PRACTICE REVIEWED

Indications for cardiac transplantation

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The prognosis of patients with end stage cardiac failure is poor. It can be improved by medical treatment, for example by adding vasodilators¹ or angiotensin converting enzyme inhibitors² to diuretic treatment. None the less, the survival rate at 12 months in a group treated with enalapril was only 53%.² At Papworth Hospital the cumulative survival rate for patients treated with "triple" immunosuppressive therapy (cyclosporin, azathioprine, and prednisolone) after cardiac transplantation was about 90% at 1 year and 80% at 3 years, which is similar to the experience world wide.³ Clearly, the quality of life as well as its duration must be considered. This has been shown to be substantially improved by cardiac transplantation, which has a good cost/benefit ratio.⁴

The major causes of mortality in the first year after transplantation are acute graft rejection and uncontrolled infection. After the first year, coronary occlusive disease is the commonest cause of mortality. Advanced occlusive disease, which tends to be diffuse and affects the proximal and distal coronary arteries, may lead to a repeat transplantation being considered.

Cardiac transplantation will continue to be restricted by the limited supply of donor organs.⁵ In 1988, around 2500 cardiac transplants were performed in almost 250 international centres; this was only a small proportion of the total population of patients with end stage cardiac failure.

How should we decide which patients should receive the available organs? On the basis of clinical findings and the results of non-invasive and invasive investigations it is usually obvious which patients are severely disabled by left or right ventricular failure or both. The first question is: "is it likely that this patient would return to normal or near-normal activities if their heart was replaced?" Clearly, the procedure is not appropriate if the patient has severe coexisting cerebrovascular disease, peripheral vascular disease, pulmonary disease, or renal disease. In some patients, however, combined organ transplantation may be the preferred option—for example, heart and kidney or heart and liver. Patients accepted for cardiac transplantation should be well motivated and able to cope with immunosuppressive treatment after operation and also the inconvenience of repeated endomyocardial biopsy, particularly in the early postoperative period.

In many transplant centres the upper age

limit for the recipient is between 55 years and 60 years. Biological age as well as chronological age should be considered. The age range for recipients of cardiac transplants world wide is 1 day to 78 years and in our unit it is 6 to 63 years.³ At Papworth Hospital the age limit is around 55 years for the patients with coronary artery disease and around 60 years for those with dilated cardiomyopathy. This is because in the early postoperative period vascular complications, particularly cerebrovascular events and gastrointestinal ischaemia, are more common in the more elderly patients with coronary artery disease.

Most of our patients undergoing cardiac transplantation had heart failure refractory to medical treatment associated with either coronary artery disease (53%) or dilated cardiomyopathy (44%). This resembles experience world wide—43% and 49% respectively.³ The timing of cardiac transplantation may be difficult in some patients. The symptoms of cardiac decompensation in patients with coronary artery disease usually remain stable, unless there is an event causing further myocardial damage, and sudden death is a continuing risk. In contrast, the condition of those with dilated cardiomyopathy can deteriorate quite rapidly, or in some cases improve, making their assessment for cardiac transplantation and the timing of surgery even more difficult. Therefore, careful and frequent follow up is required for each patient. The remaining group of patients undergoing transplantation—in our series, 3% of the total population—includes those with other types of cardiomyopathy (for example, hypertrophic or restrictive), end stage valve disease, severe angina caused by coronary artery disease that is not amenable to revascularisation, and patients with ventricular tachycardia that is refractory to other forms of treatment. Occasionally, therefore, it may be appropriate to give a cardiac transplant to a patient who is severely limited by angina rather than by the symptoms of cardiac failure—if they are unsuitable for coronary angioplasty or bypass surgery. Patients with ventricular tachycardia that is refractory to drug treatment, many of whom have considerable left ventricular dysfunction, are an interesting group. Transplantation should be considered in those who are severely restricted by symptoms of cardiac failure. For those with life threatening tachycardia but no cardiac failure the relative cost/benefit of implantable cardioverter-defibrillators and

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cardiac transplantation could be established in a randomised, controlled trial.

In our experience about 6% of patients referred with a view to cardiac transplantation are suitable for "conventional" cardiac surgery. This is usually either left ventricular aneurysmectomy or mitral valve surgery, with or without myocardial revascularisation. Clearly, cardiac catheterisation will establish the cause of heart failure and will determine whether any conventional treatment would be of benefit. A fixed, raised pulmonary vascular resistance in excess of 5–6 Wood units that does not fall when the oxygen saturation is increased is an absolute contraindication to orthotopic cardiac transplantation. The pressure drop across the pulmonary vascular bed (mean pulmonary artery pressure minus mean left atrial pressure) is a useful measurement, particularly if the data on cardiac output are unreliable; and at Papworth Hospital we believe that a value of more than 15 mm Hg should preclude orthotopic transplantation. In patients with raised pulmonary vascular resistance who undergo transplantation, acute right ventricular failure commonly occurs in the early postoperative period.^{6,7} Clearly, pulmonary vascular resistance can change so every 4–6 months we reassess patients awaiting assessment for transplantation or awaiting surgery, particularly those in whom resistance is at the upper end of the accepted range.

Heart-lung transplantation may have to be considered in patients who have a fixed, raised pulmonary vascular resistance. An alternative is the "domino" procedure in which the heart from a heart-lung recipient (for example who has primary pulmonary hypertension or cystic fibrosis), which has a pre-stressed right ventricle, is used. In theory, such hearts may be suitable donor organs for the group of patients with a raised pulmonary vascular resistance, though experience is too limited to make definitive conclusions.

Most recipients and donors of cardiac transplants are male. In our unit 89% of recipients and 74% of donors are male (83% and 70% world wide respectively).³ The donor and recipient are matched for blood group and size. The risk of postoperative complications is higher in grafts from female donors.⁸ This is partly because female recipients, a high

proportion of whom receive grafts from female donors, are more likely to suffer fatal rejection. In addition, the risk of graft loss from coronary occlusive disease is higher in female donor grafts in male recipients.

The use of mechanical circulatory support devices as a "bridge" to cardiac transplantation has increased.⁶ While the results of surgery in this group continue to improve, they generally have not been as good as in patients who do not require mechanical support preoperatively; so this is probably not the best use of available donor organs. Similarly, the results of repeat cardiac transplantation are not as good as those for the first operation. We often face a conflict between the needs of an individual patient and the overall best use of available organs.

There is no doubt that cardiac transplantation is a highly effective treatment for many patients with end-stage cardiac failure. The gap between the demand for transplantation and the supply of organ donors is likely to increase. We must make the best use of the organs available and aim to have as many donor organs as possible functioning 5 or 10 years after transplantation. We must work towards preventing the occurrence of advanced coronary occlusive disease several years after cardiac transplantation because this too will increase the demand for donor organs.

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