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A Comparative Study: Angioplasty with Stenting & Coronary Artery Bypass Graft surgery

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This review paper discusses about the treatment plan for the patients suffering from atherosclerosis or its complication. Briefly, what treatment plan suits best in what conditions is the question that is being answered here. Before entering the section to discuss about the management, first discussing about the pathology and the clinical features seems more understandable

Coronary Artery Disease:

The hardening or in other words plaque formation in the walls of coronary artery giving rise to symptoms is termed as coronary artery disease. Can also be termed as atherosclerotic heart disease, ischemic heart disease. Plaque deposition in the vessel wall leads to narrowing of the coronary vessels which subsequently leads to compromise in the oxygen supply to the myocardium. The atherosclerotic plaque consists of lipoproteins, macrophages, T lymphocytes, vascular endothelial cells and smooth muscle cells.

Clinical manifestations of CAD:

The principal manifestation id Angina, followed by breathlessness, swelling, sweating, fatigue, pain in arms and jaw and syncope. Sudden exertion triggers stable angina moreover, it subsides with rest. The risk of suffering with CAD increases with positive risk factors in patients viz. old age, male, diabetes, hypertension, smoking, unhealthy diet, hyperlipidaemia, family history, etc.

Investigations for CAD:

Investigations can be broadly classified as non-invasive and invasive. Former consist of methods like, 12 lead EKG, Cardiac Isoenzymes, treadmill stress test, 2D ECHO, MRI, CT, PET-CT. Latter includes, Coronary Angiography being the gold standard investigation. Performing these tests tells us the severity of the disease, next step in management, extent of ischemic tissue, reduction in diameter of the coronary artery. Angiography is performed under local anaesthesia where catheters are inserted in the artery of upper(radial) or the lower limbs (femoral) with iodinated contrast Xray film is made which gives clear visualisation of the blockages in the coronary arteries furthermore, it gives idea about the perfusion of the tissues beyond the narrowing too.

Management:

The first choice of treatment for mild cases is lifestyle modification and lipid lowering drugs with antihypertensive medication. For moderate to severe cases which is based on the findings of the angiography the treatment options are shortlisted. The 2 most popular procedures are angioplasty with stenting and coronary artery bypass graft surgery. There are many factors on which it depends what procedure gives the most benefits to the patient, with thinking it through the decision is presented to the patient or his/her relative for consent.

Angioplasty with stenting:

The second choice of treatment after medications, the reason being a simpler procedure compared to CABG, cheaper than CABG, minimally invasive, no scar on chest, popular now a days. About a 1/3 of patients opt for this procedure after being diagnosed with CAD that cannot be managed my medications alone. The procedure is performed in a cath (catheterisation) laboratory. Another crucial reason, this procedure is preferred because the procedure involves inserting the same catheter that is used for angiography, so usually as soon as the blockages are seen on the angiograph the processes of consent is started (considering the patient conditions seems to be fit for angioplasty procedure) and if everything works out, the procedure of balloon angioplasty with stenting is commenced then and there. Angioplasty is a process which pushes the plaque of the vessel towards the wall or cut out the plaque from the wall which causes the widening of the narrowed artery and betterment in the perfusion of the myocytes. Coronary stent is a wire mesh tube which is placed at the lesion which usually follows the procedure of angioplasty it provides support to the walls to prevent re-narrowing of the artery. The

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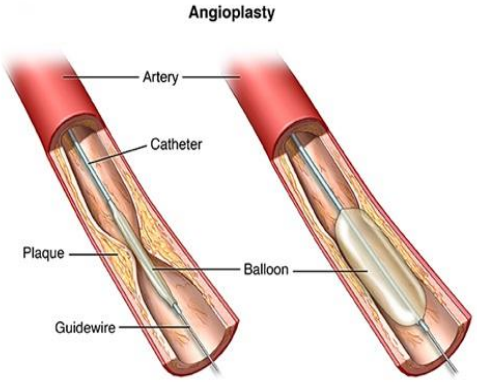
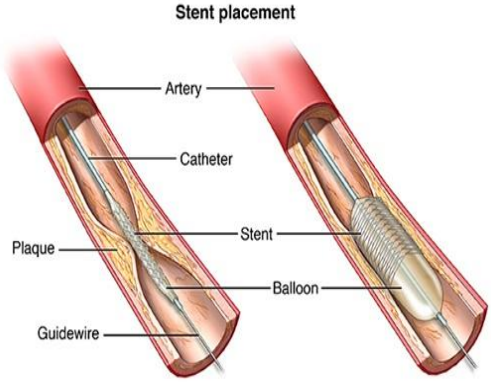
procedure takes about 1 to 2 hours with angiography the procedure in performed with blood thinners to prevent pathologic blood clotting. The patient is kept in ICU overnight and then discharged the next day.



(Ref: figure1 johns Hopkins medicine angioplasty and stent placement for heart.)

The post-operative management include 1 month of anti-platelet agent and 1 year of aspirin to prevent blood clot. This procedure is best of patients having moderate blockage of arteries providing they are not proximal (major) ones (e.g., LAD, RCA)



(Ref: figure 2 johns Hopkins medicine angioplasty and stent placement for heart.)

Coronary artery bypass graft surgery:

CABG is a surgery done to treat the blocked or narrowed arteries by bypassing the atherosclerotic area. The bypass is done by a healthy vessel, vein or an artery derived either from the lower or upper limb or from the chest.

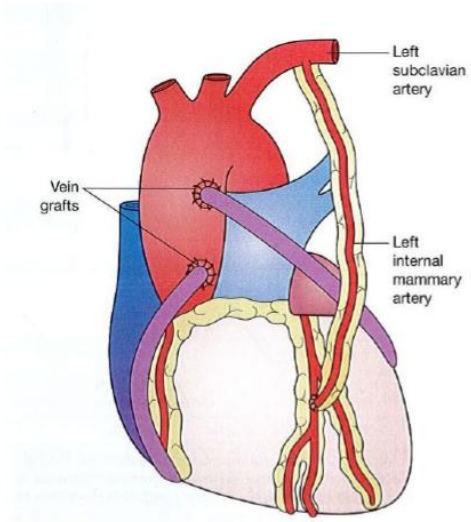


Figure 54.6 Completed coronary artery bypass grafts.

(Ref: figure 3 bailey & love e27 cardiac surgery p891.)

Out of all patient with CAD only about 10% will go for CABG surgery. With the introduction of percutaneous coronary intervention (PCI) that includes angioplasty, since the 1980s the population undergoing CABG has marginally decreased, at present CABG is usually used for patient who are progressively sicker with most benefit to gain. The indications for the surgery are as follows:

- >50% stenosis of left main stem
- >50% stenosis of the proximal left anterior interventricular artery
- Two or three main coronary arteries diseased
- Poor ventricular function with multivessel disease.

Ref: bailey & love (e27) cardiac surgery p889

The preparation of surgery includes assessment of the patient, the patient should be checked for co-morbidities and the medication history where the anti-platelets need to be stopped prior to surgery and continued thereafter. Risk assessment of the patient needs to be done with some popular scoring systems like euroSCORE II & STS score.

The vessels that are usually selected for the grafts are:

- Venous grafts
1. Long saphenous vein
2. Short saphenous vein
3. Cephalic vein
- Arterial grafts
1. Left internal mammary artery/ internal thoracic artery
2. Radial artery

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3. Gastroepiploic artery

After having talked about both the procedures and certain condition where a specific procedure is obligatory, now it's time to compare both procedures in detail.

Complications of angioplasty with stenting:

- **Acute**
1. **Acute stent related perforation of coronary artery**
2. **Stent thrombosis**
3. **Cardiac biomarker elevation**
- **Chronic**
1. **Restenosis**
2. **Chronic stent thrombosis**

Complications of CABG surgery:

- **Infectious**
1. **Pneumonia**
2. **UTI**
3. **Mediastinal infections**
4. **Wound infections**
5. **Sepsis**
6. **Empyema**
- **CVS and Respiratory**
1. **DVT**
2. **Low output syndrome**
3. **Cardiogenic shock**
4. **Pulmonary embolism**
5. **Pleural effusion**
6. **Haemothorax**
7. **Arrhythmias**
8. **MI**
9. **Graft failure**
10. **Phrenic nerve dysfunction**
11. **ARDS**
12. **Atelectasis**
13. **Prolonged ventilation requirement**
- **Neurologic**
1. **Stroke**
2. **Neurocognitive impairment**
- **Renal**
1. **ARF**
2. **Kidney injury**
3. **Electrolyte dysfunction**

The long list of complications of CABG surgery makes it non preferrable over angioplasty or in other words patient should opt for CABG only if the pathology cannot be managed by stenting.

But however, the choice totally depends on the patient and physicians' preferences, physicians usually choose the procedure on which they have a good hands-on experience while, a patient may demand for a specific procedure because of some influence or an event in history which was fruitful to someone whom he/she knows.

Researches in this field:

1) Charles A. Herzog in 2002 in his research made a comparative study between angioplasty, stenting and CABG surgery among patient on dialysis. A retrospective study from 1995 to 1998 showed the 2 years survival for dialysis patient undergoing CABG was 56.4% while, 48.2% for angioplasty and 48.4% for stent. Furthermore, for 42 months the survival was 37% CABG, 28.6% for angioplasty, 29.4% for stenting. They also found with their results, CABG surgery proved to be more beneficial than angioplasty in diabetic ESRD patients but, for non-diabetic ESRD patient angioplasty and stenting proved to be more beneficial. Secondly, they saw angioplasty with stenting lowered the mortality rate by around 10% compared to just angioplasty done in a ESRD patient. In conclusion, CABG surgery showed better long-term survival than PCI for dialysis patients in the US.
2) Alfredo Rodrigues in 2000 in his Argentine randomised study compared PCI procedures with CABG among patients having multiple vessel disease. Out of total 2759 patients reviewed just 450 patients were included in the study who had multiple vessel disease. In their study, during the first 30 days, lower major adverse events were seen in PCI patients compared to CABG patients. Mortality rate for PCI was nearly 1% while for CABG was 5.7% however, the revascularization risk for PCI patients was higher than CABG patients. The stroke risk within the first 30 days was 0.9% for CABG patients and on the other hand none of the PCI patients suffered from stroke. Conclusively, the study stated that for the high-risk group selected i.e., patient with multivessel disease angioplasty with stenting proved to give better survival numbers compared to CABG surgery.
3) Patrick W. Serruys in 2001 carried out a study of comparison of CABG and stenting for multivessel disease. A total of 1200 subjects were included in the study, Patrick found out that at one year, no significant difference was observed between both the procedures in terms of death, stroke, MI. round about 17% of patient from the PCI group had to go for revascularization procedure while, 3.5% patient had to go for the same, with CABG

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surgery. They even found out the event free survival rate which landed to 73.8% for PCI patients and 87.8 for CABG. Now, in terms of cost CABG surgery was round about $4,000 more expensive than PCI but, those who went for revascularization procedure i.e., 17% out of all patients undergoing PCI the cost difference was pinned down to $3,000 from the initial $,4000. In conclusion, cost wise PCI is cheaper than CABG but with PCI there comes a risk of needing revascularization.

4) Mouin S. Abdallah in 2013 in his study compared quality of life after PCI vs CABG in diabetic patients. From 2005 to 2010 around 1900 subjects from 18 different countries were chosen for the study. The status for health of patients was assessed based on angina frequency, quality of life domains, physical limitations at 1 month, 6 months and 12 months and annually thereafter. The scale ranged from 0 to 100 with 100 being the highest quality of health. For the results, it was seen that the scores at 2 years follow up were 96, 82.2, 87.8 respectively among the CABG group on the other hand the scores were 94.7, 80.4, 86 respectively for the PCI undergoing patients showing, greater benefit of CABG over PCI. In conclusion, CABG proved to be more effective than PCI for diabetic patients.

Having discussed a lot about CAD, perhaps it is far reaching important to study how to prevent Coronary Artery Disease.

Prevention of CAD:

1) **Get active:** aerobic exercise makes your heart strong and healthy, reduces the plasma lipid levels.
2) **Healthy diet:** high fibres and low amounts of carbs in the diet can boost your health and promise you a healthy tomorrow.
3) **Smoking caseation:** smoking plays a major role in aggravating atherosclerosis**.**
4) **Weight loss:** just by losing weight you can reverse diabetes, hypertension and eventually reduce your risk of CAD.
5) **Blood pressure maintenance:** high blood pressure may damage the vessel wall leading to disturbance in blood supply to myocytes.
6) **STRESS SALT SLEEP:** the three "s" of hypertension, stress, high salt diet and sleep deprivation can shoot your Blood pressure up and can eventually land to a severe ailment.

Newer trends:

CABG: for the CABG surgery the patient is usually given Cardiopulmonary Bypass (CPB) which has its own complications, perhaps it is relatively contraindicated in old patients. The concept of off pump coronary artery surgery (OPCAB) is introduced where, the CPB is not used, instead a stabilizing machine known as the OCTOPUS© is used during the surgery. The advantages of this technique are questioned because of the introduction of mini-bypass pumps, which offer minimal risk of thromboembolisation due to its small surface area moreover, gives the surgeon the benefit of bloodless, stable heart for surgery.

Another concept that has emerged is the MIDCAB- minimally invasive direct coronary artery bypass. Through a small sub mammary incision, the grafting is performed. More lateral incision gives access to other coronary vessels for the grafting.

There is emergence of combining both the procedures, MIDCAB approach to connect internal mammary artery to Left anterior descending artery along with PCI for less accessible arteries.

PCI: in a study (5) it was stated that the 3 major problems faced among PCI undergone patients are, failure to open completely clogged arteries, acute complications of embolism during procedure, problem of restenosis. To compete with the first issue many approaches has been practised viz, using Bare fibre lasers, rotating ball tip devices, stiff ball tip wires, rotablation with attached microscopic diamond chips to the burr to cut through hard plaques, etc. now some further approaches are under trials to decrease the frequency of restenosis.

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