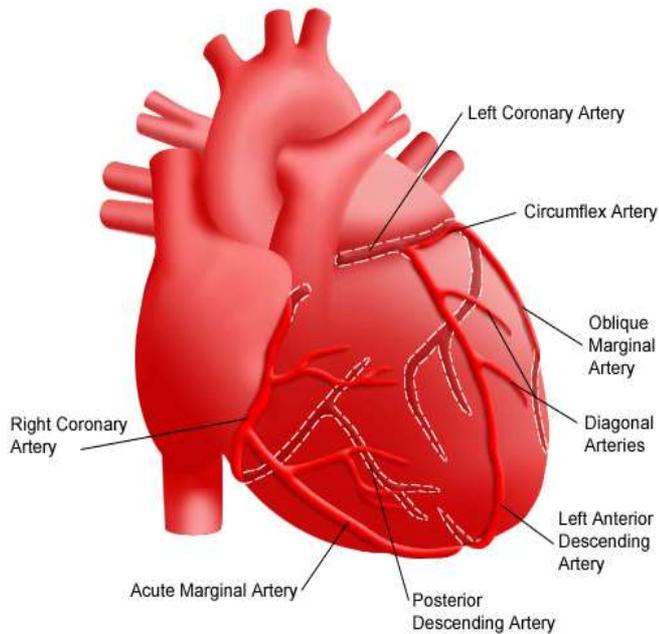


## Coronary Arteries of the Heart



# CABG



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# CORONARY CIRCULATION

-Blood circulation to the heart muscles is called coronary circulation

-through coronary vessels

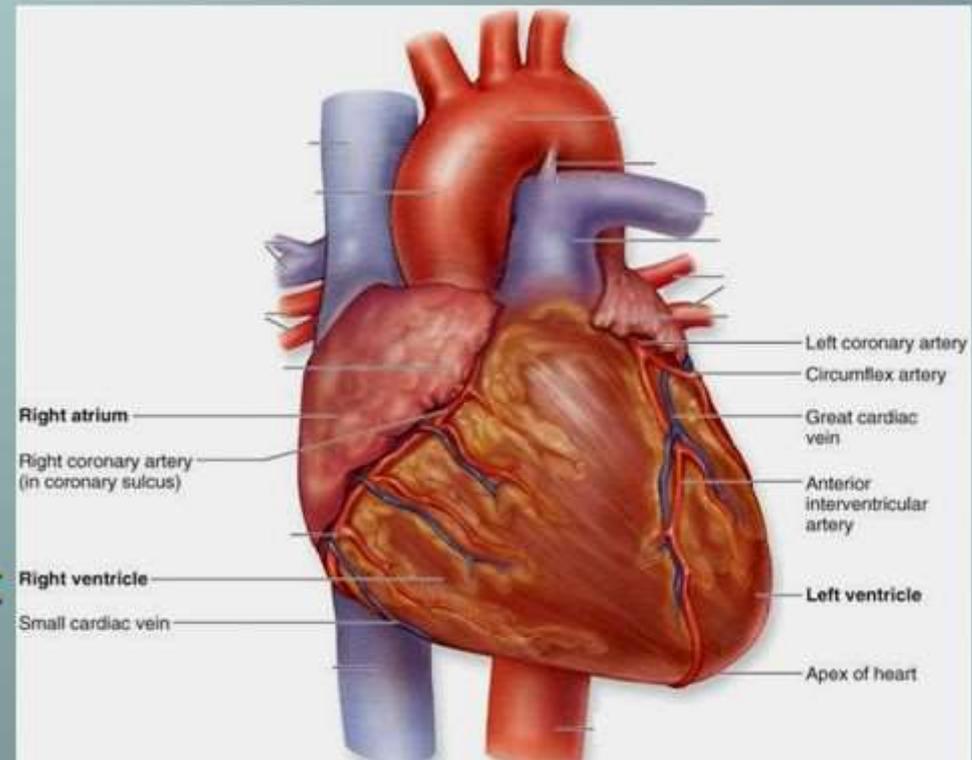
## I. ARTERIAL SUPPLY

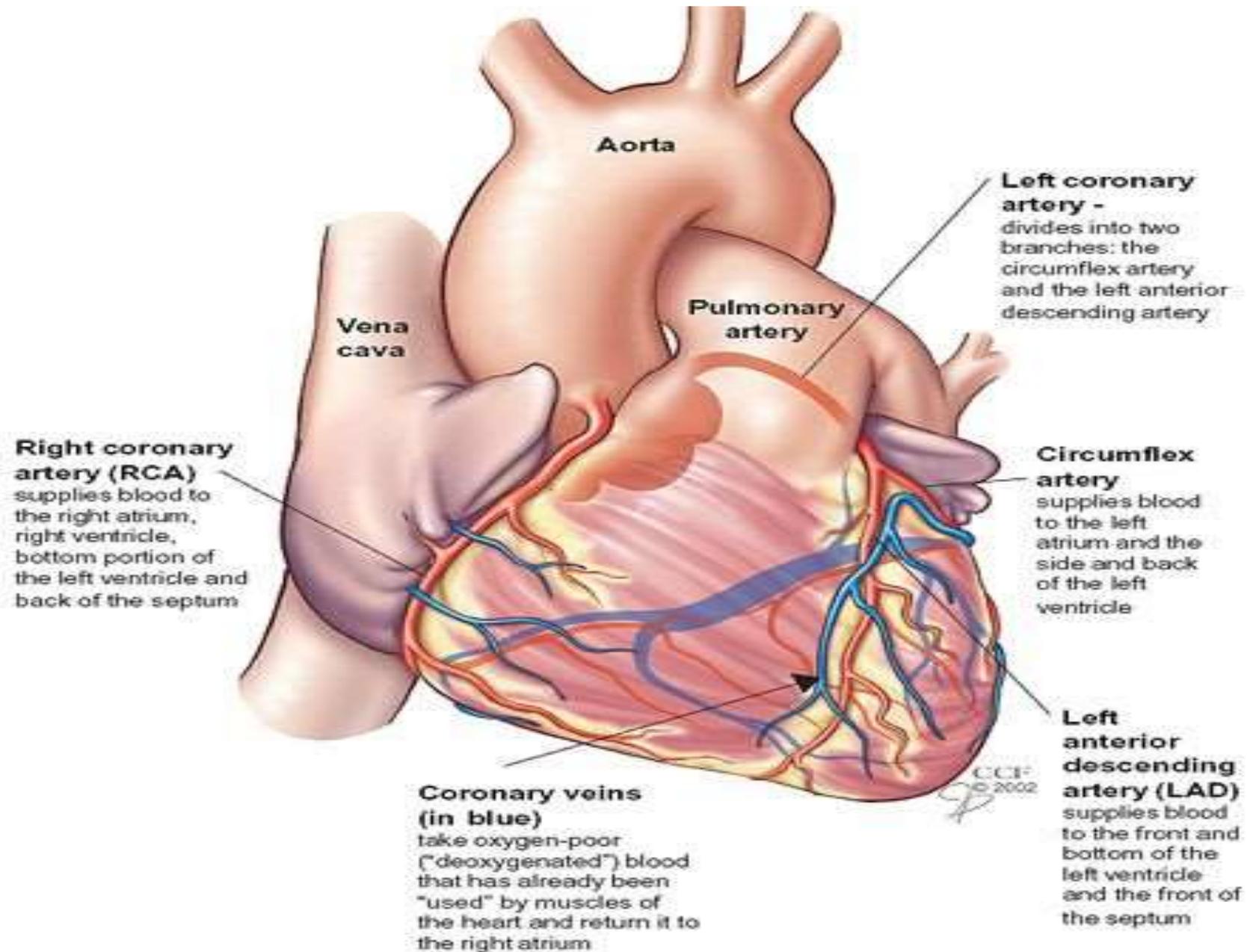
-Two coronary arteries

1. Right Coronary artery and

2. Left Coronary artery

-both arteries arise from the root of ascending aorta





**Aorta**

**Vena cava**

**Pulmonary artery**

**Left coronary artery** - divides into two branches: the circumflex artery and the left anterior descending artery

**Right coronary artery (RCA)** supplies blood to the right atrium, right ventricle, bottom portion of the left ventricle and back of the septum

**Circumflex artery** supplies blood to the left atrium and the side and back of the left ventricle

**Left anterior descending artery (LAD)** supplies blood to the front and bottom of the left ventricle and the front of the septum

**Coronary veins (in blue)** take oxygen-poor ("deoxygenated") blood that has already been "used" by muscles of the heart and return it to the right atrium

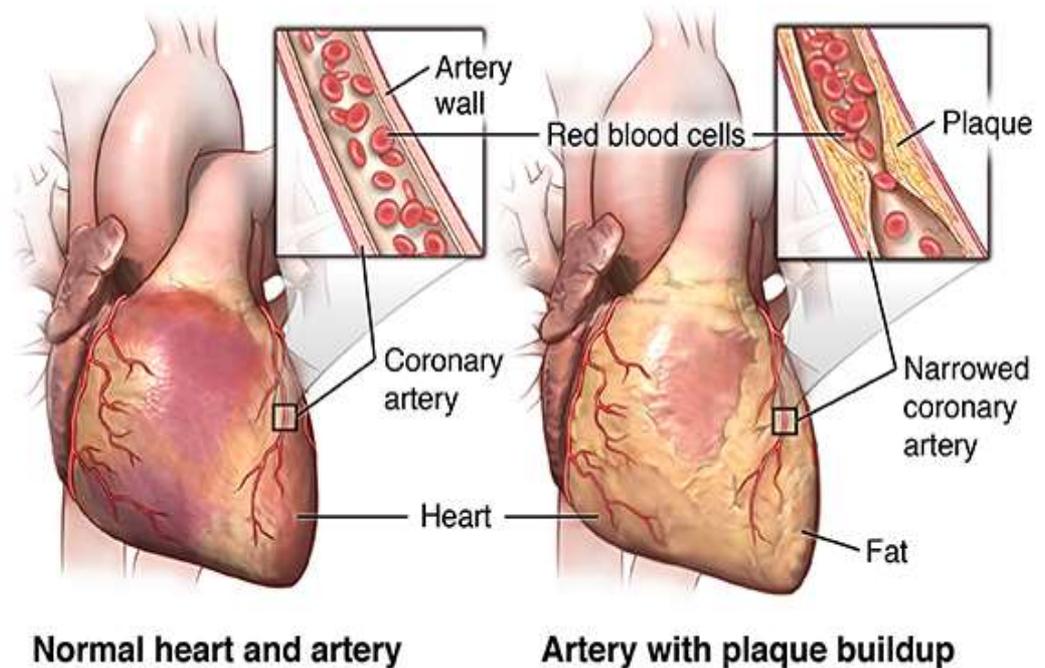
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# Coronary Artery Disease CAD

- Ischemic heart disease, also referred to as coronary Artery disease, is the term associated with an inadequate supply of blood to the myocardium due to obstruction of the epicardial coronary arteries, usually from atherosclerosis.
- Patients may have chronic (stable) or acute (unstable) disease.

# Risk factors for CAD

- **SMOKING**
- D.M
- HTN
- Hyperlipidemia
- Male gender
- Obesity
- Advanced age
- Rheumatoid arthritis
- Family history of CAD



- Patients with stable coronary artery disease should be assessed periodically to determine whether
  - >>medical therapy or
  - >>medical therapy with revascularization is a more appropriate strategy.

# Two principal options for revascularization :

- Percutaneous coronary intervention (PCI) with stenting.
- Coronary artery bypass graft surgery (CABG)

**Regardless of which method of revascularization is used, aggressive risk-factor modification is necessary in all patients**

# INDICATIONS FOR REVASCULARIZATION

- Patients with activity-limiting symptoms despite maximum medical therapy.
- Active patients who want PCI for improved quality of life compared to medical therapy, such as those who are not tolerating medical therapy well, or who want to increase their activity level.
- Patients with anatomy for which revascularization has a proven survival benefit such as significant left main coronary artery disease (greater than 50% luminal narrowing) or multivessel coronary artery disease with a reduction of left ventricular ejection fraction and a large area of potentially ischemic myocardium.

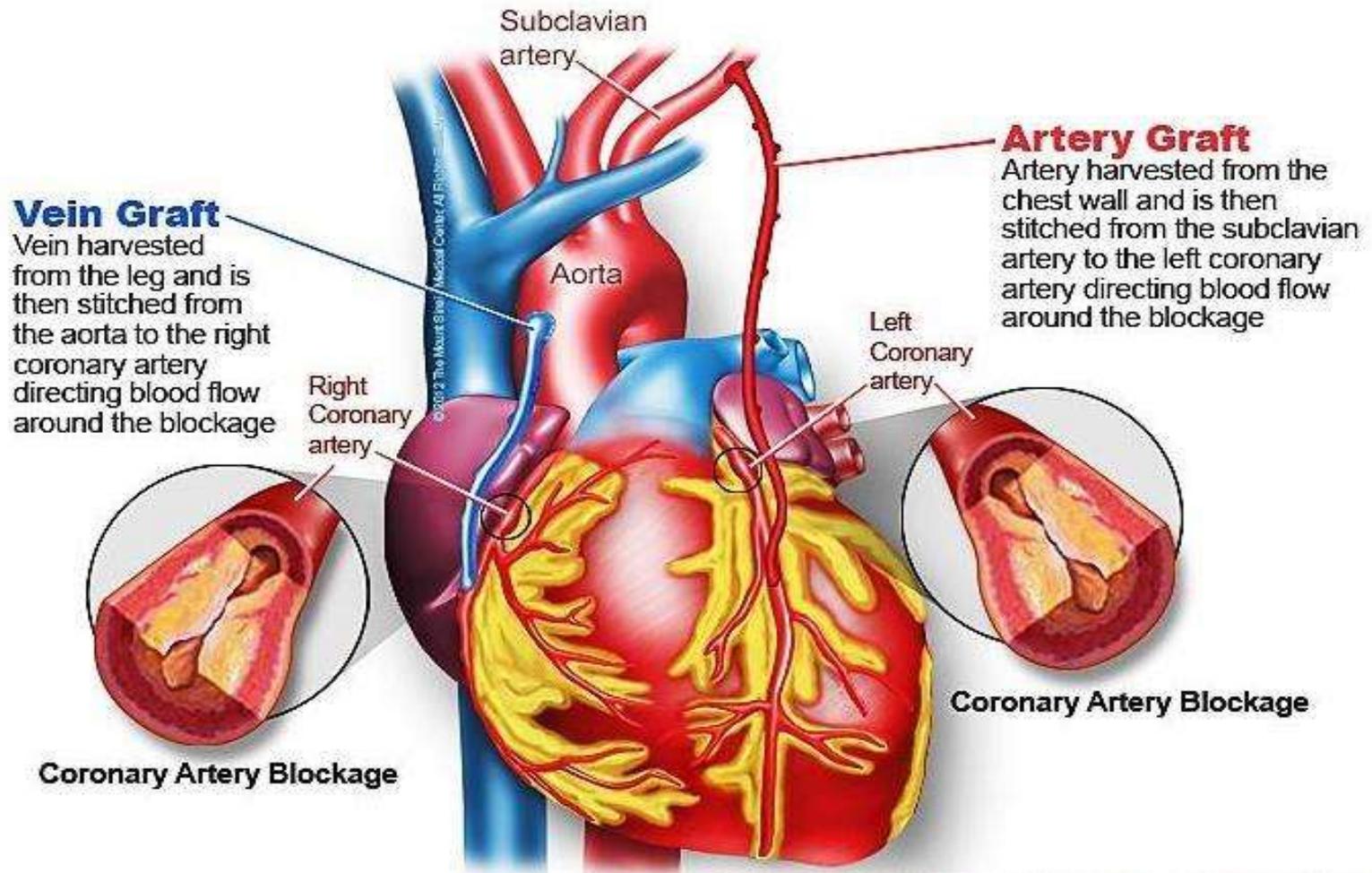
# PCI VS CABG

- Patients with single-vessel disease>>PCI with drug-eluting stents.
- Patients with two-vessel disease involving the right and circumflex coronary arteries>>PCI with drug-eluting stents.
- Patients with disease of the left anterior descending and either right or circumflex coronary arteries>>  
**CABG**
- Patients with three-vessel disease>>**CABG**.
- Patients with two- or three-vessel disease in whom **complete revascularization** cannot be accomplished by PCI>> **CABG**.

# CABG

- CABG involves the placement of one or more grafts between the aorta and coronary artery circulation.
- Arterial and venous grafts are used as bypass grafts and most patients receive some combination of the two.

# CABG

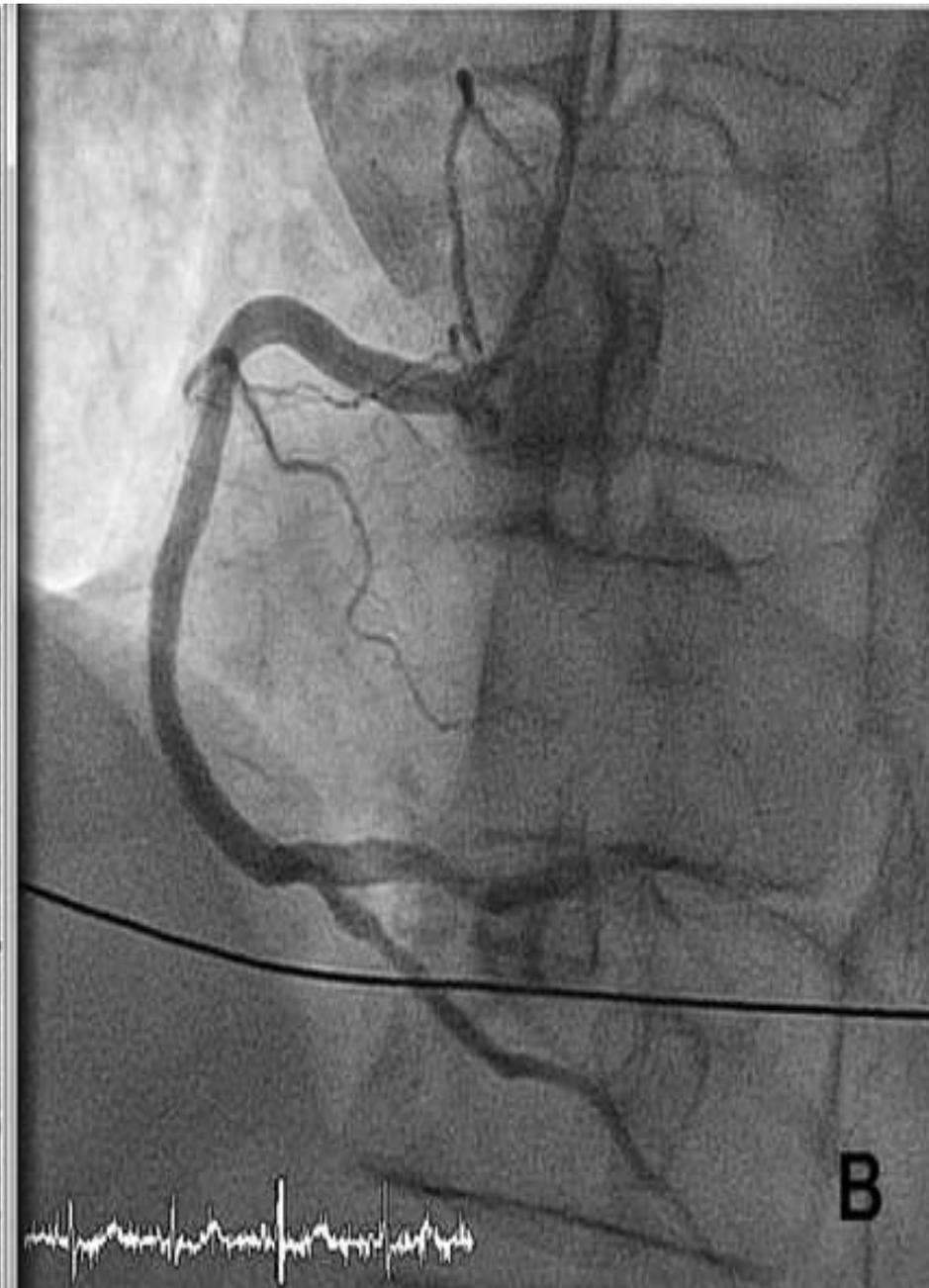


# CABG

- long-term graft patency is significantly better with the Arterial grafts.
- Potential consequences of graft failure (loss of patency) include the development of angina, myocardial infarction, or cardiac death.

# Preoperative assessment.

- All patients with considerations of CABG will have a **coronary angiogram** performed, which will give information about coronary arterial branches are completely or partially occluded and not visualizes.
- Another important component of preoperative assessment is the **availability of suitable conduits.**



# Arterial Conduits

- The most usable arterial conduit in coronary grafting procedure is **Left Internal Thoracic (Mammary) Artery (LIMA)**.
- The ITA arise from subclavian artery just above and behind the sternal end of the clavicle.

# Arterial Conduits

- The second artery that can be used as arterial conduit for coronary graft is **Radial Artery (RA)**.
- The RA arises from the bifurcation of the brachial artery in the cubital fossa and terminates by forming the deep palmar arch in the hand.
- The main concern using RA is blood supply to the wrist and hand but in recent anatomical study was found that superficial palmar arch of the ulnar artery provides the blood supply to all fingers In 67% of hands. Additionally to it in 87.5% of hands there is intense communication between deep palmar branches of the radial and ulnar arteries .

# Vein grafts

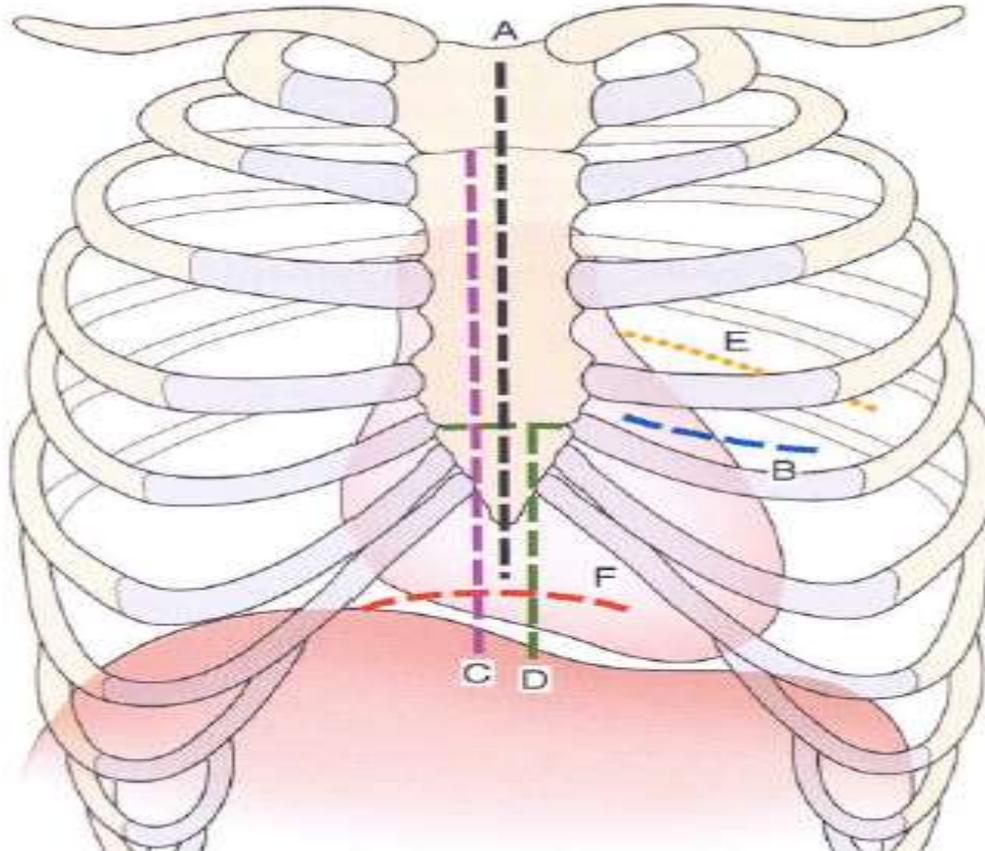
- **Saphenous Vein Graft.**
- Despite of the **progressive atherosclerosis** that has been founded in the vein graft, it is one of the major conduits for coronary arteries bypass surgery.
- The **Greater Saphenous Vein (GSV)** of the lower extremity is the best choice of this type of graft based on:
  - There are two independent types of low extremity vein system and removal of superficial one (GSV) does not jeopardize the venous flow from the leg .
  - Position, diameter and length of the GSV are in constant pattern which simplifies its harvest.

# Patency rate

- PCI with stent : 90% at 1 year.
- Saphenous vein graft : 80% at 5 years.
- **LIMA to LAD : best conduit for CABG with about 90% patency rate at 15-20 years.**

# Incision

- A :Median Sternotomy



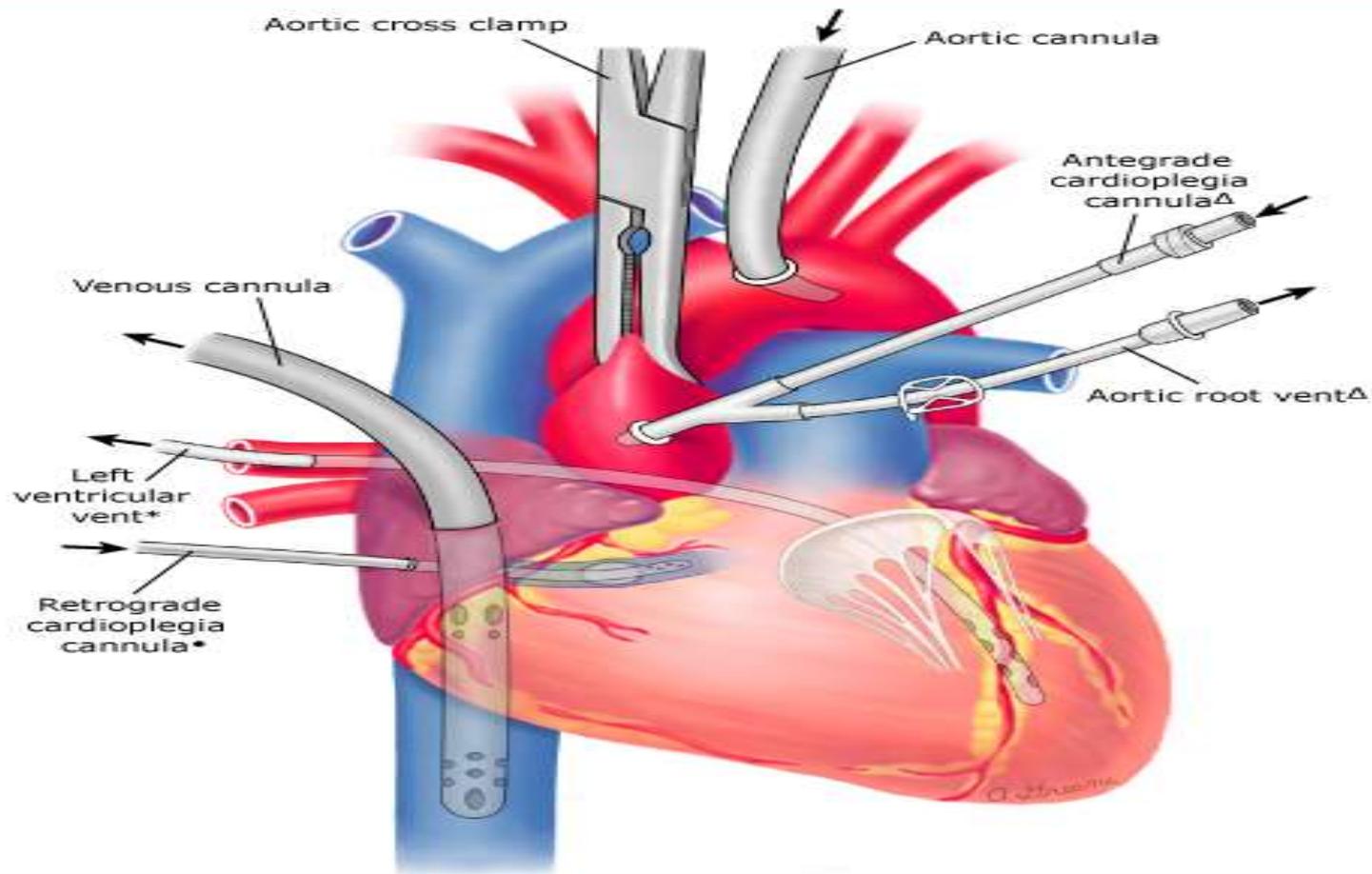
# Median Sternotomy

- Permits excellent visualization of all mediastinal structures.
- it is associated with a rate of infection (including osteomyelitis and mediastinitis) of approximately 1 - 1.5 %.
- This risk is increased with :
  - Obesity.
  - poorly controlled diabetes.
  - COPD chronic obstructive pulmonary disease.
  - Smokers
- four to six weeks is required for bony union, limiting the patient's ability to resume unrestricted physical activity.

# Cardiopulmonary bypass

- It's a form of extracorporeal circulation in which the patient's blood is diverted from the heart and lungs and rerouted outside of the body.
- The right atrium (RA) is usually cannulated to divert blood through the venous line of the CPB circuit, with return of the blood via an arterial cannula positioned in the ascending aorta or other major artery.
- Typically, the ascending aorta is cross-clamped and cardioplegia ( arrest heart in diastole ) is administered to allow the cardiac surgeon to operate on a nonbeating heart in a field largely devoid of blood.

## Intracardiac and vascular cannulae utilized during cardiopulmonary bypass



\* Left ventricular vent enters right upper pulmonary vein then passes into left ventricle through mitral valve.

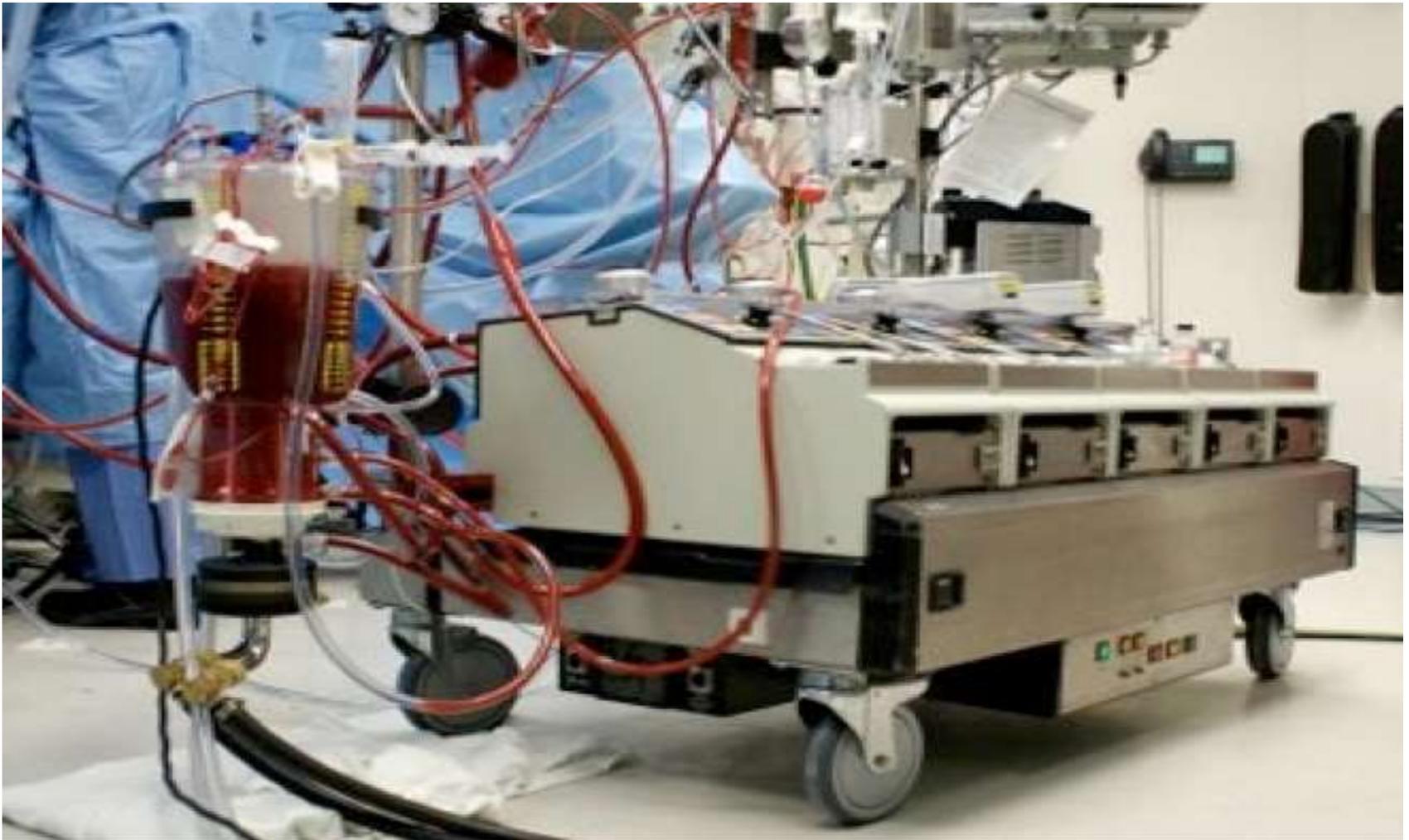
• Retrograde cardioplegia cannula enters right atrium and passes into coronary sinus.

Δ Aortic root vent allows suction to be applied to the aortic root, thereby indirectly emptying the left ventricle.

UpToDate would like to thank Bruce Searles, MS, CCP, and Kit Hefner, MS, SUNY Upstate Medical University, for their assistance with this illustration.

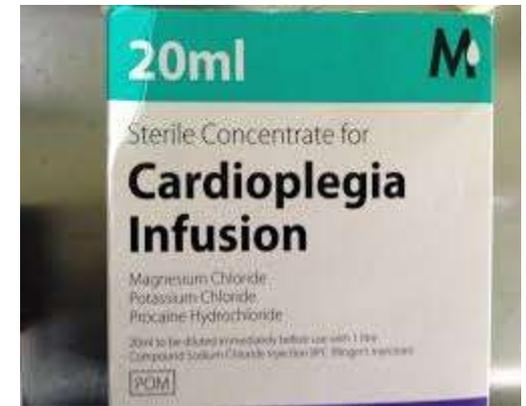
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**The normal physiologic functions of the heart and lungs, including circulation of blood, oxygenation, and ventilation, are temporarily taken over by the CPB machine so that other end organs remain adequately oxygenated and perfused.**



# Cardioplegia

- a pharmacological therapy administered during cardiac surgery to intentionally and temporarily arrest the heart.
- Cold potassium solution used.
- An influx of **potassium** depolarizes the myocardial membrane causing contraction and thus release and subsequent sequestration of calcium ions resulting in a **diastolic** arrest.



# Off-pump CABG

- CABG without the use of cardiopulmonary bypass.
- The rationale for developing this procedure, which is also called "beating heart surgery," was to avoid the morbidity associated with cardiopulmonary bypass:"
  - Induction of a systemic inflammatory response
  - Activation of platelets.
  - Cross-clamping the aorta.
  - Bleeding.
  - Vasodilatory shock

# Off-pump CABG

- Patients felt to be at high risk of stroke due to aortic manipulation may reasonably choose off-pump CABG.
- Patients choosing to undergo off-pump surgery should be made aware of the higher mortality associated with emergent intraoperative conversion from off- to on-pump CABG.

# MIDCAB

- Minimally invasive direct CABG (MIDCAB): minimal or limited access CABG, is applied to procedures that use alternative incisions to standard median sternotomy.
- In most instances, MIDCAB is performed off-pump.

# OPERATIVE MORTALITY

- The perioperative mortality for patients undergoing (CABG) varies according to the extent of patient comorbidities.
- Mortality is about 1 %for the lowest-risk elective patients, and 2-5% for all patients.

## **Factors have been demonstrated to influence the rate of operative mortality after CABG:**

- Hospital and surgeon experience.
- Degree of left ventricular systolic dysfunction(HF).
- Increasing age.
- Presence and extent chronic kidney disease.
- Type and number of bypass grafts.

# **General recommendations for preventive measures to minimize the risk of both morbidity and mortality after CABG :**

- Aspirin to improve morbidity and mortality.
- Beta blockers to prevent perioperative atrial fibrillation.
- Statin therapy.
- Prophylactic antimicrobials to prevent surgical site infection.
- Glycemic control (using an insulin infusion) during the perioperative period.

# Non-cardiac complications related to CABG

- **Bleeding:** 30 %of patients require a blood transfusion after CABG.
- **Neurologic complications:** Stroke, Depression
- **Infection.**
- **Acute kidney injury.**

# Major early cardiac complications

- Myocardial infarction (MI)
- Graft occlusion (with or without MI)
- Low cardiac output
- Vasodilatory Shock
- Atrial and ventricular arrhythmias:

AF occurs in 15-40 % of patients undergoing CABG and up to 60 % of those who undergo combined CABG with valve replacement.

- Pericarditis