Loup-assisted technique to create arterio-venous fistulas in elderly. A single centre experience

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Abstract

Aims. The radio-cephalic arteriovenous fistula (RCAVF) is the first choice treatment in end-stage renal disease patients. In the last few years, the hemodialysis population has shown a high percentage of elderly patients (> 65 year old) with comorbidities, mainly vascular diseases, which may adversely affect their vascular access success. The aim of this study was to evaluate the effectiveness of a loup-assisted technique to create RCAVFs in over 65 patients.

Patients and Methods. 98 consecutive patients with renal failure were prospectively observed. The patient were divided in relation to their age (> 65 year old; < 65 year old). In both groups, a microsurgical distal RCAVF was created. Statistics included the prevalence of distal RCAVF created, the incidence of immediate failure, the primary and secondary patency rate at one year.

Results. Distal RCAVF was created in 82.60% of patients younger than 65 years and in 73.07% of patients older than 65 years, with no statistically significant difference. The incidence of immediate failure, the primary and secondary patency rate at one year were not statistically significant between the two groups.

Conclusions. Distal RCAVF should be the first choice vascular access even in ESRD elderly patients. The loup-assisted microsurgical fistula creation, allows to perform distal RCAVF with success, even in patients older than 65 years old, achieving similar results to younger patients. Clin Ter 2019; 170(6):e454-459. doi:10.7417/CT.2019.2175

Key words: elderly patients; hemodialysis; radio-cephalic arteriovenous

Introduction

Approximately 10% of the general population suffers from kidney damage, and a proportion will progress into end-stage renal kidney disease (ESRD). ESRD ranks among the most severe chronic non-communicable diseases (1). Haemodialysis (HD) has become the standard renal replacement therapy for patients with ESKD, with >2 million patients now treated worldwide. Various problems are related to vascular access in patients on haemodialysis. These vascular access complications are similar to those seen in any patient with a vascular surgical procedure (e.g., bleeding, local or disseminated intravascular infections, vessel occlusion). The native peripheral vascular system is also affected with higher rates of amputation and revascularization procedures. A patient’s survival depends on proper functioning of dialysis vascular access, yet it remains the Achilles’ heel for haemodialysis patients. Unfortunately, because of the myriad medical problems faced by a patient with renal failure, the dialysis access gets the least amount of attention. The distal radiocephalic arteriovenous fistula (RCAVF) is the vascular access of choice for chronic haemodialysis (2-4). This statement is based on the evidence that AVF, upon reaching maturity, gives the best results in terms of patency over time, associated with lower incidence of complications (thrombotic, infectious, ischemic), compared to other vessels with native vascular access, prosthetic, or central venous catheters. Differently than prosthetic fistula, the main problem of this native vascular access is represented by early failure, coming up to 30-50%, with an average of 15.3%, according to recent meta-analysis (5-7). The diameter of the vessels (radial artery and cephalic vein) seems to be the limiting specific factor according to various works (8-12). The diameter should not be less than 1.6-2 mm for the radial artery and 1.6-2.5 mm for cephalic vein. However, despite these findings, excellent results were obtained in paediatric populations through the use of microsurgery, which reduces the incidence of immediate failure of the 5-10% (13,14). The use of this technique may result useful in those circumstances in which a failure is likely to happen, such as in presence of a poor peripheral vascular system (15). In this prospective study, the effectiveness of a loup-assisted technique to create RCAVFs in over 65-years old patients was evaluated.

Patients and methods

From November 2013 to December 2015, 98 consecutive ESRD patients were prospectively observed. These
patients were enrolled to undergo a first permanent AVF creation or for treating a vascular access complication. We made the comparison between patients younger than 65 years (group A – 46 patients) and patients older than 65 years (group B – 52 patients); the prevalence of distal RCAVF created, the incidence of immediate failure, the primary and secondary patency rate at one year, were considered. The average age in group A was 47.78 ± 16.11, in group B it was 72.12 ± 5.117 (p <0.001). The prevalence of hypertension, diabetes, obesity (BMI > 30) and vascular disease in non-elderly patients versus elderly patients was respectively 87% vs 86%, 22% vs 28%, 17% vs 21%, 35% vs 74% (Tab. 1).

Forty-seven percent of patients younger than 65 years were in conservative treatment for chronic renal insufficiency, compared to 54% of elderly patients; 52% of non-elderly patients and 45% of elderly performed haemodialysis through central venous catheterization (CVC). All patients were submitted to the same pre-operative protocol, consisting of clinical examination and superficial venous system colour-doppler ultrasound examination of the non-dominant upper limb (12). A venography was performed in patients with risk of central venous stenosis (previous use of CVC for haemodialysis, presence of a pacemaker or a history of trauma), in order to evaluate the patency of deep venous system of the surgical site. Distal RCAVF was created only in presence of pervious arterial and venous vessels, regardless of the diameter. All patients were prospectively followed in relation to the outcome. The results of group B were compared to group A patients. All surgical operations were performed by the same surgeon, confident with loup-assisted microsurgical vascular access creation. Anaesthesia was obtained by axillary brachial plexus block (BPB) using an electric neurostimulator (17). All patients signed an appropriate informed consent, before the procedure. The distal access was created using 3.5x magnifying glasses (DESIGN FOR VISION, INC.). All patients were followed-up at one and four weeks postoperatively. Maturatory was assessed when AVF reached flows and diameters adequate to perform haemodialysis. The immediate failure was defined as thrombosis of the AVF or delayed maturation: an AVF could be considered pervious, but it could not be functional enough for haemodialysis, cause an insufficient increase in diameter and flow. After loco-regional anaesthesia using BPB, and after performing a longitudinal incision in the non-dominant distal forearm of each patient, the cephalic vein and the radial artery were exposed. In our practice, small adhesive retractors are used to allow good exposure of the operating field (18). The vein, manipulated exclusively through the adventitia that is not removed, was prepared by careful dissection, for a sufficient length to reach the radial artery. Ligation of collateral vessels is performed by means of slow resorption 4-0 laces. Once the aponeurotic fascia was opened, the radial artery was prepared tying small collateral branches. Finally, both vessels were approached in parallel and clamped thanks to two small Satinsky clamps. Vascularotomy was approximately 8 mm wide. A double 180° 8/9-0 monofilament running suture was used to anastomose the two vessels. After declamping, a gauze soaked in warm saline solution was used to stop residual anastomotic bleeding. The presence of a thrill confirmed the proper functioning of the AVF. The operation ended with skin closure by means of a simple interrupted 3-0 silk suture.

The statistical analysis - made by statistical software GraphPad Prism 6 – compared the AVF early failure in the two groups, using t Student’s test. A p < 0.05 was considered significant. Kaplan-Meier survival curve was employed to analyse late results, after one year of observation.

Results

Distal RCAVF was created in 82.60% of patients younger than 65 years (group A) and in 73.07% of patients older than 65 years (group B), with no statistically significant difference (Fig. 1).

Table 1. Patients features of the study group.

<table>
<thead>
<tr>
<th></th>
<th>Patients &lt; 65</th>
<th>Patients &gt; 65</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Age (range ±DS)</td>
<td>47.78±11.16</td>
<td>72.12±5.117</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>87%</td>
<td>86%</td>
<td>ns</td>
</tr>
<tr>
<td>Diabetes</td>
<td>22%</td>
<td>28%</td>
<td>ns</td>
</tr>
<tr>
<td>Obesity</td>
<td>17%</td>
<td>21%</td>
<td>ns</td>
</tr>
<tr>
<td>Vasculopathy</td>
<td>35%</td>
<td>74%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Dialisys</td>
<td>52%</td>
<td>45%</td>
<td>ns</td>
</tr>
<tr>
<td>Conservative therapy</td>
<td>47%</td>
<td>54%</td>
<td>ns</td>
</tr>
</tbody>
</table>

Fig. 1. Percent survival of distal RCAVF in two patients groups
The incidence of immediate failure (early failure) was 13.89% in the group of non-elderly and 16.27% in the elderly group. In this case, the difference was not statistically significant (Fig. 2).

The primary patency at one year was of 61.02% in group B vs. 68.39% in group A (Fig. 3).

In group B, secondary patency at one year was of 80.76% vs 86.36% in group A (no statistically significant differences) (Fig. 4).

In Table 2 the results are summarized.

In Table 3 and in Table 4 the distribution of the causes of early failure and their treatment are shown in detail.

**Table 2. Results**

<table>
<thead>
<tr>
<th></th>
<th>Patients</th>
<th>Patients</th>
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<tbody>
<tr>
<td></td>
<td>&lt; 65 n 46</td>
<td>&gt; 65 n 52</td>
</tr>
<tr>
<td>Radiocephalic AVF</td>
<td>82.60%</td>
<td>73.07%</td>
</tr>
<tr>
<td>Early failure</td>
<td>13.89%</td>
<td>16.27%</td>
</tr>
<tr>
<td>1 yr primary patency rate</td>
<td>68.39%</td>
<td>61.02%</td>
</tr>
<tr>
<td>1 yr secondary patency rate</td>
<td>86.36%</td>
<td>80.76%</td>
</tr>
</tbody>
</table>

**Table 3. Causes of early failure**

<table>
<thead>
<tr>
<th>Causes</th>
<th>Patients</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial stenosis</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Iuxta anastomotic vein stenosis</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Median vein stenosis</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Distal vein stenosis</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>24 hrs postoperative thrombosis</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1 wk postoperative thrombosis</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1 month postoperative thrombosis</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table 4. Early failure treatment**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Patients</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>New AVF creation</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Anastomotic proximalization</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Endovascular therapy</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Discussion**

The long-term survival and quality of life of patients with ESRD is strongly influenced by the proper functioning of their vascular access. RCAVF is reported to be the first choice vascular access by the American (19) and European (20) guidelines. The RCAVF presents a low incidence of infectious, thrombotic and ischemic complications, associated to the best results in terms of primary and secondary patency, compared to proximal AVF (PAVF), prosthetic accesses (ProAVF) and central venous catheterization (CVC). The most frequent complication of RCAVF could be represented by the relatively frequent delayed maturation, which ranges from 18% to 53% in different case series. The Dialysis Outcomes and Practice Patterns Study (DOPPS), which involved 28196 patients from 300 dialysis centres in three different continents, analysed the relationship between vascular access and mortality (21) and clearly demonstrated the effectiveness of native fistulas (RCAVF and PAVF) in comparison to ProAVF. In the article, the authors concluded their analysis with three main points:

- vascular accesses are managed differently depending on world’s area considered. Particularly, in the north of America, CVC and ProAVF are frequently used whereas AVF significantly outweigh in Europe and Japan;
Native distal AVF: the best option

- elderly patients, especially those with comorbidities, tend to dialyze more frequently by CVC or a ProAVF;
- correcting data for comorbidity-related mortality, the type of vascular access is an independent variable. Therefore, although the higher mortality in the group treated with catheters or prostheses is largely attributable to the poor starting clinical conditions of the patients, the widespread use of CVC and ProAVF affects adversely long-term survival.

In the United States (US), the US Federal Health Agency started in 2003 the Fistula First Coalition Program (FFCP) to spread the guidelines on vascular accesses, and promote the use of native AVF, involving 4234 dialysis centres in the United States. Thanks to the FFCP efforts in the course of seven years, there was a substantial increase in the number of patients who had been treated by native AVFs (54.8% in 2010 vs. 32.2% in 2004); in parallel, the use of ProAVFs was reduced from 40% to 20.6%. To this change of strategy did not followed, as well as feared, a decreased use of temporary CVC, which was instead reduced slightly (26.9% in 2003, 24.4% in 2010).(22) Excluding those cases of substitutive therapy in acute renal failure, an excessive use of CVC is caused by late referral, absence of a ready-to-use AVF or could be due to its failed maturation (early failure).

An US case series, published in the CHOICE study, reported that 68% of patients started dialysis using a CVC as first choice vascular access (23).

The first RCAVF was realized by the Brescia and Cimino in 1966 (24). In the last few years, the haemodialytic population has considerably changed in relation to high percentage of elderly patients, with a higher prevalence of comorbidities, such as diabetes and hypertension. Frequently, these patients suffer from vascular diseases, often involving arteries, which may adversely affect the creation, the patency rate and longevity of a vascular access. Increasingly often, these elderly patients are advised late to a nephrologist care, when they already need haemodialysis. The late referral affects the prognosis adversely (25). From these considerations, many concerns have been rising about the absence of guidelines for vascular access in elderly patients. By definition, one patient could be considered “elderly”, when he/she is older than 65 years. In 2007, the Lazarides group analysed the outcome of vascular access in the elderly, (7) considering 10 different studies. This meta-analysis involved 670 elderly patients and 1171 non-elderly patients, globally. From the results, the RCAVF in elderly patients showed a lower patency rate at 12 and 24 months, compared to non-elderly. A better one-year secondary patency rate of PAVF in comparison to RCAVF, was also demonstrated (82% vs 66.1%). The authors concluded that although RCAVF is rightly considered as the first choice vascular access in general population, this statement should be re-evaluated in the subgroup of elderly, despite international guidelines do not give any specific indication on the matter. A PAVF could guarantee a better median survival on dialysis, for over 75 year old patients (31 months), (26) and a tangible reduction of early failure. Konner (27) proposed the creation of a PAVF in diabetics and elderslies, since these patients may be unable to achieve adequate flows using the radial artery. In diabetic patients, atherosclerotic lesions have a characteristic centripetal evolution, the proximal vessels being less affected than the distal ones (28). Contrarily, a better overall survival of European and Japanese dialysis patients has been observed, in comparison with North America ERSD patient (29). The DOPPS showed also that a proximal access could affect adversely the prognosis.(21) Furthermore, elderly patients are more susceptible to typical complications of PAVF, such as distal steal syndrome or heart failure with right ventricle overload (30). If a distal RCAVF in an arteriopathic patient is at risk of early failure, associated with a low inflow, the same patient treated with a PAVF will be exposed to the risk of distal ischemia. In the first case, the arterial lesion could be treated by means of a simple percutaneous transluminal angioplasty (PTA), as shown by Raynaud’s (31) and Turmel-Rodrigues (32), whereas, in the second case the procedures are complex and often insufficient (AVF closure and CVC placement) (33).

A European prospective study, which compared RCAVF and PAVF in the elderly, showed no significant differences between the two vascular accesses, suggesting that the advanced age could not be used as an exclusion criterion for the creation of a distal RCAVF.(7) A survey carried out by Xi et al. (34), considering the opinion of North America nephrologists, showed that PAVF and CVC are the vascular accesses of choice, in elderly patients, due to a possible “rejection” of RCAVF, a delay in deciding the dialytic modality (peritoneal dialysis or haemodialysis), an excessive waiting before RCAVF creation, frequent maturation failure of RCAVF. Currently, absolute contraindications to RCAVF are: an age older than 90 years, a severe systolic heart failure (EF < 15%), poor patient compliance, a life expectancy lower than one year, absence of arterial pulse, dementia. In the United States, Chan et al. (35) confirmed a growing use of CVC, likely due to increasing native AVF failures and associated to the increasing need of emergency haemodialytic treatment, especially for elderly patients. The analysis of US Renal Data System (USRDS) underlined the equivalence of RCAVF and PAVF, in terms of mortality and patency, in elderly patients, diabetics or non-diabetics. In the conclusions, the authors suggested changes of vascular access guidelines, especially for the elderly subgroup. However, the results not agree with those of the DOPPS and the Fistula First Coalition. To date, there are no definitive data and the debate remains still open. International guidelines indicate the RCAVF as the gold standard for vascular access for haemodialysis. Unfortunately, the management of vascular access in the elderly is still an open question. As discussed above, Lazarides, in his meta-analysis,(7) showed that distal RCAVF is at increased risk of failure in over 65 years old patients, suggesting the PAVF as the first choice vascular access. In our experience, however, the use of magnifying glasses has showed excellent results in vascular access surgery, allowing RCAVF creation even in difficult cases. The loup-assisted technique offers numerous advantages, especially in those cases of fragile and small calibre vessels (36) In particular, image magnification and the use of ad hoc tools (pliers, scissors and sutures), help the surgeon to perform with better accuracy the fundamental steps of surgery: from the handling and preparation of vessels, to intima juxtaposition, and, finally, to the correct execution of a haemodynamically effective anastomosis. From data on paediatric patients,(37) microsurgery could appear a
promising tool to increase the prevalence of distal AVF in adults, thus reducing the incidence of early failure. To date, guidelines do not mention at all any particular surgical technique to be adopted, thus leaving the choice to the operators’ preferences. Lo Monte and Buscemi already showed that the distal radio-cephalic fistula is also possible by using a mechanical stapler (38). The present study has the aim to demonstrate the effectiveness of a loup-assisted distal RCAVF in terms of vascular access survival, with a reduction of early failure or delayed maturation, even in over 65 years old patients. Age should not be strictly considered as a guiding principle in the programming and creation of vascular access for haemodialysis. The distal RCAVF, referred to as the gold standard by European and American guidelines, maintains clear advantages in the elderly, too. The distal accesses have a lower incidence of complications such as distal ischemia and high output heart failure, particularly frequent in ESRD patients with a proximal AVF. Contrarily, the early failure is the only most important complication of a distal AVF. In this case, the treatment is based on a simple percutaneous transhumeral angioplasty (PTA), as reflected by Raynaud (31) and Turmel-Rodrigues (32); in case of distal ischemia, the possible therapeutic options could be complex and often insufficient (33), leading to the closure of the AVF and CVC positioning. According to the Italian Register of Dialysis (29), the survival of over 65 dialysis patients is about 50%, at 3.5 years. For this reason, the preservation of the vascular heritage is of crucial importance to ameliorate the quality of life of these category of patients. As discussed above, the use of proximal fistulas or prosthesis as first choice vascular access could adversely affect elderly patient prognosis. The results of our research are not in agreement with those published by other groups. In their meta-analysis, Lazarides et al. (7) suggested the creation of a brachial-cephalic AVF in over 65 ESRD patients, in order to avoid the early failure of a distal AVF. The differences in results could be explained by the surgical technique used (standard vs. microsurgery) and with the patient enrollment protocol (unknown vs clinical study and ultrasound). As claimed by Lazarides himself, the use of sub-optimal vessels could not be ruled out, due to a high prevalence of RCAVF. An expansion of the series and an extension of the follow-up will allow, for sure, a further definition of these results. Due to the design of the present study (single centre with single operator), the results could not be generalized. New results provided by other centres will be able to confirm or reject data taken by our work.

Conclusions

Distal RCAVF should be the first choice vascular access even in elderly patients. The loup-assisted microsurgical fistula creation, allows to perform distal RCAVF with success, even in patients older than 65 years old, achieving similar results to younger patients. In our view, this could be the first step towards a new microsurgical approach to the creation of vascular access, particularly useful for elderly patients, often considered as difficult patients, in the literature. Further studies will clarify the contribution of microsurgical loup-assisted technique in reducing the incidence of early failure by maintaining a high prevalence of distal RCAVF in elderly patients.

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