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*Viewpoint Article*

## AV Fistulae and Catheters for Hemodialysis: How Much Should Nephrologists be Involved in Vascular Access for Hemodialysis

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### Cimino-Brescia AV fistula

Native arteriovenous (AV) fistula which was introduced into clinical practice in 1966 by Brescia, Cimino, Appel and Hurovich [1] is still a vascular access of choice for chronic hemodialysis patients. The main advantages were longevity and fewer, especially infectious, complications. For the patients with exhausted vasculature, AV grafts made of expanded polytetrafluoroethylene (ePTFE), introduced in 1976, were the second best choice to native AV fistula. They had shorter life span, with outflow stenosis of the vein as the most common complication. Infection usually necessitated complete removal of the graft in spite of antibiotic therapy.

### Ultrasound/ Doppler examination

Preoperative Duplex sonography of arteries and veins became the golden standard for preoperative examination before AV fistula or graft creation. It prevents unsuccessful and unnecessary surgery and pain to the patient in circumstances when arteries are too narrow (<1,8-2,0 mm) or veins are absent or flebitic. In our Dialysis center for acute and chronic dialysis at the University Medical Center in Ljubljana more than 400 vascular mappings are being performed by nephrologists every year. Ultrasound/ doppler examination is being performed both before AV fistula or graft creation and before salvage surgeries.

### Native AVF and grafts

Data from registries published in NDT 2009 revealed that percentage above 80 of native AV fistula is achieved only in few countries in the world [2]. Slovenian ESRD registry revealed that in 2005 85,1% of chronic hemodialysis (HD) patients had native AV fistula, 4,7% had grafts and 10,5 % catheters. In 2010, still 82% of our patients had native AV fistula. However, in 2011 the percentage dro-

pped to 79% and the percentage of hemodialysis catheters increased to 15%, while the percentage of grafts remained stable, 6% [3]. One of the reasons for the reduced number of AV fistulas in our hemodialysis population might also be the shift of dialysis patients (having been in excellent health condition with predominantly AV fistula as vascular access) to transplantation (with functioning fistulas) and their loss from hemodialysis registry. In the remaining hemodialysis population the mean age rose, number of comorbidities increased, possibilities for native AV fistula placement declined and more AV grafts have been created. Interestingly, mortality rate of old hemodialysis patients (>80 years) between those with native AV fistula and those with AV graft, was the same [4]. At the beginnings of hemodialysis, nephrologists like Cimino and Brescia gave the idea of AV fistula creation, and others like Stanley Sheldon, were access surgeons themselves. In our Dialysis center vascular access has been performed by nephrologists since 1974 and since then more than 6,500 vascular access surgeries have been performed in chronic hemodialysis patients. The author of this paper, a nephrologist, has performed more than 3,000 surgeries, of which about 1,500 in the last 10 years. Majority of access interventions (85%) were performed by nephrologists in Italy while other countries rely mainly on vascular surgeons [5]. Nevertheless, the opinion that nephrologists should be closely involved in AV fistula creation is getting an increased support [6,7]. Preferable surgical technique is "end to side" anastomosis as distal as possible. AV grafts could be placed in the forearm as loop or in the upper arm or in the thigh. Surprisingly, thigh AV grafts have longer lifespan in comparison with native AV fistulae [8,9]. A new challenge has arisen recently with functioning vascular access in transplant patients: there is an additional hemodynamic burden for the heart, increasing dilation of AV fistula aneurysm, cosmetic effects and painful thrombosis with usually seen systemic signs of inflammation [10]. Salvage of thrombosed AV fistulas and grafts is at least as important as creation of new ones. Successful salvage means immediate function, no need for a catheter, no need for a new AV fistula/graft creation, thus sparing vasculature and at last but not least it increases the patients' sense of safety and wellbeing. Salvage could be perfor-

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med by interventional radiologists or interventional nephrologists. The latter could act endovascularly or by surgery. Surgical thrombectomies and revisions of AV fistulas and grafts had better results compared to endovascular procedures. This is true especially for thromboses due to perianastomotic stenosis. In our group of 111 thrombosed native AV fistulae, 128 surgical salvage procedures were performed, immediate success rate was 93.8% and 1-year postinterventional patency rate was 68% (for both thrombectomies alone and thrombectomies with creation of a new anastomosis) and 73% for thrombectomies with reanastomosis [11]. Analysis of our group of 59 AV grafts thrombosis revealed that 129 thrombectomies were needed, immediate success rate was 78% and 1-year postinterventional rate was 76%. In all grafts fistulography was performed after thrombectomy and percutaneous transluminal angioplasty was performed if necessary [12].

### Hemodialysis catheters as acute or permanent vascular access

For acute hemodialysis and apheresis patients as well as for chronic hemodialysis patients without possibility of creating either native AV fistula or AV graft, central vein catheters were vascular access of choice or, for few of them, the last resort for hemodialysis. Femoral catheters were introduced by Stanley Sheldon in 1961, jugular in 1971 and subclavian in 1978. Broviac introduced silastic catheters for cancer patients and they were modified by Hickman and used for hemodialysis vascular access in 1977. According to the European and American guidelines tunneled, cuffed catheters have been suggested as the best permanent vascular access for certain chronic HD patients with exhausted vasculature for creating AV fistulas or grafts. The main reasons for this suggestion were lower incidence of catheter-related infections, at exit site, and bacteremias or septicemias compared to nontunneled ones. Our experience with 103 tunneled, cuffed catheters, placed by nephrologists, can be compared with the experience of other experts. The median time free of complications was 3 months, incidence of exit site infection was 0,09/1000 and septicemias 0,1/1000 catheter days [13]. An important issue in the catheters is locking solution, the most promising is 3-sodium citrate [14]. Surprisingly, design of temporary jugular catheters might also have an important impact on catheter-related infections: in precurved catheters, compared to straight ones, the incidence of bacteremia was 0 vs. 5,6/1000 catheter days [15]. Our experience with 30 temporary, precurved jugular catheters, locked with 4% and 30% citrate, with antibiotic ointment at the exit site, was similar to tunneled catheters: incidence of exit site infections and bacteremias was 0,2/1000 and 0,2/1000 catheter days, respectively. However, these results should be confirmed by controlled randomized clinical analysis. The advantage of our precurved jugular temporary catheters as permanent vascular access was in the easier way to insert or to replace by guidewire or to remove it. All these maneuvers could be done by the majority of the nephrologists at any time,

even at night, whilst insertion, replacing or removal of tunneled catheters require surgical skills [16].

### Conclusions

Since the introduction in 1966, native AV fistula is still a vascular access of choice for the majority of chronic hemodialysis patients. The second best access choice is AV graft and the worst but many times the last resort, tunneled catheters. Recent publications have revealed surprising data that thigh AV grafts are of high quality, comparable to native AV fistula. Salvage of AV fistula or graft, mainly by thrombectomy, is as important as creation of a new fistula. It should be performed at any time after thrombosis, it is optimal to do it as soon as possible and is quite successful. Although the European and American guidelines recommend exclusive use of tunneled catheters as permanent vascular access when vasculature is exhausted, there are data revealing that temporary jugular catheters, especially designed (precurved), locked with citrate have as low incidence of catheter-related infection as tunneled catheters. However, randomized controlled trials should be performed to confirm these observations. Growing amount of evidence has indicated that locking solution of choice for hemodialysis catheters is citrate. Nephrologists, at least those who are treating hemodialysis patients, should be involved in the process of vascular access: they should be capable of performing ultrasound/doppler sonography along with vascular mapping before access surgery and before salvage procedures. They should also be capable to insert (at least temporary) hemodialysis catheters at any time. Nephrologists are also very much interested in creating and maintaining vascular access for hemodialysis. Although they can create technically excellent AV fistula or AV graft, their perfect understanding of the problems of vascular access for hemodialysis together with their knowledge of hemodialysis therapy, give them the advantage over vascular surgeons.

*Conflict of interest statement.* None declared.

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