

Commentary

Evolution of Surgical Coronary Revascularization

Sanjeeth Peter*

*Cardiovascular Surgeon, DDMM Heart Institute, Nadiad, Gujarat, India.



Dr. Sanjeeth Peter is the Director and Chief of Cardiovascular Surgery at Dharmasinh Desai Memorial Methodist Heart Institute Nadiad, Gujarat. He qualified from the Christian Medical College, Vellore in 1996 and was awarded the Dr MGR Medical University gold medal. He worked as a Fellow at the Royal Melbourne Hospital, Australia, training in arterial revascularisation. He has since pursued total arterial revascularisation, use of bilateral radial arteries, off-pump CABG, high risk CABGs and has a sizeable experience with ESRD patients awaiting renal transplant. His areas of interest also include aortic surgery, valve repairs and minimally invasive surgeries.

Corresponding author - Sanjeeth Peter (director@ddmmheart.org)

Chettinad Health City Medical Journal 2015; 4(1): 2 - 5

Introduction

A heart attack in the 1950s was like a death warrant¹. Those who reached the hospital alive would be sentenced by the physician to be confined to bed for six weeks or longer and in spite of this 'treatment', nearly a third succumbed. Such devastating effects of Coronary artery disease stimulated physicians to look frantically for treatment. It was a challenging time for clinicians investigating treatment options for Angina Pectoris. Armed only with Electro Cardiograms - ECGs (recorded painstakingly on a drum or photographically to be developed in a dark room), the journey to understand the pathophysiology of Coronary Artery Disease and its treatment had just begun - with no Coronary Care Units, no echocardiography, no biological markers, no nuclear imaging, but just an infectious passion to contain the dreaded killer¹.

The pioneering work of Dr. Mason Sones in delineating the 'block' in epicardial coronary vessels through cine angiographies suggested that restoring blood supply to the affected territories would help. The routine use of the heart lung machine after Dr. John Gibbon corrected a congenital defect on 22 March 1955, gave surgeons the confidence to get involved in the search for treatment of a heart attack, a field monopolized hitherto only by physicians. Different surgical strategies were tried - endarterectomy, vein patch plasty and sutureless grafts to name a few. It was finally on 25 February 1964, that Dr. Vasilii Kolesov successfully anastomosed the Left Internal Mammary Artery to a coronary artery with fine sutures, effectively bypassing the coronary block - a technique that has been the mainstay of surgical coronary revascularization even today. This surgery has since been known as the Coronary Artery bypass Graft Surgery (CABG). The reversed saphenous vein, introduced as a conduit soon after, became the preferred choice due to the ease of harvesting. Thus Surgical Coronary Revascularization revolutionized treatment for Coronary Artery Disease^{2,3,4}. A new era in healthcare had begun.

With the tremendous success of CABG surgery in other countries, Indian surgeons who had trained in centers where this surgery was performed wondered about its feasibility in India. So, 11 years after Dr. Kolesov performed the historic surgery, India witnessed the first successful CABG by Dr. KM Cherian at Railway Hospital, Chennai in 1975. By the early 1980s, coronary

surgery was being performed in a handful of centers in Chennai, Mumbai, Delhi and Vellore (Table 1).

Corporatization of CABG

The burden of Rheumatic Heart Disease and Congenital Heart Diseases was so huge that CABG in teaching hospitals was not a priority. By the late 1980s many surgeons had returned from training abroad and most were absorbed into the private health care system with better infrastructure and remuneration. It was believed that coronary artery disease affects the more affluent strata of society, who could also afford the treatment. With this mindset, CABG was regarded as an 'elitist' operation.

This was not without reason. The 'corporatization' of CABG began with the establishment of the Apollo Hospital, Chennai in 1984 and the Escorts Hospital, Delhi in 1988. Mumbai became the hub of multispecialty private hospitals like Bombay Hospital, Breach Candy and Jaslok which catered to those who could afford this expensive surgery. Though a few teaching hospitals offered CABG, the vast majority of these surgeries were done in the private hospitals - using only reversed saphenous vein grafts for all the coronary vessels.

Many cardiac centers opened in the 90s and CABG surgery was being performed more frequently. Better infrastructure even in small centers lead to a boom in availability of tertiary care in the country. Considering it to be a matter of prestige, hospitals vied with each other to offer CABG surgery. Long term results of the CABG surgery indicated that the Left Internal Mammary Artery (LIMA) used on the Left Anterior Descending (LAD) artery was better in every way. By mid 1990, the standard surgery for Coronary Revascularization was the LIMA to the LAD and reversed saphenous vein as aorto-coronary grafts to the other vessels^{5,6}.

Sharing space

The 1990s witnessed an increase in the number of fixed cath labs from around 50 to nearly 150. As multiple imaging modalities became the mainstay in the diagnosis of structural heart disease, this meant more coronary imaging. A proliferation of ICUs ensured better care for patients of coronary disease with coronary angiography as an essential component. Importantly, it also

translated to an increase in patients referred for coronary surgeries. By the mid '90s, about 10,000 CABGs were performed in India annually. The accompanying dramatic rise in percutaneous coronary interventions in India prompted the National Intervention Council to maintain a national database of procedures.

Arterial Grafting

The global thrust on Arterial Revascularization at the turn of the century resulting from the knowledge of poor longevity of venous grafts was not lost on Indian surgeons. With better patency rates, this seemed to be the perfect answer to the younger Indian patients with limited resources looking for a 'one-time' solution of their coronary blockages. Encouraged by the long term results of the radial artery, a few surgeons started its routine use, in addition to the LIMA. The reported dismal patency of the radial artery forced a slump in its usage, but once it was clear that handling of the arterial conduit during harvesting, storage and deployment contributed to its behavior, there has been a resurgence in its use. There was a greater interest in 'Total Arterial Revascularization' (TAR) by the early part of the first decade of the new millennium. TAR was possible in most if not all of the patients, using limited arterial conduits by employing different strategies. Sequential anastomoses and pedicled grafts like the 'Y' graft – LIMA – RIMA, LIMA- Radial and the use of bilateral radial arteries became popular. The 'Y' graft also meant no manipulation of the aorta – a sound strategy to avoid neurological complications. Surgeons across the country started to use more arterial conduits.

Beating Heart Era

The first CABG performed by Dr. Kolesov was in fact on a beating heart without stabilizers. But the introduction of Cardiopulmonary Bypass and the still, bloodless field it provided, pushed beating heart surgery to the backburner. Though its revival began in the early 1970s, 'beating heart' CABG was done for the first time in India in 1992. The advent of stabilizing devices by the late 90s made it easier and 'Off Pump Coronary Artery Bypass' (OPCAB) caught the imagination of skilled Indian surgeons. Initially only the LAD, being anterior, was being grafted on a beating heart. With better techniques and an understanding of the need to position the heart differently before stabilizing it for anastomoses on other territories, multi vessel OPCAB gained more acceptance. It resulted in shorter ICU stay and promised to be more economical – important attributes in a resource-constrained country. A variety of stabilizers, intra coronary shunts and devices to assist proximal anastomoses helped the rapid rise in OPCAB procedures. It is estimated that now, more than 60% of the CABGs done in India are done on a beating heart. However, a note of caution has been expressed due to the recent discouraging reports of OPCAB and Indian surgeons need to justify this practice.

With the turn of the century, the dominance of surgeons as the main custodians of coronary revascularization also changed. More than 400 cath labs were installed by 2005 in India. Angiographies were being done on many more patients – even on those who

would have earlier been considered high risk. With tremendous improvement in imaging and hardware, Coronary Angioplasties with mainly Drug Eluting Stents were being performed on almost all types of lesions such as triple vessel, chronic total occlusions and left main disease. This change in the practice of Interventional Cardiology meant that mainly high risk patients were being referred for CABG – those with severe diffuse disease, with left ventricular dysfunction and with calcific vessels. OPCAB was logically a good option for these patients as it would avoid the deleterious effects of Cardio Pulmonary bypass. As experience with off pump techniques grew, results of OPCAB in patients with low ejection fraction, chronic kidney disease of various grades and even those with left main disease got better with each passing day.

Minimally Invasive Surgery

The Indian surgeon is restless! On the heels of beating heart surgery were further improvements. The natural progression seemed to be minimally invasive surgeries. So, 2 years after the introduction of OPCAB surgery, 'Minimally Invasive Direct Coronary Artery Bypass' (MIDCAB) involving the LIMA graft to the LAD through a left anterior thoracotomy in the 4th Inter Costal space, was done by Dr. Vivek Jawli in 1994. Preserving the shoulder girdle with a partial sternotomy has also been described, especially in obese patients. There is now a keen interest on sternal sparing surgeries spurred on by the success of minimally invasive surgery in multivessel disease. With better technology evolving for imaging and instrumentation, it promises to be the future of CABG.

Innovations in CABG surgery extended to harvesting techniques. Endoscopic vein harvesting avoids long scars on the legs especially in diabetics who have problems with wound healing. The radial artery has been harvested through a small incision with the use of a harmonic scalpel. Robotic coronary surgery has also been introduced in India, but its widespread use will be possible only when it makes better economic sense.

The unique Indian patient

Indian patients have smaller vessels with a more aggressive disease pattern. Hence endarterectomy was added to the armamentarium quite early in the Indian experience. Multiple skip grafts on the LAD to tackle such a diffuse disease has been advocated with good results. It must be noted that only minority of patients presenting for CABG are women. With smaller, fragile vessels and more comorbidities, they pose a challenge to the surgeon resulting in higher morbidity and mortality.

CABG for the masses

Coronary Artery Disease in India is of epidemic proportions. People of all strata of society – the rich, middle class and the poor are affected. It is alarming to note that younger patients, invariably the breadwinners suffer and unfortunately treatment costs cripple the family. Charitable hospitals offering free or subsidized treatment for such patients are few and not adequate for the vast majority of those afflicted. Fortunately this

is also changing. Government 'insurance' schemes and microfinancing schemes have been launched which make cardiac surgery – especially the much needed but expensive CABG surgery available to the masses. Over the last few years several state governments have made it possible for needy patients to undergo such treatment even in private hospitals. Reimbursements and insurance holders are on the rise and by keeping costs low, surgical revascularization has reached rural India. It is disturbing to note that there is widespread use of 'referral fees'. While trying to involve the primary medical practitioner, this route of questionable ethics, leads to the treatment becoming more expensive and threatens to derail the process of making tertiary cardiac care available to every Indian.

Future of CABG in India

Often patients presenting today for surgical coronary revascularization have already undergone a percutaneous procedure or have severe multi vessel disease. The challenge in today's times is to ensure that the overall morbidity and mortality of this surgery remains low with long lasting benefits in spite of sicker patients.

Surgical revascularization using the LIMA to the LAD has stood the test of time and is the gold standard of treatment for CAD. With an aging population and the high percentage of diabetics, the number of patients requiring CABG is escalating.

Because of the lack of a central surgical database, CABG numbers in the country and the pattern of its

practice are just estimates. It is believed that about 85,000 CABGs were performed in 2012, 92,000 in 2013 and more than 1,00,000 patients have undergone CABG in 2014. In comparison, Angioplasties saw a meteorological increase, nearly doubling, from 1,17,420 in 2010 to 2,16,817 in 2013, a growth of 23% . With around 2,48,000 angioplasties in 2014, the growth has now been pegged at 14%. Reading deeper into these statistics raises the question whether all options are presented to the patient at the time of treatment⁸.

Being the first point of contact to the patient, the primary physician and the cardiologist are the ones to recommend the treatment plan. Realizing that this is not an optimal practice, a 'heart team' approach has been emphasized the world over to ensure that the patient gets the best possible treatment – including the option of a hybrid procedure. It is in the interest of the medical fraternity in India to implement this expeditiously.

Surgical revascularization in India is practiced very differently from the west. Indian surgeons work with a difficult subset of patients and use beating heart techniques with arterial grafts. There has been a rise in the number of surgeries and the knowledge that these surgeons have to offer is immense. Establishing a national database is of paramount importance to start the process of analyzing this experience. Though India has lagged behind the West by about 10 years at the start of this era, there is no time lag today and in fact India has the potential to be in the lead.

Table 1 - Notable contributors to the evolution of CABG in India

K M Cherian	First CABG in India, Endarterectomy, OPCAB
Sharad Pandey	CABG in Mumbai
G B Parulkar	CABG in Government Teaching hospital (Mumbai)
P S Jairaj	CABG in Teaching Hospital (Vellore)
M R Girinath	CABG in corporate, Use of LIMA, Endarterectomy
P Venugopal	CABG in teaching Hospital, OPCAB, High risk CABG
S S Bhattacharya	TAR, LIMA-RIMA 'Y', OPCAB, High risk CABG, Endarterectomy, Re-do CABG
Naresh Trehan	CABG in Corporate, Arterial grafts, High Risk CABG, OPCAB, Minimally invasive, Robotic, Endoscopic
Vivek Jawli	1 st OPCAB in India, 1 st MIDCAB in India, LIMA-Radial 'Y', Arterial grafts, 1 st Awake CABG,
V V Bashi	BIMA use, OPCAB, High Risk CABG
Ramakant Panda	Radial artery use, TAR, OPCAB, High risk CABG, Re-do CABG
Devi Prasad Shetty	Insurance Microfinancing schemes, CABG to the masses, OPCAB, High Risk CABG
Yugal Mishra	OPCAB, Minimally Invasive, Arterial grafts, High Risk CABG, Robotic, Sternal sparing OPCAB
A Bhan	OPCAB, Radial artery use
Janardhan Reddy	OPCAB, partial sternotomy
Lokeshwar Rao Sajja	OPCAB, Bilateral MA, Radial Artery, CABG research
A. Gokhale	OPCAB, Sternal sparing CABG
T. Roy Chaudhary	OPCAB, Sternal sparing CABG
Murali Vettath	OPCAB, Proximal anastomotic obturator
Sanjeeth Peter	TAR, BIMA, Bilateral Radial use, OPCAB, High Risk CABG,

Surgical Coronary Revascularization - at a turning point

CABG with arterial grafts has gained popularity and will be the mainstay of treatment for multivessel and complex coronary artery disease. To stay relevant and be the treatment of choice, surgeons have to ensure that in addition to providing long term benefits, the technique of surgical revascularization is associated with a short period of recuperation thus allowing patients to return to regular work quickly.

We are at the cross roads of Surgical Coronary Revascularization. The path we choose will shape the future not just of coronary revascularization, but also of the specialty. This has the ability to rekindle the waning interest among young surgeons. Focusing on (i) sternal sparing arterial revascularization with fast recuperation and minimal morbidity, (ii) joining hands to form a heart team and (iii) establishing an accurate real time database is the route to take. With this, Indian surgeons are capable of being at the forefront of coronary revascularization in research, technique and training. The journey of Surgical Coronary Revascularization promises to be challenging, thrilling and rewarding.

References

- 1) Julian D. The forgotten past: the practice of cardiology in the 1950s and now. *European Heart Journal* 2000; 21; 1277-1280
- 2) Stuart J Head, Teresa M Kieser, Volkmar Falk, Hans A Huysmans, A Pieter Kappetien. Coronary Artery bypass Grafting –Part I, the evolution over the first 50 years. *European Heart Journal*. 2013; 34; 2862-2872
- 3) James J Livesay; Reflections in the history of coronary surgery; *Texas Heart Institute Journal*; 2004;31(3):208-209
- 4) Rene G Favalaro. Landmarks in the development of Coronary Artery Bypass Surgery. *Circulation* 1998; 98;466-478
- 5) Upendra Kaul, Vineet Bhatia. Perspective on Coronary Interventions and Cardiac Surgeries in India. *Indian Journal of Medical Research*. 132; November 2010; 132:543-548
- 6) Padmavati S. Development of Cardiothoracic Surgery in India. *Indian Journal of Thoracic and Cardiovascular Surgery*. 2004; 20: 50-52
- 7) G B Parulkar. Landmarks and progress of Cardiac Surgery in India (1952-2003). *Souvenir 50th Annual Conference of IACTS* 2004: 19-37
- 8) Data of the National Intervention Council of India; nicregistry.org/data/2013

Women and Alzheimer's

Nearly two-thirds of persons with Alzheimer's disease are women. The usual explanation given is that the women on an average live 4-5 years longer; this longevity predisposes them to pre-senile dementia. Although age is considered to be the single most important risk factor, other as yet undefined factors may be at play. A recent estimate suggests that at the age of 65, a woman has 1 in 6 chance of developing Alzheimer's during the rest of her life; while in man that risk is 1 in 11!. Besides, after Alzheimer sets in, it progresses much faster in women than in men. But gene research provides most compelling evidence of a sex difference. Researchers from Stanford University analysed the gene associated with increased risk for Alzheimer's - ApoE-4 - in 8000 individuals. In women, this gene doubled the risk while in men, the increase in risk was only marginal. The increased susceptibility of women may be related to the nature of interaction of this gene with oestrogen.

- Dr. K. Ramesh Rao