The Use of Gastroepiploic Artery for Coronary Artery Bypass Surgery

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Abstract

The use of arterial conduits in surgical treatment of coronary heart disease has been widely used. As we all know that saphenous vein graft occluded more than 50 per cent after 10 years. Most arterial conduits come from internal mammary artery, radial artery than been used for decades.

Another arterial conduit, the right gastroepiploic artery (GEA), is now more popular among cardiac surgeons. This artery can be used along with other arterial conduit for "all arterial coronary bypass surgery" with better long-term patency

We reviewed the recent reports on GEA and to add on our experience on this subject.

Key word : Coronary Artery Bypass Surgery, Gastroepiploic Artery, Off-Pump

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Arterial conduits are the first choice in multiple CABG for younger patients because they offer well-known, longer patency than vein grafts. In coronary artery bypass grafting (CABG), selection of the conduits is varied because most patients require multiple coronary revascularizations. The internal mammary artery (IMA) is the first choice of graft conduit for left anterior descending artery (LAD) revascularization. The next choices for arterial conduits are the free radial artery (RA) and the right gastroepiploic artery (GEA). Information pertaining to the use of IMA and RA are abundant but very few

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with the GEA. Therefore, this communication was to review the recent reports on GEA and to add on the authors' limited experience on this subject.

The GEA is a terminal branch of the gastro duodenal artery, which arises from the common hepatic artery, and runs along the greater curvature of the stomach. In the late 1960's, the GEA was used for indirect myocardial revascularization (Vineberg's operation) by Bailey et al[1]. In 1984, John Pym[2] started the GEA-coronary anastomosis. Since the clinical reports of successful use of the GEA grafts by Pym[2] and Suma[3] and their colleagues in 1987, this particular conduit has received keen attention. Late angiographic patency of the GEA graft was reported at 82 per cent in 5 years by Voutilainen et al[4] and Suma et al[3] reported a 87 per cent patency rate, over 5 years, in 118 GEA grafts.

Patient selection

So far there are not many contraindications for the use of GEA. The following criteria, however, preclude the harvesting of GEA:

- Previous upper abdominal operation (excluding laparoscopic procedure)
- Previous gastrectomy, active peptic ulcer, and presence of abdominal mass, or
- Liver enlargement such as liver cirrhosis

because the GEA must lie anterior to the stomach and liver before entering into the pericardium.

Operative technique

Through an extended median sternotomy, left internal mammary artery (LIMA) was harvested along with the radial artery simultaneously. The abdominal cavity was entered by extending the median sternotomy 4-5 cm caudally. The stomach was pulled up anteriorly, and GEA was evaluated by finger palpation. If there was extensive adhesion around the stomach or a palpable mass in the stomach or liver, the GEA harvest was abandoned, and alternative conduits were chosen.

Dissection of the GEA was carried out from the midportion of the greater curvature of the stomach to the pylorus ring. All gastric branches on the stomach side were ligated first, then handled on the omental side with hemoclips (the authors preferred 3 mm clips) or a Harmonic scalpel (Ethicon endosurgery, Cincinnati, Ohio). The advantages of harmonic scalpel were faster dissection, less thermal injury, and the ability to avoid use of excessive hemoclips. After an adequate length was obtained (usually 10-15 cm) with good size of the distal GEA (2 mm), the GEA pedicle was transected. Diluted papaverine hydrocloride (1 : 10) was injected intra-luminally along with the heparin solution. The stump was then temporally clipped. A partial skeletonized procedure was done on a GEA stump, 3-5 cm proximally, to find a good size of artery for coronary anastomosis. The harvested pedicle was wrapped in a warm saline-soaked sponge and kept in the abdominal cavity until its use.

After completion of LIMA to LAD, either diagonal anastomosis, GEA to right coronary artery (RCA) system or RA to left circumflex (LCx) system will be performed, depending on the severity of disease (more severe first). The GEA was brought to the pericardial cavity through a small cruciate hole made in the diaphragm between inferior venacava (IVC) and midline. If the anastomosis is to the distal RCA, the hole is closer to IVC in order to avoid kinking of the pedicle.

Coronary revascularization

Off-pump CABG is the authers' preferred choice in all CABG. The Octopus Tissue Stabilization System (Octopus 2 plus and Octopus 3) was used in all patients. Deep pericardial traction sutures were used to rotate the heart for posterior wall revascularization along with tilting and rotating the operating table. In general, the LAD/diagonal system was bypassed first to secure revascularization to the anterior wall and intraventricular septum. The LCx/RCA/PDA (posterior descending artery) were bypassed later, the sequence dependent on the severity of the lesion from most to least. LIMA was used mostly to the LAD/diagonal system in sequential fashion. Radial artery was used for the left circumflex system in sequential fashion. The bypass target of the GEA was mainly to the distal RCA and PDA due to the limitation of graft length. If a long GEA was available, the target was extended to PL and circumflex system. GEA anastomosis was performed in "downstream" fashion. All distal anastomosis were done with interrupted 7/0 Prolene.

Single-vessel redo coronary artery bypass grafting using the gastroepiploic artery

The use of GEA in single-vessel redo CABG to the distal RCA or proximal PDA also has the benefit of avoiding full sternotomy and extensive dissection that can cause more injury to the heart and the pre-

vious patent grafts[5]. By performing a subxyphoid incision and partial lower sternotomy along with the off-pump technique, the GEA anastomosis can be performed with adequate exposure.

CABG with gastroepiploic artery composite graft

Gastroepiploic artery composite graft with free radial artery was reported by Suma[6] in 2000, by using free radial artery anastomose to obtuse marginal (OM), posterolateral (PL), PDA in sequential anastomosis. Then the proximal RA was anatomosed to GEA in end-to-side or end-to-end fashion. The GEA size must be at least 2 mm to have adequate flow, and the advantage of this technique is no proximal anastomosis, and is, therefore, suitable for patients with calcified aorta.

Sequential grafting of gastroepiploic artery

GEA can be used for multiple distal anastomoses as reported by Ochi[7], and the GEA can be revascularlized to 2-3 distal anastomoses. What's important is the size of the distal end must be at least 2 mm when measured by pre-operative angiogram.

Complications

There are some reports on complications after using GEA. Schroeyers[8] reported a case of ischemic gastric ulcer in a patient with severe celiac trunk disease. Other complications such as intra-abdominal bleeding from gastric branches or GEA stump, intra-abdominal collection or abscesses and strangulated giant transdiaphragmatic hernia[9] have also been reported.

Our experiences

From January 2002 to December 2002, 110 all-arterial off-pump CABGs were performed in our hospital, and among them, GEAs were used in 65 cases. There were 53 male and 12 female, patients ranging in age from 39-84 years (mean 68). The harvest time for GEA was 15-20 minutes using hemoclips or 8-10 minutes using harmonic scalpel. The target vessels were distal RCA in 8, PDA 53, PL 3, distal LCx 1. The authors also performed sequential GEA to PDA and PL in 3 patients. Composite GEA-radial graft was used to multiple vessels along the inferior wall in 2 patients. The number of distal anastomoses ranged from 1 to 6 (mean 4.39), and the authors performed redo Subxiphoid CABG for single vessels using GEA graft in 3 patients. There were 28.3 per cent with poor LV function (LVEF < 40%). The conversion rate to on-pump was 1.6 per cent, and the mortality in GEA patients was 4.8 per cent

Comment

The superiority of arterial grafts for myocardial revascularization has progressively led surgeons to common use of the IMA and increasingly frequent use of GEA to reach coronary arteries on the inferior ventricular wall[10]. Yasuura et al[11] reported a theoretical model analysis of the gastroepiploic artery graft flow. Clinical impression on this graft acknowledges potential limited flow reserve and possible flow competition. This can also lead to a physiologically nonfunctioning bypass graft if some conditions are not respected for its clinical use. The degree of stenosis of the right coronary artery and the size of the GEA are both very important factors that are relative to the recipient coronary artery, and help avoid flow competition with the recipient artery. The GEA should be used first, only in cases of thrombosed or very tight stenosis of the RCA, and second, if its diameter is large enough for the recipient coronary artery.

In clinical practice, many cardiac surgeons may decide to use or discard in situ arterial grafts according to free flow measurements. However, measurement of free flow just before anastomosis is unreliable because of potential spasms or mechanical damage during harvesting. Instead of free flow measurements, some reports emphasize that an in situ arterial graft should be at least equal in size to a grafted artery[12].

There are several factors influencing the performance of sequential grafting of GEA[7]. For example, when a longer graft is needed, the diameter of the distal GEA is usually much smaller than the proximal segment. When the GEA is relatively small and the lesion of the coronary artery is not critical, flow competition can easily occur. Additionally, the GEA is a third branch of the abdominal aorta, while the IMA is a second branch of the aortic arch. Consequently, the diastolic pressure is significantly lower in GEA than in IMA. To generate adequate perfusion pressure, the GEA should have a large luminal diameter (2-3 mm) at its anastomotic point. Lastly, if GEA luminal diameter and length are not consistent, GEA grafting is not always possible and should be performed only when the adequacy of its length and luminal diameter has been confirmed.

The largest report on GEA was from Hitoshi et al[13]. They reported a series of 1,000 patients using

GEA mostly to the RCA system (87.8%) and to circumflex in 10 per cent. The GEA patency rates at one, three, and five years were 98.7 per cent, 91.1 per cent and 84.4 per cent respectively.

SUMMARY

Multiple CABG with all arterial conduits can be performed. The best all-arterial CABG in the authors' institute is a combination of LIMA, radial artery and GEA with off pump technique - mainly LIMA anastomose to LAD and diagonal, radial to OM branches and PL, GEA to RCA and PDA. This procedure is safe and effective, and long-term patency after CABG may be expected. The long-term patency of GEA is still a little bit inferior to IMA but still better than vein graft.

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การใช้หลอดเลือดแดงจากกระเพาะอาหาร ในการผ่าตัดบายพาสหัวใจ

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การผ่าตัดรักษาหลอดเลือดหัวใจตีบในปัจจุบัน มีการนำหลอดเลือดแดงจากที่ต่าง ๆ มาใช้กันอย่างแพร่หลาย เนื่องจากเราทราบกันดีว่า การใช้หลอดเลือดดำจากที่ขามาทำบายพาสนั้น หลังจากผ่าตัด 10 ปี หลอดเลือดเหล่านี้มีการตีบตันมากกว่า 50% หลอดเลือดแดงที่นำมาใช้นั้น สามารถนำมาจากหลอดเลือดแดงใต้กระดูกหน้าอก (Internal mammary artery), เส้นเลือดแดงจากแขน (radial artery) ซึ่งใช้กันอย่างแพร่หลายมานาน

หลอดเลือดแดงอีกเส้นที่มีศัลยแพทย์นิยมกันมากขึ้นคือ หลอดเลือดแดงจากกระเพาะอาหาร (Right gastroepiploic artery, GEA) หลอดเลือดนี้สามารถนำมาใช้ร่วมกับหลอดเลือดแดงอื่น ๆ เพื่อทำการผ่าตัดรักษาหลอดเลือดหัวใจตีบ โดยที่ใช้หลอดเลือดแดงทั้งหมดในการผ่าตัด (All arterial CABG) และกผลการรักษาได้ดีและ ยาวนานกว่า การใช้หลอดเลือดดำ

เราได้ review รายงานเกี่ยวกับการใช้ GEA ในต่างประเทศ และ ประสพการณ์ในการใช้ GEA ของเราที่ผ่านมาในรายงานนี้

คำสำคัญ : การผ่าตัดบายพาสหัวใจ, หลอดเลือดแดง, กระเพาะอาหาร

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