Can Lower Limb Vascular Reconstruction be Based on Colour Duplex Imaging Alone?

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Objectives: To determine the safety and efficacy of Duplex scanning as the only imaging modality prior to lower limb vascular reconstruction.

Design: Retrospective review.

Setting: A single university vascular unit.

Patients and methods: Review of all lower limb vascular reconstructions over a 2 year period.

Results: Eighty-five limbs underwent vascular reconstruction based on colour Duplex alone. A wide range of revascularising operations were performed, including 29 cases of infragenicular reconstruction. In the latter cases, the findings of Duplex scanning were confirmed by on table pre-reconstruction angiography in 28 cases and the graft occlusion rate in the first month was 14%. There were no postoperative complications that could be attributed to a failure of preoperative Duplex imaging.

Conclusion: Vascular reconstruction can be undertaken safely in patients with lower limb arterial disease on the basis of Duplex scanning alone.

Key Words: Duplex; Arterial disease; Lower limb; Vascular reconstruction.

Introduction

It is becoming increasingly apparent that colour Duplex sonography can accurately image lower limb arterial disease.1-5 The theoretical merits of Duplex compared to conventional arteriography include the provision of haemodynamic in addition to anatomical information,6 its safety and relative cost-effectiveness.7 Despite these advantages, preoperative diagnostic arteriography is widely considered an essential investigation prior to lower limb revascularising surgery.

Our own results with colour Duplex imaging of the lower limb indicate that colour Duplex scanning correlates well with conventional arteriography8 and we have therefore adopted a policy of preoperative Duplex assessment rather than conventional arteriography in patients undergoing lower limb revascularisation. The purpose of this study was to review the outcome of lower limb revascularisation based on Duplex alone.

Patients and Methods

Patients

The management of all patients who underwent lower limb vascular reconstruction over the 2 year period October 1, 1993 to 1995 was reviewed. The Unit policy over this period was to investigate patients presenting with significant symptoms of occlusive lower limb disease using Duplex scanning as the primary imaging modality. On the basis of the Duplex scans patients were treated conservatively, referred for percutaneous transluminal angioplasty (PTA) or surgery. All patients who underwent femorodistal bypass had dependent Doppler studies9 in addition to colour Duplex scanning.

Patients who had either diagnostic arteriography or limited arteriography as part of a therapeutic intervention in the 6 months prior to surgery were excluded from this study.
**Duplex scans**

Duplex scans were performed by one of four vascular technologists using an ATL ultramark 9 duplex scanner with a colour coding facility (Advanced Technology Laboratories, Bothell, Washington, U.S.A.). Duplex examinations took 30–45 mins for each limb scanned, and findings were recorded on a 'Duplex map'. When iliac scans were requested, patients were asked to attend starved for 6 h. Iliac segments were examined with a 3.5 MHz probe with the patient supine. A 5 MHz probe was used for the femoropopliteal segments which were scanned with the legs relaxed in slight external rotation. Insonation of the popliteal arteries and the origins of the tibial arteries were performed in a lateral position with the knees flexed. The infrapopliteal vessels were similarly scanned with a 3.5 MHz probe with the patient either supine or in a lateral position.

A peak systolic velocity ratio of greater than 2 was considered to define a significant stenosis, whilst absence of colour flow or absence of flow on pulsed Doppler was taken to be diagnostic of vessel occlusion.

**Surgery**

A peroperative papaverine test was performed when Duplex findings indicated a borderline significant iliac stenosis. All limbs having femoropopliteal or femorodistal procedures underwent on-table pre-construction arteriography as a matter of policy at this unit and completion angiography was also performed as a matter of routine.

**Results**

Over the 2 year study period, 215 patients (250 limbs) underwent lower limb revascularisation and of these 75 (85 limbs) were referred for surgery on the basis of colour-coded Duplex scans alone. The clinical details of these 75 patients are given in Table 1. The 85 limbs discussed in this study therefore form 34% of the total number of limbs revascularised during the study period.

**Limbs excluded from the study**

This study excluded limbs that had undergone diagnostic arteriography (33) or arteriography at the time of angioplasty (126) in the previous 6 months. In addition, six limbs were urgently revascularised without any preoperative imaging. Diagnostic arteriography had been performed in 33 limbs because the patients were on the surgical waiting list prior to the adoption of the Duplex policy, the arteriograms had been performed at other centres, three limbs were referred for arteriography after technically unsuccessful Duplex examinations, whilst in another two cases, arteriography confirmed Duplex findings without adding extra information.

A wide range of procedures were performed in the 85 limbs referred for surgery (Table 2). In four cases of proximal disease in which colour Duplex indicated a probable significant iliac stenosis, a peroperative papaverine test was performed which confirmed the stenosis to be significant. Pre-reconstruction arteriography was performed in all limbs having any form of infragenicular procedure. In only one of these cases was there a discrepancy between pre-reconstruction arteriography and colour Duplex — a posterior tibial
vessel reported on Duplex to be patent from its origin was found to be occluded to 5 cm above the ankle. The rate of graft occlusion in the first month after infragenicular bypass surgery was 4/29 cases (14%). None of the graft occlusions could be attributed to a failure of preoperative imaging with Duplex.

Discussion

Colour Duplex offers a number of advantages compared to angiography. First, it provides both haemodynamic and anatomical information. Secondly, it is non-invasive and finally it is relatively cheap. Although lower limb colour-coded Duplex sonography has been shown to correlate well with arteriography, it has failed to displace diagnostic arteriography in most vascular units. This is partly because of the natural hesitancy involved in introducing any new technology, but also because vascular surgeons have been taught to make decisions on anatomical pictures and feel insecure without them. Indeed, in a recent publication that evaluated the role of duplex in the clinical management of patients with lower limb arterial disease, of 32 patients scheduled for surgery on the basis of Duplex, 24 underwent arteriography to determine the definitive policy and yet it provided additional information in only five cases!

The results of the present study show that a wide range of revascularising operations, including re-do limb salvage (Table 2), surgery can be performed on the basis of Duplex scans alone. There was only one unexpected finding at surgery and further indirect evidence of the accuracy of Duplex evaluation is provided by the low rate of early graft occlusion (14%) following distal revascularising surgery. It should be stressed that we decided as a matter of policy not to include in this study patients who had any form of arteriography in the previous 6 months, even if the arteriogram was a limited study as part of an angioleak, as was the case in 121 limbs. This is because if we included these patients then it could be argued that the arteriograms contributed to their preoperative work up. Although the 6 month cut-off is somewhat arbitrary, it does correspond to the time limit that many vascular surgeons would allow before requesting a further preoperative arteriogram.

In conclusion, these results show that lower limb revascularising surgery can be safely undertaken in the majority of patients on the basis of Duplex findings alone. We would caution however that Duplex scanning is "operator dependent" and requires highly trained, experienced vascular technologists.

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References


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