

5. Surveillance of vascular access

Guideline 5.1. Prior to any cannulation, autogenous arteriovenous fistulae and grafts should be assessed by physical examination (Evidence level IV).

Guideline 5.2. Objective monitoring of access function should be performed at a regular base by measuring access flow (Evidence level II).

Rationale

It is necessary to evaluate the vascular access clinically prior to any cannulation, both in autogenous AV fistulae and AV grafts. Inspection may reveal swelling, infection, haematoma, aneurysm or stenoses. Palpation evaluates the characteristic thrill and the intravascular pressure as it may differ between a pre- and a post-stenotic vessel segment. Post-stenotic collapse of the vein after elevation of the arm above the heart is proof of the haemodynamic relevance of a stenosis in autogenous AV fistulae. Auscultation is indicated if a stenosis is suspected and a high-pitched bruit can be heard in the presence of a stenosis. Clinical evaluation for the monitoring of prosthetic grafts may be difficult because of their rigidity, however, has been reported reliable to indicate flow changes [1]. Usually, no dilatation is observed, except in case of cannulation-related pseudo-aneurysm formation. Any suspicion of complications arising from the clinical examination should be confirmed by objective measurements. There are a wide variety of functional and anatomic imaging techniques such as access flow measurement, ultrasonography and angiography, each with their own applicability and accuracy rates. The goal of these measurements is the early diagnosis of AV fistula or AV graft dysfunction, aiming at a pre-emptive correction by interventional techniques [2] (See Guideline 7). These measurements require technical equipment and can never substitute for physical examination. Modern dialysis machines always provide venous and arterial pressures which can be used to monitor access function. Numerous dialysis facilities exclusively rely on this type of monitoring, although standardization and comparability is lacking as the pressures are influenced by blood flow, needle diameter and cannulation site. Today, we know that these parameters have a poor predictive value compared with access flow measurements [3]. With the introduction of prosthetic graft materials and their well-known high complication rate, more sophisticated methods came into use such as dynamic and static venous pressure measurements [4,5]. Static intra-access pressure ratio (static venous pressure in relation to mean arterial pressure) as introduced by Besarab [6] offers some advantage over dynamic

pressure [7]. Smits et al. [8] reported that standardized monitoring of either venous pressure, access flow or the combination of both with subsequent corrective intervention can reduce thrombosis rate in grafts. Recently, Spergel et al. [3] concluded in a preliminary report that all types of pressure measurements should be abandoned in favour of access flow measurements.

Various techniques to measure access flow have been described:

Duplex ultrasound, Ultrasound flow dilution (Transonic®), Crit-Line III, Crit-Line III TQA, Variable flow Doppler, In graft Velocitymetry, Blood Velocity Meter and Glucose Pump Test. There is no clear preference for any one of these techniques [7].

In summary, access flow measurement is an accurate predictor of fistula/graft dysfunction, which may result in access thrombosis. An access flow <600 ml/min in AV grafts [8–10] respectively, a reduction of flow >20% per month [9] or <300 ml/min in forearm AV fistulae is an indication for pre-emptive intervention [11]. For upper arm fistulas these flow data are lacking. Monthly flow measurements for grafts and three monthly for fistulae are recommended. Monitoring and surveillance with subsequently pre-emptive radiological or surgical intervention reduce the rate of thrombotic events in AV grafts as well as in AV fistulae, thus substantially decreasing patient morbidity, hospital admissions and costs of healthcare delivery [12–14]. Access monitoring programmes should be included as an integral part of routine dialysis care [13].

Recommendations for further research

Improvement of monitoring methods to accurately detect failing vascular access remains an important issue for research.

References

1. Trerotola SO, Ponce P, Stavropoulos SW et al. Physical examination versus normalized pressure ratio for predicting outcomes of hemodialysis access interventions. *J Vasc Interv Radiol* 2003 Nov; 14(11): 1387–1394
2. Sands JJ, Jabyac PA, Miranda CL, Kapsick BJ. Intervention based on monthly monitoring decreases hemodialysis access thrombosis. *ASAIO J* 1999; 45: 147–150
3. Spergel LM, Holland JE, Fadem SZ, McAllister CJ, Peacock EJ. Static intra-pressure ratio does not correlate with access blood flow. *Kidney Int* 2004; 66: 1512–1516
4. Schwab SJ, Raymond JR, Saeed M, Newman GE, Dennis PA, Bollinger RR. Prevention of hemodialysis fistula thrombosis. Early detection of venous stenoses. *Kidney Int* 1989; 36: 707–711

5. Sullivan KL, Besarab A, Dorrell S, Moritz MJ. The relationship between dialysis graft pressure and stenosis. *Invest Radiol* 1992; 27: 352–355
6. Besarab A. Preventing vascular access dysfunction: which policy to follow. *Blood Purif* 2002; 20: 26–35
7. McCarley P, Wingard RL, Shyr Y, Pettus W, Hakim RM, Ikizler TA. Vascular access blood flow monitoring reduces access morbidity and costs. *Kidney Int* 2001; 60: 1164–1172
8. Smits JH, Linden J van der, Hagen EC et al. Graft surveillance: venous pressure, access flow, or the combination? *Kidney Int* 2001; 59: 1551–1558
9. May RE, Himmelfarb J, Yenicesu JM et al. Predictive measures of vascular access thrombosis: a prospective study. *Kidney Int* 1997; 52: 1656–1662
10. Kim YO, Yang CW, Yoon SA et al. Access blood flow as a predictor of early failures of native arteriovenous fistulas in hemodialysis patients. *Am J Nephrol* 2001; 21: 221–225
11. Tessitore N, Mansueto G, Bedogna V et al. A prospective controlled trial on effect of percutaneous transluminal angioplasty on functioning arteriovenous fistulae survival. *J Am Soc Nephrol* 2003; 14: 1623–1627
12. Tonelli M, Jindal K, Hirsch D, Taylor S, Kane C, Henbrey S. Screening for subclinical stenosis in native vessel arteriovenous fistulae. *J Am Soc Nephrol* 2001; 12: 1729–1733
13. Sands JJ. Vascular access monitoring improves outcomes. *Blood Purif* 2005; 23: 45–49
14. Besarab A. Access Monitoring is worthwhile and valuable. *Blood Purif* 2006; 24: 77–89