

INTRODUCTION

Coronary artery atherosclerosis is the single largest killer of men and women in the world. It is the principal cause of coronary artery disease (CAD), in which atherosclerotic changes are present within the walls of the coronary arteries. CAD is a progressive disease process that generally begins in childhood and manifests clinically in middle to late adulthood.

Etiology:

A complex and incompletely understood interaction is observed between the critical cellular elements of the atherosclerotic lesion. These cellular elements include endothelial cells, smooth muscle cells, platelets, and leukocytes. Interrelated biologic processes that contribute to atherogenesis and the clinical manifestations of atherosclerosis.¹

Presentation:

The symptoms of atherosclerosis vary widely. Patients with mild atherosclerosis may present with clinically important symptoms and signs of disease and MI, or sudden cardiac death may be the first symptom of coronary heart disease. However, many patients with

anatomically advanced disease may have no symptoms and experience no functional impairment.²

The spectrum of presentation includes symptoms and signs consistent with the following conditions:

- Asymptomatic state (subclinical phase)
- Stable angina pectoris
- Unstable angina (ie, ACS)
- AMI
- Chronic ischemic cardiomyopathy
- Congestive heart failure
- Sudden cardiac arrest

History may include the following:

- Chest pain
- Shortness of breath
- Weakness, tiredness, reduced exertional capacity
- Dizziness, palpitations
- Leg swelling

- Weight gain
- Symptoms related to risk factors

Coronary Artery Bypass

The usual incision for coronary artery bypass grafting (CABG) is a midline sternotomy (Fig.1), although an anterior thoracotomy for bypass of the left anterior descending (LAD) artery or a lateral thoracotomy for marginal vessels may be used when an off-pump procedure is being performed.

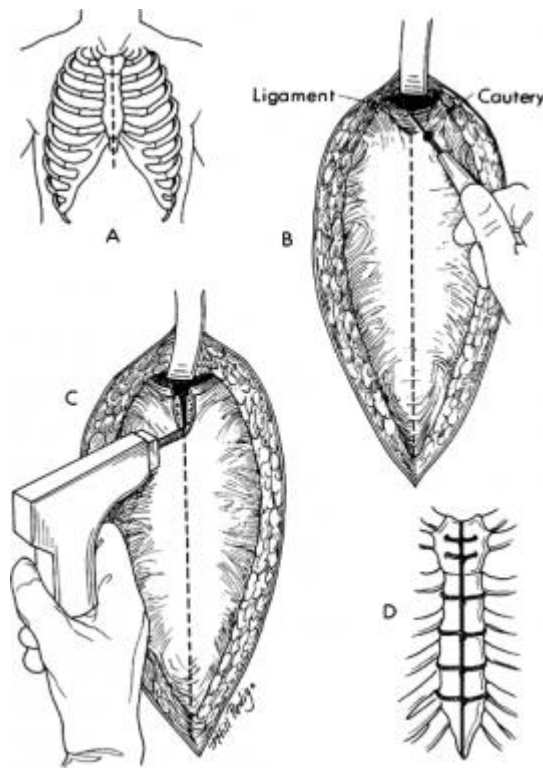


Figure 1 Midline Sternotomy

Cardiopulmonary bypass

The first step in cardiopulmonary bypass is to cannulate the aorta and right atrium. The aortic area selected for cannulation must be soft and non-atherosclerotic. To insert the aortic cannula, unfractionated heparin is given, and the systolic blood pressure is lowered to below 100 mm Hg. At this point, two purse-string sutures are placed into the aorta, and the aortic adventitia within the diameter of the purse-string sutures is divided. An aortotomy is performed with a scalpel, the cannula is placed, and the purse-string sutures are tightened around it.³

The aortic cannula is then secured to a rubber tourniquet with a heavy silk tie. Once in place, the cannula is de-aired and connected to the arterial pump tubing, where its position in the aorta can be confirmed by watching the pattern of tube filling. The venous cannula is inserted into the right atrial appendage in a similar fashion, with the end of the cannula positioned in the inferior vena cava. Adequate anticoagulation is confirmed by assessing the activated clotting time; once this is done, cardiopulmonary bypass can be commenced.

The aorta is cross-clamped distal to the cannula, and cold cardioplegia solution is infused via the aortic cannula (some centers also cool the patient). Retrograde

cardioplegia may also be administered via the coronary sinus, especially in the patient who is undergoing repeat CABGs and has few or no patent grafts for adequate perfusion with antegrade cardioplegia. Compared with crystalloid cardioplegia, blood cardioplegia is associated with a lower incidence of intraoperative mortality, postoperative myocardial infarction, shock, and conduction defects.

Placement of graft

After the initiation of cardiopulmonary bypass, the distal coronary bypass targets are identified. As a rule, anastomoses to the right coronary artery and the marginal branches of the circumflex artery are completed first.

The circumflex artery is accessed by retracting the heart laterally, whereas the posterior descending artery and posterolateral circulation are accessed by retracting the heart cephalically. The left internal mammary (thoracic) artery (LIMA) is then usually anastomosed to the LAD if possible. In rare circumstances (eg, CABG performed for acute anterior myocardial infarction), a saphenous vein graft may be placed to the LAD artery for expediency.

To accomplish the bypass, an incision is made in the distal coronary artery, and the conduit ostium is sutured around the full circumference of the anastomosis (Fig.2). The conduit is then infused with cold cardioplegia solution, and the end is tied with a polypropylene suture. A very fine monofilament suture, commonly 7-0 or 8-0, is used to complete the distal coronary anastomosis. Most often, it is an end-to-side anastomosis as shown in the picture below. Often ,we can construct a side-to-side anastomosis when a sequential anastomosis was performed with the same conduit.

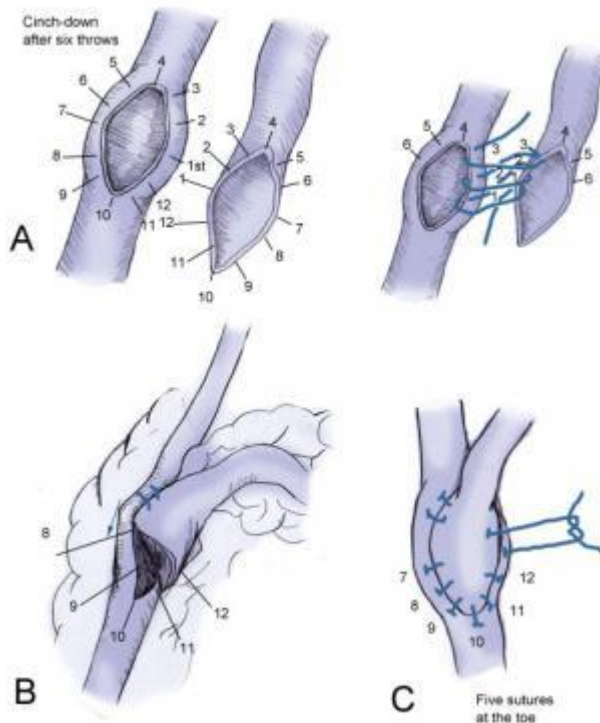


Figure 2 Distal Anastomotic Technique

When all the distal anastomoses are completed, rewarming of the heart is initiated, the aortic cross-clamp is removed, and a partially occluding clamp is placed on the ascending aorta where the grafts are to be anastomosed. Holes are punched in the ascending aorta, secured by the partially occluded clamp, and the proximal ends of the anastomoses are sutured into place in the aorta (Fig.3). Before the cross-clamp is finally removed, air is evacuated from the grafts and ascending aorta. The patient is then weaned off the bypass.

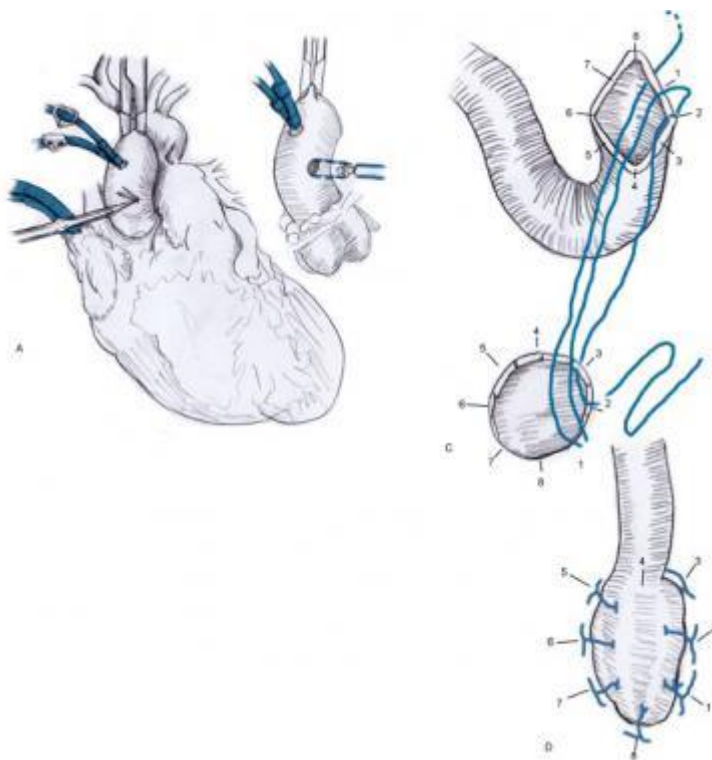


Figure 3 Proximal Anastomotic Technique

When normal rhythm is resumed, the patient is once again mechanically ventilated and electrolyte abnormalities (commonly hypomagnesemia and hypokalemia) are corrected. If the patient is bradycardic or experiences temporary heart block, temporary pacing is performed using wires placed to the right atrium and right ventricle. When cardiopulmonary bypass has been successfully stopped, protamine is given to reverse the heparin.

“Recently Coronary Artery Bypass Grafting (CABG) has contributed to an increase in survival, quality of life, life expectancy, and lower costs for medical treatment in the treatment of patients with ischemic heart disease due to a reduction of ischemic complications. The anastomotic quality in CABG is directly associated with both perioperative and long-term clinical results. Therefore, it is critical for cardiac surgeons to directly evaluate the quality of anastomoses in CABG procedures”.⁴

The choice of the graft conduit for coronary artery bypass grafting (CABG) has significant implications both in the short- and long- term. The patency of a coronary conduit is closely associated with an uneventful postoperative course, better long-term patient survival and superior freedom from re-intervention. The internal

mammary artery is regarded as the primary conduit for CABG patients, given its association with long-term patency and survival. However, long saphenous vein (LSV) continues to be utilized universally as patients presenting for CABG often have multiple coronary territories requiring revascularization.⁵

Usually, the LSV is harvested by creating incisions from the ankle up to the groin termed open vein harvesting(OVH). However, such harvesting methods are associated with incisional pain and leg wound infections. In addition, patients find such large incisions to be cosmetically unappealing. These concerns regarding wound morbidity and patient satisfaction led to the emergence of endoscopic vein harvesting (EVH).

Traditionally cardiac surgeons used to determine the adequacy of anastomoses by palpation of graft pulsation, by injection of a test solution into the bypass graft prior to connection to the aorta, to assess hemodynamic stability and electrocardiographic changes after weaning from extracorporeal circulation. But these methods are unreliable and indirect.

To increase the reliability of anastomotic quality a number of methods have been advocated for intraoperative assessment of the anastomoses in CABG .Among these, transit time flow measurement is considered to be more convenient, less invasive, more reproducible, more cost-effective compared to angiography, and less time consuming. Nevertheless the gold standard for anastomotic assessment still remains postoperative angiography.

Intraoperative bypass flow measurement

Transit-time flow measurement gives important and accurate intraoperative information about the status and patency of each individual graft. It enables technical problems such as kinked, twisted, or stenotic grafts to be diagnosed accurately, thereby allowing prompt revision of the constructed grafts before the patient leaves the operating room.

Graft flow tracing was obtained intraoperatively after completion of extracorporeal circulation using a transit time flow meter. An adequate flow probe of 1.5 mm, 2 mm, 3 mm, 4mm or 5mm was placed around the graft to fit the actual size of the vessel. Based upon the obtained flow profile the variables mean graft flow (Q_m), pulsatility

index (PI, calculated by maximal flow–minimal flow/ Q_m), and visual evaluation of the flow curve were assessed.

Revision of the anastomosis or the bypass grafts was performed when Q_m was below 12 ml/min, PI was high, or the waveform (diastolic flow pattern) was estimated to be insufficient.

AIM OF THE STUDY

The aim of this study is to assess the intra-operative flow of the LSV grafts harvested with the two methods conventionally and endoscopically by using Transit Time Flow meter.

ANATOMY OF THE GREAT SAPHENOUS VEIN

Great saphenous vein (GSV, alternately "long saphenous vein") is a large, subcutaneous, superficial vein of the leg. It is considered the longest vein in the body, running along the length of the lower limb, returning blood from the foot, leg and thigh to the deep femoral vein at the femoral triangle.(Fig.1)

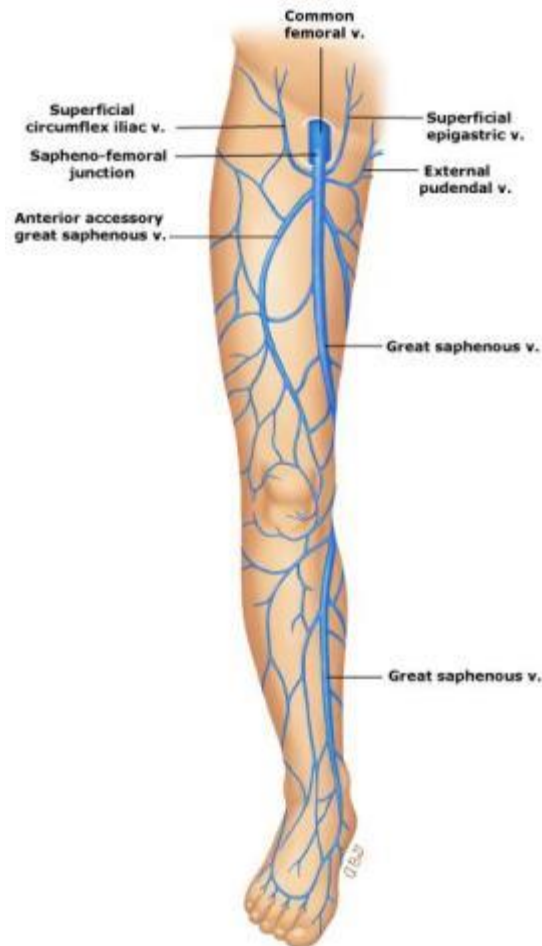


Figure 4 Anatomy of the LSV.

Structure:

The great saphenous vein originates from where the dorsal vein of the big toe (the Hallux) merges with the dorsal venous arch of the foot. After passing in front of the medial malleolus (where it often can be visualized and palpated), it runs up the medial side of the leg. At the knee, it runs over the posterior border of the medial epicondyle of the femur bone. In the proximal anterior thigh 3-4 centimeters inferolateral to the pubic tubercle, the great saphenous vein dives down deep through the cribriform fascia of the saphenous opening to join the femoral vein. It forms an arch, the saphenous arch, to join the common femoral vein in the region of the femoral triangle at the sapheno-femoral junction.

Tributaries:

At the ankle it receives branches from the sole of the foot through the medial marginal vein; in the lower leg it anastomoses freely with the small saphenous vein, communicates by perforator veins (Cockett perforators) with the anterior and posterior tibial veins and receives many cutaneous veins; near the knee it communicates with the popliteal vein by the Boyd perforator, in the thigh it communicates with the femoral vein by perforator veins (Dodd perforator) and receives numerous tributaries; those

from the medial and posterior parts of the thigh frequently unite to form a large accessory saphenous vein which joins the main vein near the sapheno-femoral junction.

Near the fossa ovalis it is joined by the superficial epigastric, superficial circumflex iliac vein, and superficial external pudendal veins.

The thoracoepigastric vein runs along the lateral aspect of the trunk between the superficial epigastric vein below and the lateral thoracic vein above and establishes an important communication between the femoral vein and the axillary vein.

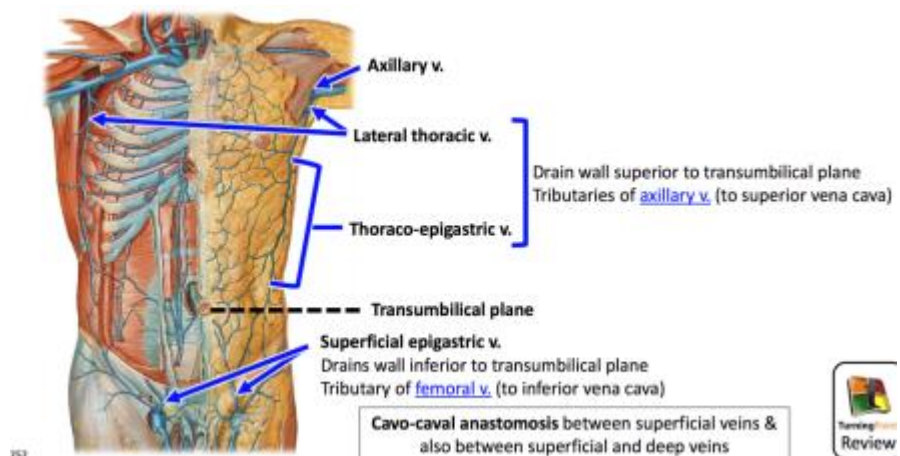


Figure 5 Thoracoepigastric Vein