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PERCUTANEOUS TRANSLUMINAL ANGIOPLASTY FOR STENOSIS OF ARTERIOVENOUS FISTULAS IN HAEMODIALYSED PATIENTS

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Summary

Fifteen stenoses of direct radial arteriovenous fistulas were treated by percutaneous transluminal angioplasty in 12 haemodialysed patients. Immediate success was obtained in 13 stenoses. Two definitive thromboses occurred several weeks after percutaneous transluminal angioplasty, and recurrent in situ stenoses occurred in six cases; the latter were retreated by percutaneous transluminal angioplasty, with success in five of them. Thus, at the end of the study 10 of the 15 dilated stenoses were patent and the corresponding arteriovenous fistulas functional. Therefore, percutaneous transluminal angioplasty seems an efficient treatment of fistula stenosis and should be performed before considering surgery.

Introduction

Arteriovenous fistulas are the most common type of vascular access for chronic haemodialysis. Stenosis of the venous side is a frequent cause of dysfunction which is responsible for diminished blood flow and inadequate dialysis. It might eventually lead to fistula thrombosis with loss of the vascular access. As percutaneous transluminal angioplasty proved to be efficient in the treatment of stenosis of renal and coronary arteries we decided to apply this procedure to stenoses of arteriovenous fistulas. We report on results of the treatment by percutaneous transluminal angioplasty of 15 stenoses of direct radial arteriovenous fistulas in 12 patients.

Patients and methods

Over a period of 27 months (1st January, 1983 to 31st March, 1985), 62 chronic uraemic patients received maintenance haemodialysis in a single unit. All patients were dialysed four hours three times a week. Anticoagulation during haemodialysis session was obtained by heparin. While vascular access was either a Gore-Tex® or a bovine artery graft in nine patients, it was a direct arteriovenous

fistula in the 53 others. Arteriovenous fistulas were made by a side-to-end anastomosis between the radial artery and either the cephalic vein or the dorsal vein of the thumb. During the period of the study stenosis of the venous side of direct arteriovenous fistulas occurred in 12 (23%) of the 53 patients (9 men, 3 women; mean age 57 years; range 42–74). One patient developed a proximal stenosis on two different arteriovenous fistulas. Among the 11 others, nine developed only one proximal stenosis and two developed successively two different stenoses on the same arteriovenous fistula, the first being proximal, the second distal. Therefore, on the whole 15 stenoses were dilated.

Arteriovenous fistula stenosis was considered in all patients with a diminished dialysis blood flow (<200ml/min) indicated by the blood pump monitor. In addition, post-anastomotic veins were obviously insufficiently developed in most patients. Arteriovenous fistula stenosis was always confirmed by a fistulogram performed through a 5F Teflon® catheter inserted into the brachial artery.

Fourteen stenoses occurred within a rather short period of time after arteriovenous fistulas were created with a mean interval of 38 weeks (range 4–50) while the last one (patient No 2) occurred three and a half years after formation. The 13 proximal stenoses were located within 1 to 4cm from the anastomosis, while the two distal ones were located at 10 and 15cm from the anastomosis respectively. Fourteen of the 15 stenoses had a length ranging from 1 to 4cm, whereas the last one (patient No 3, distal stenosis) was 10cm long.

Percutaneous transluminal angioplasty was performed as follows. The venous side of the arteriovenous fistula was punctured with a 5F Teflon sheath distally to the stenosis. A straight or 3mm J-wire guide was used to traverse the stenosis. A 30mm Olbert balloon was then introduced across the stenosis. When difficulty was encountered in traversing the stenosis, the use of progressively larger dilators, from 5 to 7F, allowed the passage of the balloon. To reduce pain during dilatation, 2% xylocain was subcutaneously injected at the site of the stenosis. Five thousand units of heparin were injected prior to the dilatation. The balloon was inflated up to 12 atmospheres for 45 seconds, from two to 10 times, until disappearance of the deformity that this stenosis had marked on it was obtained. It was then pulled back distally to the stenosis and a fistulogram was performed. No anti-aggregant or anticoagulant drugs were given to the patients after percutaneous transluminal angiography.

Results were assessed according to both the results of the fistulogram performed immediately after percutaneous transluminal angiography and the values of the dialysis blood flow measured during the sessions following percutaneous transluminal angioplasty. Percutaneous transluminal angioplasty was judged successful when (1) fistulogram showed correction of the stenosis; (2) dialysis blood flow returned to values >300ml/min. In addition, blood flow through the fistula ($\dot{Q}$ AVF) was measured by a pulsed Doppler method [1] in the follow-up of 12 percutaneous transluminal angioplasties.

Results

Immediate results Immediate success judged by the angiographically proved correction of the stenosis was obtained in 13 of 15 stenoses. In spite of the

persistence of a slight narrowing in four of them, dialysis blood flow increased after percutaneous transluminal angioplasty to values >300ml/min in all. Moreover, fistulas became easier to puncture and they developed within the weeks following percutaneous transluminal angioplasty as well as the post-anastomotic veins. Percutaneous transluminal angioplasty was unsuccessful in two cases (patients Nos 7 and 9) in which a definitive thrombosis occurred within a few hours after percutaneous transluminal angioplasty. No other complication was observed.

Late results (Figure 1) The 13 stenoses corrected by percutaneous transluminal angioplasty had a mean follow-up of 48 weeks until the end of the study (range 10–108). $\dot{Q}$ AVF was measured in 12 of them at intervals of time varying from one to 14 weeks after percutaneous transluminal angioplasty (mean 5 weeks). Satisfactory values (mean $\dot{Q}$ AVF 500ml/min; range 350–750) were found in all cases. In two cases (patients Nos 9 and 12) comparison of pre- and post-percutaneous transluminal angioplasty values showed an increase of $\dot{Q}$ AVF of 240 and 100ml/min respectively.

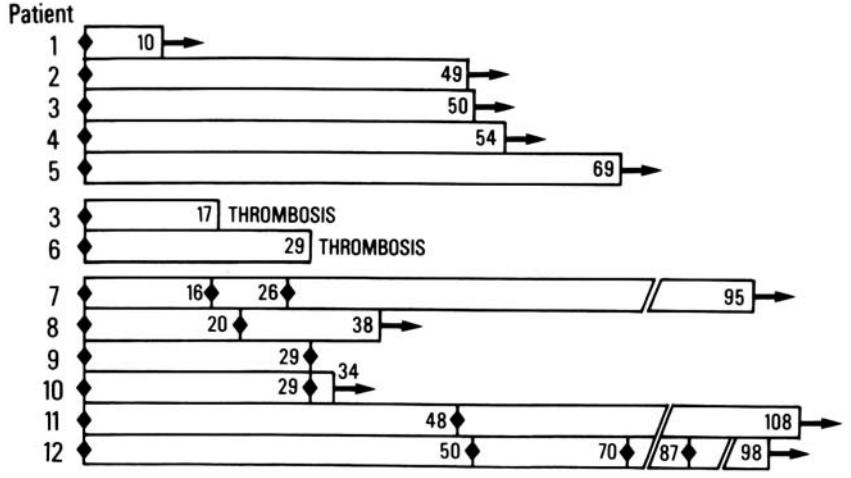

Figure 1. Follow-up of the 13 of 15 stenoses initially corrected by percutaneous transluminal angioplasty (PTA) (see text for details). ♦=PTA; Numbers indicate weeks after first PTA; Arrows indicate patent arteriovenous fistulas at the end of the study (patient No 3 appears twice since he was successively treated for two stenoses at different locations)

In a first group of five stenoses (patients Nos 1 to 5) the arteriovenous fistulas remained patent until the end of the study with a mean follow-up of 46 weeks after percutaneous transluminal angioplasty (range 10–69). In a second group which comprised two stenoses (patients Nos 3 and 6) a brisk and definitive thrombosis of the arteriovenous fistula occurred 17 and 29 weeks after percutaneous transluminal angioplasty respectively. In a third group which

comprised six stenoses (patients Nos 7 to 12) stenosis recurred in situ between 16 and 50 weeks after percutaneous transluminal angioplasty. A second percutaneous transluminal angioplasty was performed in all these cases with success in five, while it failed in one (patient No 9). A sustained patency of the arteriovenous fistula was obtained in three of the five successfully treated cases (patients Nos 8, 10 and 11) with a mean follow-up of 28 weeks after the second percutaneous transluminal angioplasty (range 5–60). The other two patients later developed one (patient No 7) or two (patient No 12) recurrent stenoses respectively. Percutaneous transluminal angioplasty was again performed and was followed by recovery of both arteriovenous fistulas which remained patent until the end of the study. Finally, 10 of the 15 (67%) dilated stenoses were still patent and the corresponding arteriovenous fistulas functional at the end of the study.

Discussion

The present study confirms the frequency of arteriovenous fistula stenosis: indeed it occurred in 12 of 53 unselected chronic uraemic patients dialysed via a direct radial arteriovenous fistula. Proximal stenoses were much more frequent (13 of 15) than distal ones, a finding in agreement with previous reports [2–4] which has been related to the surgical trauma and to the shear stress of arterial blood flow entering the anastomosed vein [5].

Until recently, surgical repair was considered as the sole method of therapy for such stenoses. However, in the past few years several authors reported that arteriovenous fistula stenoses could be corrected by percutaneous transluminal angioplasty. Most of the initial reports dealt with small numbers of cases [6–9], larger series having been reported only by Gaux et al [3], Hunter et al [4] and Glantz et al [5]. In these studies, percutaneous transluminal angioplasty was performed for stenosis of arteriovenous fistulas of different types, i.e. bovine carotid artery or Gore-Tex grafts, saphenous vein autografts as well as direct radial arteriovenous fistulas; moreover these series included stenoses of the anastomosis as well as stenoses of the venous side of the fistulas. As type and location of the stenosis may influence the result of percutaneous transluminal angioplasty we chose to assess the efficiency of angioplasty only in stenoses of the venous side of internal direct radial arteriovenous fistulas. In such stenoses, percutaneous transluminal angioplasty was followed by an immediate success in 86 per cent of cases; similar results have been achieved by other authors [3–5].

Post-percutaneous transluminal angioplasty long-term follow-up showed that (1) recurrence of stenosis is frequent since it occurred in 46 per cent of the cases initially dilated with success; (2) percutaneous transluminal angioplasty can be successfully repeated for restenoses of the same venous segment. The possibility of post-percutaneous transluminal angioplasty restenoses has already been emphasized by Gaux et al [3] and by Glantz et al [5], and the efficiency of repeated percutaneous transluminal angioplasty mentioned by Glantz et al [5]. Two-thirds of the stenosed arteriovenous fistulas were functional at the end of the study, with a mean total duration of post-percutaneous transluminal angioplasty

patency of 46 weeks in the cases with no restenosis (n=5) and of 75 weeks in the cases with one or more recurrences (n=5). A similar proportion of long-term success has been reported by Gaux et al [3] and by Hunter et al [4]. The lower long-term success rate of percutaneous transluminal angioplasty in direct antebranchial arteriovenous fistula stenoses reported by Glanz et al [5] might be ascribed to the inability to exert a sufficient pressure at the site of the stenosis with the Grüntzig angioplasty balloon; therefore the use of an Olbert balloon catheter must be recommended since it allows reaching inflation pressure of 12 atmospheres, which appears necessary to dilate particularly resistant stenoses [3,5]. We also recommend continuing heparin therapy several days after a successful percutaneous transluminal angioplasty in order to diminish the risk of angioplasty-induced thrombosis.

The obvious advantages of percutaneous transluminal angioplasty over surgical correction of stenosed arteriovenous fistulas are (1) the preservation of the 'vascular reserve' in the dialysed uraemic patient; (2) the possibility of treating ambulatory patients. Therefore we recommend the ready performance of fistulograms in cases of arteriovenous fistula dysfunction in order to diagnose stenosis at an early stage when percutaneous transluminal angioplasty is most likely to be successful. Finally, in view of our own results and of those from the literature we think that percutaneous transluminal angioplasty should be considered as the first choice in treatment of stenosis of Cimino-Brescia arteriovenous fistulas in chronically haemodialysed patients.

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