Association of VA Surgeons

Percutaneous profunda femoris artery revascularization to prevent hip disarticulation: case series and review of the literature

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\textbf{Abstract}

\textbf{BACKGROUND:} Little is known about the role of percutaneous revascularization of the profunda femoral artery (PFA) in patients with amputation stump ischemia who are at risk of hip disarticulation. 

\textbf{METHODS:} We identified 4 patients who were treated for persistent amputation stump ischemia by PFA percutaneous revascularization over a 3-year period. All 4 patients had significant cardiopulmonary comorbidities and 2 patients had at least 3 previous groin surgeries. The short- and long-term outcomes of the patients were evaluated with regard to stump salvage, wound healing rate, complications, and mortality rate.

\textbf{RESULTS:} Technical success was 100% with no procedure-related complications. All 4 patients had multilevel vascular disease involving the iliac, common femoral artery, and the profunda femoral artery. All 4 patients were treated with angioplasty and/or stenting of the PFA. The amputation stump was closed primarily in 3 patients and 1 amputation stump was closed with a skin graft. One patient died during the same hospital stay shortly after declining hemodialysis. Three patients are alive at a mean follow-up period of 9 months (range, 5–14 mo).

\textbf{CONCLUSIONS:} Percutaneous PFA revascularization should be considered, over open revascularization, in patients with persistent above-knee amputation stump ischemia and multiple previous groin surgeries to avoid hip disarticulation.

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\textbf{KEYWORDS:} Hip disarticulation; Percutaneous revascularization; Profunda femoris artery

Ongoing ischemia of an above-knee amputation (AKA) stump caused by profunda femoral artery (PFA) disease or poor inflow is a dreaded complication that can lead to hip disarticulation (HD). HD is associated with high morbidity and mortality rates.\textsuperscript{1–3} Fortunately, only a small percentage of vascular patients will present with persisting ischemia of an AKA stump. Manouguian\textsuperscript{4} reported a 2.3% persistent stump ischemia among the 168 AKA cases performed in his vascular department from 1985 to 1999. Open revascularization of the ipsilateral deep femoral artery by femoral to femoral bypass graft was performed and prevented reamputation or HD. Another option is a hybrid open PFA, possible iliac stenting, and revascularization that can be performed under local anesthesia. However, most of these vascular patients had prior groin surgeries and failed previous bypasses, making open surgery under local anesthesia very difficult and poten-
Patient 1

A 59-year-old man presented to the VA Hospital with acute right leg ischemia 1 year after undergoing a complex, hybrid, multilevel, right, lower-extremity revascularization because of right superficial femoral artery stent occlusion. He underwent successful thrombolysis and balloon angioplasty of the superficial femoral artery stents as well as angioplasty and stenting of the right popliteal artery using Viabahn stents (W.L. Gore, Flagstaff, AZ). He was found to have severe right PFA-origin stenosis and recurrent diffuse disease in the right common femoral artery (CFA). He declined open revascularization of the diseased CFA and PFA. He presented, 4 months later, with severe acute right leg ischemia with profound both motor and sensory deficit. He underwent a right AKA. After discharge from the hospital, he continued to smoke 3 cigarettes daily. Despite adequate wound care for 2 months, and one revision to a higher level AKA, the wound did not heal. The angiogram showed no flow past the iliac artery. He underwent endovascular revascularization of the PFA (4-mm Expert stent; Abbott Vascular, Abbott Park, IL), from the PFA into CFA (6 × 40 mm Lifesent; Bard, Lowell, MA), and from the CFA into the external iliac artery (EIA) (7 × 80 mm Lifesent; Bard) (Fig. 1). The AKA stump already was healed at his 2-month follow-up evaluation.

Patient 2

A 75-year-old man presented with acute right leg ischemia associated with severe motorsensory loss requiring lifelong antibiotics. He presented to an outside hospital 5 months later with acute right leg pain caused by thrombosis of his bypass graft. An attempt at limb salvage was performed but was unsuccessful and he eventually underwent a right AKA. The treating surgeon at the outside hospital elected to leave the skin incision open and transferred him to the VA Hospital for further management. Multiple debridements were performed without improvement of the stump healing. A hip disarticulation was considered. A duplex ultrasound showed no flow to the PFA. An aortogram showed no flow past the mid-right CIA stent. Recanalization of the right CIA, EIA, and PFA was successful. In-line flow to the PFA was established with stenting of the PFA with a Medtronic Complete 4 × 40 mm stent (Medtronic, Santa Rosa, CA), CFA, EIA, and CIA with 5 × 78 mm and 7 × 78 mm Sentinol stents (Boston Scientific, Plymouth, MN). The procedure was performed percutaneously under local anesthesia via the contralateral femoral artery. He received a split-thickness skin graft to his AKA stump. He developed a right CFA pseudoaneurysm that required ligation, groin debridement, and a muscle flap 60 days after the initial intervention. Fortunately, the skin graft healed after 2 months and remained intact at the 14-month follow-up evaluation. The intraoperative cultures from the groin grew *Pseudomonas aeruginosa*.

Patient 3

A 75-year-old man presented with acute right leg ischemia associated with severe motorsensory loss requiring
Table 1  Patient demographics, outcome, and follow-up evaluation of all four patients treated with percutaneous PFA revascularization

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age, y</th>
<th>Comorbidities</th>
<th>Smoking status</th>
<th>Number of previous groin surgeries</th>
<th>Extent of disease</th>
<th>Primary healing vs skin graft</th>
<th>30-d death or complication</th>
<th>Time to wound healing, mo</th>
<th>Length of follow-up period, mo</th>
<th>Status of ipsilateral internal iliac artery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59</td>
<td>HLD and COPD</td>
<td>Active (90 pack-years)</td>
<td>1</td>
<td>EIA to PFA</td>
<td>Primary healing</td>
<td>None</td>
<td>2</td>
<td>8</td>
<td>Severe diffuse disease</td>
</tr>
<tr>
<td>2</td>
<td>64</td>
<td>Alcohol abuse, glucose intolerance, COPD</td>
<td>Active (50 pack-years)</td>
<td>3</td>
<td>CIA to PFA</td>
<td>Skin graft</td>
<td>None</td>
<td>2</td>
<td>14</td>
<td>Occluded</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>MI, HLD, TIA, COPD, HTN</td>
<td>Active</td>
<td>3</td>
<td>CFA to PFA with occluded femoral to femoral bypass EIA to PFA</td>
<td>Primary healing</td>
<td>None</td>
<td>4</td>
<td>5</td>
<td>Occluded</td>
</tr>
<tr>
<td>4</td>
<td>62</td>
<td>CHF, DM, HTN</td>
<td>Active (20 pack-years)</td>
<td>1</td>
<td>EIA to PFA</td>
<td>N/A</td>
<td>Death</td>
<td>N/A</td>
<td>N/A</td>
<td>Severe diffuse disease</td>
</tr>
</tbody>
</table>

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus; HLD = hyperlipidemia; HTN = hypertension; MI = myocardial infarct; N/A = not applicable; TIA = transient ischemic attack.
AKA. He had multiple bilateral lower-extremity revascularizations including a left-to-right femoral bypass. The AKA stump at the time of the surgery looked viable but had marginal perfusion. The wound was left open and an angiogram was performed after the patient was resuscitated and stabilized clinically. He was found to have thrombosis of the femoral–femoral bypass graft with thrombus extending into the PFA, which was treated with thrombolysis. Angiogram revealed occlusion at the proximal PFA and high-grade stenosis of the femoral-to-femoral bypass anastomosis. Both lesions were treated and responded well to balloon angioplasty using a 5-mm balloon. The procedure was performed under local anesthesia. His AKA stump wound was managed with local wound care. It took almost 4 months for the wound to heal completely despite a patent femoral–femoral bypass and PFA by duplex scan. We attributed his prolonged wound healing to his poor nutritional status (albumin level, 2.3 g/dL) and heavy smoking.

**Patient 4**

A 62-year-old man was transferred to the VA Hospital with a 2-day history of cold and ischemic left leg. He underwent multiple bilateral lower-extremity surgeries related to his peripheral vascular disease in the past. He underwent a left guillotine AKA because of the severe motorsensory deficit at presentation. Perfusion of the AKA stump was marginal during the amputation. He was resuscitated in the intensive care unit to correct his acidosis and electrolyte abnormalities. When his clinical condition stabilized, an angiogram was performed via a left brachial access the following day. He was found to have occlusion starting at the level of the distal EIA. This was treated with on-table thrombolysis and recanalization of the EIA into the PFA followed by placement of several stents. The procedure was performed under local anesthesia. The patient declined hemodialysis to treat his acute renal failure and died shortly after that.

**Comments**

The incidence of HD surgeries among patients with amputations has been reported as .5% to 3.0%. Most of these surgeries are the result of vascular impairment or malignancy. Morbidity and mortality after HD reported in the literature varied considerably. Unruh et al reported an overall 44% mortality rate after the procedure in 34 patients (38 disarticulations); infection was present in 23 patients (25 disarticulations), and 12 of these 23 patients died (52.2%). Endean et al describing the outcomes of disarticulation in 53 patients, reported a 33% mortality rate when it was performed emergently compared with 4% when it was performed electively. Dénes and Till reported 62 patients with 63 hip disarticulations: the majority either had malignancy (24 cases; 38.71%) or arteriosclerosis (23 cases; 37.1%). The postoperative mortality rate for HD in patients with known vascular disease was 43%, and wound healing complications were observed in 65%. Only .05% of these patients were able to walk with a prosthesis. On the other hand, Pack reported no surgical deaths in 96 patients who underwent HD for malignant tumors. Similarly, another study had no deaths in 11 patients who had HD for severe infections after hip arthroplasty. The outcome after HD significantly depends on the primary illness: in vascular cases it is poor, whereas in malignancies it is fairly good (Table 2).

Among the survivors, HD resulted in significant morbidity, affecting their quality of life.
Table 2  Mortality of hip disarticulation based on preoperative indications

<table>
<thead>
<tr>
<th>Preoperative indications</th>
<th>Mortality percentage (reference)</th>
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<td>Malignant tumor</td>
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<td>Atherosclerosis</td>
<td>20 [1]</td>
</tr>
<tr>
<td>Osteomyelitis</td>
<td>22 [1]</td>
</tr>
<tr>
<td>Presence of preoperative infection and ischemia</td>
<td>60 [1]</td>
</tr>
<tr>
<td>Elective</td>
<td>4</td>
</tr>
<tr>
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Mortality of hip disarticulation based on preoperative indications.

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Mortality of hip disarticulation based on preoperative indications.

Debilitating with high morbidity and mortality, particularly among the vascular patients, any intervention to prevent this procedure is highly desirable.

The PFA is a major blood supply for the thigh and is a major collateral artery for the leg and foot. The importance of PFA revascularization in lower-extremity ischemia has been described previously. Bernhard et al. subsequently showed that the flow through the unobstructed profunda femoris artery in the presence of chronic superficial femoral artery occlusion is equal to the flow through the external iliac artery when both major branches of the common femoral artery are patent. Profunda flow was shown to be more than twice that measured through a femoropopliteal bypass graft. These studies clearly show the capacity for the development of deep femoral collateral pathways to support perfusion of the entire lower extremity.

Most of the reports on profundaplasty in the literature are focused on the role of its treatment in limb ischemia. Bernhard et al. obtained significant improvement in all 10 limbs treated for claudication by isolated profundaplasty and 69% limb salvage of the 39 limbs treated for advanced ischemia. Similarly, another study reported 66.9% limb salvage success in 74 legs treated by extended deep femoral angioplasty and suggested this procedure as an alternative to femoropopliteal bypass. Motarjeme et al. first described this procedure in 12 patients; all cases were treated successfully with excellent response and alleviation of their symptoms. Subsequently, many studies have looked at the outcomes of percutaneous treatment of the PFA on patients with lower-extremity ischemia. However, unequivocal evidence on the beneficial effects of treating profunda disease percutaneously remains scarce. Silva et al. reported a series of patients in whom PFA revascularization was performed percutaneously, with results comparable with open surgery, suggesting that percutaneous profundaplasty is safe and effective. Another study achieved 90% procedural success in 26 limbs in 25 patients. At a median 17.5-month follow-up period, their overall mortality and amputation rates were 30% and 11%, respectively. As expected, patients with limb-threatening ischemia had worse outcomes than those with claudication. Varty et al. reported a procedural success rate of 96% in 28 limbs. Although 5 (18%) of their patients had rest pain, none underwent an amputation, only 3 (11%) required an additional revascularization procedure, and the remaining patients had significant improvement of their symptoms. The role of endovascular treatment of deep femoral artery especially in patients with persistent ischemia of the amputation stump is not well established. Manouguian in Germany described 4 patients with persistent above-knee amputation stump ischemia treated successfully with open profundaplasty and avoided reamputation or hip disarticulation. Donas et al. reported 15 patients with critical limb ischemia treated with percutaneous profundaplasty, of those, 3 patients had ischemic amputation stumps (2 above the knee and 1 below the knee). After the treatment, the patient with the below-knee amputation required a conver-
sion to above-knee amputation, but no patient required hip disarticulation.

This series shows that minimally invasive PFA revascularization should be considered over open PFA surgery in certain high-risk patients. All 4 patients had multiple medical problems, had multiple previous groin surgeries, as well as prosthetic grafts implants. Putting these patients through an open PFA revascularization carries high morbidity and mortality, and is near impossible to perform under local anesthesia. All 4 patients were treated successfully, under local anesthesia, with no procedure-related complications. All 3 surviving patients healed their AKA stump without subjecting them to HD.

Conclusions

Percutaneous PFA revascularization may be particularly valuable in certain patients with a nonhealing above- or below-the-knee amputation stump as a result of extensive PFA disease. This procedure can be performed with high technical success, low morbidity, and with an acceptable 30-day mortality rate.

References