Axillary to saphenous vein bypass for treatment of central venous obstruction in patients receiving dialysis

Nikos Kavallieratos, MD,[a] **Antonios Kokkinos, MD,**[a] and **Petros Kalocheretis, MD,**[b] *Piraeus, Greece*

Objective: **Venous hypertension due to subclavian or innominate vein stenosis coexisting with a functioning arteriovenous access in the ipsilateral arm is a complex problem in patients undergoing hemodialysis. Therapeutic solutions must optimally relieve symptoms, permit use of the angioaccess, and carry minimal surgical risk. The purpose of this study was to evaluate a simple surgical option, bypassing central venous obstruction to the great saphenous vein.**

Methods: **Eight patients undergoing hemodialysis with severe symptoms and signs of venous hypertension due to subclavian or innominate vein obstruction and ipsilateral arteriovenous fistula or graft underwent axillosaphenous bypass via a subcutaneous 8-mm polytetrafluoroethylene bridge graft.**

Results: **No intraoperative or immediate postoperative morbidity was observed. Early and 6-month patency rates were 100% and 87.5%, respectively. All patients reported improvement of symptoms, and the angioaccess was usable in all cases. Average follow-up was 21.5 months. One patient had a relapse at 5 months, which necessitated revision of the graft–saphenous vein anastomosis.**

Conclusion: **Bypassing a central vein occlusion to the saphenous vein relieves symptoms of venous hypertension and prolongs use of the hemodialysis angioaccess. (J Vasc Surg 2004;40:640-3.)**

Stenosis or obstruction of the superior vena cava or more frequently its major tributaries is common in patients with end-stage renal failure undergoing maintenance hemodialysis.[1] The situation causes no symptoms unless coexistence of an arteriovenous fistula or arteriovenous graft in the ipsilateral arm causes severe venous hypertension.[1,2] Mild edema may be tolerated by the patient; in contrast, severe incapacitating arm swelling, ulceration, high-pressure venous return during hemodialysis, or persistent bleeding from cannulation points require some therapeutic intervention. Abolition of the arteriovenous communication seems the simplest option[3]; nevertheless, it does not provide a solution to the underlying disorder, and furthermore it deprives the patient of a site of angioaccess. Venous reconstruction[4] or bypass to the internal jugular vein, the external jugular vein, or the right atrium have been described as alternative options of surgical management.[2,5-11]

We describe a new approach for bypassing the occluded central vein via a prosthetic graft to the saphenous vein. This approach was used in 8 patients with a functioning angioaccess in the ipsilateral arm.

MATERIAL AND METHODS

Eight patients (4 men, 4 women) with a median age of 61 years (range, 47-63 years) had severe arm swelling and a functioning arteriovenous angioaccess. All patients had a history of ipsilateral subclavian vein catheter insertion, to be used as a temporary hemodialysis access. No accurate data concerning the number of catheter insertions, duration of use as an angioaccess, or infections were available. Previous deep venous thrombosis was ruled out by history; iliofemoral vein patency was confirmed at meticulous clinical and Doppler ultrasound examination. Clinical presentation and location of obstruction are presented in Table I.

Perioperative management. A single intravenous dose of 400 mg of teicoplanin was given preoperatively. Before preparation of the operative field a pneumatic tourniquet was applied to the ipsilateral arm to restrict extreme blood loss by inflation and occlusion of the arteriovenous communication in case of bleeding. Postoperatively no restriction in patient motility was advocated, and as a rule no anticoagulant agents or antiplatelet drugs were administered; no use of elastic stockings was recommended.

Surgical technique. The procedure was performed with the patient under local anesthesia in 7 cases. Systemic heparinization was used in 3 patients. The axillary vein was accessed through a 5-cm to 6-cm subclavicular incision in 6 patients, and through axillary incision in 2 patients. The long saphenous vein was dissected at the saphenofemoral junction and 5 to 6 cm distally. An 8-mm polytetrafluoroethylene (PTFE) graft was inserted subcutaneously to bridge the 2 veins. The graft was standard wall in 3 cases and thin wall externally supported in 5 cases. A 10-mm venotomy was made in the axillary vein, and a 20-mm venotomy in the saphenous vein. The graft was anastomosed end-to-side to the veins. The great saphenous vein was not ligated distally (Fig).

Graft patency during follow-up was controlled by murmur auscultation and Doppler ultrasound scanning every 3

From the First Department of Surgery[a] and the Nephrology Department,[b] General Regional Hospital Nikea.

Competition of interest: none.

Reprint requests: Nikos Kavallieratos, MD, Chiou 38-40, 17673 Kallithea, Greece (e-mail cbelessi@otenet.gr).

0741-5214/$30.00

doi:10.1016/j.jvs.2004.07.009

months. In 2 patients color Doppler scanning was performed.

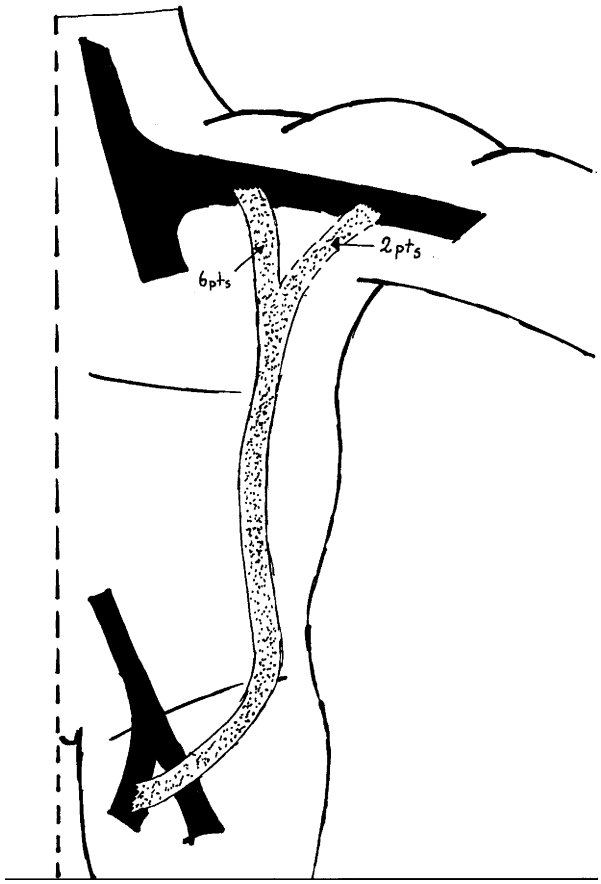
RESULTS

No blood transfusion was required. The postoperative period was uneventful in all patients. The access was used on the first postoperative day. No leg edema or varicosities were recorded during follow-up. Four patients reported immediate improvement with regard to a sensation of heaviness. In all patients arm stiffness and swelling began to subside during the first postoperative day; within 7 to 10 days the affected arm had less than 4 cm difference in perimeter compared with the contralateral arm, and patients were absolutely symptom-free. Ipsilateral hand hyperpigmentation remained in 2 patients; however, 1 of those patients experienced healing of an accompanying ulcer. Follow-up ranged from 7 to 56 months. One graft failed 5 months after insertion; patency of this graft was restored with thrombectomy and revision. Infection of an inguinal wound was observed in this patient, which resolved after drainage. Bridge graft and access patency data are presented in Table II.

DISCUSSION

Marked edema has been reported in 11% of patients with a history of subclavian vein catheter after A-V fistula creation.[1] Functional disability of the involved extremity remains the major side effect, occurring in approximately 75% of patients.[5] Treatment options include closure of the fistula, percutaneous transluminal angioplasty, and bypass of the occluded vein segment. Ligation of the access is a simple and effective method for correcting symptomatic stenosis or occlusion of a central vein, and is probably the most frequently performed procedure.[1-3] However, such treatment not only destroys the functional A-V access in a patient critically dependent on hemodialysis, but renders the limb unsuitable for future use as an angioaccess site. Percutaneous transluminal angioplasty is widely performed as a less invasive procedure, with satisfactory short-term results, but high reccurence rates with balloon dilation alone have led to the widespread adoption of stenting.[12] In a series comparing surgical and transcutaneous procedures, primary symptomatic relief at 1 year was achieved in 88% of patients in the surgical group versus 36% in the angioplasty group. One-year and 2-year success rates with repeated angioplasty were 86% and 66%, respectively.[13] Complication rates of stent therapy have ranged from 0% to 50%.[12-14] Direct repair of the stenotic vein seems to be the most reasonable approach, but requires a major surgical procedure. The results of this approach do not seem to differ markedly from those of other procedures.[4]

Surgical bypass of the thrombosed area enables conservation of the fistula and preserves other areas for future access sites[9]; it is currently considered the gold standard,[12] given satisfactory long-term patency and low perioperative morbidity rates. A spiral vein[15] or PTFE[10] graft has been used to bridge the axillary, subclavian, or innominate vein



Schematic representation of bridge graft route from axillary vein (subclavian region, n = 6; axilla, n = 2) to long saphenous vein.

with the right atrium. Nevertheless, there are concerns about the magnitude of such a procedure in a patient population at high risk. Ipsilateral, or rarely contralateral, internal jugular vein has most commonly been used, either as a conduit [6,7,16] or as a site of anastomosis of the bypassing graft from the axillary or the distal subclavian vein.[2,5,8,16] Although internal jugular vein is a suitable option for bypass, because of its vicinity to the axillary vein, it is associated with 2 main disadvantages. First, if the vein is used as a conduit, it must be ligated and transected, depriving the patient of a site for possible future catheter insertion. Furthermore, the procedure is feasible only if the contralateral internal jugular vein is normal. Second, contrast agent–enhanced studies rarely permit precise localization of the obstruction or accurate estimation of its length, because abundant collateral vessels often obscure the region of obstruction, and frequently the vascular defect extends farther from the previous catheter insertion point.[4] Thus, if the obstruction happens to be located or extends proximally to the jugular-subclavian junction, this kind of bypass is useless. This problem is also relevant to use of external jugular vein[9,11] as a receptor site of the bypass. Although bypass to the saphenous vein is free of all of these

Table I. Clinical data

Patient	*Symptoms at presentation*	*Type of access*	*Access construction to bypass (mo)*	*Location of central vein occlusion*
1	Arm, face, and breast swelling; ectropion; thrombosis of jugulo-jugular graft	s-s A-V fistula	18	Left innominate
2	Arm, breast edema; difficulty cannulating fistula	s-s A-V fistula	5	Right innominate
3	Arm edema	e-s A-V fistula	No data	Left subclavian
4	Arm edema, hand ulcer, hyperpigmentation, bleeding cannulation sites	s-s A-V fistula	8	Right subclavian
5	Arm edema; difficulty cannulating fistula	A-V graft loop, forearm	10	Left subclavian
6	Arm edema, hand ulcer, hyperpigmentation	s-s A-V fistula	7	Right subclavian
7	Arm edema, prolonged bleeding time, breast edema, epiphlebon, ectropion	A-V graft mid-humer	12	Left innominate
8	Arm edema, impossible cannulation	s-s A-V fistula	7	Right subclavian

s-s, Side-to-side; *e-s,* end-to-side; *A-V,* arteriovenous.

Table II. Results

Patient	*Follow-up (mo)*	*Bridge graft patency (mo)*	*Access patency (mo)*	*Clinical outcome*
1	56	56	54	Bridge graft thrombosed owing to diminished arteriovenous fistula patency; no relapse of any symptom or sign
2	18	18	18	Death from unrelated reason; bridge graft and access patent
3	36	36	36	Lost to follow-up
4	20	20	20	Graft still functioning
5	17	17	17	Graft still functioning
6	8	8	8	Graft still functioning
7	7	5	7	Thrombectomy and dilation of graft-saphenous anastomosis in postoperative month 5; partial resolution of edema, access in use, bridge graft patent
8	10	10	10	Graft still functioning

disadvantages, previous experience with the procedure is limited, focused on management of superior vena cava syndrome.[17,18]

A major concern is the patency of such a long veno-venous graft. Many factors contribute to poor patency rates of conduits used in vein reconstruction,[16] including inadequate flow, material thrombogenicity, and graft collapsibility. Autologous vein grafts (long saphenous vein either reversed or sewn in a spiral pattern) have been used for vein reconstruction or bypass, because of minimal material thrombogenicity, but the technique depends absolutely on the availability and quality of the saphenous vein. Moreover, vein conduits are collapsible, and in the case of axillary-saphenous bypass their length is inadequate to bridge the gap between the 2 vessels, and their occlusion rate is high.[19] PTFE conduits are less thrombogenic than other synthetic grafts, and less collapsible, especially in the externally supported version, and thus are widely used.

A well-established treatment of the low velocity problem in vein reconstructive surgery is creation of an A-V fistula distal to the reconstruction.[20] This is a preexisting advantage in these patients, and must be considered as the main factor maintaining graft patency.[8] In our first patient the graft became thrombosed after deterioration of the A-V fistula; that was the reason for no symptom relapse. The success of surgery in this group of patients should be judged on the duration of A-V fistula function.[4] In 1999 Schindler et al[12] published a meta-analysis of 5 series with a total number of 53 patients who had undergone surgical bypass to treat superior vena cava syndrome since 1990. Most of those patients received a PTFE graft; spiral vein grafts were used less often. Primary patency rates ranging from 67% to 100%, secondary patency rates of up to 100%, and 5-year patency rate of 86% were reported.[12] In patients undergoing hemodialysis after different surgical procedures, Bhatia et al[20] reported 100% initial patency, 92% 6-month patency, and 83% 1-year patency. In the present study the initial patency was 100%, primary 6-month patency was 87.5%, and secondary 6-month patency was 100%.

Satisfactory results have been reported with internal jugular vein–superior vena cava transposition, but multiple incisions are necessary, most probably along with resection of the clavicle. Internal jugular vein is sacrificed, therefore precluding its use for temporary access, hemodynamic monitoring, or even outflow for A-V fistulas. The procedure is contraindicated if there is occlusion of the contralateral internal jugular vein or innominate vein. Unless the clavicle is resected to enable complete mobilization of the internal jugular vein down to the innominate vein, the internal jugular vein kinks and may be functionally ob-

structed at the point where it is turned back to reach the superior vena cava.[4] The recently reported technique of decompression of A-V graft to the ipsilateral femoral vein[21] offers a solution only to the excess pressure problem, leaving the arm unsuitable for further use in case of occlusion of the decompressed graft. Graft dissection in an arm with venous hypertension is not an attractive option, and the method is of questionable applicability in cases of A-V fistula. Use of femoral vein is also a less safe alternative in a complicated case. An axillosaphenous bypass is a much more simple procedure, accomplished easily with the patient under local anesthesia, and carries substantially less risk, with comparable results.

REFERENCES

1. Clark DD, Albina JE, Chazan JA. Subclavian vein stenosis and thrombosis: a potential serious complication in chronic hemodialysis patients. Am J Kidney Dis 1990;15:265-8.
2. Currier CB, Widder S, Ali A, Kuusito E, Sidawy A. Surgical management of subclavian and axillary vein thrombosis in patients with a functioning arteriovenous fistula. Surgery 1986;100:25-8.
3. Kahn D, Pontin AR, Jacobson JE, Matley P, Beningfield S, van Zyl-Smit R. Arteriovenous fistula in the presence of subclavian vein thrombosis: a serious complication. Br J Surg 1990;77:682.
4. Gradman WS, Bressman P, Sernaque JD. Subclavian vein repair in patients with an ipsilateral arteriovenous fistula. Ann Vasc Surg 1994;8:549-56.
5. Campistol JM, Abad C, Torras A, Revert LI. Salvage of upper arm access graft in the presence of symptomatic subclavian vein thrombosis. Nephron 1989;51:551-2.
6. Fulks KD, Hyde GL. Jugular–axillary vein bypass for salvage of arteriovenous access. J Vasc Surg 1988;8:169-71.
7. Puskas JD, Gertler JP. Internal jugular to axillary vein bypass for subclavian vein thrombosis in the setting of brachial arteriovenous fistula. J Vasc Surg 1994;19:939-42.
8. Myers JL, Mukherjee D. Bypass graft to the contralateral internal jugular vein for venous outflow obstruction of a functioning hemodialysis access fistula. J Vasc Surg 2000;32:818-20.
9. Fernandez E, Frutos JL, Perez L, Montoliu J. Cephalic to external jugular vein bypass to preserve arteriovenous fistula for haemodialysis after subclavian vein thrombosis. Nephrol Dial Transplant 1990;5:977-9.
10. El-Sabrout RA, Duncan JM. Right atrial bypass grafting for central venous obstruction associated with dialysis access: another treatment option. J Vasc Surg 1999;29:472-8.
11. Tordoir JHM, Leunissen KML. Jugular vein transposition for the treatment of subclavian vein obstruction in hemodialysis patients. Eur J Vasc Surg 1993;7:335-8.
12. Schindler N, Vogelzng RL. Superior vena cava syndrome: experience with endovascular stents and surgical therapy. Surg Clin North Am 1999;79:683-93.
13. Wisselink W, Money SR, Becker MO, Rice KL, Ramee SR, White CJ, et al. Comparison of operative reconstruction and percutaneous balloon dilatation for central venous obstruction. Am J Surg 1993;166:200-4; discussion 204-5.
14. Glanz S, Gordon DH, Lipkowitz GS, Butt KMH, Hong J, Sclafani S. Axillary and subclavian vein stenosis: percutaneous angioplasty. Radiology 1988;168:371-3.
15. Doty DB, Doty JR, Jones KW. Bypass of superior vena cava: fifteen years' experience with spiral vein graft for obstruction of superior vena cava caused by benign disease. J Thorac Cardiovasc Surg 1990;99:889-96.
16. Moore WM, Hollier LH, Pickett TK. Superior vena cava and central venous reconstruction. Surgery 1991;110:35-41.
17. Ham RJ, Buldstrode C, Eadie DGA. Saphenous-jugular bypass for superior vena caval obstruction. Br J Surg 1985;72:193-4.
18. Vincze K, Kulka F, Csorba L. Saphenous-jugular bypass as palliative therapy of superior vena cava syndrome caused by bronchial carcinoma. J Thorac Cardiovasc Surg 1982;83:272-7.
19. Molina JE. A new surgical approach to the innominate and subclavian vein. J Vasc Surg 1998;27:576-81.
20. Bhatia DS, Money SR, Ochsner JL, Crockett DE, Chatman D, Dharamsey SA, et al. Comparison of surgical bypass and percutaneous balloon dilatation with primary stent placement in the treatment of central venous obstruction in the dialysis patient: one-year follow-up. Ann Vasc Surg 1996;10:452-5.
21. Ayarragaray JEF. Surgical treatment of hemodialysis-related central venous stenosis or occlusion: another option to maintain vascular access. J Vasc Surg 2003;37:1043-6.

Submitted Apr 26, 2004; accepted Jul 2, 2004.
Available online Aug 21, 2004.