

TECHNICAL NOTE

Technique of Duplex Scanning for Selection of Optimal Peripheral Anastomosis Site for Distal Bypass

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Introduction: Selection of the optimal anastomosis site is essential for obtaining good results from distal bypass. Herein, a unique, precise technique that uses pre-operative duplex scanning for selecting this site is presented.

Technical summary: Before distal bypass surgery, duplex scanning is performed to assess patency and flow. Use of the venous preset mode and controlling the slant function allows visualisation of colour Doppler flow inside the arteries, thus enabling selection of the best segment for anastomosis.

Conclusion: Use of duplex scanning in the appropriate mode consistently enables selection of the best anastomosis site for distal bypass, even when there is heavy calcification.

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INTRODUCTION

Distal bypass is considered a very effective means of salvaging critically ischaemic legs in patients with peripheral arterial disease. An important factor affecting long-term patency is the quality of the distal anastomosis. In patients with critical limb ischaemia (CLI), especially those with end stage renal disease, calcium deposits may be so thick that vascular surgeons are forced to abandon attempts to create a distal bypass. The authors routinely perform pre-operative duplex ultrasound scanning (DUS) in such patients and have found it very effective for selecting the best anastomotic sites. The efficacy of DUS has previously been reported.^{1,2} However, the precise technical aspects of this detection and assessment methodology have not been described in published reports.

SURGICAL TECHNIQUE

The patient is placed in a prone position. Prior to performing DUS, angiography is performed to roughly identify the region of the optimal distal anastomosis site, that is, the best quality tibial portion of an artery with enough runoff vessels. A linear probe is then used to assess the vessel wall characteristics and the vessel's diameter, thus enabling identification of a precise anastomotic site in the crural or para-malleolar portion of the target vessel. The extent of

calcification is easily estimated by the thickness and intensity of echo density (Fig. 1). Regions with thick calcium deposits with strong acoustic shadows are unsuitable for anastomosis. However, close examination with colour Doppler scanning may reveal weak flow elsewhere in the same artery. In the authors' experience, colour Doppler signals of a certain length (almost 5 mm) generally indicate that calcium deposits in the arterial wall are thin enough to cut and to allow placement of stitches in the arterial wall, and thus denote a feasible anastomosis site (Fig. 2). The important technical points vital to locating such sites are to use the venous, rather than arterial, preset mode and to



Figure 1. Identification of anastomosis site by duplex scan. The extent of calcification is easily estimated by the thickness and intensity of echo density. The figure shows the calcified tibial artery, which is not suitable as a distal anastomosis site.

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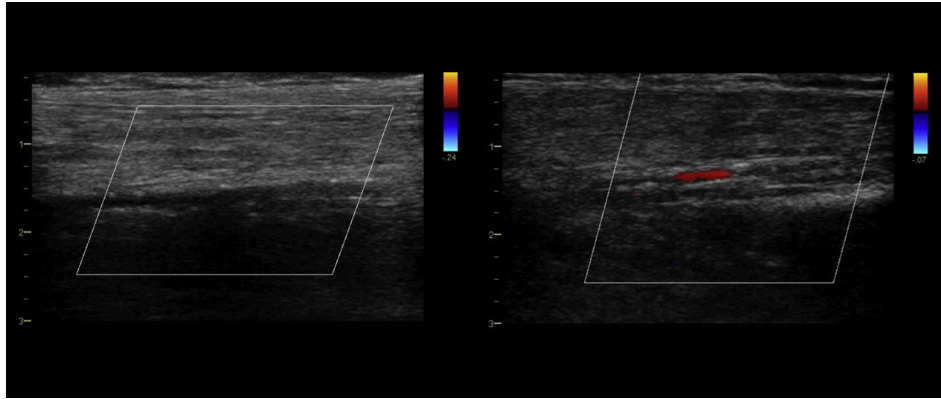


Figure 2. Colour Doppler duplex scan imaging to identify the optimal anastomosis site. Weak flow in a distal artery, especially when there is dense calcification in that artery's walls, cannot be seen with standard colour Doppler duplex scanning in the arterial preset mode (left panel). However, use of the venous preset mode and appropriate slant function provides a colour Doppler signal at the same site (right panel). Detection of such a signal guarantees that the surgeon will be able to incise the arterial wall and easily insert a stitch.

adjust the slant function, which controls the Doppler insonation angle, to best visualise colour Doppler signals. An angle of 60° of Doppler insonation relative to the vessel axis provides the most accurate colour Doppler signal. Correct adjustment of this angle enables detection of very slow blood flow in the distal artery.

Between February 2013 and June 2016, 58 distal bypasses were performed, 28 (48%) of them in patients with end stage renal disease who were undergoing haemodialysis. Pre-operative DUS was performed and anastomosis to the portion selected by DUS completed in all patients. There were no operative deaths or bleeding complications. Early graft failure (within 1 month) occurred in one patient, who was later diagnosed as having antiphospholipid antibody syndrome. Two patients required secondary interventions to the distal anastomosis within 1 month. One of these patients developed a distal pseudoaneurysm that required surgical repair. The other had an arterial stenosis just distal to the anastomosis that was probably caused by clamping. This patient recovered after balloon angioplasty. Long-term results of distal bypasses have been reported elsewhere.³ Briefly, the accumulated primary and secondary patency rates were 81.0% at 1 year and 78.7% at 3 and 5 years. The amputation free rates at 1, 3, and 5 years were 94.5%, 82.6%, and 76.7%, respectively.

DISCUSSION

In Japan, nearly 50% of patients with CLI undergoing bypass surgery have end stage renal disease and are undergoing haemodialysis.⁴ The most serious problem in these patients is arterial calcification. Both during their first visit and immediately pre-operatively, DUS is used to assess the quality of the patients' veins and to identify the precise point of anastomosis in every patient. Generally, a minimum of 1 mm of diameter is considered to be worth trying, however severe the calcification. It is believed that the most important means of identifying the optimal artery is visualisation of colour Doppler flow inside it. In particular, the use of venous mode and precise control of slant function enables identification of the optimal anastomosis site, even

in patients with "porcelain" tibial arteries. Distal bypasses have safely and accurately been completed in all such patients, including those undergoing haemodialysis. Long-term results, which have previously been reported,³ support the efficacy of DUS. Mazzariol et al. reported 185 cases of pre-operative duplex scanning, including 58 having tibial bypasses, and concluded that duplex scanning was a safe alternative to angiography.⁵ A guideline developed in collaboration with the American College of Radiology and the Society of Radiologists in Ultrasound recommends peripheral arterial ultrasound examination for mapping of arteries before surgical interventions.⁶ The present unique technical methodology could help surgeons to create successful anastomoses consistently.

CONCLUSION

Pre-operative assessment with DUS and angiography is essential to achieving high quality anastomoses and optimising long-term results of distal bypasses.

CONFLICT OF INTEREST

None.

FUNDING

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