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Volume 1
Volume 2

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2 CHAPTER

Development of Interventional Cardiology: Indian Perspective

MJ Gandhi

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INTRODUCTION

It was in 1844, French physiologist Bernard coined the term cardiac catheterization and used catheters to record intracardiac pressures in animals. Prior to that in 1711, Hales conducted first cardiac catheterization of a horse using brass pipes, a glass tube and trachea of a goose. However, the first human cardiac catheterization was performed by Dr Warner Forssmann on himself, in Eberswalde, Germany in 1929. Cournand and Richards employ cardiac catheter as a diagnostic tool for the first time in 1941 to measure cardiac output. All three received Nobel Prize in 1956, where in acceptance speech, Cournand mentioned—"The cardiac catheter was the key in the lock".[1,2] Cardiac cath labs were established in early fifties at Christian Medical College (Vellore), AllMS (New Delhi) and KEM Hospital (Mumbai).

In coronary artery disease (CAD), Pandora's box was opened by Mason who introduced the diagnostic coronary angiogram in 1958. This was merely an accident, when catheter entered coronary artery while doing aortic angio. Subsequently, with the introduction of Judkin's technic in 1967, coronary angiography became an easy procedure.

Even though the concept of remodeling of the artery by transluminal angioplasty was introduced by Charles T Dotter way back in 1964, the credit for coronary angioplasty goes to Andreas Gruentzig. He performed first peripheral human balloon angioplasty in 1974. In 1976, he presented animal studies of coronary angioplasty at American Heart Association meeting. In 1977, the first human coronary balloon angioplasty was performed intraoperatively by Gruentzig, Myler and Hanna in San Francisco. In the same year, the first cath lab percutaneous transluminal coronary angioplasty (PTCA) was done on awake patient in Zurich. The era of coronary angioplasty had just begun, subsequently the field has exploded worldwide with development by John Simson over the wire coaxial balloon system (1982), coronary atherectomy device (1986), coronary wall stent in Toulose, France, by Jacques Paul and Ulrich Sigwart (1986), Palmas-Schatz stent (1994) and the first Drug eluting stent in 2003. The saga continues.

In India, first coronary angiogram was done by MJ Gandhi and DB Pahlajani at Nanavati Superspeciality Hospital, Mumbai, in 1975. But the first coronary angioplasty was performed on left anterior descending artery on 5th February, 1985 at Breach Candy Hospital, Mumbai, by Dev Pahlajani and Vidya Banka from USA. This was incidentally the year of loss as the world lost Ditter, Jarkins and Gruentzig all interventional stalwarts. Subsequently, Manchanda at AllMS (New Delhi), Soma Raju at Nizam's Institute at Hyderabad and Mathews at Chennai soon followed. Intracoronary urokinase and primary angioplasty in acute myocardial infraction was started in 1980s by MJ Gandhi, AB Mehta and DB Pahlajani at LTMG Hospital and Medical College. Two years later, first PTCA registry meeting was held at PD Hinduja Hospital, Mumbai, by Mathew, AB Mehta, DB Pahlajani, Ashok Seth, Upendra Kaul and Soma Raju. This has gone on every year since then with huge attendance.

Since then, coronary angioplasty has spread like wild fire all over the country, in 624 centers with an annual growth rate of 18–22%[3] (Table 1).

The industry data suggests that there are 800 cath labs. The number of percutaneous coronary intervention (PCI) is 300,000 and stents is 425,000. The disparity is explained by

TABLE 1: National interventional council data (2014)

Year	*2010*	*2011*	*2012*	*2013*	*2014*
Centers	251	332	369	404	396
PCI	117,420	152,332	177,240	216,817	248,152
Prim. PCI	14,271	20,541	21,343	24,375	41,057
Stents	146,719	193,728	215,662	262,349	310,190
DES	90,926	156,919	160,668	205,419	257,140

the fact that not all centers report to National Interventional Council. About ten centers do more than 1,000 case/year, about 34% centers do less than 200 case/year. The rest are in between 200 and 1,000/year.

All types of cases are taken, including multivessel, left main, Bifurcation and CTOS. Agewise 11% of our patients are less than 40 years, 14% are above 70 years and 28% are female (2014, NIC Data).

Interventions in arteries other than coronaries were also undertaken: Renal (2,832); Carotid (6,124); Stentgraft (181) and Peripheral (3,938) in 2014.

In USA, PCI/CHD prevalence is 3.24%, while in India it is 0.28% (US is twelve times higher). The causes are less number of centers and the cost. The pattern of funding also needs improvement. Currently, 37.41% is funded by the government, private insurance contributes 18.73% and the rest is self-financed. So we still have a long way to go.

PEDIATRIC INTERVENTIONS

During the late 1960s and early 1970s, pediatric catheterization was limited to diagnostic procedures. The first balloon atrial septostomy was probably done by Dr Tandon in the early 1970s. The cine angiography was first introduced at Nanavati Heart Institute, Mumbai, in 1973. Balloon valvuloplasties for congenital pulmonary and aortic stenosis started in mid to late 1980s in various centers across the country (Table 2). The early 1990s brought in device closure of PDAs with Rashkind's device and atrial septal defect (ASD) closure with the sideris buttoned device. Both these devices went out of vogue with the advent of Amplatzer family of devices in the late 1990s.

In the year 2014, as per NIC data, almost 7,500 device closures were done: PDA (2,591), ASD (3,646), ventricular septal defect (VSD) (1,129) and POST MI VSD (43). Soon with the standardization of protocols for neonatal interventions, a number of centers started doing aortic and pulmonary valvuloplasties and dilatation of coarctations in the newborn. In the past decades, novel procedures such as perforation of the pulmonary valve in pulmonary atresia with intact IVS, stenting of the PDA for duct dependent circulation, hybrid approach for closure of muscular VSDs have been met with measurable success.

CARDIAC ELECTROPHYSIOLOGY IN INDIA

In 1957–58, intracardiac ECGs were done at KEM Hospital, Mumbai. Few papers were published in international journals.[4,5] In the late 1970s, there was same interest in cardiac electrophysiology (EP) in a few centers in India, Delhi (GB Pant Hospital) and Mumbai (Sion Hospital). In this period, the work in this field was restricted to sinus node function and His bundle studies. But later this did not pick up since it was realized that these tests remained only as academic exercise and not translate into much clinical relevance.

In the early 1990s, EP was rejuvenated with the advent of RF ablation for SVT. In 1996, there were very few centers in India (AIIMS and GB Pant Hospital, Delhi, KEM Hospital, Mumbai) offering this modality. At this time several emerging cardiologists went to Europe and the USA, for training in EP.

In the last decades, there has been significant progress in this field in India. Today there are more than 25 centers all over the country active in performing EP studies and RF ablations. At a conservative estimate, over 40,000 RF ablation procedures have been performed so far in the country. Hyderabad, Bengaluru, Chennai, Thiruvananthpuram, Ahmedabad, Lucknow, Pune and Mumbai are today among the cities where expert care is available in the field of cardiac EP. They have also published their work in reputed journals, though not to the extent desired. Apart from SVTs, todays routinely RF ablations are being performed for idiopathic VT and atrial flutter. Some centers are also adept at 3-D mapping and RF ablation for scar VT and paroxysmal atrial fibrillation.

The Indian Society of Electrocardiology (ISE) and the Indian Heart Rhythm Society (IHRS) have been conducting regular seminars and workshops to encourage the development of more cardiac electrophysiologists. Dual-chamber pacing is increasingly becoming prevalent. ICD and CRT implantations are being performed routinely in most parts of the country. Most newly established large cardiac centers are also investing in state-of-the-art EP system. Many patients from several other countries, notably the African continent, the Middle East and neighboring Asian countries come to India for advance EP procedures. The outlook for future growth of EP in India is very good. In 2014, as per NIC Data, the following pacemaker procedures were done in the country. Single chamber pacemaker (7,710) Dual chamber P (6,266), CRT-P (507), CRT-D (637), epicardial pacemaker (60), epicardial LV lead implant (82) and lead extraction (165). The growth of interventional cardiology owes a great deal of help by interventional industries in funding of conferences of and individual training. Mr Kaseem played a major role in initial phases. Industries in India have not lagged behind Surat in south Gujarat, the most prosperous city in the country is also 90,000 crores diamond hub with their expertise in laser technology, making a stent was easy for them. There are now nine companies in Surat making stents. It is a very welcome news that almost 40% of stent market valued at 2,500 crores is with Indian companies (Table 3).

Thus close cooperation between cardiologist, pharmaceutical and interventional industries should be encouraged. The terms like pharmacophobia, unethical practices should be discouraged.[6] It is only through such collaboration that innovative ideas will emerge.

Medical standards have advanced very rapidly in India over past 25 years. The rising middle class, solid economic growth, universal coverage provided by some state govt., growing access to private insurance have contributed a great

TABLE 2: Interventions in valvular disease

PTMC	12,788
PVBD	1,257
AVBD	777
TVBD	85
	14,907

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TABLE 3: Gujarat's contribution to stents	
1	Meril Life Sciences Pvt. Ltd.
2	Sahajanand Medical Technologies Pvt. Ltd.
3	Heart Beat Intervention Pvt. Ltd.
4	MIV Therapeutics Pvt. Ltd.
5	Nano Therapeutics Pvt. Ltd.
6	Purple Medical Solutions Pvt. Ltd.
7	Invent Biomed Pvt. Ltd.
8	Multimedics
9	Lancer Medical Technology Ltd.
	(30% Market share: 9/11 Companies)

deal to development of many hospitals, with excellent cardiac facilities in over 175 centers. Some private corporate hospitals are excellent and are even recognized by JCI. It has now given birth to "Medical Tourism".

Increasing availability of modern technology, JCI credited hospital, availability of large number of specialists with their quest to give most modern treatment available anywhere in the world and their desire to update themselves constantly, personalized care, very close patient-physician relationship are some of the reasons why many patients from surrounding countries and even USA and Europe prefer to come here to get treatment for cardiac ailment. In spite of the fact that we are able to give the best that "cardiology has to offer" such places are still in small number, compared to our needs so much so that these places have become hospitals for the rich few. We also have lacked innovation. In spite of tremendous facilities and vast patient-population, our innovative output is close to zero. However, in coronary field, many centers have participated in many international trials. But very few novel ideas have emerged. Kalam-Raju stent was innovated by Soma Raju and former President APJ Abdul Kalam. MJ Gandhi with Bhabha Atomic Research Centers scientists collaboration developed Isotope P32 Mounted stents. With easy availability of drug coated stents, these ideas died down.

Attempts by Chennai group to reduce the time of reperfusion in acute myocardial infarction is very laudable.

First P32 stents was implanted in human coronary artery at Borgess Medical Centers, Kalamazoo, MI, USA, on July 10, 1997. First P32 stents in India was implanted on July 23, 1997 at Nanavati Heart Institute, Mumbai.[7]

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CARDIOLOGY UPDATE 2015



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