



Dr. Murali. P. Vettath  
Chief Cardiac Surgeon

The MIMS Heart Journal is a journal from the Institute of Cardiac Sciences, Malabar Institute of Medical Sciences; aimed at keeping the medical fraternity informed about the changing concepts in cardiac care. The journal seeks to put all those involved in cardiac care in the Malabar region - both Specialists and General Practitioners - in contact with the latest concepts and practices in the management of heart disease.

The management of cardiac lesions has undergone drastic changes in the past few decades. MIMS Heart Journal is committed to publishing excellence and the latest developments in this field with a focus on the originality and totality of publication. The first edition features various facts based on our experience at MIMS. We have tried to include a good analysis of some of the recent concepts, starting with a simple background and slowly progressing to a liberal and repeated analysis based on published articles along with pictures.

The aim is not to daunt tentative and curious readers, but to escort them. It has been designed to help them arrive at the terminus with their own safe interpretation of what they observed en route.

We sincerely do hope that this novel venture of ours is of help in keeping you abreast with the recent advances in cardiac care.

*“Read not to contradict or confute  
Nor to believe and take for granted  
But to weigh and consider”*



# Implantable Cardioverter Defibrillators for the prevention of sudden cardiac death

Dr. Ali Faizal, MD, DM  
Chief Cardiologist

## CASE SUMMARY

A 56-year-old male had a cardiac evaluation for angina and dyspnoea on effort in 1999. He was diagnosed to have non-obstructive hypertrophic cardiomyopathy and was started on beta-blockers. Coronary angiogram showed normal epicardial coronary arteries. He started having syncopal episodes associated with palpitations from Jan 2002. Holter monitoring showed frequent episodes of non-sustained VT and amiodarone was initiated. In July 2002, he was hospitalized with a sustained VT that subsequently degenerated into VF requiring multiple high energy cardioversion. He had cardiorespiratory arrest requiring temporary ventilatory support, and was finally resuscitated. The need for an ICD implantation was explained to the patient and the family who finally agreed for the procedure. ICD implantation was done on 13-09-2002 through left subclavian route using Medtronic Gem-SR device. Post-implantation hospital stay was uneventful. During 6 months follow-up, ICD interrogation showed two episodes of VF, which were successfully treated by high-energy defibrillation. Patient remained asymptomatic except that he was aware of the shocks.

## INTRODUCTION

Sudden cardiac death [SCD] is defined as sudden, natural and unexpected death due to cardiac causes heralded by abrupt loss of consciousness within one hour of the onset of acute symptoms. Vast majority of sudden deaths are due to malignant ventricular tachyarrhythmias. The overall adult population has an estimated sudden death incidence of 0.1 to 1.2 percent /year, accounting for a total number of events of more than 3,000,00/year. In the adult population, the incidence of sudden cardiac death due to coronary artery disease increases as a function of advancing age in parallel with the age related increase in total coronary heart disease deaths. There is a huge preponderance in males compared with

females, because of the protection, the latter enjoying from coronary Atherosclerosis before menopause. Two population studies suggest familial clustering of SCD, as an expression of coronary artery disease, but requires further clarification.

Coronary artery disease and its consequence account for at least 80 % of the SCDs. A previous myocardial infarction can be identified in as many as 75 % of patients who die suddenly and in the rest, SCD is the first clinical manifestation of coronary heart disease. A marked reduction via left ventricular ejection fraction is the single most powerful predictor for SCD. In addition, occurrence of premature ventricular contractions, particularly if frequent (> 10/hour), multifocal, repetitive (occurring in Salvos of three or more ectopic beats) and with short coupling intervals, in survivors of myocardial infarction, predicts an increased risk of SCD on long-term follow up.

Cardiomyopathies, dilated and hypertrophic cause another 10-15 % of SCDs. Arrhythmogenic right ventricular dysplasia, a genetically determined condition is associated with high incidence of ventricular arrhythmia and sudden cardiac death. Valvular heart diseases (aortic stenosis and mitral valve prolapse), congenital heart diseases (Eisenmenger syndrome, operated TOF etc) and primary electrical diseases like congenital and acquired long QT syndromes are among the less common causes of sudden cardiac death.

Implantable Cardioverter Defibrillators (ICDs) are devices used for the treatment of malignant ventricular arrhythmias and survivors of cardiac arrest. Clinical trials with ICDs for secondary prevention (AVID, CASH trials) and primary prevention (MADIT, MUSTT) have all demonstrated significant improvement in overall survival with ICD therapy compared with conventional or drug treatment. The underlying disease state may affect the decision to implant an ICD. In patients with coronary artery

disease, active ischaemia may be the cause of significant ventricular tachyarrhythmias and should be assessed and treated before implantation of the ICD.

#### RECOMMENDATIONS FOR IMPLANTATION OF ICD (ACC/AHA joint committee.)

##### CLASS I

- Cardiac arrest due to VF or VT not due to a transient or reversible cause.
- Spontaneous sustained VT.
- Syncope of undetermined origin, with inducible VT/VF during Electrophysiological study when drug therapy is ineffective, not preferred or not tolerated.
- Non-sustained VT with prior MI, LV dysfunction and inducible VF or VT at electrophysiological study not suppressed by a Class I anti-arrhythmic drug.

##### CLASS II B

- Cardiac arrest presumed to be due to VF when electrophysiological study is precluded by other medical conditions.
- Sustained VT while awaiting cardiac transplantation.
- High risk condition for life-threatening arrhythmias like long QT syndrome or hypertrophic cardiomyopathy.
- Non-sustained VT with coronary artery disease, prior MI, LV dysfunction and inducible VT/VF during electrophysiological study.
- Recurrent syncope of undetermined etiology in presence of ventricular dysfunction and inducible VT at electrophysiological study when other causes of syncope are excluded.

##### CLASS III

- Syncope of undetermined cause in a patient without inducible ventricular tachyarrhythmias.
- Incessant VT or VF.

#### BASIC DESIGN AND FUNCTION

The basic components of the ICD are electronic circuitry, power source and memory with a microprocessor co-ordinating the various parts of the system. High voltage capacitors transform the battery provided voltage into discharges ranging from less than 1 V for pacing to 750 V for defibrillation. The most important function of ICD is to sense ventricular tachyarrhythmias and deliver appropriate therapy. ICD can be programmed to different tachycardia zones like slow VT, fast VT, and VF. Detection criteria and appropriate therapy can be programmed in different tachycardia zones. The initial response to sensing in a slow VT zone will be anti-tachycardia pacing (ATP). If initial ATP (ATP1) is unsuccessful, a second and different ATP therapy (ATP2) is automatically delivered. If this is unsuccessful, low energy cardioversion with synchronized shocks are attempted. Faster ventricular tachycardias and ventricular fibrillation are treated with high energy defibrillation shocks. In addition, ICDs provide anti-bradycardia pacing in single or dual chamber modes like ordinary pacemakers.

#### IMPLANTATION PROCEDURE AND FOLLOW-UP:

Most ICD implantations are done under conscious sedation and local anaesthesia. ICD leads are introduced transvenously through the left sub-clavian vein. The pulse generator is positioned in the left pre-pectoral pocket. During defibrillation threshold (DFT) testing, patient is placed under deep anaesthesia with mask-supported ventilation. An acceptable DFT should be at least 10 Joules less than the maximum output of the device. Aspects of follow-up include history of awareness of tachyarrhythmic events and delivered shocks, device interrogation, assessment of battery status and charge time and retrieval of the stored diagnostic data. Exposure to electromagnetic field can interfere with ICD function and after any known exposure to EMI, ICD should be reinterrogated and reprogrammed if necessary.



# OFF PUMP CORONARY ARTERY BYPASS GRAFTING - OPCAB

**Dr. Murali.P.Vettath. DNB, Mch**  
Chief Cardiac Surgeon

## INTRODUCTION

Over 8,00,000 Coronary Artery Bypass Surgeries are being performed every year worldwide. In India itself, more than 40,000 CABGs are performed every year. The annual perioperative mortality is reported to be 1-2% in almost all the reputed cardiac centers in India and abroad.

## HISTORICAL BACKGROUND

Coronary Artery Bypass Surgeries (CABG) were first performed in the fifties on beating heart, as the heart lung machine was not yet invented. Later, the invention of heart lung machine (HLM) and introduction of Cardiopulmonary Bypass (CPB) revolutionized the concept of Open Heart Surgery (OHS). This provided the surgeon with a bloodless and motionless field for performing surgeries on the heart. With the improvement in techniques of myocardial preservation and modification of oxygenation and HLM, surgeons were able to achieve excellent results.

But in the early nineties few group of surgeons and researchers started performing these surgeries on beating heart, so as to avoid the incremental risk factors associated with the CPB. The research was aimed to avoid the neurological problems associated with it that varied from mild neurocognitive defects to frank stroke seen in 1-2% of patients undergoing CABG on pump. It was thought that the Heart Lung Machine (HLM) was the main culprit which caused this problem. Other complaints like respiratory problem, immunosuppression and injury to the blood products, prompted researchers to press on improving technique to prefer beating heart surgery.

## STABILIZING THE HEART

Octopus is one of the dozen or so stabilizers (instrument used to stabilize the coronary artery to perform anastomosis) now in the market. This is a type of suction stabilizer. This has eight

suckers on its arms, which helps in sucking the heart up and holding that bit of the heart immobile, while grafting the coronary artery. There are other types of stabilizers called compression stabilizers which hold the heart firm, thereby immobilizing that part of heart which remains between the prongs of these stabilizers.



Nowadays, with these stabilizers, surgeons are able to perform coronary anastomosis on the front, behind and the side of the heart.

## POSTIONING THE HEART

To position the heart with its apex up and also to the right, numerous techniques and aids have been developed, thus by applying stitches to the pericardium (covering of the heart) behind the heart and lifting them, the surgeon is able to flip the heart over, so as to access the arteries behind the heart. Along with this, maneuvering the table with a head down position and towards the right brings the coronary arteries directly under vision.

There are also newer 'positioners' called 'Starfish' and 'Xpose' devices, which will again act as suction cups on

the apex of the heart. These also help in tilting the heart, allowing it to contract as usual and maintain haemodynamics.



Thus, with comfortable positioning and stabilizing, all the coronary arteries around the heart can be accessed to perform bypass surgery.

#### MYOCARDIAL PROTECTION IN BEATING HEART SURGERY

Now comes the issue of preventing ischemia (lack of blood supply to a region of the heart), when a coronary artery is snared or blocked while it being operated upon.

Snaring is performed by sutures or by silastic bands, proximal and distal to the proposed site of Arteriotomy (opening to be made on the artery). The snare isolates a segment of artery so that the anastomosis can be performed in a blood-less field. But in critically ischemic areas of the heart, snaring the coronary artery could aggravate ischemia, and cause a compromise in haemodynamics (fall in cardiac output and systemic perfusion). In such circumstances, we use Intracoronary shunts (intraluminal shunts across) or Aorto-Coronary shunts (shunts from the aorta to the distal coronary artery).

These help to maintain haemodynamics and allow surgeons to perform these surgeries with ease.

#### ADVANTAGES OF BEATING HEART SURGERY

In spite of performing surgeries on beating heart, it was found that in some centers, the risk of neurological complications have not come down. It was found that the

risk was high when side clamps were used for proximal anastomosis of vein grafts onto the aorta – dislodging of plaques within the aorta being the major culprit.

Hence the use of Bilateral Internal Mammary arteries and the ‘T’ and the ‘Y’ graft procedures became routine, along with radial arteries for performing Total Arterial Coronary Revascularization (TACR) on beating heart.

Hence it was hypothesized that avoiding Cardiopulmonary Bypass and manipulation of aorta should definitely reduce the incidence of stroke in Coronary Artery Surgeries.

Last year more than 300,000 beating heart surgeries have been performed world wide and India has caught up with it in a big way. Most of the coronary centers perform the coronary surgeries on beating heart. We have also caught up quite well with the bandwagon. As of today we are one of the few centers in India performing almost all our Coronary Artery Bypass Surgeries on beating heart. This has definitely improved our postoperative management in a big way. We are able to extubate patients within six hours if there is no bleeding; mobilize them in 12 hours and discharge them within one week.

The perioperative Myocardial infarction is zero and morbidity is negligible and most of our patients are pain free quite early in their postoperative course. This has helped us in operating on elderly patients, with stroke, with renal and hepatic dysfunction and other blood dyscrasias.

The blood loss and transfusion requirements remain nearly the same in some of the patients. But in majority of the patients we are able to perform surgery without any blood loss at all.

We have now devised and fabricated couple of anastamotic devices for performing proximal anastomosis on the aorta without side clamping. This helps us in performing our top ends on calcified aorta and by not decreasing the systolic pressure.

#### CONCLUSION

Nowadays, OPCAB procedures are performed in almost all specialized cardiac centers in the country with excellent results. Different types of shunts, stabilizers and positioners are flooding the market and making the operating field more and more congenial for surgeons to operate conveniently.



## FAST TRACKING IN CARDIAC SURGERY

**Dr. A.V Kannan. MD, PDCC**  
Chief Cardiac Anaesthesiologist

Cardiac Surgery has had a sea of change during the last two decades. The recent advances in Coronary Artery Surgery have brought a complete change in the type of patients being taken up for surgery. We have been operating on patients with very low LV function, post-infarction angina and very elderly patients with multiple systemic problems.

The latest developments are focusing on decreasing the overall morbidity and reducing the duration of ICU and hospital stay. The most important factor in establishing this is the development of Off Pump Coronary Artery Bypass (OPCAB) surgery where the use of heart-lung machine is avoided. Unlike conventional Coronary Artery Bypass surgery on cardiopulmonary bypass, the Cardiac Anaesthesiologist has to play an active role during the beating heart surgery; he has to be on his toes always anticipating problems and be alert and vigilant to prevent them or treat them as quickly as possible.

### WHAT IS FAST TRACKING?

Following open heart surgeries, usually the patients are mechanically ventilated on the day of surgery and are extubated next day morning. This practice of overnight ventilation is becoming obsolete now. Patients are taken off the ventilator as early as possible after cardiac surgery. This technique of early extubation is called 'Fast Tracking'. Beating heart surgery goes hand in glove with fast tracking. Early extubation and early mobilization helps in faster recovery of the patients following cardiac surgery.

### DEFINITION OF FTCA (FAST TRACK CARDIAC ANAESTHESIA)

"Treatment and anaesthetic technique permitting extubation within six hours after cardiac surgery".

### HISTORY OF CARDIAC ANAESTHESIA

Traditionally, high doses of opioids were used either alone or in combination with sedatives and hypnotics to provide anaesthesia for cardiac surgeries. This resulted in persistence of anaesthesia for longer time and delayed extubation. A longer ventilation time is definitely associated with a higher morbidity. The use of short acting fast emergent anaesthetics avoids prolonged sedation and helps in faster recovery.

To facilitate fast tracking, a wide range of anaesthetic drugs are at the disposal of the cardiac anaesthesiologist in the form of inhalational anaesthetics, intravenous anaesthetics, short acting narcotics and muscle relaxants. The choice of anaesthetic drugs depends on the comfort in usage, familiarity with the drug and personal preference. The speed and skill of the surgeon also plays a vital role in choosing a particular technique.

### RISK FACTORS FOR DELAYED EXTUBATION (FAILURE OF FTCA)

Preoperative factors:

1. Elderly patients (age > 70 years)
2. Female gender

Postoperative factors:

1. Excessive bleeding
2. High inotropic support
3. Arrhythmias
4. IABP (Intra Aortic Balloon Pump)

## FAST TRACKING - OUR EXPERIENCE

In our centre, we analyzed the first 100 patients who underwent open heart surgery in the first 5 months. These include CABGs both on pump and off-pump; valve replacements; ASD closure, etc. The age ranged from 10 to 79 with a mean age of 52 years. Our first patient underwent Coronary Artery Bypass Grafting x 3 grafts on CPB. The surgery lasted for 3 hours. He was extubated 7 hours after arrival in the ICU. Our fast tracking started from the very first day.



## FAST TRACKING - OUR TECHNIQUES

Anaesthesia is induced with Fentanyl, Midazolam and sleeping dose of Thiopentone or Propofol. Pancuronium is our drug of choice for intubation. Anaesthesia is maintained with Propofol infusion supplemented with intermittent doses of Morphine or Fentanyl in one group of patients. The other group received continuous infusions of Fentanyl, Midazolam and Atracurium with intermittent use of Isoflurane.

Propofol infusion or FEMA infusion (Fentanyl, Midazolam and Atracurium) is continued postoperatively in the intensive care unit.



## FAST TRACKING - OUR RESULTS

Propofol infusion is associated with higher incidence of hypotensive episodes compared to FEMA infusion. With FEMA, we are able to obtain stable haemodynamics and also 'lightning-fast' awakening response after stopping sedation. We are able to extubate patients in less than half an hour from the time of stopping FEMA infusion.

The main factors, which delayed extubation in our patients, were haemodynamic instability, arrhythmias, excessive bleeding and surgical re-exploration. The number of patients above 70 years was 10 and the average extubation time was 5.2 hours.

## CONCLUSION

At present, most of the patients who undergo Cardiac Surgery in our unit are fast tracked and they are off the ventilator in 4-6 hrs. They all are fully awake, pain free and do not have residual neuromuscular blockade. With the use of SAFE (short-acting fast emergence) anaesthetics, modern Cardiac Anaesthesia is indeed very SAFE.



# VIDEO ASSISTED THORACOSCOPIC RIGHT ANTERIOR MINI THORACOTOMY FOR CLOSURE OF ATRIAL SEPTAL DEFECT

**Dr. Murali.P.Vettath. DNB, Mch**  
Chief Cardiac Surgeon

Closure of Atrial Septal Defect (ASD) has been performed for the past five decades through conventional midline sternotomy. Since the last two decades, cardiologists have been performing Device closure of ASD with excellent results. If the defect has a good rim, and is of reasonable size, device closure is still the best corrective procedure we can offer to the patients. The only disadvantage is its high cost.

With the advent of minimally invasive cardiac surgery, surgeons have been performing this procedure through thoracotomy - anterior, lateral or posterior, and trying to hide the incision. Though this has produced good results, the postoperative pain due to injury to intercostal nerves has been well documented. Hence we have started using a mini anterior right thoracotomy approach, entering the chest through the fourth intercostal space in the region of costal cartilages. We have performed this on children, and adults- both males and females with excellent results.

## TECHNIQUE

Along a right anterior submammary incision, pleura is entered through the fourth intercostal space and the pericardium is opened. The pericardial stays are cradled in such a way that the heart is pulled to the surface as much as possible.



A femoral arterial cannulation is performed. Separate venacaval cannulation is done. Cardioplegia cannula is inserted into the ascending aorta and normothermic CPB is instituted. Aortic cross clamp is introduced through a stab in the right second intercostal space. RA is opened after warm blood cardioplegic arrest and ASD closure is performed. The patient is weaned off CPB as usual and the chest is closed over two drains and a temporary epicardial ventricular pacing wire. No pericostal sutures need be applied.

## DISCUSSION

Since there are no sutures going through the intercostal spaces and there is no risk of injury to the intercostals nerves, post op pain is negligible in such patients. As the incision is submammary and medial, there is no injury to the breast tissues too and the cosmesis is at its best.



The video assisted thoracoscopy (VAT) device is of help, especially in visualizing the venacavae and the ASD. This procedure is recommended for cosmesis and for fast tracking in cardiac surgery. The patient is mobilized from day one onwards and can be discharged on the fifth postoperative day itself.



## Conquering Restenosis?

**Dr. Ashish**  
Cardiac Surgeon

Restenosis has been the Achilles heel of Coronary Angioplasty. Restenosis rates following Percutaneous Transluminal Coronary Angioplasty (PTCA) reported to be around 40 % were reduced to about 30 % with stents, 10 % with brachytherapy and 0-8 % with drug-eluting stents. The process implicated in the phenomenon of restenosis involves vascular smooth muscle cell activation, migration, and proliferation. The drug-eluting stent has to inhibit this process if it has to be effective.



There are 3 components to a drug-eluting stent system - stent design, pharmacological agent and the carrier. The pharmacologic agents in use include immunosuppressant (Sirolimus or Rapamycin, Tacrolimus), anti-neoplastic agents [Paclitaxel, Actinomycin D] or inhibitors of smooth muscle cell migration [Batimastat\*]. The largest experience is with the Sirolimus- eluting stents. Its advantages are that:

- It is cytostatic and not cytotoxic.
- Diffuses readily across vascular tissue.
- It has a prolonged half-life.
- It inhibits arterial hyperplasia.
- Safe in humans at levels far exceeding the dose delivered from the stent.



RAVEL study using Sirolimus eluting stent [CYPHER Cordis] reported 0 % restenosis rate. While unable to match the perfect restenosis rate of this trial, data from other trials [ELUTES, TAXUS I-IV, DELIVER 1-II, ASPECT] have shown encouraging results with anti-proliferative agent eluting stents.

Concern regarding drug-eluting stents are related to the non-availability of long term results and economic issues; drug-eluting stents at present being at least 3 times as superior as the standard stent. The available evidence looks promising and if the results of RAVEL can be reproduced and maintained long-term, it could mean the 'death of coronary surgery'.





## POSTOPERATIVE PAIN MANAGEMENT FOLLOWING CARDIAC SURGERY

Dr. Abdul Vahab T.T., MD, PDCC

Cardiac Anaesthesiologist

Patients undergoing surgery fear about the pain during the surgery. This pain is well controlled by the anaesthesiologist with the use of potent analgesic drugs. It is the postoperative period in which the patients start experiencing pain. They get the pain relieving medicines from nurses, which are prescribed by doctors, as SOS basis. Many times this leads to inadequate pain relief. Pain after a cardiac surgery has many origins. The surgical incision in the chest and legs, multiple intravascular cannulas in the hand and neck, drainage tubes in the chest, tissue injury caused by diathermy during surgery and the use of sausage under the shoulder along with retraction of chest bones. Even now the management of the postoperative pain is a challenging task for the doctors managing the ICU. We present here the simple and effective regimen used in our cardiac surgical ICU for treating the postoperative pain.

### MATERIALS AND METHODS

All patients who underwent OPCAB (Off Pump Coronary Artery Bypass Grafting surgery) were studied. All of them were premedicated with oral diazepam 10 mg, 2 hours before surgery. The induction of anaesthesia was done with fentanyl, midazolam and thiopentone. Anaesthesia was maintained with continuous intravenous infusion of fentanyl and intermittent isoflurane. All cases were done through median sternotomy incision. The number of grafts ranged from 1 to 5. The average op-

eration time was 3 hr 50 min (range from 1 hr 30 min to 4 hr 30 min). All patients were extubated within 6 hrs after receiving in CSICU. On the day of surgery, after extubation, tramadol 50 mg was given intravenously every 6 hrs.

From 1st postoperative day onwards, all received tablet Tramadol 50 mg and tablet Paracetamol 1gm 6-hrly alternately. The severity of the pain was assessed with a numerical rating scale of 0 to 10, in which 0 represents no pain at all and 10 indicates the worst possible pain. If the patient had a pain score more than 5, either morphine or diclofenac injection was administered.

### RESULTS

Most of our patients had no pain at all or very minimal pain. They were ambulated on the first postoperative day. They were able to carry out their regular activities like walking without any discomfort. Few patients had pain score ranging from 3 to 5, but they did not require any supplemental analgesics. 3 patients had severe pain while coughing, requiring use of injection morphine or diclofenac sodium.

All patients were alert. None of them had significant sedation or respiratory depression. Nausea and vomiting occurred in few patients, which was controlled with anti-emetic injections. Excessive sweating was noticed in some patients. Few patients complained of dizziness. 6 patients had mild elevation in renal function tests which returned to normal values on 5<sup>th</sup> postoperative day. None of the patients had gastritis.

### CONCLUSION

Oral Tramadol and Paracetamol combination is a very effective regimen in controlling the postoperative pain after cardiac surgery. This avoids the complications like respiratory depression associated with narcotic drugs and also the gastro intestinal and nephrotoxic side effects, seen with the use of non steroidal anti-inflammatory drugs (NSAIDs).





## MINIMALLY ASSISTED DIRECT CORONARY ARTERY BYPASS (MADCAB) FOR ISCHAEMIC VENTRICLES

Dr. Baburajan A.K., DNB, Mch  
Cardiac Surgeon

Coronary artery bypass grafting (CABG) on beating heart, a relatively new concept, has come very much into vogue even in this part of the world. Today even multiple revascularizations can be done without stopping the heart. The most important advantages of performing CABG on a beating heart are - avoidance of Cardiopulmonary Bypass (CPB) and Cardioplegic at. Though the deleterious effects produced by exposure of blood to non physiological surfaces, CPB and global ischemia induced by cardioplegia are well known, revascularization without CPB is not always technically feasible, especially in some patients with poor Left Ventricular function, who may not stand the haemodynamic alterations produced during off pump CABG. This led the surgical world to explore an intermediary approach based on maintenance of a beating heart with CPB support but without cross clamping the aorta or arresting the heart. Thus evolved the concept of Minimally Assisted Direct Coronary Artery Bypass (MADCAB) grafting or pump assisted beating heart coronary revascularization procedures which aims at supporting and decompressing the heart while at the same time it avoids the global ischemia induced by cardioplegia.

Various studies have shown that conventional CABG on CPB, under cardioplegic arrest not only triggers a systemic inflammatory response, but also causes direct ischaemic damage to the myocardium. More over the systemic influence of CPB causes coagulopathies and affect multiple organ systems, which prolongs the postoperative recovery of the patient. Thus OPCAB patients are predicted to have lower incidence of arrhythmias, need for transfusion, reduced postoperative ventilation, faster recovery, shorter hospital stay and reduced risk for multiorgan dysfunction. This has been proven by many studies worldwide.

At the same time there are certain limitations for OPCAB procedures. The haemodynamic compromise induced by positioning and stabilizing the heart may not be tolerated well by ischaemic ventricles with poor overall function. Moreover the global ischaemic damage of cardioplegia - however minimal it may be - will only add to the injury in hearts with already compromised LV function. Such patients who have poor LV function and bad coronary anatomy do well with pump assisted beating heart CABG or Minimally Assisted Direct Coronary Artery Bypass (MADCAB).



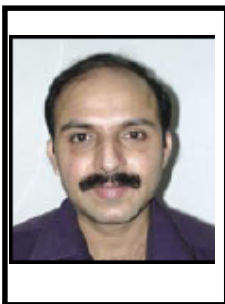
We performed 118 Coronary Artery Bypass surgeries in this new centre since it started functioning 6 months back. 14 (12%) of them were performed on normothermic CPB and warm blood cardioplegic arrest, 64 (54%) OPCAB and 40 (34%) MADCAB procedures. Those patients with poor overall LV function, i.e. LVEF <40% (56 patients - 57.1%) were grouped into 4 as Group I (20 to 25%) - 7 patients (6%), Group II (26 to 30%) - 11 patients (9%), Group III (31 to 35%) - 15 patients (12.7%) & Group IV (36 to 40%) - 23 patients (19%).

All Group I patients, those with ischaemic ventricles, and buried diffusely diseased coronaries were primarily selected for MADCAB (20 cases- 17%). All others were planned for OPCAB, 20 (17%) of which had to be converted to MADCAB. We studied factors like the average time for anastomosis, postoperative bleeding, cardiac enzyme levels, multi-organ function,

postoperative ventilation time, need for inotropes / Intra Aortic Balloon pump support, onset of mobilization, ICU stay, and hospital stay.

We had no operative mortality or stroke. None of our patients required IABP support. Time taken for anastomosis, CPKMB rise & need for inotropes were relatively less on MADCAB - in patients with comparable LV function and coronary anatomy, compared to OPCAB. Bleeding, postoperative ventilation, time for mobilization and ICU stay were comparable. Temporary renal impairment occurred in 2 patients on OPCAB compared to 1 on MADCAB. No difference in the hospital stay between the two groups. There was no neurological deficit in any of our patients.

Thus in select high risk patients with dilated ischemic ventricles and poor LV function Minimally Assisted Direct Coronary Artery Bypass (MADCAB) grafting or pump assisted beating heart coronary revascularization procedures is an acceptable alternative to ward off the detrimental effects of global ischemia induced by cardioplegia and the haemodynamic compromise inducible during OPCAB.



# LEFT VENTRICULAR FREE WALL RUPTURE A unique presentation

**Dr. Dinesh Babu MD, DM**  
Cardiologist

Rupture of the Left Ventricular free wall - one of the mechanical complications of Myocardial Infarction (MI); occurs in about 1% of patients and together with cardiogenic shock accounts for over 20% of early deaths following a first acute MI. We came across a case of sub acute rupture of LV free wall in an old man who has no history of Coronary Artery Disease (CAD).

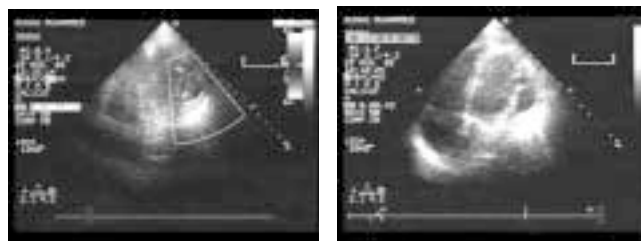
## CASE REPORT

A 70-year-old frail man, was referred to us with history of Transient ischemic attack followed by recurrent episodes of postural giddiness. He had no history of angina/palpitation/dyspnoea on exertion. He was a known diabetic, asthmatic and chronic smoker. On Clinical examination he was found to have a heart rate of 140/min, pulsus paradoxus, BP- 80/systolic, raised JVP with prominent x descent, diminished heart sounds and extensive bilateral rhonchi.

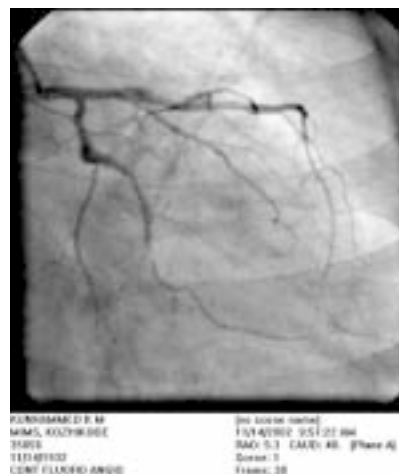
Chest skiagram showed widened mediastinum and transthoracic echocardiography revealed moderate pericardial effusion (15mm) with some strands in the pericardium and diastolic collapse of RA and RV. Cardiac markers (CPK 92 U/l, CKMB 33 U/l and Troponin T positive) and renal parameters were raised.

With a diagnosis of pericardial effusion causing cardiac tamponade, surgical decompression of the pericardium was done through a subxiphoid incision and clots were evacuated from the pericardial cavity. He improved haemodynamically and since there was no evidence of progressive bleeding, the wound was closed over a pericardial drain. He improved dramatically. Bedside echo done on the first postoperative day revealed a LV pseudo aneurysm, arising from the lateral wall of the LV, nearer to the apex. LV function was good. In view of his general condition he was managed conservatively

after informing the relatives about the disease process, its natural history and the various treatment options available. He was discharged in good health.

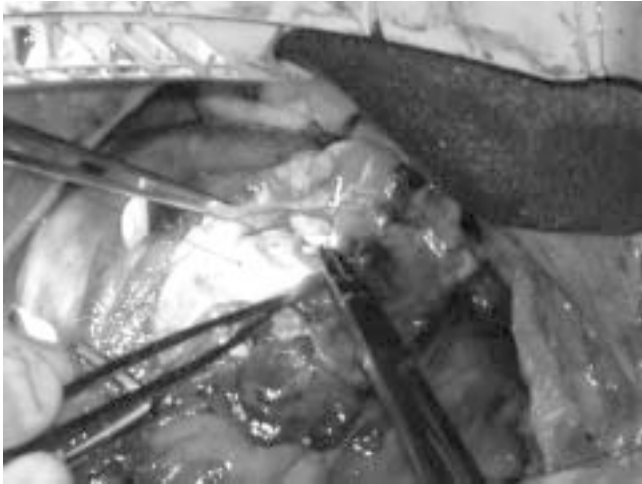


He was readmitted after a period of two months with history of chest pain and vomiting. He was having tachycardia and his BP was low. He had no ECG changes or cardiac markers suggestive of ischemia or infarction. Enlargement of the pseudo aneurysm cavity was evident on echocardiography. Coronary angiogram with LV angio was done and he was found to have a solitary critically stenotic lesion in his marginal circumflex which was a 1.5 mm vessel. LV angio revealed a narrow outlet from the LV, with faint filling of the pseudo aneurysm cavity.

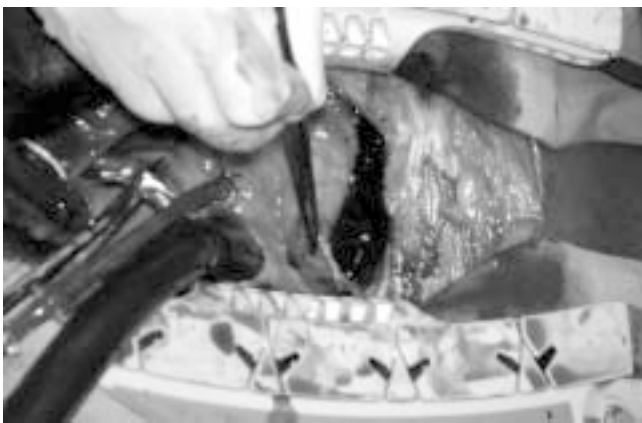


He was prepared for CABG+ LV pseudo aneurysm repair. Under general anesthesia, with the pump set ready for an emergency femoro-femoral CPB, Median sternotomy was done. Pericardium was opened and normothermic CPB instituted via aortic and two stage venous

A clot filled cavity was found under the diaphragmatic surface of the heart, extending laterally towards the apex. Clots were slowly evacuated.



The apex was slowly mobilized after warm blood cardioplegic arrest. There was a narrow fibrotic slit like opening on the lateral wall of the LV. The same was closed with Teflon pledgetted interrupted mattress sutures. Approximating the walls of the pseudo aneurysm over it reinforced the suture line. Since the marginal circumflex was on the wall of the pseudoaneurysm, no grafting was done.



The patient had an uneventful stay in the hospital and he made a speedy recovery. He was discharged in good health on the seventh postoperative day. He has been followed up twice and is keeping good health. His Echo revealed Good LV function, normal valves and no pericardial effusion. This case is being presented to highlight the occurrence of a dreaded complication like LV free wall rupture following acute MI affecting a relatively small vessel and the dramatic improvement, patients may have with conservative management of the acute problem.

## DISCUSSION

Left Ventricular free wall ruptures after myocardial infarction occur more commonly than, ventricular septal ruptures. Acute ruptures rarely survive to reach the hospital. SubAcute ruptures present with tamponade and Chronic ruptures present with pseudo aneurysm of the left ventricle.

Though early thrombolysis has considerably reduced the incidence of these complications, occasional cases are still reported. Lateral wall infarctions are more prone for rupture than anterior or inferior wall infarctions. Elderly females are at a higher risk, so are hypertensives.

Subacute rupture accounts for 20 to 40% of LV free wall ruptures. Pseudo aneurysm is rare and has a very high risk of rupture. Early diagnosis and prompt surgical repair holds the key to survival. Patients may do well with conservative management, but definitive surgical repair is a must. The various surgical techniques described include (i) Simple pledgetted suture closure of a fibrotic neck, (ii) Interrupted suture closure, reinforced by an onlay patch, (iii) Excision of the infarct and endoventricular patch closure - for recent infarctions with friable margins and (iv) Sutureless technique - patch and glue repair.

Early diagnosis and prompt surgical management alleviates the risk of sudden death.

Those who survive the surgery tend to do well thereafter.



## MAMMARY PATCH ANGIOPLASTY OF DIFFUSELY DISEASED LAD, WITHOUT ENDARTERECTOMY, ON BEATING HEART - OUR EXPERIENCE

Dr. Sheen Peeceeyen C.S., MS, MCh.  
Cardiac Surgeon

Coronary Artery Bypass Grafting (CABG) Surgery has undoubtedly shown to improve the quality of life, and to increase the life expectancy (Myers 1989). Left Internal Mammary Artery (LIMA) to Left Anterior Descending artery (LAD) grafts have shown to remain patent in 96 to 97% of patients at 20 years. This improves the long-term survival of the patient and reduces the incidence of repeat procedures and subsequent cardiac events (Lytle 1985, Loop 1986, Cameron 1996 and Okies 1984). But in our Southeast Asian population (like in India and Bangladesh) where, severe diffuse coronary artery disease is more prevalent, conventional CABG with vein grafts or mammary artery are not usually feasible. Our technique of mammary patch angioplasty has offered us gratifying results.

Coronary artery bypass grafting associated with open endarterectomy and venous patch angioplasty has been described (Brenowitz JB 1988, Goldstein J 1991, Sommerhaug RG 1990). Coronary artery endarterectomy for extensive coronary disease, on CPB has also been described (Barra 2000).

In our technique of mammary patch angioplasty, no endarterectomy is performed whatsoever. As LIMA is the only vessel, which has proved to achieve long-term patency, we have been performing this routinely for diffusely diseased LADs. Our aim is to revascularise all the perforators and the branches along the whole length of the LAD if possible, thereby maintaining the vascularity of the septum and the anterior wall of the left ventricle.

### SURGICAL TECHNIQUE

We perform this mammary patch angioplasty only on

the LAD, as we consider that the LAD is the most important of the coronary arteries, and apart from Posterior Descending Artery (PDA), all other arteries are end arteries. We usually perform our beating heart surgery using the Axios Guidant Stabilizer or Octopus Stabilizer. LIMA is usually dissected as a pedicle graft and the dissection extends beyond the bifurcation if necessary, in order to gain extra length. LAD arteriotomy is extended distally till a plaque free area is reached. Occasionally, if the arteriotomy is longer and the stabilizer is not able to stabilize the whole length, then another Stabilizer is positioned on the proximal LAD, as shown in (Fig 2). This has made surgery easier by stabilizing the whole LAD and still maintaining good haemodynamics.



In patients with LAD dependent circulation, we use Aortocoronary shunts fabricated by us, as shown in (Fig 11). In patients with proximal left main stenosis, we have used two shunts, one to perfuse the proximal and another to perfuse the distal LAD. The LIMA split longitudinally is now anastomosed end to side to the LAD using a 7.0 prolene suture. We do not perform endarterectomy or exclude the atheromatous plaques from the anastomosis. We see to it that all the plaques are



plastered to the wall of the LAD. If we find no perforators from the mid LAD region on a coronary angiogram, then we opt not to perform this patch angioplasty.

90% of our decisions to perform patch angioplasty are made before surgery itself based on coronary angiogram. Only 10% are made on the table. We were able to perform this procedure off pump in 52 of our 78 patients with diffuse disease. Sixteen of them had to be performed as pump-assisted beating heart procedures. In our early days, 10 of our patients had this procedure performed on normothermic Cardiopulmonary Bypass (CPB), under warm blood cardioplegic arrest.

## RESULTS

We have performed more than 400 beating heart procedures so far in the last four years. 78 of them had diffusely diseased coronaries and had mammary patch angioplasty done. 52 of these were performed off pump. The mean age of the patients who underwent this procedure was 42 years. There were no unusual risk factors in these patients. Their coronary artery diameters varied from 1 to 2 mm. 50% of all our coronary artery patients had a very strong family history. Obesity was seen only in less than 5% of these patients. 75% of them were diabetic. 26% of these patients had history of recent MI. More than 50% of this group of patients had been referred to our center after being termed, inoperable, due to the diffuse nature of the disease. 80% of these patients had an EF more than 40%.

All of the 78 patients had LIMA to LAD as the principal graft. 5 patients had Right internal mammary artery (RIMA) to Right coronary artery (RCA) and 8 patients had saphenous vein graft on Marginal Circumflex in addition to LAD graft. The mean length of the arteriotomy was 3.2 cms. No Intra aortic Balloon Pump (IABP) had to be used in any patients. ECG and Echo done during follow up of these patients showed improved LV function. 30% of them underwent Treadmill test after 6 months, and were found to have no signs of provokable ischaemia. There was no incidence of stroke, mediastinal or sternal wound infections in this group.

## DISCUSSION

The alarming number of diffusely diseased coronary arteries and the gratifying results from the technique adopted by us to treat this successfully, prompted us to bring this to light. Unlike in the West, in our region, even the lower middle class people are prone to this type of disease. Sedentary work, food habits, diabetes and smoking adds to it. Since majority of patients with this disease pattern fall in the forties, the overall implication of this on the society is enormous. Hence, if we are able to standardize this procedure, we might be able to provide these patients with a better quality of life. Barra et al has shown that the patency of internal mammary artery (IMA) grafts on diffusely diseased coronaries in their series were similar to that of those on non-diffuse coronary artery lesions (Zeff RH 1988, Cosgrave 1986).

Our technique of using aortocoronary shunts has made it possible for us to perform these procedures on beating heart, off pump even in cases which otherwise may have OPCAB (Off Pump Coronary Artery Bypass) induced haemodynamic compromise. By avoiding endarterectomy, there is no disruption of the intimal lining and hence there is no new nidus for intraluminal thrombus formation or intimal hyperplasia, which may affect the long term patency. We are happy that our results have so far been good in terms of absence of recurrent symptoms or readmissions for cardiac related events.

# CARDIAC REHABILITATION

Sunitha

The emotional and psychological trauma of the patients who have heart disease and their families is immense. Cardiac rehabilitation programme is aimed at people who are under evaluation or diagnosed to have heart disease and patients who require further interventional procedures like Coronary Angioplasty, Coronary Artery Bypass Surgeries etc., for management of their cardiac problem. The rehabilitation team which involves the doctors, the physiotherapists, the dietician and the cardiac rehabilitation nurses work hand in hand in preparing the patient and the family towards a smooth recovery.

## PRE-OPERATIVE COUNSELLING

The patient gets admitted two days prior to surgery. During this time, the team develops a good rapport with the patient and makes them feel at ease. Apart from the various investigations, the patients and their families are counselled about the various events involved during and after the surgery. The patients are told about their stay in the Cardiac Surgical Intensive Care Unit (CSICU) during the immediate postoperative days. They are educated about being ventilated, the need for mechanical ventilation and how they would feel when they first wake up after surgery. They are also educated about the presence of the endotracheal tube in their mouth and that they would be unable to speak as long as they are ventilated. To get them familiar with the ICU set up they are shown the CSICU and the equipments that are used there. They get to know that these gadgets, which are used to monitor them, may sound alarms and may sound rather “noisy” in the beginning. They get an opportunity to meet the CSICU staff who would be with them during their ICU stay. The pre operative anaesthetic check up is done. The patients are taught breathing exercises and incentive spirometry pre-operatively to familiarize them so as to enable them to perform these exercises without difficulty after surgery. The incentive spirometry helps the patients to expand their

lungs effectively post operatively.

The advantage of pre-operative counselling and patient education is evident when patients are taken for emergency surgery directly from the catheterization lab giving almost no time for any pre-operative mental preparation. After the surgery such patients are confused and have whatsoever no idea as to what is happening around them. This decreases the patient’s cooperation towards his speedy recovery.

## EARLY MOBILISATION

As all CABG’s are being performed here on beating heart, it enables a faster extubation and post-operative recovery. This makes early mobilization possible as com-



pared to the conventional CABG so much so that the patients are capable of walking to the toilet independently on the 1<sup>st</sup> postoperative day itself. In the CSICU, patients are taught active exercises of the major joints in lying and sitting positions. Exercises of the major joints are done passively on patients who are unable to perform them on their own.

#### POST-OPERATIVE COUNSELLING



Usually the patients who get admitted for a bypass surgery have little knowledge about what Coronary Artery Disease is and the risk factors that are involved. Each patient is assessed about both modifiable and non modifiable risk factors which could have lead to Coronary Artery Disease. In our post-operative counselling session we educate the patient about basic life style changes in the modifiable factors that could make a world of difference. Now, let us see what these modifiable factors are and how they can be modified.

#### DIET

The dietician prescribes a heart healthy diet, which includes lots of fresh vegetables, fruits, and milk in moderate quantities and very less fat. The Body Mass Index of each patient is calculated and if necessary advise on weight reduction is made. The waist: hip ratio is another indicator of excessive fat in the body. A ratio of 0.85 and below in women and 0.9 and below in men is generally considered ideal.

#### STRESS

Along with the above, the patients are taught about how “stress” is a major risk factor. By stress we do not mean only the “bad” things in life. Any change in life is stress. It is “eustress” when it is a “good” change, take for instance getting a new job. It is called “distress” when it is a bad change like falling ill, or the death of a loved one. We have two systems called the “sympathetic and the “para sympathetic”. The sympathetic system gets activated when we are in “stress” like in a flight or fight situation. Research studies say that the increase in heart disease in the modern day is due to the fact that there is more of sympathetic activity involved in today’s life style. Let us consider the sympathetic system as “red” and the para sympathetic as “blue”. The more of red means danger and unfortunately unlike other factors like the blood pressure and the level of sugar in the blood, the amount of stress is not measurable. The best way out is to realize for ourselves that we are under stress and find means of getting out of it. The relaxation techniques, which we teach our patients, are breathing exercises, meditation and visualization.

The importance of deep diaphragmatic breathing exercises, which are taught pre operatively, is taught as a way of relaxation. Then comes, meditation. Many of our patients ask us that they say their prayers regularly and hence is it really necessary to meditate? The answer is a big “YES”. We communicate to God when we pray, while meditation is entirely different and leads to total relaxation. Our brain waves reach the “alpha” state in meditation, which is not achieved even in deep sleep.

All of us get a nice feeling when we look at our old photographs, good scenery pictures and the children playing in groups happily, don’t we? This is exactly what we tell our patients when we talk about visualization. Every individual has his own choice as to what he would visualize. The success lies in conveying the importance of these relaxation techniques. We tell our patients if you want the best outcome of this session, realize that you need to “depress” yourself when you aim to achieve a healthy heart.

## EXERCISES



The patients are taught exercises of all major joints, which are called the Range of Motion exercises and are, advised to continue the same at home. These exercises help to prevent joint stiffness, alleviate pain and create a sense of well being in the patient. The main emphasis is on regular walking and increasing the pace and distance gradually. Usually on the day of discharge, the patients walk up one flight of stairs comfortably. By the end of three months they are encouraged to jog.

After surgery it usually takes approximately 4 weeks before normal sexual activity can be resumed comfortably. We advise our patients to initially find a position that does not put undue pressure on the breastbone. It has been calculated that sexual intercourse involves the same degree of activity as climbing 2 flights of stairs.

## ATTITUDE

The other factor is “right attitude”. We do not tell our patients the standard phrase “Worrying is bad for the heart”. The idea, which we impart, is “stress” is a part and parcel of life. If you are leading a “normal” life, you are very likely to be under stress. One must realise this basic truth and choose one’s own destressors.

## MOTIVATION

Last but not the least is being correctly “motivated”. Over motivation is one thing, which patients can easily develop when they get too enthusiastic. Under motivation is mostly seen in depressed patients. We teach that neither under motivation nor over motivation is good. Correct motivation goes a long way towards the overall success of our rehabilitation programme.

## CONCLUSION

From the time of admission each patient is given individual care in assessment of risk factors, pre operative counseling, and recovery after surgery. By the end of the post operative counseling session the patients and their families are educated about the right methods of managing heart disease. The patients are made to feel at ease to enable them to talk freely, clear all their doubts about heart disease and its management with any member of the rehabilitation team. Although each member of the team has their specific role in caring for the patient, we work in unison where each one contributes their best.