Case Report

Haemodialysis access graft with shunting through an iatrogenic fistula—the diagnostic role of magnetic resonance flow measurement

Bastiaan P. M. van Kempen, Henk F. M. Smits and Peter J. Blankestijn

Departments of Radiology and Nephrology, University Hospital Utrecht, The Netherlands

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Introduction

Typically blood flow through a haemodialysis graft ranges from 500 to 1500 ml/min, but higher flows may occur [1]. These high flows may be detrimental for the patient because they mean an extra burden for cardiac function.

We present a case of high graft flow and we show how modern radiological technology may help to quantify the problem.

Correspondence and offprint requests to: Henk F. M. Smits, Dept. of Radiology, University Hospital Utrecht, Room E.01.132, Heidelberglaan 100, 3584 CX Utrecht, The Netherlands.

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The patient is a 47-year-old male with polycystic kidney disease. Because a Cimino fistula failed to mature, a forearm PTFE graft in loop configuration was implanted in August 1996. Two months later, MR Angiography (MRA) of the graft was performed as part of a research programme (Figure 1). It was normal and MR flow measurement showed a blood flow of 1130 ml/min. In February 1997, MRA showed a communication between the arterial limb of the graft and an adjacent vein, and filling of the forearm veins (Figure 1). Conventional angiography confirmed the existence of an iatrogenic fistula. It further showed that the haemodialysis needle was not placed in the graft but in an adjacent vein (Figure 2). At MR flow quantification, the flow in the arterial limb just upstream of the iatrogenic fistula was 1770 ml/min. Downstream of the iatrogenic fistula, in the venous limb, the flow was 852 ml/min (Figure 3). Thus, a volume of 918 ml/min was shunted from the arterial limb of the graft through the fistula to the forearm venous system. The dilated veins of the forearm became palpable. Otherwise, the patient was symptom free. Because he did not show clinical signs of cardiac failure, we decided on a wait-and-see policy. In January 1998, the graft thrombosed and thrombolysis was performed. Control angiography at the end of the procedure showed a patent loop-graft. The iatrogenic fistula was occluded.

The formation of an iatrogenic fistula in the access is uncommon and has, to our knowledge, not previously been described. Recurrent placement of the needle into the wall of the graft can provoke a communication between the graft and the surrounding tissue. Usually this will lead to a haematoma, which is readily noted and treated with compression. If the surrounding tissue, however, is a vein, the communication may lead to an iatrogenic fistula between the graft and the neighbouring native vein. Due to the high pressure in the vein, the hole in the wall of the vessel will gradually enlarge and the efferent veins will grow in size. The vascular resistance of a graft is low due to the absence of a capillary bed in this circuit. An iatrogenic fistula causes a further reduction of the vascular resistance, leading to a further increase in flow. The high flow will be limited to the part upstream of the fistula. Blood flow into the graft will be divided to run through the fistula or the venous part of the graft, depending on the ratio of the resistance through the fistula and the resistance of the venous part of the graft and the venous outflow tract. Therefore, in the presence of a stenosis in the venous outflow tract, flow downstream of the fistula can diminish rapidly, leading to thrombosis of this part of the graft.

Conventional angiography only provides information on the anatomy. It visualizes the vessel lumen. The clinical relevance of an iatrogenic fistula needs to
be established by quantification of flow. Ultrasound dilution technique is unsuitable for measuring flow upstream and downstream of the fistula simultaneously [1]. Conventional Doppler flow measurements have poor accuracy [2]. MR angiography offers imaging of haemodialysis grafts without the use of contrast materials. The MR angiogram displays flowing protons inside the vessel and not vessel lumen. Areas of flow disturbances in the access, such as vascular stenoses, are displayed as areas of low signal or signal void in the MR angiogram. MR flow measurements offers the ideal technology to quantify flow in tubes [3]. Integrated in the MRA study, MR flow measurements take not more than 2 min. Flow can be measured on any site of the graft. Thus MR provides both anatomical and functional information on a graft. We have shown in vivo that flow can be quantified in haemodialysis grafts [1,4].

High access blood flow increases risk for development of left ventricular hypertrophy and cardiac failure [5]. Clinically evident heart failure in the presence of high access flow may necessitate surgical banding of the arterial anastomosis of the access in an effort to reduce flow [6]. In such cases, it is important to consider iatrogenic fistula as possible cause of high flow, because closure of the fistula is the logical treatment.

This case illustrates a rare cause of high blood flow. It also shows the unique possibilities offered by MRA to obtain both anatomical and functional data of a graft.

References


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