The radial artery as a conduit for coronary artery bypass grafting

Over the past five years several groups have promoted the use of the radial artery as the second conduit of choice for coronary artery bypass grafting (CABG), after the left internal mammary artery (LIMA) and in preference to the saphenous vein. The attractions of the radial artery to the surgeon are immediate and obvious: it is a versatile conduit that can be harvested easily and safely, it has handling characteristics superior to those of other arterial grafts, and it reaches comfortably any coronary target.1 For the patient it offers the long term prospect of superior patency compared to vein grafts2 3 and the immediate benefit of avoiding the frequently underestimated morbidity of leg wounds.4

Long term patency of arterial and venous conduits
Ten years after CABG, 90% of LIMA grafts are patent and disease free while 75% of vein grafts are occluded or severely stenosed.5 As well as establishing the LIMA as the conduit of first choice for CABG this has promoted the use of other arterial conduits including the right IMA, the gastroepiploic, and the inferior epigastric artery. Despite evidence of clinical and survival benefits of using more than one arterial graft6 the absence of any large randomised trials with long term follow up, allied to the increased technical demands of using multiple arterial grafts, has precluded widespread use. A similar position existed over the use of a single IMA graft before the seminal article from the Cleveland clinic in 1986,6 but the user friendliness of the radial artery may be changing this perspective.

Increasing interest in the use of the radial artery for CABG
Carpentier and colleagues first proposed the use of the radial artery for CABG in 1973,7 but within a few years reports of spasm and occlusion led to its abandonment.8 As well as establishing the LIMA as the conduit of first choice for CABG this has promoted the use of other arterial conduits including the right IMA, the gastroepiploic, and the inferior epigastric artery. Despite evidence of clinical and survival benefits of using more than one arterial graft7 the absence of any large randomised trials with long term follow up, allied to the increased technical demands of using multiple arterial grafts, has precluded widespread use. A similar position existed over the use of a single IMA graft before the seminal article from the Cleveland clinic in 1986,6 but the user friendliness of the radial artery may be changing this perspective.

Morphology and pharmacology of the radial artery
The radial artery is a muscular artery with a prominent adventitia.14 The more muscular media of the radial artery explains in vitro and clinical observations of an increased tendency to spasm compared with the IMA.7 We reported that an increased tendency to spasm in the proximal radial artery, because of more smooth muscle, is minimised by its greater functional diameter.15 Because the vasa vasorum of the radial artery does not penetrate into the media,14 oxygen and nutrients are provided by luminal diffusion, which suggests that transposition of the radial artery as a free graft should not have adverse ischaemic implications for the vessel wall over the long term.

Pre-existing disease in the radial artery
We compared histological specimens from 177 radial arteries, 168 IMA, and 86 long saphenous vein grafts obtained from the same patients.16 There was an increased prevalence of intimal thickening, medial sclerosis, and medial calcification in the radial artery compared to the other conduits, but in the vast majority of specimens this was mild. Mild pre-existing disease in the radial artery is probably of little relevance to long term patency.

One and five year angiographic patency
Several groups have reported radial artery patency rates to non-left anterior descending coronary vessels in excess of 90% at one year8–13 compared with vein graft patency rates of around 80% at one year.9 This may reflect the superior haemodynamics of radial artery grafts, which have no valves and are more uniform in calibre than vein grafts. Furthermore, whereas the diameter of the radial artery exceeds the coronary artery by only 20%, that of vein grafts is often in excess of 50%,12 promoting relative stasis in the vein graft.

Two groups have reported five year radial artery patency rates of between 83%9 and 92%.2 As well as establishing the LIMA as the conduit of first choice for CABG this has promoted the use of other arterial conduits including the right IMA, the gastroepiploic, and the inferior epigastric artery. Despite evidence of clinical and survival benefits of using more than one arterial graft7 the absence of any large randomised trials with long term follow up, allied to the increased technical demands of using multiple arterial grafts, has precluded widespread use. A similar position existed over the use of a single IMA graft before the seminal article from the Cleveland clinic in 1986,6 but the user friendliness of the radial artery may be changing this perspective.

Morphology and pharmacology of the radial artery
The radial artery is a muscular artery with a prominent adventitia.14 The more muscular media of the radial artery explains in vitro and clinical observations of an increased tendency to spasm compared with the IMA.7 We reported that an increased tendency to spasm in the proximal radial artery, because of more smooth muscle, is minimised by its greater functional diameter.15 Because the vasa vasorum of the radial artery does not penetrate into the media,14 oxygen and nutrients are provided by luminal diffusion, which suggests that transposition of the radial artery as a free graft should not have adverse ischaemic implications for the vessel wall over the long term.

Pre-existing disease in the radial artery
We compared histological specimens from 177 radial arteries, 168 IMA, and 86 long saphenous vein grafts obtained from the same patients.16 There was an increased prevalence of intimal thickening, medial sclerosis, and medial calcification in the radial artery compared to the other conduits, but in the vast majority of specimens this was mild. Mild pre-existing disease in the radial artery is probably of little relevance to long term patency.
Figure 2 Wound healing in patient with bilateral IMA and radial grafts. Lazy S incisions result in optimal forearm wound healing.

In our experience intravenous infusions of calcium channel blockers, aimed at reducing radial artery vasospasm, led to a high intraoperative incidence of bradycardia and hypotension. There is no definite evidence regarding the efficacy of perioperative calcium channel blockers to reduce or abolish postoperative radial artery spasm. In view of the proclivity for spasm in the radial artery in the early postoperative period, however, it is our practice to prescribe a calcium channel blocker for one year after the operation. We avoid intraluminal dilatation of the radial artery with antispasmodic agents but place the harvested artery in a papaverine and blood solution.

The site of the proximal radial artery anastomosis is determined by vessel calibre. Around 80% of radial artery grafts can comfortably be anastomosed to the aorta while smaller calibre vessels are anastomosed as a ‘Y’ graft to the left or right IMA.

Cautions and contraindications to the use of the radial artery

The radial artery should not be placed to coronary arteries with < 70% stenosis as this may reduce patency rates. All arterial grafts should be used cautiously in unstable patients where high immediate flow rates are important and may be best avoided in patients with severely impaired ventricular function because of the likely need for inotropes (and the consequent risk of vasoconstriction). The radial artery should not be harvested in patients who are future candidates for renal dialysis.

Conclusions

The increasing use of the radial artery for CABG is due to its attractions from both the patient’s and the surgeon’s perspective. If superior long term patency over vein grafts is confirmed the radial artery will have an increasingly important role in coronary revascularisation.

D P TAGGART
Cardiothoracic Department, The John Radcliffe Hospital, Oxford OX3 9DU, UK


