

Role of Coronary Bypass in the Treatment of Ischaemic Heart Disease

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As you all know, Air Marshal Subroto Mukerjee laid the foundation of the IAF and it was his foresightedness that led to the development of Aviation Medicine in India and I am happy that the medical wing of IAF is one of the foremost of its kind in the world. I have been asked to talk on surgery of coronary artery disease. Coronary artery disease is becoming of great interest, especially in the Armed Forces because it cuts short the careers of a large number of its personnel. We are becoming more and more involved in their management as an increasing number of Armed Forces personnel are being referred to us for Coronary Artery Bypass Grafting Surgery (CABG). Treatment of coronary artery disease (CAD), whether it is medical therapy, coronary artery bypass surgery or more recently, Percutaneous Transluminal Coronary Angioplasty (PTCA), is palliative in nature. Coronary atherosclerosis cannot be cured at the present but its damaging effects can be delayed or prevented.

The basic problem in CAD is the development of atherosclerotic obstruction in the coronary arteries. Unless these obstructions involve more than 75% of the cross sectional area of the lumen of the blood vessels, the reduction in blood supply may not be much and the patient may be completely asymptomatic, as the obstructed artery can supply enough blood to meet the needs of the myocardium under resting conditions. However, when the patient exercises, the amount of blood that goes through the obstructed artery cannot meet the increased myocardial demands and that is when angina manifests. Medical treatment of CAD has two aims - reduction of workload of the heart or redistribution of the blood flow through collateral channels to ischaemic areas. It can not produce a sustained increase in blood supply to all areas of myocardium in the presence of significant CAD. Medical treatment therefore, has its limitations.

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The most direct means of restoring blood supply through an obstructed coronary artery is by balloon angioplasty (PTCA). This technique was pioneered in Switzerland by Andreas Gruentzig in 1976. Obviously, if you can relieve the obstruction, that would be far better than bypassing the artery or giving medicines to reduce the workload of the heart. The decision regarding the proper therapy - surgery, medical treatment or PTCA will depend on the distribution of the obstructions in the coronary arteries as determined by coronary angiography. Investigations such as nuclear studies and exercise tests give pointers but do not help in deciding the therapeutic strategy for an individual patient.

The left coronary artery divides into anterior descending and circumflex artery and a number of studies have demonstrated that most of patients with left main CAD do best with CABG and not medical treatment.

In Western countries, patients do not want their life style to be affected, whereas in India, patients come for surgery only when they cannot continue any longer on medical therapy alone. There is also a group of patients with silent myocardial ischaemia, picked up by various non-invasive tests and on coronary angiography, who are seen to have critical obstruction needing PTCA or CABG. If a patient has three vessel disease, a number of studies have demonstrated that he does better with surgery. However, cardiologists are now doing balloon angioplasty even in patients with three vessel disease, provided the lesions are suitable for balloon dilatation. The bypass operation works by bringing extra blood supply from the aorta or internal mammary artery to the affected artery beyond the point of obstruction. Symptoms alone cannot indicate which patients need angiography. Many patients with minimal angina or even no angina have severe CAD. Periodic checkups and once a year stress tests can pick up a large percentage of patients with myocardial ischaemia.

The technique of PTCA has revolutionized the treatment of CAD but unfortunately it is not applicable to all cases. The same applies for CABG. Patients with diffuse disease are not the best candidates for surgery. Medical therapy is superior to bypass surgery in cases where there is diffuse obstruction in the distal segments of the arteries.

Surgery can also be used to repair perforations of inter-ventricular septum as a consequence of myocardial infarction (MI) and also for resecting aneurysms of the left ventricle (LV). These procedures are usually combined with bypass surgery. The heart expends a lot of energy in expanding the aneurysmal portion of the LV. By resecting the aneurysm and restoring the geometry of the LV, the efficiency of the heart is improved. Removal of the clots usually present within the aneurysm obviates the danger of thrombo-embolic complications.

Most surgeons now believe in the concept of total revascularisation of the myocardium. If an artery can not be bypassed, reconstruction of the artery is done by removing the atheromatous plaque and repairing it with vein patch in some cases. This procedure is rarely used as the long term effects of endarterectomy are not as good as bypass without endarterectomy. The entire atheromatous plaque should be removed and patient anticoagulated for 8-12 weeks to improve results. Endarterectomy is associated with higher incidence of peri-operative infarction. Green and associates popularized the internal mammary artery as a bypass conduit and the technique has gained wide acceptance over the years. This artery to artery bypass is superior to aorto-coronary saphenous vein bypass with respect to long term patency which is more than 95% at 10 years, as compared to 60% to 70% for vein grafts. Unfortunately these arteries can not reach the back of the heart, therefore, their use is restricted to certain arteries such as the left anterior descending, proximal right coronary artery and proximal marginal branches of the circumflex artery. Vein grafts show degenerative changes and atheromatous deposition in their walls with the passage of time and may ultimately become totally occluded.

One of the pre-requisite before coronary artery bypass surgery is support of circulation with heart-lung machine. During the operation, we do not open the heart but work on the arteries on its surface but we require a heart that is completely still because one has to perform microvascular surgery. These days we use the membrane oxygenators as they provide the most physiological circulatory support during operation. We also need a good anaesthetist, otherwise the morbidity of the operation can be high. With good anaesthesia, good perfusion and meticulous surgery, the CABG operation is one of the safest of all surgical operations. In centres where the operation has been standardised, the mortality of the procedure in uncomplicated cases is less than 1%. After gaining sufficient experience, we started combining these operations with other procedures. These days it is quite common for us to do bypass surgery with replacement of one or more heart valves, resection of left ventricular aneurysms or repair of ventricular perforations.

A large number of studies have been conducted abroad on the long term results of CABG surgery. I am not sure whether these are applicable to our Indian patients because our patients are different in many respects, but we can gain some idea about what the long term results are likely to be. Many studies have given us information regarding which of the patients do better with bypass surgery and which do not. We have found that patients with left main coronary artery disease do better with surgery than with any other form of treatment. Patients with three vessel disease, especially when associated with left ventricle dysfunction, do better with bypass than with any other form of treatment. If the patient has a critical lesion in the proximal left anterior descending artery compromising the blood supply to a large portion of the myocardium, surgery gives better long term results but today some of these cases can be dealt with equally well by balloon angioplasty. If the vessel fails to dilate, we can take up the patient for surgery. We have also found, that, if the patient has abnormal resting ECGs, he does better with surgery. Patients with strongly positive stress tests also do better with surgery than with medical treatment. Patients who have associated disease such as

valvular heart disease, aneurysm of the ventricles or perforations of the septum do better with surgery, because we can deal with haemodynamic problem that places additional burden on the ischaemic myocardium. These days, the risk of combining valve surgery with coronary bypass surgery is less than 3%.

Nearly one third of the patients who come to us have unstable angina. This is not so abroad, where most of the patients come for surgery with stable angina. Our patients come with advanced disease and often have angina that is not controlled by medical treatment. Our basic approach for patients with unstable angina is to try and stabilise them with stepped up medical treatment. We put them to rest, sedate them, rule out MI, and intensify the medical therapy. If the patient has hypertension, arrhythmias or congestive heart failure, we control these. If the patient does not stabilize, we take the patient to catheterisation laboratory for coronary angiography and then decide whether PTCA of culprit lesions is possible. If this is not possible we take up the patient for immediate CABG surgery. If the coronary angiography reveals normal coronary arteries, (surprisingly 10% of patients with unstable angina have normal coronary arteries), these patients usually have spasm of the arteries and do well with withdrawal of beta blocking drugs and addition of calcium channel blocking drugs which have a specific effect in relieving coronary artery spasm. If the patient has left main coronary artery disease, we consider him for emergency surgery. If he has three vessel disease with good distal anatomy, we consider him for angioplasty or surgery. Surgery, however, is preferable because balloon angioplasty in such cases is not only risky but also expensive because each balloon costs \$ 700-800 and patient may end up spending something like Rs. 50-60 thousand whereas CABG surgery will cost less. If it is not possible to carry out angioplasty because of unsuitable distal anatomy, or surgery because of global ventricular dysfunction, then there is no choice but to step up medical treatment. Bypass surgery is only palliative and not curative and unless the patient takes care of himself, he can not expect good results.

Between 1979 and 1984, we did not have much experience of coronary bypass surgery and we had done 68 patients with an overall 7.4% mortality. But after May 1984 till date, at Apollo Hospital, we have done surgery on 1756 patients with an overall 2.8% mortality. This group also includes patients with combined procedures, patients with impaired ventricles and nearly $\frac{1}{3}$ rd of patients had unstable angina, a large number of them had chronic bronchitis because nearly 40% of these patients were smokers. I would like to emphasise that there is now incontrovertible evidence that smoking promotes CAD and smokers have a lesser chance of good result from CABG surgery or PTCA, should they require these procedures. Bronchial asthma and cerebrovascular disease are not common associations. For some reason, atherosclerosis affects coronary arteries more than other arteries in Indians. Why this is so, we do not know.

The associated procedures which we did were aortic valve replacement, mitral valve replacement, mitral valve repair, double valve replacement, aneurysectomy of the left ventricle, repair of perforations of the inter-ventricular septum and pacemaker implants. We have done forty two of these combined procedures. These days we do not attempt single grafts, most of them have PTCA instead. Grafts ranged from one to six in number, the most frequent being three graft surgery. We have used the internal mammary artery in 451 patients and now these numbers are increasing because every patients has at least one mammary bypass.

By the end of one year, 10-15% grafts became blocked because of progression of lesion in the native vessel or development of lesion in the vein graft or if a graft is attached to a small artery with poor run off. When the blood flow through a bypass graft is less than 40 ml/min, blood within the graft tends to clot. Mortality in stable angina has been less than 1%. Around 8% of patients will have ECG changes of peri-operative MI. Less than 10-15% of these patients develop low cardiac output problems. After one year, the mortality is 1-2% and 75 to 85% remain angina free. After 5 years, 60-70%

remain angina free and after 10 years, 50 to 60% of the patients remain angina free.

In our series of 1756 patients, there were 51 hospital deaths, and of these 22 patients had peri-operative infarction. In earlier days we did not know how to select the patients for surgery. We operated on a larger number of patients who had diffusely diseased arteries. These mistakes are now becoming less common with the experience we have gained. Post operative renal failure has been a problem because $\frac{1}{4}$ th of our patients have been diabetics and many of them had undetected diabetic nephropathy. Neurological complications have been rare. Bleeding and tamponade are not uncommon complications as most of these patients were on Aspirin and Persantin therapy prior to surgery. Of the 1705 survivors there were 8 late deaths. More than 85% of the survivors are angina free and doing well. More than 75% have negative stress test. We have also had extensive experience with PTCA, the largest in the country with 330 angioplasties done so far. The real secret lies in selection of patients and if you do not select patients properly, you are not going to have good long term effects.

To summarise, coronary bypass surgery is a very useful method of treating coronary artery disease. Balloon angioplasty and bypass surgery are complementary techniques and are not mutually exclusive of each other. Balloon angioplasty is far more acceptable to the patient than coronary bypass because he is out of hospital within a day or two and there are no incisions to heal. It is a marvelous technique but it has its limitations and dangers. We have had 7 patients out of 330 who crashed during angioplasty and had to have emergency bypass surgery and of these, one patient died. We have found, that some of the bypass surgery cases who come with the recurrent angina are benefited by angioplasty. All treatment that we can offer the patient with coronary artery disease today is palliative and not curative in the strict sense of the word. All the same, by the judicious application of one or the other of the three modes of therapy available to us, we can improve the life span as well as the quality of life of the individual patient. This is where the surgical and medical treatment remains today.