematomas at the puncture site.

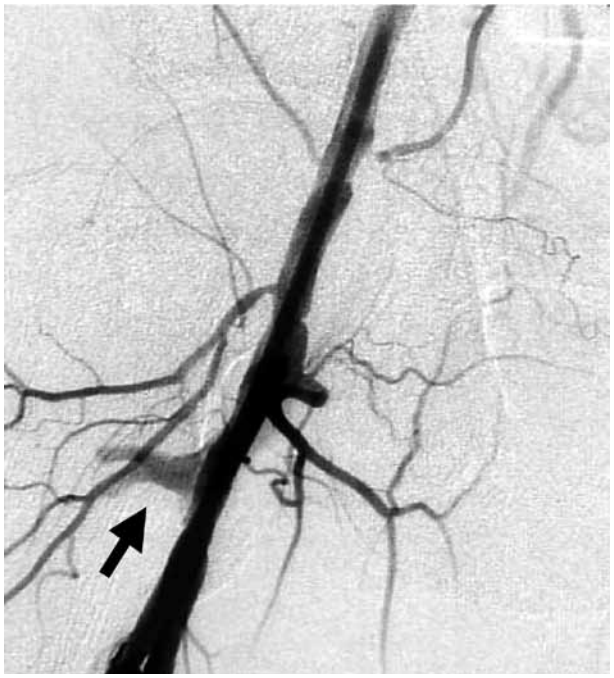

Fig. 1 A femoral artery angiogram shows extravasation of the contrast media (arrow) from the common femoral artery immediately after placement of the sheath.

Fig. 2 Hemostasis was obtained after manual compression for five minutes.

Discussion

Currently, CAS is regarded as being a less invasive and effective alternative to carotid endarterectomy for the treatment of carotid artery stenosis, although it is associated with the risk of puncture site complications.[8),9)] In the present series, extravasation at the puncture site was observed in five patients, while arteriovenous fistula formation was noted in one patient.

The incidence of arteriovenous fistulas following femoral artery puncture is reported to be 0.01–0.86%.[3),10)] The lesions can be identified based on complaints of hematoma formation and local pain and are diagnosed using auscultation and ultrasonography.[10)] Treatment includes local compression, stent placement and surgical repair; cases not improved with local compression under ultrasound guidance require stent placement or surgical repair.[11)] In the present series, an arteriovenous fistula was detected on femoral arteriography in one patient

(0.8%), an incidence comparable to that previously reported. The lesion was detected immediately after sheath insertion and successfully treated with simple manual compression for five minutes and did not progress to any serious conditions. Although the long-term course of arteriovenous fistulas is unknown, the lesions may cause systemic complications, including congestive heart failure, lower limb edema and femoral artery occlusion, necessitating early intervention.

Hematoma formation at the puncture site is a common local complication of arterial puncture, with an incidence of 0.26-6.18%.[1),3),4)] This complication produces clinical symptoms of pain and neuralgia, as well as anemia if accompanied by significant bleeding. In the present series, local extravasation was observed immediately after sheath insertion in six of 124 patients, although no postoperative hematoma formation was observed. Subcutaneous hematoma formation after CAS was also noted in six patients without extravasation. In these patients, the hematomas resolved following local compression and rest. This is likely because postoperative subcutaneous hematomas are caused by bleeding from the punctured artery as well as hemorrhage from small subcutaneous veins and oozing from subcutaneous tissue.

Another known complication of arterial puncture is false aneurysm formation, whose incidence has been reported to be 0.05-7.7%.[3),12)] This complication was not observed in the present series, which may also be related to the fact that early hemostasis was achieved in all cases of bleeding from the femoral artery puncture site.

Various hemostatic devices, including the Angio-Seal STS Plus, can be used in arteriography for femoral artery puncture and angioplasty. Studies examining the effects of hemostatic devices on the incidence of puncture site complications[13),14)] have shown that the use of these devices is beneficial for shortening the time to hemostasis as well as the average period of hospitalization, although no significant benefits have been reported compared to manual compression in terms of the incidence of local complications, such as the formation of puncture site hematomas, false aneurysms and arteriovenous fistulas. In our series, we used the Angio-Seal™ STS Plus to achieve hemostasis in all cases and observed no episodes of arterial occlusion or dissection due to its use.

While abnormal findings on femoral arteriography performed immediately after arterial puncture do not always correspond to puncture site complications, they should be detected and treated early; if left untreated, they may result in the formation of subcutaneous hematomas or arteriovenous fistulas.

Conclusion

Hemorrhagic complications detected on femoral arteriography immediately after sheath insertion for CAS can be treated with local compression without recurrence of complications at the puncture site. Performing femoral arteriography immediately after sheath insertion can prevent the occurrence of puncture site complications after CAS.

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