



The keyhole or the manhole? What internists need to know about minimally invasive CABG

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ABSTRACT

New alternatives to standard coronary artery bypass surgery reduce the incision size from 30 cm to 8 cm, presenting a less traumatic surgical option for patients undergoing coronary artery bypass surgery. Two minimally invasive techniques and patient selection criteria are summarized.

R EPORTS OF fast recovery and lower cost continue to generate public interest and high expectations 2 years after minimally invasive techniques for coronary artery bypass grafting (CABG) made news as an alternative to standard open heart surgery.^{1,2} Patients facing CABG may ask their internists about the techniques when sorting through their medical and surgical options.

This brief overview describes minimally invasive CABG techniques, their role in comparison with standard open heart bypass grafting, and selection of appropriate candidates.

MINIMALLY INVASIVE CABG TECHNIQUES

Media reports have labeled minimally invasive CABG “keyhole” surgery, contrasting it with the standard operation performed through a 30-cm median sternotomy or “manhole” incision. But “keyhole” is something of a misnomer, since the minimally invasive approach currently requires an 8-cm incision.

Media hype aside, the reality is that thousands of patients have safely undergone single-

vessel and multivessel CABG through incisions substantially smaller and less traumatic than the standard median sternotomy. The two minimally invasive techniques in current use are the MIDCAB (minimally invasive direct coronary artery bypass) operation and the port-access coronary artery bypass operation (FIGURE 1). The MIDCAB operation is performed while the heart is still beating, which is why many refer to it as the “beating heart” operation. The port-access operation, developed by HeartPort of Redwood City, CA, is performed on an arrested heart with the use of cardiopulmonary bypass and pharmacologic cardioplegia.

The beating heart operation

The MIDCAB operation is indicated in patients who have single-vessel coronary artery disease, with the diseased artery on the anterior surface of the heart (eg, the left anterior descending artery or the right coronary artery). It is an excellent surgical option for patients with peripheral vascular disease (who are at increased risk during cardiopulmonary bypass) and single-vessel coronary artery disease. The MIDCAB can be performed as a primary operation or a reoperation.

The technique. The MIDCAB technique involves an 8-cm right or left anterior thoracotomy in the fourth intercostal space. The internal thoracic artery is dissected from the chest wall and used for bypass grafting. Specially designed mechanical stabilizers help to keep the heart muscle motionless in the area of the coronary artery to be grafted, while the heart continues to beat. Intravascular shunts are used to keep the operative field bloodless and prevent myocardial ischemia.

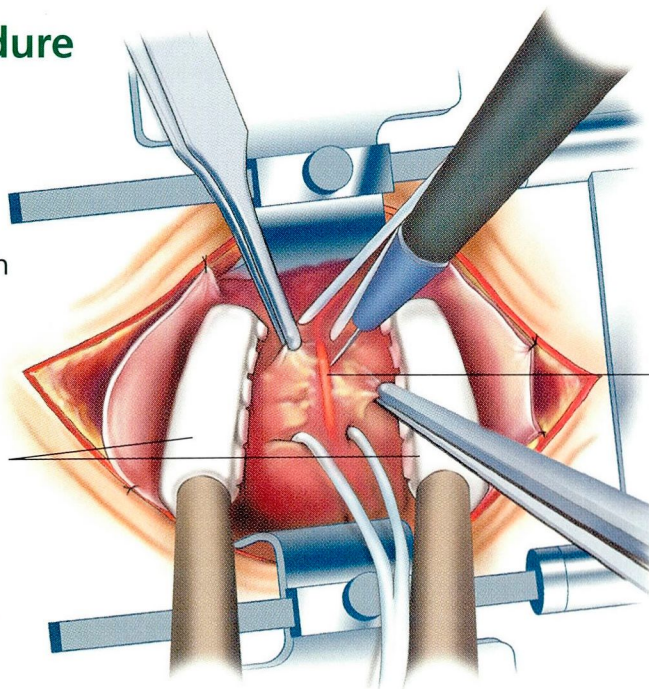
**MIDCAB is
not a good
option for diffuse
coronary artery
disease**

■ Minimally invasive coronary artery bypass grafting

The MIDCAB procedure

is performed on a beating heart through an 8-cm thoracotomy in the fourth intercostal space. Due to its technical difficulty, this operation is for patients with only single-vessel coronary artery disease.

Specially designed stabilizers apply mechanical pressure to minimize the motion of the heart muscle around the diseased vessel to be grafted



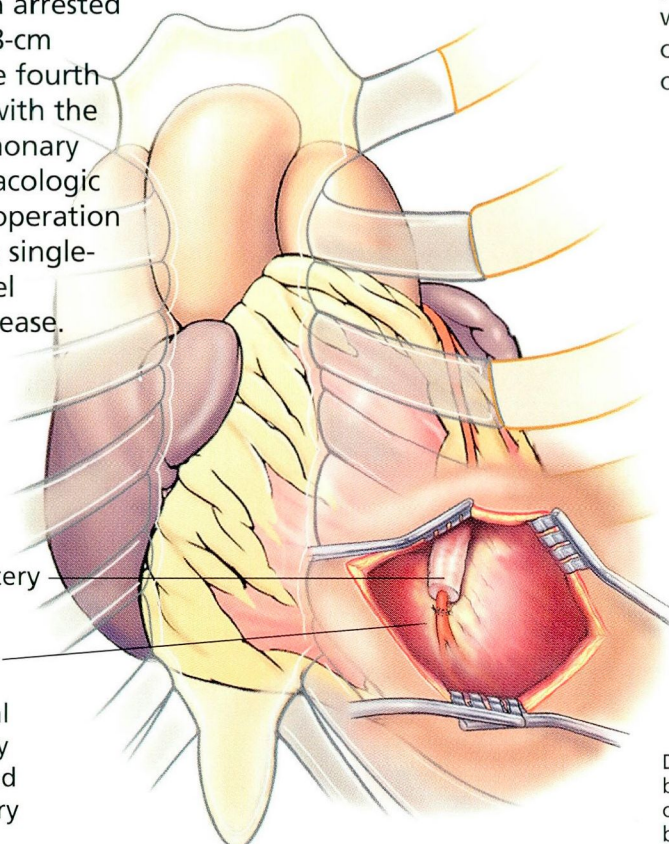
The diseased vessel is dissected out and prepared for grafting

The port-access procedure

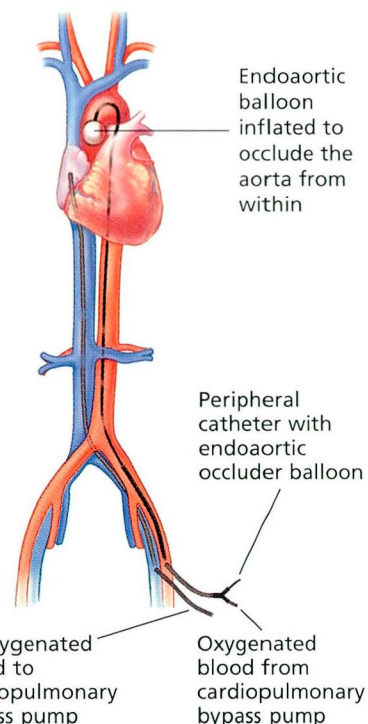
is performed on an arrested heart through an 8-cm thoracotomy in the fourth intercostal space, with the help of cardiopulmonary bypass and pharmacologic cardioplegia. This operation is for patients with single-vessel or multivessel coronary artery disease.

Internal thoracic artery

Completed anastomosis of the internal thoracic artery to the diseased coronary artery



Cardiopulmonary bypass for the port-access procedure is achieved with the use of specially designed catheters and a balloon that occludes the aorta from the inside



Endoaortic balloon inflated to occlude the aorta from within

Peripheral catheter with endoaortic occluder balloon

Deoxygenated blood to cardiopulmonary bypass pump

Oxygenated blood from cardiopulmonary bypass pump

FIGURE 1



Contraindications. Patients with a diffusely diseased coronary artery, an intramyocardial vessel, or a coronary artery less than 1.5 mm in diameter are not candidates for the MIDCAB operation. Performing an anastomosis on coronary arteries with these characteristics through a small incision while the heart is beating is technically too difficult.

The port-access operation

The port-access operation, performed on an arrested heart, is an option in patients with single-vessel or multivessel coronary artery disease. Like the MIDCAB, it can be performed as a primary operation or a reoperation.

The technique. The port-access coronary artery bypass grafting procedure is similar to standard CABG in that cardiopulmonary bypass and myocardial arrest with cardioplegia are used. The difference is that, as with the MIDCAB operation, an 8-cm anterior thoracotomy is used instead of a 30-cm median sternotomy to perform the operation. Another difference is that, to arrest the heart, an endovascular occluder balloon is positioned in the ascending aorta and inflated, thus effectively “cross-clamping” the aorta from the inside. Circulation is supported by a standard heart-lung machine and peripheral (femoral) cannulation with specially designed cannulas.

This approach permits multivessel grafting, and the surgeon can work with the same precision as through a median sternotomy.

Contraindications. Patients with peripheral vascular disease are not candidates for this operation, because peripheral vascular disease increases the risks associated with peripheral cannulation and cardiopulmonary bypass.

COMPARISONS

Advantages

- A major advantage of minimally invasive CABG is the much smaller, less traumatic incision, which results in less pain, less bleeding, and better cosmetic appearance.
- Since minimally invasive procedures are less traumatic, hospital stays are shorter. Length of hospital stay is approximately 3 to 4 days for the minimally invasive operations and 5 to 7 for standard CABG.

- Postoperative recovery is quicker—2 to 4 weeks for a minimally invasive procedure vs 8 weeks for standard open heart surgery.

- The risk of serious wound infection is lower since the sternum is not involved.
- If a patient needs a reoperation in the future, the procedure would be easier to perform.
- In addition, patients who undergo the MIDCAB operation avoid the risks associated with cardiopulmonary bypass and cardioplegia.

Disadvantages

- Minimally invasive CABG is technically difficult: the learning curve is steep.
- These new procedures require more technology in the operating room.

Cost

The cost savings associated with minimally invasive CABG thus far lie in shorter hospitalization and in quicker overall recovery, which means the patient can return to work sooner.

FUTURE OF MINIMALLY INVASIVE CABG

Minimally invasive CABG will not replace the standard operation, especially in complex cases that require more complete visualization and access. Like angioplasty, it is another treatment option for patients with coronary artery disease.

Although minimally invasive techniques are improving, the ability of the surgeon to see the necessary anatomy is still a challenge. Future technical refinements will involve greater use of the thoracoscope and of robotics, which will bring minimally invasive CABG closer to the description “keyhole” surgery.

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SUGGESTED READING

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Recovery is quicker after minimally invasive surgery