

VIEWPOINT

Minimal access coronary artery surgery

A J Bryan, G D Angelini

In recent months a frenzy of interest from cardiothoracic surgeons, cardiologists, patients, and the media has accompanied the widespread realisation that less invasive approaches to cardiac operations are technically possible. The relatively small numbers of patients treated by a variety of methods in a number of different centres mean that it is not yet possible to draw definite conclusions about the place of these innovative approaches in contemporary practice. Nevertheless, one thing is certain, less invasive cardiac surgery is here to stay (minimal seems to us a hopeful rather than a descriptive title) and it is up to surgeons to lead the development, evaluation, and clinical application in this area. The pathway to foster these worthwhile developments must be found without ignoring experience in other areas of surgery and without prematurely discarding established practice with a defined degree of patient safety and clinical benefit.

In the clinical arena, significant experience exists with minimally invasive surgery in relation to single-vessel disease, predominantly involving the left anterior descending coronary artery (LAD),¹⁻⁴ although more complex operations have been reported in individual cases.⁵ A range of approaches has been used, with a variety of limited anterior thoracotomy incisions, and partial or complete mobilisation of the internal thoracic artery, with or without thoracoscopic assistance. Revascularisation can be undertaken on the beating heart alone,¹⁻⁴ with femoro-femoral cardiopulmonary bypass support, and with the addition of complete cardioplegic arrest using an ingenious intravascular system developed for this purpose, the feasibility of which has been demonstrated in animals^{6,7} and is now being applied in humans.

If each of these "advances" is considered in turn, the alternative approaches proposed include a range of parasternal incisions or anterior thoracotomies of which most involve excision or division of one or more costal cartilages. Small size incisions of course do not necessarily correlate with low morbidity, particularly with reference to pain, compared with conventional median sternotomy, and techniques of intrapleural analgesia have been used to address this.⁴ Nevertheless, median sternotomy does entail a significant incidence of brachial plexus traction injury which may persist.⁸ It may actually be quite difficult to

evaluate whether what we gain on the swings we lose on the roundabouts. Thoracoscopic mobilisation of the internal thoracic artery is technically straightforward and is likely to become the norm in this type of surgery in the future.^{1,2} The idea that obsessive complete mobilisation of the internal thoracic artery with division of each and every intercostal is necessary to avoid steal syndromes is probably ill founded. The degree of mobilisation may have a bearing on graft positioning and length as well as the safety of a subsequent median sternotomy if reoperation should be necessary. Thoracoscopic mobilisation should also limit the amount of chest wall retraction required during the procedure.

Whether these operations are performed on the beating heart, with cardiopulmonary bypass support, or incorporating cardioplegic arrest remains to be seen. While avoidance of cardiopulmonary bypass is an attractive option,⁹ it must be remembered that in the case of single-vessel disease, where bypass times will be short, morbidity will be low and graft patency should be extremely high. Surgical precision and therefore long term outcome cannot be sacrificed for an elusive notion of benefits ascribed to reduced short term morbidity.¹⁰

Inevitably there will be immediate calls for randomised controlled trials against conventional revascularisation of the LAD in patients with single-vessel disease. In addition, the potential reductions in morbidity and hospital stay, and improved late outcome may swing the pendulum away from LAD angioplasty; indeed, this comparison may be the more important one. Lytle has pointed out that the relative rarity of the surgical case with single-vessel disease indicates that expansion of these surgical techniques will inevitably need cases to be clawed back from angioplasty.¹⁰ Nevertheless, planning such trials will not be easy as there is a bewildering array of techniques currently being developed with rapid evolution of case selection, surgical approach, and instrumentation and equipment as adjuncts to these procedures. In addition, the parallel development of techniques of percutaneous transluminal angioplasty particularly with reference to stent technology means that the playing field is unlikely to remain even for long. Few surgeons have enough experience with minimally invasive approaches to allow a

**Bristol Heart Institute,
University of Bristol,
Bristol Royal
Infirmary, Bristol
BS2 8HW**
A J Bryan
G D Angelini

Correspondence to:
Professor G D Angelini.

Accepted for publication
26 November 1996

fair comparison with conventional techniques of coronary artery surgery in which all practising surgeons have huge experience. Finally, the relative ease of revascularisation of the LAD territory by minimally invasive approaches, and the perceived difficulties in multi-vessel revascularisation by these methods may open new horizons to cardiologists and surgeons of integrated approaches using staged or synchronised angioplasty and surgery to achieve complete revascularisation—this is where our own efforts are directed.¹² This offers a further opportunity to achieve complete revascularisation by less invasive means and we speculate it may be the preferred approach in certain groups: the very elderly or young people in whom prognosis of the disease is likely to necessitate further surgery at a later stage; young people with aggressive disease where further revascularisation procedures seem likely; those with severe comorbid conditions; and other situations where conventional approaches may be seen as suboptimal. There are many questions and few answers at present.

From our perspective and experience, the techniques described without cardiopulmonary bypass using a small anterior thoracotomy represent the most attractive approach with minimal damage to costal cartilages and avoidance of cardiopulmonary bypass in the majority.^{1,2,4} Nevertheless, avoidance of cardiopulmonary bypass must be shown not to compromise outcome, and operating on the beating heart not to jeopardise early and late graft patency. It is hard not to be impressed by the mean postoperative stay of two days and 95% early patency presented in the largest published series.⁴ However, while this relatively simple approach is feasible, effective performance of more complex operations will necessitate more complex techniques^{6,7} and we must avoid the prospect of sacrificing operative precision, cardiopulmonary bypass time, and patient safety for the sake of a smaller incision,¹⁰ although already these approaches are being extended to valve surgery.^{11,12}

This highlights one aspect of the consideration peculiar to cardiac surgery compared with other areas of minimally invasive surgery in general—the use of cardiopulmonary bypass. While other minimally invasive approaches in the chest and abdomen may require increased operating time, at least initially, this may be a relatively minor issue. However, with cardiac surgery, increases in cardiopulmonary bypass time to perform more complex operations may supplant the relatively low morbidity associated with median sternotomy approaches. It would be foolish to ignore lessons learned in

other areas of surgery such as laparoscopic cholecystectomy where initial observations of major reductions in postoperative morbidity and hospital stay have not been confirmed even though the procedure has been widely adopted.¹³ Indeed other authors have drawn our attention to the high degree of success, low operative risk, and short hospital stay that can be achieved with conventional single-vessel revascularization.¹⁴ This will immediately indicate recruitment of relatively large numbers of patients in trials when adverse events occur infrequently.

There is little doubt that the face of coronary artery surgery has been changed forever by the advent of minimally invasive approaches. The full extent of these changes, only time will tell. Cardiac surgeons must continue their good record of careful evaluation of new procedures, particularly at a time when surgical research is under fire from the medical media.¹⁵ While every effort should be made to develop these approaches, let us take care not to submit too many patients to too many surgeons' learning curves in the name of progress without the appropriate scientific foundation.

- 1 Benetti FJ, Ballester C, Sani G, Doonstra P, Grandjean J. Video assisted coronary bypass surgery. *J Cardiac Surg* 1995;10:620-5.
- 2 Acuff TE, Landreneau RJ, Griffith BP, Mack MJ. Minimally invasive coronary artery bypass grafting. *Ann Thorac Surg* 1996;61:135-7.
- 3 Stanbridge RDeL, Cohen A, Hadjinicolaou L, Al-Katoubi A. Early experience with minimal invasive coronary artery bypass grafting [abstract]. *Heart* 1996;75(Suppl 1):P69.
- 4 Calafiore AM, Di Giammarco G, Teodori G, Bosco G, D'Annunzio E, Barsotti A, et al. Left anterior descending coronary artery grafting via left anterior small thoracotomy without cardiopulmonary bypass. *Ann Thorac Surg* 1996;61:1658-65.
- 5 Sani G, Benetti F, Mariani MA, Lisi G, Maccherini M, Toscano M. Arterial myocardial revascularization without cardiopulmonary bypass through a small thoracotomy. *Eur J Cardiothorac Surg* 1996;10:699-701.
- 6 Stevens JH, Burdon TA, Peters WS, Siegel LC, Pompili MF, Vierra MA, et al. Port-access coronary artery bypass grafting: a proposed surgical method. *J Thorac Cardiovasc Surg* 1996;111:567-73.
- 7 Schwartz DS, Ribakove GH, Grossi EA, Stevens JH, Siegel LC, St. Goar FG, et al. Minimally invasive cardiopulmonary bypass with cardioplegic arrest: A closed chest technique with equivalent myocardial protection. *J Thorac Cardiovasc Surg* 1996;111:556-66.
- 8 Shaw PJ, Bates D, Cartledge NEF, Heaviside D, Julian DG, Shaw DA. Early neurological complications of coronary artery bypass surgery. *BMJ* 1985;291:1384-7.
- 9 Westaby S. Coronary surgery without cardiopulmonary bypass. *Br Heart J* 1995;73:203-5.
- 10 Lytle BW. Minimally invasive cardiac surgery. *J Thorac Cardiovasc Surg* 1996;111:554-5.
- 11 Lin PJ, Chang C-H, Chu J-J, Liu H-P, Tsai F-C, Chu P-H, et al. Video-assisted mitral valve operations. *Ann Thorac Surg* 1996;61:1781-7.
- 12 Cosgrove DM, Sabik JF. Minimally invasive approach for aortic valve operations. *Ann Thorac Surg* 1996;62:596-7.
- 13 Downs SH, Black NA, Devlin HB, Royston CMS, Russell RCG. Systematic review of the effectiveness and safety of laparoscopic cholecystectomy. *Ann R Coll Surg Engl* 1996;78:240-323.
- 14 Bonchek LI. Discussion of Calafiore et al (reference 4). *Ann Thorac Surg* 1996;61:1664.
- 15 Horton R. Surgical research or comic opera: questions, but few answers. *Lancet* 1996;347:984.