Central venous thrombosis may often arise following central venous cannulation for temporary haemodialysis access. Venous thrombosis may be clinically asymptomatic due to the presence of collateral circulation. However, if an arteriovenous (AV) fistula is prepared below the obstructed venous segment, then symptoms may occur. Central venous hypertension interferes with dialysis, compromises limb function and threatens its safety. Percutaneous treatment is mostly used. However, in some cases endovascular treatment may not be as easy and long term patency uncertain.

We report our experience on 3 patients on chronic hemodialysis treatment presenting with a patent AV fistula and ipsilateral subclavian vein chronic fibrotic obstruction. They were treated by ipsilateral internal jugular to distal subclavian vein transposition. Two separate surgical incisions were performed to expose the subclavian vein distally to the occlusion and the jugular vein that was distally ligated and transposed. There was no mortality nor significant postoperative complications. Resolution of hypertensive symptoms was achieved within 3–4 weeks in all patients. The AV fistula was used for dialysis treatment starting from the first postoperative day. At follow-up (mean 13 months), there was no recurrence of upper limb venous hypertension.

In patients with subclavian occlusion and ipsilateral low flow, patent AV fistula, jugular to distal subclavian vein transposition may prove useful in cases when percutaneous angioplasty is technically not feasible or long term patency is not expected.

Keywords: central vein obstruction, haemodialysis, interventional therapy, veno-venous bypass, surgery

Introduction

Central venous cannulation is a common practice for temporary haemodialysis access. Despite the relative ease of the procedure, the positioning of the catheters may be responsible for central venous thrombosis in up to 35% of cases. This condition would eventually lead to chronic fibrotic obstruction. Central venous obstruction may be clinically asymptomatic due to the presence of collateral circulation. However, if an arteriovenous (AV) fistula is prepared below the obstructed venous segment, then symptoms may occur. 1 to 5% of these patients may present with a clinical picture of venous hypertension with arm swelling, pain and functional impairment, requiring treatment therapy.
Usually, a simple fistula ligation resolves the symptoms, but it eliminates a valuable vascular access and prevents the creation of a new ipsilateral one. Percutaneous angioplasty (PTA) is often used to treat venous stenosis. However, technical difficulties may arise with particular anatomical findings and recurrence may occur. Surgical reconstruction of venous continuity may prove useful to resolve symptoms of venous hypertension, allowing use of the same ipsilateral vascular access. We report our experience with three patients presenting with a patent AV fistula and ipsilateral subclavian vein occlusion, treated by ipsilateral internal jugular to distal subclavian vein transposition to relieve upper limb venous hypertensive syndrome.

Case Report

We report on 3 patients under chronic hemodialysis treatment. They had subclavian vein occlusion, ipsilateral low flow AV fistula ineffective for dialysis treatment and upper limb venous hypertensive syndrome. This was characterized by painful and incapacitating arm swelling and subcutaneous venous collaterals. None of the patients presented skin ulceration or tissue loss.

The mean age was 67 years (range, 58–74 years); 2 men and 1 woman.

All patients had a long term history of haemodialysis treatment (range 6 to 8 years), and previous vascular access surgery on both upper limbs. In all patients, it was considered imperative to save the AV fistula if possible. The AV fistula was patent but at a low flow at duplex US examination. All patients had a history of previous central venous temporary cannulation, ipsilateral to the AV fistula. At duplex US and venous angiography, in all three cases there was occlusion of the subclavian vein and patency of the internal jugular and axillary veins.

Conservative treatment with rest, limb elevation, and anticoagulation were ineffective for relieving venous hypertension syndrome.

All patients underwent preoperative evaluation with duplex ultrasound (US) mapping to locate venous occlusion and confirm AV fistula, jugular and axillary vein patency. Venous angiography confirmed central venous obstruction with collateral circulation (Fig. 1).

Intraoperative PTA, when attempted, was abandoned if the result was considered to be not appropriate for long term patency (i.e.: in case of extensive chronic fibrotic obstruction). None of the patients had previous stenting treatment. In all patients, surgery was considered as the last option to relieve upper limb venous hypertension and to save the ipsilateral functioning low flow AV fistula.

Surgical technique

Patients were treated by transposition of the internal jugular vein to the ipsilateral subclavian vein to achieve venous decompression (Fig. 2). Intraoperative venous angiography was performed in all patients before and after venous transposition. All patients were first evaluated for possible endovascular treatment before open surgery began. In case of chronic fibrotic obstruction of a long segment of the subclavian vein, a surgical approach was then preferred.

Two separate surgical incisions were performed: A first sub-clavicular incision to expose the subclavian-axillary vein segment and a second incision along the anterior border of the sternocleidomastoid muscle to expose the internal jugular vein (Fig. 3a).

The internal jugular vein was mobilized as far as possible and distally ligated. It was tunneled behind the clavicle and anastomosed to the axillary vein distally to the occluded segment (Fig. 3b).

With the aim to decrease the extrinsic compression on the transposed internal jugular vein, in the last two treated patients we associated resection of the first rib, while in the first one, we had passed the transposed vein...
Fig. 2  Drawing illustrating the ipsilateral jugular to subclavian vein transposition, with resection of the first rib. IJV: internal jugular vein; SCM: sternocleidomastoid muscle

Fig. 3  Operative findings showing.

a) Two surgical incisions exposing the jugular and subclavian veins. The subclavian artery is circled by soft vessel loops.
b) Detail of subclavian incision with the jugular vein transposed and anastomized on the distal subclavian vein. IJV: internal jugular vein; *: subclavian vein
inside a 10 mm reinforced polytetrafluoroethylene (PTFE) (W.L. Gore & Associates, Inc. Flagstaff, AZ, USA) prosthesis.

Postoperative results

There was no mortality nor significant postoperative complications. Postoperatively, there was a gradual reduction of arm swelling and cutaneous collateral circulation together with recovery of arm function. Complete resolution of hypertensive symptoms was achieved within 3–4 weeks in all patients. The AV fistula was used for dialysis treatment starting from the first postoperative day. Postoperative treatment included low-molecular-weight heparin (LMWH) treatment for 1 month followed by antiplatelet treatment. Postoperatively, patients doing well clinically after surgery were followed up at regular intervals at 1, 3 and 6 months, and every 6 months thereafter. Duplex US study showed AV fistula patency, without recurrence of the venous hypertensive syndrome. At follow-up (12, 14 and 15 months), clinical examination showed no recurrence of upper limb venous hypertension. US duplex scan demonstrated good function of the AV fistula and patency of the jugular subclavian vein anastomosis, with patients still remaining on antiplatelet treatment.

Discussion

Central venous catheterization is widely used in medical practice: for central venous pressure monitoring, pacemaker lead insertion, parenteral nutrition, chemotherapy, and as temporary vascular access for haemodialysis. Despite the benefits it offers, the technique may lead to different complications, including central venous thrombosis, eventually leading to chronic fibrotic obstruction.

In most patients, central venous obstruction is not followed by the occurrence of an evident hypertensive venous syndrome: this is due to the rapid development of collateral circulation. Collateral circulation is usually adequate for venous drainage under basal conditions, but once an ipsilateral AV fistula is prepared, then collateral circulation may not be sufficient to accommodate the high flow during dialysis sessions, unmasking venous hypertension. Venous hypertension interferes significantly with dialysis, decreasing vascular bed availability. This condition compromises limb function and threatens its safety with the impeding risk of phlegmasia cerulea dolens. Treatment options are limited. Conservative treatment with limb elevation and anticoagulant or thrombolytic therapy has low success probability. The solution would be AV fistula ligation, which would reduce venous hypertension symptoms. However, in this case, a new vascular access should be prepared. Unfortunately, these patients often have a previous history of vascular access surgery, and the ligation of a patent fistula would not be the best option. This decision would preclude any future ipsilateral vascular access for haemodialysis. The aim should be to treat upper limb venous hypertension and to save the AV fistula, as well.

Nowadays, percutaneous angioplasty (PTA) with or without stent implantation is frequently used for the treatment of central venous stenosis. Frequent restenosis has been reported with PTA alone, with a primary one-year patency of less than 40% in most studies. With the aim to reduce re-interventions, many groups use routine stent placement with each PTA procedure.

Other groups instead use stenting only for significant, early or frequent restenoses. Stenting has improved the patency rate. However, despite improvements in results, the problem is far from having been solved. Results after PTA with stenting are quite inhomogeneous, with primary patency ranging from 60% to 28%, and secondary patency between 84% to 33% after 2 years. Using a covered stent or the use of endovascular brachytherapy seems to enhance the patency rate. Several anatomical changes inside the central veins may predispose to PTA failure. Long-standing stenosis may provoke vein fibrosis and occlusion of long venous segments. In this case, endovascular treatment may not be as easy and long term patency can be jeopardized.

A surgical approach may represent an alternative. Different surgical techniques have been proposed, from direct exploration to venous reconstruction or bypass surgery, including subclavian vein-to-right atrial bypass, cephalic to external jugular vein bypass and cross-over bypass to the axillary or jugular vein. Autologous (saphenous or jugular vein) or prosthetic materials have been used as interposition grafts or for subclavian-caval and axillo or subclavian-jugular bypass. Thrombogenicity of a synthetic prosthesis may favour further graft thrombosis. An alternative surgical technique may be represented by ipsilateral jugular to subclavian vein transposition. The choice of this technique may prove useful in selected cases, as in our series of patients, where the proximal subclavian vein was occluded without involvement of the internal jugular or the axillary veins. Puskas and Gertler first proposed this technique in 1994, and since then, a few cases have been reported in the literature.
modified the original technique. We found that compression may arise on the transposed vein from contiguity with the first rib and clavicle. In the first treated patient, we thought to protect the jugular vein, passing it inside a reinforced PTFE prosthesis. Then, in the last two cases, we added resection of the first rib, in order to adequately decompress the space to prevent rib-clavicular compression of the jugular vein. This modification of the original technique may prove useful to improve patency rate.

Conclusions

Central venous hypertension in patients with ipsilateral patent AV fistula requires early diagnosis and appropriate treatment to resolve hypertensive venous syndrome, respecting the patent AV shunt. Nowadays, endovascular options are usually considered first in consideration of their reduced invasiveness. However, in cases of subclavian occlusion and in cases when long term patency is not expected, then an alternative surgical procedure may be proposed. Ipsilateral jugular to subclavian vein transposition may prove useful in selected cases. First rib resection may prove valuable to prolong patency of the transposed jugular vein. A larger series of patients and longer follow-up would help to better demonstrate the real advantage of this technique.

References

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