OPERATING MANAGEMENT OF CENTRAL VENOUS HYPERTENSION COMPLICATING UPPER EXTREMITY DIALYSIS ACCESS

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Aim: To evaluate the importance of surgical bypass between the terminal part of functional arteriovenous shunt (av) for hemodialysis on upper extremity and inner jugular vein in axillosubclavian venous segment obstruction associated with central venous hypertension.

Method: Retrospective assessment of surgical bypass between central segments of av fistula and ipsilateral/contralateral inner jugular vein using ePTFE graft in 17 patients over a 20 year period (1987–2006).

Results: The surgical procedure was not associated with intra- or post-operative complications. Primary cumulative bypass and av fistula function persisted for 26 months on average.

Conclusion: An accurate bypass to salvage the functional dialysis access associated with central venous hypertension requires careful decision based on clinical and radiological examination. The bypass procedure is beneficial where endovascular treatment is not indicated. Clinical and radiological bypass monitoring is crucial.

INTRODUCTION

Hemodialysis av fistulas are mostly constructed using autologous vessels or prosthetic graft on the upper extremity. There are an increasing number of patients with primary or secondary av fistula with brachial artery inflow. Such av fistulas are associated with rare complications such as hyperfunction of the fistula and central venous hypertension. Central venous hypertension occurs in patients with a history of subsequent attempts at dialysis access and repeated central venous system catheterization where the subclavian vein is often strictured or obstructed. It presents as an edema and upper extremity functional disorder while the av fistula remains functional. The pathologically altered venous tract is currently most often treated by endovascular transluminal angioplasty which can be followed by stent implantation.

Endovascular treatment is not suitable in cases of long vein occlusion and under adequate anatomical conditions the surgical procedure can maintain the av fistula function.

MATERIAL AND METHODS

We evaluated central venous hypertension requiring treatment in 72 patients over a 20-year period from January 1987 to December 2006. In the first period (1987–1990) cases were documented clinically and by venography. The av shunt was intentionally discontinued or spontaneously failed in 5 patients. In the following period (1991–2006)

with better examination and treatment methods available, 3 more av fistulas were discontinued as the simultaneous neo-av shunt on the contralateral extremity was regarded as easier. Forty seven patients were treated endovascularly. Radiologically confirmed central venous hypertension caused by extensive axillosubclavian venous occlusion requiring surgical treatment was reported in 17 patients. Complications were seen in 6 men and 11 women aged 54 on average. The av shunts were performed at various surgical facilities. All patients had a history of repeated central venous catheterization. In most cases, the bilateral subclavian vein was repeatedly catheterized to enable central venous catheter placement. Central venous hypertension was most frequently associated with av shunt created in the cubital fossa with brachial artery blood inflow. Av shunts were autologous or with ePTFE graft with venous anastomosis to the brachial vein. Complications caused by radiocephalic shunt were observed in only 2 patients. All av fistulas were secondary, with a history of repeated surgical procedures for stenotic and thrombotic complications. In 5 patients, the precise form of surgical revision remained unclear and the evaluation was based only on angiographic study. Clinical signs were very similar in all patients. An upper extremity edema spreading from the fingers to the arm predominated, the extremity was bluish and range of phalanx movement was limited. The finger tips often had skin defects, fissures and impaired ungual growth. Subcutaneous venous collaterals were visible in the area of proximal arm and shoulder. In all cases the av fistula was functional and permitted angioaccess.

All av fistulas were primarily examined by duplex ultrasound. This method was also used for central venous system evaluation. Contrast angiography with inflow artery catheterization was used for av fistula examination. Angiography evaluated the inflow artery, arterial anastomosis, the av fistula itself, its catheterization segment and outflow tract. In av shunts with synthetic graft, venous anastomosis was evaluated.

In all evaluated patients, studies showed axillosubclavian venous occlusion at the site of the av fistula. Contrast angiography mostly failed to evaluate ipsilateral and contralateral inner jugular vein. In cases of unclear findings for inner jugular vein, catheterization under ultrasound control and venography was performed to evaluate the vena cava superior as well.

Central venous hypertension was treated with bypass between central av shunt segment and inner jugular vein. Under general anesthesia (14 patients) or local anesthesia (3 patients) depending on av fistula type, vena cephalica in sulcus deltoideopectoralis, central segment of anteponed basilic vein, or synthetic graft was prepared and 6 or 8 mm ePTFE graft (GORE thinwalled) was anastomosed in an end-to-side manner to vein or graft, which was placed in the subcutaneous tissue ante clavícula and then behind musculus sternocleidomastoideus and anastomosed end-to-side to the inner jugular vein. Both anastomoses measured 15 to 20 mm. The ipsilateral inner jugular vein was used in 15 patients, the contralateral inner jugular vein in 2 patients. The surgical procedure was performed under ATB therapy and patients medicated with acetylosalicylic acid in a dose of 100 mg per day in the post-operative period. No intra-operative complications or post-operative sequelae such as bleeding, thrombosis or fistula infection occurred. Central venous hypertension receded over two or three weeks and the av fistula remain functional in all cases. This was regularly monitored, initially once a week, subsequently once a month, for a total of 30 months, using duplex ultrasound.

The long term maintenance of the av fistula function depended on patient compliance. Av fistula or graft remained functional for 26 months in patients who were checked regularly (14 patients). Av fistula function failure (not occlusion) was detected during hemodialysis or by duplex ultrasound examination and verified using angiography. Hemodynamically significant stenosis of the av fistula, graft or anastomosis was treated by endovascular, surgical or combined method, depending on the type. In av fistula obstruction surgical thrombectomy via graft was performed using Fogarty's catheter, av fistula was intra-operatively examined with angiography and the cause of the obstruction was eliminated. It is important that in all cases the inner jugular vein remained patent and could be used as the outflow tract of the re-reconstructed av fistula.

DISCUSSION

Central venous hypertension occurs in 3–11 % of patients with dialysis access^{1,3}. It is estimated that approximately 70 % may be treated endovascularly, the rest by surgical procedure or with av fistula cessation. The cause of subclavian vein impairment is mostly its central venous access catheterization which presents in 14–40 % of patients, who later need dialysis access^{4,5}. Complications occur in patients who are in the dialysis program for a long time and who undergo repeated dialysis access salvage and prior outflow tract examination⁵. Stenosis is not confirmed, or there is no better outflow tract accessible and complication is assumed. Prior to the creation of the av fistula, the stenotic segment causes no complications. Later, non-physiological inflow is associated with turbulence, thrombocyte aggregation and thrombus formation that result in intimal hyperplasia and intrastenotic fibrotisation. Stenosis progresses and leads to closure and venostasis in the extremity. In some cases finger tip necrosis can present.

The clinical signs are clear and also clear from the angiography. This can show other possible complications in the upper extremity circulation. An eventual shunt in the deep venous circulation causing peripheral edema must be eliminated. In case long axillosubclavian obstruction presents, endovascular methods cannot be used and surgical procedures are indicated. Prior to surgical procedures, the main venous stem, both inner jugular veins, contralateral subclavian vein and vena cava superior which may be used as an outflow tract, must be examined. The duplex ultrasound or venography examination should be performed by an experienced radiologist as the findings are crucial for both surgical procedure type preference and prospective av fistula function. Our experience shows that in some cases, examinations done at a local radiological clinic indicated an incorrect outcome – the central venous tract was stated to be obstructed while actually it was patent.

The general therapeutic principle involves av fistula maintenance and elimination of venous hypertension. Beside av fistula disconnection, the following types of surgical treatment can be performed:

- to prepare an enclosed vein through axillar or subclavian access and after resection interpose an ePTFE graft⁶
- to create a bypass between ante stenotic part of axillar vein and inner jugular vein using ePTFE graft^{6,7}
- to create a bypass between subclavian vein and vena cava superior using ePTFE graft or bypass to right cordial atrium^{8,9}
- to bypass the obstruction using inner jugular vein, that is proximally cut across, mobilized and led through subclavian area to axillar vein and anastomosed in an end-to-side manner distally to axillar vein obstruction¹⁰
- to create a bypass between axillar vein and vena saphena magna or femoral vein using subcutaneously placed ePTFE graft^{11,12}

Fig. 1. Clinical finding on upper extremities prior to treatment.

Fig. 2. Clinical finding on impaired upper extremity prior to treatment - detailed.

Fig. 3. Venography showing venous bloodstream in impaired upper extremity prior to treatment.

Fig. 4. Clinical finding on impaired upper extremity immediately after surgical treatment.

Fig. 5. Venography showing venous bloodstream in impaired upper extremity after surgical treatment.

Most of these procedures are complicated and a satisfactory result can be expected in only 50 % of cases⁶⁻⁸. Each patient must be treated individually. Better outcomes are associated only with bypass to inner jugular vein, if it is technically available^{13, 14}. We prefer to perform the procedure under general anesthesia, but we have also experienced good results under local anesthesia¹³. In conformity with this finding we can state that arteriovenous bypass creation proximal to an obstruction represented by axillar or subclavian vein occlusion to inner jugular vein is an uncomplicated surgical procedure that is well tolerated by patients. The central venous hypertension promptly recedes, the av fistula is functional and in case of need, the graft can be used as a catheterization segment. Av fistula function and graft can be monitored by duplex ultrasound or angiography. The graft offers access to bloodstream for potential surgical or endovascular procedures.

CONCLUSION

Surgical bypass of an obstructed venous segment, proximal to a functioning dialysis access site, is an established treatment for relieving central venous hypertension symptoms and salvage functional dialysis access. Precise pre-operative examination is crucial in choosing the right method. Regular monitoring is necessary for long term dialysis access and reconstruction function.

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