

# Endovascular intervention in Nephrology, one year on

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## ABSTRACT

Vascular access dysfunction is the main cause of morbidity and hospital admission in haemodialysis patients, entailing very high costs. Endovascular procedures performed by intervention nephrology have become the standard treatment of stenosis and thrombosis at the vascular access, as well as an excellent method to complement surgical intervention.

Computer records on endovascular procedures carried out over a 12 month period in the Nephrology Department at Hospital Garcia de Orta on patients with vascular access dysfunction were analysed in order to characterise patients and referral centre, reason for referral, procedures performed, vascular access, initial success and any residual stenosis and/or complications.

A total of 462 endovascular procedures were performed on 223 patients; 219 angiographies, 164 angioplasties, 66 thrombectomies, 4 tunnelled cuffed catheter placements and 9 stents. The mean age of patients was 63.7±15.9; 111 male, 112 female. One hundred and ninety patients (85.2%) were referred by 18 haemodialysis centres and the remaining patients were currently being treated at our hospital. The main reasons for referral were access thrombosis (32.3%), low flow rate (27.3%), increased venous pressure (20.2%) and limb oedema (12.5%). Grafts were present in 57.7% of cases and arteriovenous fistulae in 38.6%.

The territories most affected by stenosis were venous (42.6%) and venous anastomosis (34.1%). Arterial stenosis/arterial anastomosis was found in

22.8% of the patients. On average, 1.18 balloons were used per angioplasty. Initial success was total in 80% and partial in 15% of cases. Residual stenosis was detected in 31.4% of cases. Some patients (15.7%) underwent reintervention. The complication rate was 6.7%, and the main complications were vessel wall dissection (1.8%) and rethrombosis (1.8%). No case required surgical intervention.

### Key-Words:

Angiography; haemodialysis; vascular access stenosis; vascular access thrombosis.

## INTRODUCTION

Vascular access (VA) dysfunction in haemodialysis (HD) patients results in inadequate treatment, increases morbidity and is a major cause of hospitalisation in these patients, with very high costs. It is estimated that 16–23% of hospital admissions of HD patients are VA related<sup>1</sup>.

Some VA related problems may be solved effectively and safely by a nephrologist trained in interventional nephrology. This growing field reduces delays, hospital admissions, central venous catheter use and costs. Endovascular procedures have thus become the standard treatment for VA dysfunction, with several studies showing their success and safety when performed by nephrologists<sup>2</sup>.

The most serious complication of permanent VA is thrombosis, with venous stenosis the main predisposing

factor, accounting for 80–85% of thrombosis cases<sup>3</sup>. Early detection and treatment of haemodynamically significant stenosis are the primary goals.

Percutaneous transluminal angioplasty (PTA) was first described in 1982 and has been used routinely in arteriovenous fistulae (AVF) and arteriovenous grafts (AVG) related problems<sup>4</sup>. This technique gives access to whole venous territory, including central vessels. The procedure may be repeated and the patient may undergo HD after the intervention.

Pharmacomechanical thrombolysis has been used successfully in the treatment of thrombosed grafts<sup>5</sup>.

Although some results are controversial, early stenosis detection before access dysfunction seems to be related to an increase in VA survival and a fall in access-related morbidity<sup>6-9</sup>. Angiography is liable to be performed in cases of a change in normal characteristic access continuous thrill on physical examination, abnormal intra-access flow, measured either directly or indirectly, and clinical signs such as arm pain and oedema, collateral circulation, difficult haemostasis and puncture difficulty<sup>10</sup>.

## ■ SUBJECTS AND METHODS

A year's worth of all computerised records on endovascular procedures performed due to VA dysfunction in HD patients at the Nephrology Department of Hospital Garcia de Orta were reviewed.

Patients were selected for intervention by prior screening from a long waiting list, according to criteria which aim at optimising the benefit for candidates, and giving priority to therapeutic intervention rather than solely diagnostic analysis. Cases presented here reflect this selection pressure.

The type of procedure performed, type of vascular access, patient age and gender, referral centre, reason for referral, procedure repetition, initial success and any residual stenosis and/or complications were recorded.

All cases underwent diagnostic angiography. Any stenosis found was recorded, stating the affected

territory: artery, arterial anastomosis, vascular access, venous anastomosis, drainage vein and central vein. PTA was used in stenosis cases.

Percutaneous pharmacomechanical thrombolysis was used in cases of thrombosed access. The device used for mechanical thrombolysis was a Pulse-Spray® (Agyodynamics, USA) catheter, and heparinised saline solution (5000 U/100 cc saline). The results were assessed semiquantitatively in line with the anatomical findings (percent reduction of stenosis) and final flow, which in previous studies was found to be correlated to the access flow rate (Qa). The degree of initial angioplasty/thrombectomy success was defined as total, partial, and failed in cases of full flow after the intervention, compromised flow and absence of flow, respectively.

Residual stenosis was defined as any stenosis remaining after the intervention, regardless of having been subject to dilation. In some situations, stenosis could not be corrected by percutaneous intervention or was not a defect causing haemodynamic or clinical changes, and so there was no intervention.

## ■ Statistical analysis

Categorical variables are presented as distributions (frequencies and percentages). Descriptive statistics are expressed as means with standard deviation and correlations between two variables were determined using the Pearson coefficient.

## ■ RESULTS

A total of 462 endovascular procedures were performed; 219 angiographies, 164 angioplasties, 66 thrombectomies, 4 tunnelled cuffed catheters (TCC) placement and 9 stent placements. These interventions were performed in 223 patients with VA dysfunction. Fifty six patients underwent diagnostic angiography only with no following therapeutic intervention. Mean age of patients was 63.7±15.9; 111 male and 112 female. One hundred and ninety (85.2%) patients were referred by 18 haemodialysis centres and only 33 patients (17.8%) were currently being treated at our hospital. The reasons for referral were VA thrombosis in 72 (32.3%) patients, poor

VA flow rate in 61 (27.3%), increased venous pressure in 45 (20.2%), limb oedema in 28 (12.5%), collateral circulation in 6 (2.7%) and puncture difficulty in VA, change in thrill characteristics and hand ischaemia in 1 (0.4%) patient apiece. Four patients (0.8%) were referred for TCC placement. The main reasons for referring patients with AVG were thrombosis (n=70), increased venous pressure (n=34) and limb oedema (n=16), while in AVF patients they were poor flow rate (n=53), limb oedema (n=12) and increased venous pressure (n=11).

Referred VA were 131 AVG (57.7%) and 86 AVF (38.6%), and it was not possible to identify access in two cases. Seventy percent of women and forty-five percent of men had grafts. Vascular access was created in 88.9% of cases in the left arm, in 58.1% in the right arm, in 21.4% in the left forearm, in 6% in the right forearm, in 6% in the left thigh and in 5.1% in the right thigh.

Turning to stenosis, the most affected territory was the drainage vein, with 95 patients (42.6%) showing venous stenosis. The location of stenosis was venous anastomosis in 76 patients (34.1%), central stenosis in 52 (23.3%), AVF/intragraft in 47 (21.1%), arterial anastomosis in 34 (15.2%) and arterial stenoses in 17 (7.6%). Central stenosis was associated with an increased number of identified territories with concomitant stenosis ( $p<0.001$ ), as well as a higher amount of angiographic balloon use ( $p=0.025$ ). These findings were not observed in other vascular territories.

On hundred and ninety four balloons were used, with a mean of 1.18 per angioplasty procedure. Stents were used in patients with repeated intervention for resistant stenosis or early recurrence of central stenosis.

Total immediate success of angioplasty/thrombectomy was achieved in 80% of the cases, whereas 15% showed partial success and 2.5% failed. Success rate could not be determined in 2.5% of the patients due to lack of data.

At the end of the intervention, 153 patients (68.6%) did not show any residual stenosis, 61 patients (27.4%) had residual stenosis in only one territory and 9 (4%) patients had residual stenosis in two or more territories. In 48 patients (68.6%) residual

stenoses were refractory. These were present in 16 patients (33.3%) at the drainage vein, in 15 (31.2%) at the central vein, in 8 (16.7%) at the VA, in 4 (8.3%) at the artery, in 3 (6.25%) at the arterial anastomosis and in 2 (4.2%) at the venous anastomosis.

Approximately 23 patients (10.3%) underwent a repeat procedure during the year, 8 patients (3.6%) had three interventions, 3 patients (1.3%) had four and 1 patient (0.4%) five.

Complications were identified in 15 patients (6.7%): vessel wall dissection in 4 patients (1.8%), rethrombosis in 4 (1.8%), AVG rupture in 3 patients (1.3%), vessel rupture in 2 patients (0.9%), dehiscence in 1 patient (0.9%) and pseudoaneurysm in 1 patient (0.9%). Older age ( $p=0.01$ ) and a greater amount of residual stenoses ( $p=0.002$ ) were associated with an increased incidence of complications. No case required surgical intervention and no patient died.

## ■ DISCUSSION

Intervention angiography is the best method for detecting and correcting risk factors for vascular access failure and for failure reversion of already thrombosed accesses. Furthermore, it is also an excellent diagnostic method which allows planned surgical correction in cases not amenable to percutaneous correction for technical reasons or because surgical intervention is considered more favourable.

Although the number of AVF referred for angiography has been rising in recent years, AVG thrombosis is still the main reason for referral, confirming the high costs associated with graft complications. Pharmacomechanical thrombolysis is effective, easy and safe, and is the treatment of choice in thrombosed PTFE grafts<sup>11</sup>.

The most frequent stenosis is that found at venous anastomoses and in the first centimetres of the vein, which is consistent with previous data<sup>12</sup>. Arterial stenosis had been considered infrequent (<5%)<sup>13</sup>, but recent data show that its incidence is higher (14% – 42%)<sup>14,15</sup>. We found consistent data, with arterial stenosis in approximately 22.8% of the patients. Although 31.4% of the patients had residual stenosis at the end, this was mostly mild stenosis

without haemodynamic compromise; some did not even require intervention. PTA is a technique that is easy to perform, quick and preserves vascular territory for new VA, facilitating successful correction of stenosis associated with AVF and AVGs<sup>16,17,18</sup>. Percutaneous angiography can be repeated, and 15.7% of our patients underwent more than one intervention.

The initial success rate of endovascular intervention is high. Flow was detected at the end of the procedure in 95% of the cases; it was only partial in 15%, but the access remained functional. The complication rate associated with endovascular procedures was low, similar to previous reports<sup>19,20</sup>, with resolution of all situations during procedure without the need for vascular surgery.

There was a homogenous distribution of patients in terms of gender. It is possible that women are more often referred for angiography, since a smaller number undergo dialysis.

The support given to 223 patients with VA dysfunction without the need for surgical intervention is highlighted and these patients were able to have their dialysis session after the procedure.

**Conflict of interest statement.** None declared.

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