The expanded role of minimally invasive coronary grafting

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Abstract

The evolution of minimally invasive direct coronary artery bypass (MIDCAB) grafting has extended the role of this approach for limited coronary revascularization. MIDCAB techniques can now be used to address isolated stenoses in the inferior and lateral coronary distributions. MIDCAB techniques are increasingly being used in the reoperative setting, and multiple vessels can be bypassed during a single operation. This article reviews the expanded role of MIDCAB grafting in the treatment of coronary artery disease. © 1998 Elsevier Science B.V. All rights reserved

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1. Introduction

The grafting of the human coronary artery on the anterior surface of the heart using an arterial conduit through a small directed thoracotomy incision is an approach which has become increasingly popularized over the past 3 years. Two very different philosophies for the creation of the anastomotic environment have evolved in parallel. The port access approach adheres to the tenet that only full cardioplegic arrest will allow sufficient accuracy for the suturing and flexibility of choice of operative targets in the hands of all surgeons. To accomplish this, the patient is supported on cardiopulmonary bypass as in conventional surgery, usually through femoral vessel access. Grafting is done through a small incision but the risks of cardiopulmonary bypass and arterial cannulation remain [1–5].

The alternate philosophy is based on the notion that the isolated epicardial site which needs to be exposed and stabilized for grafting can be controlled with local mechanical measures without resorting to cardiopulmonary bypass support and cardioplegic arrest. This so-called ‘beating heart’ approach is most often termed minimally invasive direct coronary artery bypass (MIDCAB). The pedicled or skeletonized arterial conduit may or may not be harvested under direct vision. However, the actual conduit to coronary artery anastomosis is by definition done under direct vision on a beating heart with local mechanical stabilization and control of bleeding. The world-wide combined experience for anterior coronary grafting using the internal mammary artery now exceeds 2000 cases. Results from experienced centers have demonstrated equal patency to conventional single vessel bypass grafting of roughly 95% at one year after the requisite learning curve [6–10]. The fundamental question that remains about this approach is how much more broadly applicable this may be for other coronary locations or unusual clinical situations. Three specific questions remain to be addressed. Firstly, can the MIDCAB technique be used for multiple vessel grafting? Secondly, can ‘beating heart’ coronary grafting be done in other locations around the heart? And finally, are these techniques as readily applicable in the reoperative setting as they are with primary coronary grafting?

2. Inferior (subxyphoid) approach

The right coronary system is often the only native coronary artery involved in patients presenting with limited coronary disease. This usually involves the proximal or mid portion of the vessel, making these patients poor candidates for minimally invasive right internal mammary artery to mid right coronary artery grafting. Often the prox-
The development of these approaches to allow MIDCAB grafting of all surfaces of the heart raises the possibility of multiple coronary grafting at the same operation. Most commonly, when the angle and configuration of the diagonal coronary is suitable, a sequential internal mammary artery conduit can be placed across the diagonal to the left anterior descending as is done with conventional bypass grafting. This is accomplished through the same 4th intercostal incision generally used for anterior MIDCAB grafting. When a high ramus branch or circumflex coronary also needs to be grafted, one approach for better exposure is to move higher and more lateral on the chest wall through the 3rd intercostal space just anterior to the scapula as popularized by Subramanian [15]. This allows for multiple grafting of the left
anterior descending and further lateral targets either with sequential grafting or ‘T’ grafts off the proximal internal mammary artery conduit.

Bilateral grafting of the left anterior descending and mid right coronary can be accomplished through mirror image MIDCAB incisions on either side of the sternum. This is done in patients who have occupational or personal reasons for avoiding a standard sternotomy incision. Otherwise, bilateral ‘off pump’ grafting through a standard sternal incision works very well as long as the right coronary target is relatively proximal. Multiple grafting of the anterior and inferior circulation can be accomplished through separate 4th intercostal and epi gastric incisions and is well tolerated in appropriate cases. The lateral limited posterior thoracotomy incision is generally not done in conjunction with other directed incisions, although sequential grafts can be accomplished on the lateral wall of the heart as described previously for the lateral MIDCAB. Sequential grafting of the gastroepiploic pedicle is generally not done because of the small caliber of the conduit and the difficulties in exposing the deep postero-lateral branch of the right coronary system through this approach. Therefore, either with sequential grafting, side arm ‘T’ grafts, or multiple directed incisions, MIDCAB grafting does offer several reasonable approaches for multiple coronary grafts. In general, however if the patient needs three or four vessel bypass grafting, sternotomy is the preferred approach, usually with cardiopulmonary bypass. The sternotomy itself does not appear to be the limiting factor in decreasing the time to patient discharge, although it does prolong the return to full unrestricted activity.

5. Reoperation

The final question with respect to the expanded role of minimally invasive coronary grafting is the application of these techniques in the reoperative coronary grafting situation. The population of patients having undergone primary coronary grafting continues to increase, yielding a parallel increase in the number of patients facing reoperative coronary surgery, usually because of failed previous grafts. The most common presentation is that of a focal problem with a single graft to one coronary distribution while the remaining grafts are patent. The patient typically has failed medical management and the graft is refractory to further catheter based interventions. The morbidity and mortality associated with conventional reoperative coronary grafting is known to be related to co-morbidities which can cause significant problems during the post-operative recovery. Nevertheless, the reoperative MIDCAB approach is usually justified, as conventional reoperative approach exposes the patient to the increased risks of conventional cardiac re-dissection without eliminating the same co-morbidities. Minimally invasive grafting itself is generally well tolerated, partly because a robust collateral circulation has often developed since the first surgery, and because the previous adhesions help stabilize the area of the arteriotomy. As experience increases with reoperative MIDCAB, a number of patients who have been previously managed on medical therapy because the risks of reoperative surgery have been too high can now consider a surgical approach to their problem.

6. Summary

In summary, the initiative to develop primary minimally invasive coronary grafting to the anterior circulation of the heart has led us to realize that there is an expanded role for the technique. Investigators continue to develop these new applications for limited coronary revascularization which include combining MIDCAB grafting with complimentary therapies such as catheter based interventions and transmyocardial laser revascularization. The ability to address limited coronary revascularization problems with new surgical approaches has not only expanded the role of MIDCAB grafting, but has also expanded the potential patient population that can be considered for surgical coronary revascularization in general. In particular there has been a shift towards MIDCAB grafting in patients who have traditionally been considered high risk for catheter based interventions, patients of advanced age, and patients with significant co-morbidities.
comorbidities. Current application of these new approaches along with careful evaluation of the actual outcomes will guide clinicians and help determine the ultimate role for expanded MIDCAB grafting.

References