Efficacy of axillary-to-femoral vein bypass in relieving venous hypertension in dialysis patients with symptomatic central vein occlusion

Joshua C. Grimm, MD, Robert J. Beaulieu, MD, Ibrahim S. Sultan, MD, Mahmoud B. Malas, MD, and Thomas Reifsnyder, MD, Baltimore, Md

Objective: Central vein stenosis or occlusion remains an unfortunate complication associated with the use of dialysis catheters. In patients with a functioning arteriovenous fistula, central vein stenosis can lead to debilitating arm, breast, or neck swelling. Treatment typically involves central vein angioplasty or stenting, or both, but restenosis and reocclusion rates remain high. Presented here are the initial results of a unique series of patients with a mature arteriovenous access and symptomatic upper extremity venous hypertension who were treated with axillary vein-to-femoral vein bypass after endovascular therapy failed.

Methods: This was a retrospective analysis of 10 hemodialysis patients with a functioning right upper extremity access who underwent axillary vein-to-femoral vein bypass between December 2011 and April 2013. 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.

Results: The 10 patients (seven men) were a median age of 58 years. All patients had documentation of prior central venous catheter placement and had undergone a previous endovascular procedure that was unsuccessful or technically unfeasible. The median hospital stay was 2 days (range, 1-3 days), and the median assisted-primary patency was 197 days (25th-75th percentile, 114-240 days). Three patients presented with recurrent arm swelling that was successfully managed in one patient with revision of the proximal anastomosis. Three additional patients presented with subsequent lower extremity swelling, with one patient benefitting from femoral vein angioplasty. Ultimately, six patients continued to use their original access, and two required placement of interval central venous catheters for hemodialysis.

Conclusions: In patients who have exhausted all endovascular options, axillary-to-femoral vein bypass may represent a safe and efficacious approach to alleviate extremity swelling while simultaneously salvaging a functional dialysis access. (J Vasc Surg 2014;59:1651-6.)

Despite concerted efforts to promote placement of autogenous arteriovenous fistulas (AVFs) before the commencement of dialysis, the rate of central venous catheter (CVC) use in the first 90 days of initial treatment is still surprisingly high, at nearly 80%.1,2 Therefore, catheter-associated central vein stenosis or occlusion remains a pervasive and troubling complication.2 The discussion is not trivial: multiple studies have demonstrated a clear survival benefit, a decrease in hospitalization rates, and a substantial reduction in overall health care costs in individuals who are able to use AVFs for hemodialysis (HD).3,4,5

The correlation between CVC use and central vein stenosis has been well documented in multiple series and affects up to half of all patients with a history of CVC placement.6 Unfortunately, this figure, which seems alarmingly high, is most likely an underestimation of the true incidence of this condition because central vein stenosis is often clinically unrecognizable in most patient populations.

In the HD-dependent demographic, central vein stenosis typically manifests as extremity swelling, breast engorgement, and prominent superficial veins ipsilateral to a functioning fistula or graft.7,8 Although the pathogenesis of this condition is multifocal, the recurrent trauma from CVC placement and the inflammatory milieu that ensues results in a cascade of cellular events that undoubtedly culminate in venous thrombosis or cicatrix and, ultimately, central vein occlusion.9,10

Given the importance of reliable vascular access in HD patients, central vein disease presents a challenging problem to the vascular surgeon. Once the stenosis progresses to frank obstruction, maintaining a functional AVF becomes problematic.11 To salvage the fistula, percutaneous transluminal angioplasty is routinely used and is often combined with stent deployment; however, the durability of endovascular intervention is less than desirable. This has forced surgeons to search for alternative solutions to manage central vein stenosis and its associated clinical implications. Presented here are the initial results of a unique series of patients with a mature arteriovenous access and symptomatic upper extremity venous hypertension who were treated with axillary vein-to-femoral vein bypass after endovascular therapy failed.
METHODS

This was a retrospective analysis of 10 HD patients with functioning right upper extremity access who underwent axillary vein-to-femoral vein bypass between December 2011 and April 2013. The appropriate clearance was obtained for this study from our ongoing Institutional Review Board-approved clinical database. Indications for venous bypass included upper extremity swelling in seven patients and a combination of breast and upper extremity swelling in three patients.

Surgical technique. The operation was performed under general anesthesia in all 10 patients. In this series, an axillary incision had been used to access the vein. Most recently, an infraclavicular incision was used because two episodes of graft kinking occurred in the first 10 patients. Regardless of the approach, the axillary and ipsilateral common femoral veins were circumferentially dissected free. After systemic heparinization, an 8- or 10-mm ringed expanded polytetrafluoroethylene (ePTFE) graft was sewn to the axillary vein, tunneled along the lateral chest wall through a counter incision, and then anastomosed to the femoral vein.

Postoperative follow-up. Once discharged, the initial follow-up appointment was scheduled 2 to 3 weeks after surgery. After all of the incisions were healed, duplex scans of the graft and fistula were performed to demonstrate patency of the bypass. Phone interviews were conducted with patients who had not had recent follow-up to assess their clinical status. Assisted primary patency, which represents the absolute duration of patency from the time of bypass (including any interventions), was recorded for all patients in the study.

RESULTS

The 10 patients (seven men) in this study were a median age of 58 years (range, 42-82 years). The etiology

<table>
<thead>
<tr>
<th>Pr</th>
<th>Age, years</th>
<th>Degree of central stenosis</th>
<th>Assisted primary patency, days</th>
<th>AF volume flow, mL/min</th>
<th>Complications</th>
<th>Subsequent interventions</th>
<th>Original dialysis access</th>
<th>Ultimate dialysis access</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56</td>
<td>Right subclavian vein to distal brachiocephalic vein</td>
<td>292</td>
<td>220</td>
<td>Dilatation of fistula; lower extremity swelling</td>
<td>Plication/ligation of fistula; iliac vein stent</td>
<td>Basilic transposition AVF</td>
<td>Contralateral (nondominant) radiocephalic fistula</td>
</tr>
<tr>
<td>2</td>
<td>82</td>
<td>Distal brachiocephalic vein to proximal SVC</td>
<td>177</td>
<td>NR</td>
<td>Thrombosis of AF bypass with recurrent arm swelling</td>
<td>Failed thrombectomy/AF bypass revision</td>
<td>Radiobrachial AVF</td>
<td>Lower leg loop AVG using 6-mm PTFE</td>
</tr>
<tr>
<td>3</td>
<td>66</td>
<td>Proximal right subclavian vein and entirety of brachiocephalic vein</td>
<td>240</td>
<td>2129</td>
<td>Recurrent upper extremity swelling</td>
<td>Revision of axillary anastomosis</td>
<td>Basilic transposition AVF</td>
<td>Original access</td>
</tr>
<tr>
<td>4</td>
<td>54</td>
<td>Right subclavian vein to distal brachiocephalic vein</td>
<td>96</td>
<td>1300</td>
<td>None</td>
<td>None</td>
<td>Basilic transposition AVF</td>
<td>Original access</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>Right subclavian vein</td>
<td>162</td>
<td>1929</td>
<td>Lower extremity swelling; infection of AVG</td>
<td>Excision of infected AVG bypass; CVC placement</td>
<td>Femoral vein angioplasty</td>
<td>Axillobrachial AVG</td>
</tr>
<tr>
<td>6</td>
<td>76</td>
<td>Right subclavian vein</td>
<td>219</td>
<td>457</td>
<td>Lower extremity swelling</td>
<td>Femoral vein angioplasty</td>
<td>Basilic transposition AVF</td>
<td>Original access</td>
</tr>
<tr>
<td>7</td>
<td>42</td>
<td>Right subclavian vein to proximal brachiocephalic vein</td>
<td>216</td>
<td>300</td>
<td>Superficial wound infection</td>
<td>Antibiotic therapy</td>
<td>Basilic transposition AVF</td>
<td>Original access</td>
</tr>
<tr>
<td>8</td>
<td>52</td>
<td>Right subclavian vein and entirety of brachiocephalic vein</td>
<td>57</td>
<td>NR</td>
<td>Thrombosis and infection of AF bypass</td>
<td>Removal of AF bypass and CVC placement</td>
<td>Basilic transposition AVF</td>
<td>Femoral catheter</td>
</tr>
<tr>
<td>9</td>
<td>66</td>
<td>Left subclavian vein</td>
<td>432</td>
<td>NR</td>
<td>None</td>
<td>None</td>
<td>Brachiocephalic AVF</td>
<td>Original access</td>
</tr>
<tr>
<td>10</td>
<td>43</td>
<td>Right subclavian vein</td>
<td>114</td>
<td>NR</td>
<td>None</td>
<td>None</td>
<td>Axillobrachial AVG</td>
<td>Original access</td>
</tr>
</tbody>
</table>

AF, Axillary-to-femoral vein bypass; AVG, arteriovenous graft; AVF, arteriovenous fistula; CVC, central venous catheter; NR, not recorded; Pr, patient; PTFE, polytetrafluoroethylene; SVC, superior vena cava.
of the end-stage renal disease included hypertension in 5, diabetes in 2, lupus nephritis in 2, and focal segmental glomerulosclerosis in 1. All patients had documentation of prior CVC placement and all had undergone at least one endovascular procedure that was unsuccessful or technically unfeasible. The operations were performed without in-hospital morbidity or death, and the median duration of admission was 2 days (range, 1-3 days). The pre-existing AVFs were used for immediate postoperative HD without incident in all patients.

Right upper extremity or breast swelling, or both was noticeably improved in all 10 patients at their initial follow-up; however, recurrent arm enlargement was appreciated in three patients after varying periods of time. This was successfully remedied in patient 3 by revising the proximal anastomosis. The other two patients underwent a failed thrombectomy (patient 2) and graft removal due to systemic infection (patient 8). Three additional patients experienced lower extremity swelling after their bypass was created. Symptomatic resolution was achieved in patient 6 through femoral vein angioplasty. Patient 1 had a high-volume fistula and a widely patent iliac vein stent ipsilateral to the axillary-to-femoral vein bypass. Despite initial plication of the fistula, his lower extremity swelling persisted and, ultimately, the fistula was ligated. Fortunately, he benefitted from formation of a contralateral radiocephalic fistula distal to a known central vein occlusion, and swelling has not developed in that arm. Lastly, an arteriovenous graft infection developed in patient 5 that necessitated access excision.

The median assisted primary patency and overall follow-up for the cohort were 197 days (25th-75th percentile: 114-240 days) and 207 days (range, 114-432 days), respectively. Six of the 10 patients were able to maintain their original access for dialysis, two underwent CVC placement, and new arteriovenous graft/AVFs were created in two. The assisted primary patency also represents the duration of access functionality since bypass placement. The Table presents a more detailed overview of each patient’s postoperative course. Figs 1 and 2 illustrate time to first intervention and time to new dialysis access placement, respectively.

**DISCUSSION**

Although the prevalence of AVFs for dialysis access has been increasing, the placement of CVCs still persists at unacceptably high rates. Unfortunately, as a result of this practice, the occurrence of central vein stenosis continues to plague the HD patient and surgeon, alike. This conundrum has encouraged vascular surgeons to devise novel therapies to not only alleviate the clinical sequelae of central vein occlusion but also salvage the ipsilateral AVF. Endovascular therapies are the initial treatment for central vein stenosis or occlusion. Access is usually obtained through the fistula, but additional femoral access is occasionally necessary when the stenosis or occlusion is difficult to cross with a wire. Although the immediate results of balloon angioplasty of central veins provides relief of extremity swelling, while at the same time maintaining the fistula, the results tend to be short-lived, with restenosis and reocclusion being common. Previous reports have documented 1-year primary patency rates between 10% and 40% with angioplasty alone. The addition of stent deployment to mere balloon angioplasty has added little to long-term patency rates.

The most definitive—but simultaneously drastic—surgical remedy is ligation of the access. This has the obvious consequence of abolishing an otherwise functioning fistula in a demographic with limited alternative options. As seen in this series, all but one patient was treated for right-sided issues, the nondominant left arm having already been exhausted of options for access. However, as seen in one patient in this series and previously reported elsewhere, an overlooked forearm cephalic or basilic vein distal to a prior failed upper arm access and central vein occlusion can be successfully used for a wrist fistula without concomitant swelling. Lastly, reducing the flow in large AVFs by using one of several reported plication...
techniques may reduce the patient’s symptoms and swelling.20-22

Surgical bypass offers an additional avenue for intervention, and multiple studies have demonstrated reasonable long-term patency rates with a minimal effect on overall morbidity. Several configurations to circumvent the area of occlusion have been investigated, and include bypasses to the right atrium, ipsilateral internal jugular vein, and ipsilateral external jugular vein.23-26 These extra-anatomic bypasses have limited application if the area of interest involves the junction of the subclavian and jugular veins or if the brachiocephalic vein or superior vena cava are involved. Although right atrial bypass is effective in evading occlusions, it is a large undertaking in a population of patients with a myriad of comorbidities.

Uncommonly, extra-anatomic bypass to the lower extremity has been used to palliate the symptoms of malignant superior vena cava syndrome. Long-term data are limited, however, due to the aggressive oncologic nature of the disease process.29,30 In the dialysis population, Kavallieratos et al31 reported eight patients who underwent ipsilateral axillary-to-saphenous vein bypass with PTFE for symptomatic central vein occlusion. The 6-month patency rate was 87.5%, and all patients experienced symptomatic improvement of their swelling.31

Because our institution is a busy tertiary dialysis access referral center, central vein issues are not uncommon in our patient population. Initially, an endovascular approach with angioplasty is our routine, with stenting having largely been abandoned. This series describes our initial experience with patients undergoing axillary-to-femoral venous bypass for recurrent symptomatic central vein stenosis or occlusion after failed interventional procedures. The median assisted primary patency rate, at the time of publication, was 197 days (range, 57-432 days), with six patients still benefiting from patent axillary-to-femoral vein bypasses. Given the limitations of previous interventions in providing a durable solution to mitigating central vein issues, the outcomes in our cohort are encouraging. As the experience with this technique grows, we hope improvements in its execution will result in consistently sustainable long-term patency (Fig 3 provides an algorithmic approach to central vein stenosis).

As is typical of any patient who has required dialysis for a prolonged period of time, specifics regarding the exact number of CVCs placed and endovascular interventions performed can be difficult to ascertain. Postoperatively, lower extremity swelling developed in several patients in this series, presumably due to unknown venous abnormalities, most likely from prior catheterization. Therefore, a fistulogram and iliofemoral venogram are performed at the beginning of the operation under local anesthetic. Once favorable anatomy is confirmed, general anesthesia with a laryngeal mask airway or an endotracheal tube is induced.

Two technical factors have evolved during our experience with this procedure. Although ring-reinforced ePTFE is the obvious choice for the bypass, the diameter used should vary according to the nature of the arm access. In patients with large fistulas, an 8-mm graft may not relieve the venous hypertension, and thus, a 10-mm graft is recommended. If the arm access consists of an ePTFE graft, then an 8-mm axillary-to-femoral bypass will typically suffice. In addition, the access for the proximal anastomosis in this series was obtained through an axillary incision. Two patients, however, required surgical revision for kinking of the graft at that site that caused recurrent arm edema. Although a transaxillary approach is technically easier, an infraclavicular approach, with tunneling deep to the pectoralis minor muscle, will prevent this complication.

Fig 3. Flowchart illustrates the algorithmic approach to patients with symptomatic central vein occlusion. In patients with true central vein occlusion, surgical bypass is considered only after percutaneous therapy and fistula plication (if applicable) have been attempted.
Lastly, because graft thrombosis occurred in two patients after surgical bypass, we have considered the use of systemic anticoagulation in the postoperative setting. Before axillary-to-femoral vein bypass, four patients had been treated with therapeutic warfarin for other comorbid conditions, whereas three were receiving aspirin therapy. Interestingly, both patients who were discovered to have thrombosed PTFE bypasses had been treated preoperatively with warfarin only in those with documented hypercoagulable states or a history of previous graft thrombosis.3334 The bleeding risk associated with systemic anticoagulation in patients with end-stage renal disease is not trivial, and therefore, we do not initiate this therapy in all of our patients after bypass. Instead, we support aspirin therapy if no contraindications exist and selective administration of warfarin in those with documented hypercoagulable states or a history of previous graft thrombosis.35

CONCLUSIONS

Successful palliation of the symptoms of central vein stenosis or occlusion in the dialysis patient is a challenging problem. Percutaneous intervention is clearly the treatment of first choice due to its simplicity and low morbidity. However, in patients who have exhausted all endovascular options, axillary-to-femoral vein bypass represents a unique and relatively safe approach to alleviate extremity swelling while salvaging a functional dialysis access.

AUTHOR CONTRIBUTIONS

Conception and design: JG, MM, TR
Analysis and interpretation: JG, RB, TR
Data collection: JG
Writing the article: JG, RB
Critical revision of the article: JG, RB, IS, MM, TR
Final approval of the article: JG, RB, IS, MM, TR
Statistical analysis: JG
Obtained funding: Not applicable
Overall responsibility: TR

REFERENCES


Submitted Sep 19, 2013; accepted Dec 20, 2013.

We have the answers you are looking for.

Visit us at: http://www.vascularweb.org