

Long term complications following elbow-based autogenous haemodialysis access

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Chapter - XI
Valorisation



Introduction

Currently, approximately one million Dutch patients suffer from chronic kidney disease (CKD). Although the majority of CKD patients are treated conservatively, some 16.000 patients with end stage renal disease (ESRD) are in the need of renal replacement therapy (RRT). The incidence of ESRD in the Netherlands is about 2.000 patients per year. Both increasing numbers of ESRD patients undergo successful kidney transplantation as well as patient survival on renal replacement therapy has been improved.

Nonetheless, some 6.500 patients require a form of RRT by means of chronic intermittent haemodialysis (HD) or peritoneal dialysis (PD). HD is increasingly preferred over PD, however the creation of a well-functioning vascular access (VA) has become more challenging in the usually elderly, comorbid population. International guidelines dictate an autologous arteriovenous fistula (AVF) as the primary choice of VA. Such an AVF is preferred over a prosthetic arteriovenous graft (AVG) or a central venous catheter (CVC). However, several patient related factors determine the chance on successful maturation and long- term function of an AVF. Due to changing patient demographics (older patient, more comorbidity etc.), the use of the brachial artery for AVF inflow is often preferred over a radial artery based AVF. The down side of an accelerated maturation following a brachial artery connection with high access flow, is an increased chance on access related complications such as haemodialysis access induced distal ischaemia (HAIDI) or cardiac failure due to a high flow access (HFA, >2 L/min). At present, some 5-10% of the HD patients with a brachial artery based AVF will develop HAIDI and 2-4% HFA at a certain time period in their lives.

International guidelines and quality improvement programs such as the 'fistula-first initiative', promote creation of an autologous AVF. As a consequence, most scientific research and funding concentrate on surgical decision- making in VA surgery. In other words, 'when to create which type of VA' and 'how to improve successful AVF maturation, decrease AVF thrombosis and improve outcome'. Unfortunately, the chances on the onset of long- term complications such as HAIDI and HFA are not considered in this equation. Nonetheless, quality of life is highly influenced by these complications. In the current thesis, we sought to improve our insight concerning these complications. Consequently, daily dialysis care and quality of life will be improved.

Socio-economic relevance

When focusing on HAIDI, a hypothesis was tested that was formulated earlier on by our research group. It was previously hypothesized that hand ischaemia in the presence of an AVF is caused by a combination of peripheral blood pressure decreasing phenomena:

- Progressive arterial stiffness due to patient characteristics, such as diabetes, long-term uraemia and atherosclerosis, thereby hampering arterial remodelling capacity.
- A possible significant arterial stenosis along the arterial inflow tract.
- Turbulent blood flow at the anastomosis due to an arterial and venous vessel wall mismatch.
- Excessive shunting of arterial blood into a low resistance outflow vein and its venous side branches.

Subsequently, a novel minimal invasive surgical approach in the treatment of HAIDI was studied: The side branch ligation (SBL), in which venous side branches of the VA are ligated leading to a reduced loss of peripheral blood pressure, has provided the vascular surgeon with a new technique for HAIDI treatment. SBL appeared effective in selected cases of HD patients suffering from HAIDI while effective dialysis is maintained. Two important criteria in VA surgery for hand ischemia were thus sustained:

1. Maintain a functional VA to continue successful HD at all times, and
2. decrease the physical and psychological burden associated with ongoing hand ischaemia and improve hand function and quality of life.

Another issue, is the novel step-by-step approach that was proposed in the treatment of HAIDI. Several treatment algorithms for hand ischaemia in HD patients are available in current literature. However, the treatment of choice for HAIDI is often based on the preference of the vascular surgeon as comparative studies are lacking. In our approach towards an uniform treatment algorithm, all HAIDI patients received a standard set of diagnostics and followed a step-by-step treatment protocol. Using this protocol, dialysis nurses and nephrologists responsible for daily dialysis care are familiar with questionnaires and imaging that are needed for a proper diagnostic pathway of HAIDI. Although the exact effect on the quality of care is difficult to measure as this protocol has developed itself over the years, its utility is beyond doubt as all patients are examined and treated uniformly. As a consequence, individuals are treated with a minimal number of different treatments improving patient care and reducing medical costs.

Cornerstone in our diagnostic regime for HAIDI is a hand ischaemia questionnaire (HIQ). Although other research groups have not validated this questionnaire, its extensive use at our dialysis center in daily practice and for research purposes has given us a wealth of hands-on experience. The HIQ is a practical and useful tool for the assessment of severity of ischemic complaints in HAIDI patients and allows for an objective evaluation of the effect of treatment. Widespread use of this questionnaire would improve comparability of outcome in future studies by different/other research institutions.

In our studies concerning HD patients harbouring HFA we aimed to emphasize any potential devastating consequences of a high flow AVF on cardiac function. Cardiac dysfunction is 'endemic' in HD patients. Several factors contribute to a state of enhanced cardiac stress in HD patients, including left ventricular hypertrophy, interdialytic fluid changes, hypertension, anaemia, HD itself, and possibly the AVF. However, a HFA even puts an extra strain to the heart. Unfortunately, physicians and especially vascular surgeons are hesitant when it comes to perform an AVF revision for HFA as these HD patients are often asymptomatic. In this thesis we discuss the diagnostic pathway that patients are subjected to in order to achieve convincing reasons to reduce access flow. Nonetheless it is strongly advised to surgically revise the AVF with a high flow even if it is seemingly asymptomatic and access flow persists above 2 L/min during a 6 month follow-up.

As in HAIDI surgery, the scientific evidence on the optimal surgical option for HFA is limited. Most techniques are expert-based and solely depend on the surgeon's preference. In this thesis we demonstrate that a frequently used flow reduction technique ('banding') is less effective on the long-term than previously assumed. More favourable results are achieved with a technique called revision using distal inflow (RUDI). This RUDI technique is presently considered as a first treatment option for HFA patients.

Target groups

Findings in this thesis are useful for HD patients and all healthcare workers who are responsible for daily dialysis care (nurses, vascular surgeons, nephrologists, interventional radiologists, cardiologists).

How can further valorisation in the future be achieved?

A future challenge to improve valorisation is to convert the HIQ to an online questionnaire or even mobile (E-health) application. Furthermore, an online service may allow free access to

our step-by-step treatment protocol. Research in VA surgery is in a clear need of high standard comparative studies. Unfortunately, current knowledge is mainly based on small studies, in particular when it comes to revision surgery. Expert opinion (level IV evidence) is setting the current standard. A potential future valorisation of our studies is to create a national database in the Netherlands in which all HD patients and their VA are registered and followed creating useful datasets and a platform to facilitate future research on HAIDI and HFA.

