doi: 10.1093/ndt/gfm739
Advance Access publication 23 October 2007

Original Article

Obesity is not an obstacle for successful autogenous arteriovenous fistula creation in haemodialysis

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Abstract

Background. Obesity, which is often associated with diabetes, is increasingly encountered in the haemodialysed population, and this may produce difficulty in autogenous arteriovenous fistula creation. Prosthetic angioaccess or catheters, when used in place of autogenous fistulas, increase thrombotic and infectious complications in these already challenged patients.

Methods. This prospective study was undertaken to assess the feasibility of autogenous arteriovenous fistula creation in 71 obese patients (BMI 34.6 ± 7.8). We performed a two-stage procedure, in which radio-cephalic fistula formation was followed by subcutaneous transposition of the venous component for safe and easy puncture.

Results. Fistulas suitable for puncture, having blood flows of 799 ± 285 ml/min, and sufficient to perform adequate haemodialysis (Kt/V 1.24) were achieved in 85% of the patients. Primary patency rates were 65% and 59% at 6 and 12 months, respectively, and secondary patency rates were 83% both at 6 and 12 months.

Conclusions. Obesity does not prevent successful autogenous arteriovenous fistula formation, and may protect forearm venous vessels from the iatrogenic damage that occurs before the onset of haemodialysis therapy.

Keywords: autogenous fistula; obesity; radio-cephalic fistula; transposition; vascular access

Introduction

The number of obese end-stage renal disease patients, who frequently have type 2 diabetes, is continuously increasing. Obese and diabetic patients belong to a group with an increased risk of autogenous arteriovenous fistula placement failure due to advanced arteriosclerosis and reduced accessibility of forearm vessels because of excessive fat tissue. Moreover, puncture of the deeply located fistula becomes difficult. Obese patients, as well as diabetics, females, elderly patients above 65 years and patients with vascular anomalies, usually require the creation of other than autogenous arteriovenous fistula access for haemodialysis [1]. PTFE grafts or central venous catheters, recommended by some authors, may result in additional morbidity and mortality in these patients.

The present study examined the feasibility of successful autogenous arteriovenous fistula creation in obese patients, performed in a two-stage procedure, in which fistula formation was followed by subcutaneous transposition of the venous component for safe and easy puncture.

Methods

The present prospective study included 71 obese patients (51 females, 20 males), aged 13–87 years (mean 68 ± 15.1 years), with body mass index ranging from 29.1 to 53.73 (mean 34.6 ± 7.8), chosen from a group of 794 patients referred to our department for autogenous arteriovenous fistula creation between 1999 and 2004. All fistulas were created by two nephrologists. The prevalent cause of end-stage renal disease was diabetes mellitus in 59% of the patients. The characteristics of the study population are presented in Table 1.

Before fistula creation, each patient underwent forearm vessels examination. Asymmetry of pulse and blood pressure were assessed. Veins were initially assessed by tourniquet placement on the arm. Lack of forearm vein filling with sufficient, visible filling of the veins in cubital fossa qualified obese patients for forearm fistula creation with subsequent vein transposition. In each patient, forearm veins were localized by ultrasound guide without flow measurement (Site Rite II, Dymax Corporation, Pittsburgh, PA, USA), to confirm deep vein location and subsequent necessity for transposition. In the event of difficulties in
vessel visualization (in 12 patients), duplex scanning was performed to reveal appropriate vessel diameter and adequate flow. Forearm X-ray was performed in 14 diabetic patients with weak radial artery pulse in order to localize arterial calcifications. The most distal, less calcified part of the radial artery was chosen for anastomosis.

In all patients, a two-stage procedure was performed. In the first stage, an autogenous arteriovenous fistula was created in the wrist region. In the case of fistula placement failure, a second fistula was placed a few centimetres above the thrombosis, unless advanced atherosclerotic lesions or small arterial diameters were encountered. In the event of these complications, a fistula was created in the arm region or a catheter access was performed. In the second stage, which was carried out 10–14 days after fistula formation, an arterialized vein was transposed subcutaneously to enable safe puncture.

The time span between the two procedures allowed for saving of the vein for a second more proximal anastomosis in the event of initial fistula failure. Only functioning fistulas with arterialized veins underwent the second step—transposition.

Placement of autogenous arteriovenous fistulas were made as distally in the wrist region as possible. Under local anaesthesia with 1% Mepivacain, the standard radiocephalic fistula was created. In the case of the primary fistula failure, a second attempt was performed a few centimetres above the initial site.

Transposition of the venous part of the fistula was performed after 2 weeks. A 10–15 cm longitudinal incision was made that was slightly lateral to the arterialized vein and 3–4 cm proximal from the fistula. The arterialized vein was prepared and the bed of the venous part of fistula was closed in layers using 2–0 absorbable sutures. The vein was mobilized, repositioned superficially above all subcutaneous fat, and placed into a previously prepared subcutaneous pocket. The skin was closed in standard fashion with skin suture which was carried out 10–14 days after fistula formation, an arterialized vein was transposed subcutaneously to enable safe puncture.

The measured outcomes of our study were primary and secondary patency according to recommended standards [2]. Patency rates were evaluated by the Kaplan-Meier method and by life table analysis using statistical software (STATISTICA® 6.0).

**Table 1.** Characteristics of the study population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>68 ± 15.1 years</td>
</tr>
<tr>
<td>Gender</td>
<td>Males—28%</td>
</tr>
<tr>
<td>Race</td>
<td>All Caucasians</td>
</tr>
<tr>
<td>Diabetes</td>
<td>59.2%</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>26%</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>44%</td>
</tr>
<tr>
<td>Body mass index</td>
<td>34.6 ± 7.8 (kg/m²)</td>
</tr>
</tbody>
</table>

**Table 2.** Results of performed procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Patients</th>
<th>Patency Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fistula creation—first attempt</td>
<td>53/71</td>
<td>75%</td>
</tr>
<tr>
<td>Fistula creation—second attempt</td>
<td>8/71</td>
<td>11%</td>
</tr>
<tr>
<td>Fistula creation—third attempt</td>
<td>4/71</td>
<td>6%</td>
</tr>
<tr>
<td>Unsuccessful fistula creation</td>
<td>6/71</td>
<td>8%</td>
</tr>
<tr>
<td>Fistula creation—overall success</td>
<td>65/71</td>
<td>92%</td>
</tr>
<tr>
<td>Successful transposition</td>
<td>60/65</td>
<td>92%</td>
</tr>
<tr>
<td>Unsuccessful transposition</td>
<td>5/65</td>
<td>8%</td>
</tr>
<tr>
<td>Overall success</td>
<td>60/71</td>
<td>85%</td>
</tr>
</tbody>
</table>

operations. In six patients, fistula creation was unsuccessful because of small artery diameter and severe atherosclerosis. In these patients, the cause of fistula failure was early thrombosis. In three of these patients, a second attempt fistula was successfully created on the arm, and tunnelled jugular catheters were inserted in the two remaining patients. In one diabetic patient, all efforts for access creation failed and the patient died after a short period of peritoneal dialysis treatment.

All 65 (92%) patients with functioning fistulas underwent the second stage of the procedure (transposition of the venous part of the fistula), which was performed successfully in 60 (85%) of the study patients. The cause of unsuccessful transposition in four patients was insufficient blood flow through the vein. In one patient, transposition produced a large haematoma that resulted in whole-fistula thrombosis. Fistulas that were suitable for puncture, having a blood flow of 799 ± 285 ml/min, and that were sufficient for adequate haemodialysis (Kt/V 1.24, ranging from 1.11 to 1.41) were achieved in 60 (85%) patients. The results of these procedures are presented in Table 2. Primary patency rates were 65% at 6 months and 59% at 1 year (Figure 1). Secondary patency rates were 83% at 6 months and remained steady after a 1-year observation (Figure 2).

**Discussion**

The autogenous arteriovenous fistula is the access of choice in haemodialysed patients. It produces the highest survival compared to grafts and catheters, is less thrombotic and results in fewer infectious complications [3]. Therefore, the creation of autogenous fistulas is recommended by NFK DOQI guidelines, and has been shown to be feasible in more than 65% of patients entering haemodialysis therapy [4]. Previous studies reported a 70–90% success rate of autogenous fistula creation in a heterogenous population of end-stage renal disease patients [3]. The HEMO study, which examined the epidemiology of haemodialysis access types, presented prevalence of grafts and identified factors that reduced chances for successful of autogenous fistula creation in patients entering haemodialysis [1]. One of these factors was obesity [1], which was also mentioned by others in similar clinical settings [5]. The DOPPS study reported that successful arteriovenous fistula placement was associated with lower body mass index, younger age, male gender, non-diabetic status and lack of peripheral vascular disease [6]. In the study by Kats refers to the reference [7], obesity was reported to be the only significant factor predicting secondary fistula formation.
failure (failure after successful fistula use for haemodialysis). The likelihood of successful fistula placement, the diameters of vessels used for anastomosis, and the rate of fistula failure before initial use were similar between obese and non-obese patients [7]. However, worse long-term fistula survival in obese patients, due to earlier thrombosis, probably resulted from more aggressive myointimal hyperplasia, leading to an earlier onset of vessel stenosis in these patients. This assumption is supported by the finding that hyperinsulinemia and increased serum interleukin 6 levels are associated with accelerated myointimal hyperplasia and higher thrombosis rates in haemodialysed patients [8]. Interleukin 6 is the main inductor of C-reactive protein and plasma levels of this factor are increased in obese patients [9]. Furthermore, the previous finding of a pathogenetic role for C-reactive protein in the acceleration of myointimal

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**Fig. 1.** Primary patency rates were 65% (SE 0.056), 59% (SE 0.059), 53% (SE 0.061) and 33% (SE 0.065) at 6, 12, 24, 36 months, respectively (SE = standard error). The numbers above the curve represent numbers at risk. Observations were included in cases of fistula thrombosis before patient death. Observations were excluded in cases of death with functional fistulas.

**Fig. 2.** Secondary patency rates were 83% (SE 0.04), 83% (SE 0.04), 80% (SE 0.05) and 68% (SE 0.06) at 6, 12, 24, 36 months, respectively (SE = standard error). The numbers above the curve represent numbers at risk. Observations were included in cases of fistula thrombosis before patient death. Observations were excluded in cases of death with functional fistulas.
hyperplasia [10] supports a role for myointimal hyperplasia in the reduced fistula survival in obese patients.

In our experience, the feasibility of autogenous arteriovenous fistula creation in obese patients was comparable to the general population of end-stage renal disease patients [11]. In our study, successful creation of autogenous fistulas was achieved in 85% of obese patients.

Primary patency rates were 59% and 53% at 12 and 24 months, respectively. Secondary patency rates were 83% and 80% during the same observation times. Golldege et al. [12] reported primary patency rates of 69% and 56% at 12 and 24 months, respectively, as well as secondary patency rates of 70% and 63% during the same observation periods. Importantly, and similar to our study, the authors included only patients with radial-cephalic fistulas. Fistula patency was significantly and negatively affected by patient variables, such as diabetes, female sex, and younger age [12].

Our two-stage procedure of fistula formation with transposition of the venous portion may explain the longer fistula survival, which was 68% of patients after 36 months following creation compared with 45% during the same time reported by Kats et al. [7]. Dixon et al. [13] reported secondary patency rates of 43% at 3 years for forearm fistulas created in non-obese end-stage renal disease patients.

The abandoning of attempts to create autogenous fistulas in diabetic and obese patients resulted from observations of worse forearm vasculature conditions in this patient group due to advanced atherosclerosis and calcification. Preoperative examination of forearm vessels may positively influence the decision to perform autogenous fistula formation in these patients. Doppler ultrasound vessel imaging revealed that mean mid-forearm cephalic vein diameter, distal radial artery peak velocity and subclavian vein patency met criteria for successful fistula creation and were not significantly different between obese patients and the non-obese population [14]. Our observations support these findings. Paradoxically, obesity exerts a positive influence on the forearm vasculature by protecting against iatrogenic damage of vessels during the pre-dialysis period.

The advantage of deeply located forearm vessels may become a hindrance following vascular access creation at the time of fistula puncture. This problem can be eliminated by transposition of the venous portion of the fistula [11]. Our approach, which contrasts with others [15], includes mandatory transposition of the anastomosed vein with separation in time of the two procedures: fistula formation followed by vein transposition. There are two benefits of performing a two-stage procedure. For example, the second step-vein transposition is undertaken only after successful anastomosis creation. In case of the fistula failure, a second more proximal attempt is made before proceeding to transposition. The second benefit is the possibility of fistula rescue even after transposition, in the event of thrombosis that occurs at a later period. The time and space separation between vessel anastomosis and transposition resulted in preservation of the vein component having collaterals located between the fistula and the subcutaneously transposed vein that lacked collaterals. In the event of fistula thrombosis, this venous portion may be used for formation of a second vessel anastomosis. Furthermore, the remaining transposed vein may be saved for future puncture. When transposition is performed at the same time as fistula preparation, and the prepared vein is located in a subcutaneous tunnel [16], the entire immature venous section will lack collaterals, causing loss of the transposed vein in the event of fistula thrombosis.

The vascular inaccessibility encountered in obese and diabetic patients has created a tendency for first attempt fistula formation in the elbow area. Konner [17] reported identical success rates of fistula formation among diabetic and non-diabetic patients, but elbow fistulas were more prevalent in the diabetic group. In our study, all fistulas were distal radial-cephalic. Transposition performed after vein maturation allowed for placement of access formation as distally as possible in the forearm.

Conclusions

Obesity does not preclude successful autogenous fistula formation in haemodialysis. Autogenous fistula placement was successfully achieved in 85% obese patients. Moreover, obesity appears to protect forearm vessels from iatrogenic damage during the predialysis period. Transposition of the venous component after fistula creation provided safe and easy puncture.

Conflict of interest statement. None declared.

References


Received for publication: 5.2.07
Accepted in revised form: 20.9.07