Hotline Editorial

Myocardial laser revascularization

Some patients with severe angina have coronary artery disease which is unsuitable for conventional forms of revascularization — coronary angioplasty/stenting or coronary artery bypass surgery. These patients have usually undergone previous revascularization procedures and have disease which is diffuse and affects the distal part of the coronary circulation. Transmyocardial laser revascularization, a technique which uses laser ablation to create transmural channels in the ischaemic myocardium usually via a left anterolateral thoracotomy, has been used in recent years to treat such patients. More recently, laser ablation has been carried out from within the left ventricular cavity using a catheter-based approach—percutaneous myocardial laser revascularization.

The first reports of transmyocardial laser revascularization using a high-energy carbon dioxide laser were encouraging[1,2]. A multicentre uncontrolled trial in the U.S.A. recruited 200 patients with advanced coronary artery disease[3]. They reported an improvement in angina score by two Canadian Cardiovascular Society classes in 75% of patients at 3 months. Peri-operative mortality was 9% with a further 9% mortality after a mean of 10 months of follow-up. In an uncontrolled European and Asian registry involving 967 patients there was an improvement in two Canadian Cardiovascular Society classes in 47% of patients[4]. The peri-operative mortality was 9·7% and the peri-operative morbidity included chest/wound infections, transient arrhythmia (usually atrial fibrillation) and left ventricular dysfunction. Clearly, the symptomatic benefits of transmyocardial laser revascularization need to be weighed against the risks of mortality and morbidity.

We have recently reported the first prospective randomized controlled trial to assess the effectiveness of transmyocardial laser revascularization compared with medical management in patients with coronary artery disease not amenable to conventional revascularization techniques[5]. One hundred and eighty-eight patients were randomized to either transmyocardial laser revascularization plus their usual medication (94 patients) or to continue with medical therapy alone (94 patients). All patients were required to have a left ventricular ejection fraction of at least 30% and have evidence of reversible myocardial ischaemia on radionuclide perfusion scanning. Patients were excluded if they required intravenous therapy to control angina. Outcome measures were made at the initial assessment and at 3 months, 6 months and 12 months following randomization. The primary outcome was exercise duration on treadmill testing. In addition, the maximum distance covered during the 12 min walk test, the Canadian Cardiovascular Society angina score and the results of myocardial perfusion scanning, were recorded at each assessment point.

The mean treadmill exercise time, adjusted for the baseline evaluation, was 40 s (95% C.I. –15 to 94) longer in the transmyocardial laser revascularization group than in the medical management group at 12 months (P=0·15), and the mean 12 min walking distance was 33 m (–7 to 74) further in the transmyocardial laser revascularization group at 12 months (P=0·11). These differences did not reach statistical significance. The Canadian Cardiovascular Society score for angina had decreased by at least two classes in 22% of transmyocardial laser revascularization patients at 6 months and 25% at 12 months, as compared with 4% and 4%, respectively, in the medical management group (P<0·001). For the angina scores recorded by patients on an 11-point scale, the differences between the groups were less marked than with those recorded by physicians. In the transmyocardial laser revascularization group the peri-operative mortality was 5%. Survival at 12 months was 89% (83–86) in the transmyocardial laser revascularization group and 96% (92–100) in the medical management group (P=0·14).

Although angina symptoms improved in our trial, the degree of improvement was less than in previous studies[3,4], and the patients’ reports of perceived angina showed even less change. There was no significant difference between the groups in terms of treadmill exercise time or 12 min walking distance. One has to balance this against the morbidity and mortality associated with transmyocardial laser revascularization, as well as the costs of the procedure. The peri-operative mortality in our study of 5% compares favourably with the mortality of 9–10% reported previously. This may be due to the exclusion of patients with left ventricular ejection fractions of below 30% as well as those requiring intravenous
therapy to control angina. Morbidity associated with the transmyocardial laser revascularization procedure included wound or respiratory infection (33%) transient arrhythmias (15%) and left ventricular failure (12%). For each individual the operative risks need to be weighed against the potential benefits of moderate improvement in angina and minimal improvement in exercise capacity. From our results we felt that the widespread use of transmyocardial laser revascularization as a ‘stand alone’ procedure could not be advocated. It may, however, still have a role as an adjunctive procedure during coronary artery bypass surgery — in patients who have some vessels suitable for bypass surgery but other vessels which are not. In this situation, the risks of transmyocardial laser revascularization are diluted, since the patient is already undergoing major cardiothoracic surgery.

In view of the risks involved with transmyocardial laser revascularization, a much less invasive, percutaneous technique, has been developed. We have recently been involved in the evaluation of a Holmium-Yag laser system to perform percutaneous myocardial laser revascularization. The laser is activated on the endocardial surface of the left ventricle to produce a channel in the myocardium around 6 mm deep. Therefore, wall thickness has to be at least 8 mm in the treated regions. The results of a multicentre randomized prospective trial, carried out in conjunction with sites in North America, were recently presented at the American College of Cardiology Meeting[6]. Two hundred and twenty-one patients with angina refractory to medical therapy with disease not suitable for conventional revascularisation were randomised to percutaneous myocardial laser revascularization and usual medication (110 patients) or medication alone (111 patients). At 6 months follow-up, there was mean reduction of 1·4 Canadian Cardiovascular Society angina classes in the percutaneous myocardial laser revascularization group as compared to 0·25 in the control group (P=0·001). There was also a 30% increase in treadmill exercise time at 6 months in the percutaneous myocardial laser revascularization group, as compared with 5% in the control group, from baseline values of around 400 s (P<0·001). Importantly, there were no peri-procedural deaths in the percutaneous myocardial laser revascularization group and a low adverse event rate–1% incidence of cardiac tamponade requiring percutaneous drainage and 1% requirement for permanent pacing due to the development of atrioventricular block. Patients can usually be discharged from hospital the day after percutaneous myocardial laser revascularization, whereas the mean hospital stay for the transmyocardial laser revascularization procedure may be up to 10 days[5].

The exact mechanism of action of laser revascularization remains uncertain, although the evidence for angiogenesis continues to grow[7]. The early results from percutaneous myocardial laser revascularization are encouraging and this technique clearly carries a much lower morbidity and mortality than transmyocardial laser revascularization. It is likely that as a stand alone procedure percutaneous myocardial laser revascularization will become the preferred therapy with transmyocardial laser revascularization being used as an adjunctive technique in conjunction with coronary artery bypass grafting.

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References