Arterial infection and *Staphylococcus aureus* bacteremia after transfemoral cannulation for percutaneous carotid angioplasty and stenting

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In this report, we present a patient who developed an infected femoral artery after repuncture cannulation for carotid angioplasty and intraluminal stenting. The case was complicated by persistent bacteremia and a delay in diagnosis before it was managed successfully with an autogenous replacement graft and appropriate antibiotics. Overt stent infection is exceedingly rare, but according to the literature describing transfemoral coronary artery intervention, the spectrum of clinical syndromes related to infection of the arterial puncture site includes local invasion, pseudoaneurysm formation, septic embolization to the distal limb, and bacteremia. The diagnosis requires a high degree of clinical suspicion and is often delayed. Although the incidence of infectious complications reported for percutaneous intra-arterial interventions historically has been low, the absolute number of these complications almost certainly will increase in the future because of the expanding array of interventional procedures that is becoming available. (J Vasc Surg 2002;35:576-9.)

Ever since the introduction of percutaneous transluminal coronary angioplasty (PTCA) in 1977, catheter-based coronary procedures have allowed millions of patients to avoid open surgical operations. However, despite their success, these procedures are sometimes associated with complications leading to additional morbidity of their own. Although experience with an expanding array of new catheter interventions has been relatively limited in comparison with PTCA, the incidence and clinical presentation of complications related to their arterial access will probably be similar to those that already have been reported for coronary patients. We recently encountered an unusual problem of this kind after carotid percutaneous transluminal angioplasty (PTA) and intraluminal stenting.

CASE REPORT

Spiking fevers to 40°C developed in a 67-year-old white man, associated with diaphoresis, rigors, and transient hypotension. His symptoms began approximately 48 hours after carotid angiography with PTA and stent deployment in the right carotid artery. His examination at the time the fever began revealed a grade-2 holosystolic cardiac murmur consistent with mitral regurgitation, which was thought to be present before his catheterization procedures. He also had a tender, nonpulsatile mass in the right groin at the femoral artery cannulation site. His medical history was remarkable for severe coronary artery disease for which, in addition to coronary bypass surgery 14 years earlier, at least eight PTCAs had been performed. Most of these involved stent placement and were also performed via the right femoral artery, including the most recent PTCA that had been done only 4 days before the carotid PTA.

Vancomycin therapy was instituted immediately after blood cultures had been drawn on the night that the fever began. A duplex ultrasound scan of the right groin that was performed the next morning failed to reveal a pseudoaneurysm or even a hematoma. Blood cultures demonstrated the presence of gram-positive cocci that subsequently were identified as methicillin-susceptible *Staphylococcus aureus* (MSSA). A 2-dimensional echocardiogram was interpreted to show trace aortic insufficiency, together with the possibility of a mobile echodensity involving the aortic valve.

Because of persistent MSSA bacteremia with spiking fevers, gentamicin was added to the antibiotic regimen on the following day. The patient developed Janeway microembolic lesions[1] on the toes and the sole of the right foot (Fig 1). Including the initial set, 8 of the 12 blood cultures that were obtained during the first week of illness grew MSSA. The duplex study and the echocardiogram were repeated 5 days after the fever had begun. Neither revealed a clear source for the infection, and the mobile aortic valve echodensity was no longer seen. However, the groin, which initially had improved, became more painful, and scanty purulent drainage developed. Two days later, a third duplex study appeared to demonstrate a pseudoaneurysm of the right common femoral artery.

The groin was explored later that same day, at which time an infected intramural hematoma penetrating into an ulcerated atherosclerotic plaque was found at the previous femoral artery cannulation site (Fig 2). A typical pseudoaneurysm was not present. Given uncertainty regarding the anatomic extent of infection and the presence of an adjacent thick plaque, it was deemed appropriate to replace the entire segment of involved artery. This segment of the common femoral artery was completely resected and replaced with a reversed saphenous vein graft (harvested from the ipsilateral thigh) to the deep femoral artery, with end-to-side implantation of the superficial femoral artery into the new autogenous graft and coverage of the reconstruction with a sartorius

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muscle flap. The deep subcutaneous layer was closed over the sartorius muscle, but the remainder of the incision was left open, managed with moist saline dressings, and healed by secondary intention approximately 3 weeks later. Cultures of the excised arterial specimen also grew MSSA. The febrile illness and bacteremia promptly resolved, and the patient has fully recovered from his infection. Given the high-grade nature of the bacteremia and concern surrounding the recently implanted stents, he was treated with 8 weeks of parenteral antistaphyloccocal penicillin therapy and thereafter with lifelong suppressive oral cephalexin. After 24 months of follow-up, there has been no recurrence of his local complications or any evidence of infection involving either of his most recent intravascular stents.

DISCUSSION

Infectious complications of diagnostic cardiac catheterization and PTCA are rare events, with an incidence of less than 1%.[2-6] Even though early investigators postulated that PTCA would be associated with higher rates of infection because of prolonged arterial cannulation and frequent catheter manipulations in comparison with diagnostic catheterization, the incidence of related bacteremia remains low. Shea et al[7] prospectively studied 164 transfemoral PTCA procedures and reported an 8% incidence of catheter colonization, but only one case (0.6%) of documented bacteremia. Frazee and Flaherty[8] predicted that use of the brachial artery for catheterization might be associated with higher rates of bacteremia because this approach usually requires open exposure, but this has not been investigated prospectively.

In a retrospective series of 4217 PTCAs, Samore et al[5] also found a 0.6% incidence of related bacteremia. Of the 27 cases of bacteremia, 14 involved *S. aureus*, and 9 were associated with coagulase-negative staphylococci; other organisms included enterococcus, group B streptococci, and *Escherichia coli*. Local infectious complications occurred in 10 of the 27 bacteremic patients, including infected femoral artery aneurysms (3), groin abscesses (3), septic femoral artery thrombosis (2), and ipsilateral septic arthritis (2). Nine of the 10 local complications were caused by *S. aureus*. Several authors have described femoral artery endarteritis that sometimes has been associated with infected aneurysms or pseudoaneurysms, all but one of these cases being secondary to *S. aureus*.[8-12] Frazee and Flaherty[8] defined endarteritis as "formation of a pseudoaneurysm found to be purulent upon surgical exploration, evidence of regional septic emboli, or persistently positive blood cultures in the absence of endocarditis." Other reported complications of PTCA have included pseudomonal cardiac abscess,[13] staphylococcal endocarditis,[14] extremity osteomyelitis,[8,15] and endophthalmitis.[16]

According to the multivariate regression analysis conducted by Samore et al,[5] risk factors for infectious complications included congestive heart failure (odds ratio [OR], 43.3), recannulation of the same site (OR, 4.0), difficulty obtaining vascular access (OR, 14.9), duration of sheath retention for more than 1 day (OR, 6.8), and length of the interventional procedure extending beyond 2 hours (OR, 2.9). Bleeding from the arterial puncture site was not evaluated as a risk factor in this study, but in another prospective study of 500 patients, McHenry et al[14] found that local bleeding independently conferred risk for infectious complications. The use of percutaneous hemostatic closure devices also has been proposed as a risk factor for infection. In a retrospective series of 108 consecutive procedures in which such devices were employed, Cooper and Miller[17] found that staphylococcal bacteremia developed in two patients (1.9%). These authors speculated that the device served as a nidus for further compromise of host endovascular resistance, but they reported no comparable data for cases in which hemostatic devices were not used at their center.

Fig 1. Janeway lesion on the sole of the right foot.

Recently, the array of available stent procedures has increased, and the indications are still evolving. Carotid stenting will likely carry the attendant risks of other percutaneous angiographic interventions, including the potential risk of stent infection. Despite the deployment of hundreds of thousands of coronary stents annually, there are only two examples of documented stent infection in the literature, one caused by *Pseudomonas aeruginosa* and the other by *S. aureus*.[18,19] Theoretically, endovascular stents and the arteries in which they are deployed represent at least some risk for infection, because PTCA and stent placement injure the intima and may act as a nidus for bacterial adherence, thus establishing an environment for microbial colonization.[20] It is unclear why there have not been more stent infections, but the reason may relate to flow-directed seeding of the majority of bacteria toward the periphery. Although there are no case reports of carotid stent infection, seven cases of *S. aureus* iliac artery stent infection have been described, with pseudoaneurysm formation or septic thrombosis in all but two of them.[20]

The diagnosis of infectious complications of PTCA depends on clinical, microbiologic, and radiographic evidence. A delay in establishing the diagnosis is not uncommon. Purulent drainage from the puncture site or signs of distal embolization obviously suggest infection, but both duplex ultrasound scanning and computed tomography may fail to demonstrate infected pseudoaneurysms.[10,15]

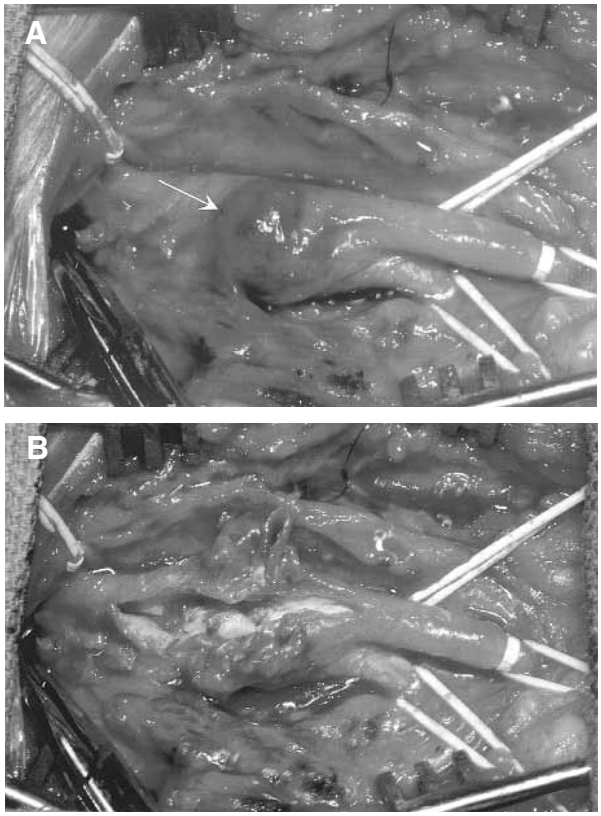

Fig 2. A, Infected intramural hematoma (*arrow*) involving the common femoral artery. **B,** Ulcerated atheromatous plaque at the puncture site.

Blood cultures can take up to 20 days to become positive even for organisms that are easily cultured, such as *S. aureus.*[5] In one case, an infected aneurysm was not clinically apparent until 1 month after PTCA.[21] Another case defied diagnosis for nearly 6 months,[15] including a negative pelvic computed tomography scan well into the course of the illness; similar to the patient described in our own report, this particular patient also had undergone cerebral angiography, albeit for the purpose of coil embolization of an intracranial aneurysm. Under appropriate circumstances, therefore, it is important to maintain a low threshold for surgical groin exploration and timely antibiotic therapy.

Arteritis complicating arterial cannulation generally is precipitated by trauma to the arterial wall with concomitant direct contamination or by seeding from a site of contiguous infection, such as an infected hematoma or pseudoaneurysm. The incidence of pseudoaneurysm formation after PTCA is 3.5% to 5.5%.[22] Atherosclerosis or endothelial ulceration may reduce resistance to intra-arterial infection. Previous vascular injury with scar formation, ongoing inflammation, or low-grade colonization from recent procedures seem likely to contribute to the increased risk noted for repuncture cannulation. The mechanism that might be responsible for the higher risk for infection that has been described for patients with congestive heart failure remains unclear.

The patient in our report presumably was at increased risk both because of recannulation of the ipsilateral femoral artery and because groin bleeding developed the day after the procedure. The presence of an ulcerated atherosclerotic plaque at the arterial puncture site and intimal damage from multiple historical procedures also may have provided a nidus for infection. Diagnostic clues included fever, persistently positive blood cultures, purulent local drainage, and septic emboli to the distal extremity (Janeway lesions). On the basis of the criteria proposed by Frazee and Flaherty,[8] the embolic stigmata alone were eventually sufficient to establish the diagnosis of endarteritis.

Prevention of infectious complications of PTCA has not been well studied. Most authors have advised against routine antimicrobial prophylaxis,[7] whereas others have recommended prophylaxis for ipsilateral repuncture when contralateral puncture is not feasible.[11,23] Prospective studies have not yet been performed to address the effectiveness and benefit of prophylactic antimicrobials in high-risk PTCAs. In the presence of significant risk factors, prophylactic antimicrobial administration directed at skin flora at the time of the procedure should be considered. For cases in which endarteritis does occur, accepted surgical management includes resection of the diseased arterial segment and antibiotic treatment that is analogous to that for infectious endocarditis.[24-26]

CONCLUSIONS

Infectious complications of PTCA occur only rarely, but those related to arterial access are probably typical of other catheter-based procedures. Most documented cases have involved *S. aureus.* High-risk clinical situations—such as congestive heart failure, a difficult cannulation, ipsilateral repuncture, prolonged sheath retention, puncture site bleeding, and a lengthy interventional procedure—should sensitize clinicians to the possibility of infection to avoid the delay in diagnosis that can otherwise often occur. When the index of suspicion is high, early management with appropriate antibiotics and consideration of surgical exploration are warranted.

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