

Historical Perspective

Development of Pacing, Electrophysiology and Defibrillation in India

Mohan Nair, MD, DM,¹ Johnson Francis, MD, DM,² K Venugopal, MD, DM³

¹Director, Metro Golden Heart Institute, New Delhi, India.

²Associate Professor of Cardiology, Medical College Calicut, Kerala, India

³Professor and Head, Department of Cardiology, Medical College Calicut, Kerala, India

Address for correspondence: Mohan Nair, MD, DM, Director, Metro Golden Heart Institute, New Delhi, India. Email: mnair@bol.net.in

Cardiac Pacing

History of cardiac pacing in India dates back to late 1960s. Kar¹ reported that cardiac pacing was introduced in India in 1966. Basu² while discussing on cardiac pacemaking in Calcutta, mentions that the first pacing was performed in April 1967 at the Institute of Post Graduate Medical Education and Research (IPGME&R). Bhatia et al³ started pacemaker implantation at AIIMS, New Delhi in 1968. Their first patient was a doctor from Assam and the pulse generator was supplied by Medtronic Inc. The pulse generator was powered by a mercury-iodide battery which lasted for about 2 ½ years, after which the patient underwent pulse generator replacement. Unfortunately he succumbed to miliary tuberculosis about a year after that. Currently around 8000 pacemakers are being implanted annually in India, in various centers around the country.

The IPGME&R is the centre which implants maximum number of pacemakers in the country¹. Various hypotheses has been put forward to explain the high incidence of conduction system disorders in the Eastern part of the country. Mustard oil is the usual cooking medium in the Eastern part of the country. Erucic acid content of Mustard oil is around 48%. Studies conducted by the Indian Council of Medical Research⁴ has shown erucic acid content in all the 50 heart samples obtained from Calcutta (Eastern part of India) while none of the samples from Trivandrum or Madras (South India) showed any trace of erucic acid. The cooking medium in the latter regions is coconut oil, with no erucic acid content. Erucic acid has been shown to produce myocardial fibrosis and lipidosis⁵⁻⁷. High incidence of heart block has also been reported from Sweden⁸, where the cooking medium is rape-seed oil which also has a high erucic acid content. More studies are needed to conclusively prove whether Mustard oil is the etiological factor in the high incidence of heart block in the Eastern regions of India.

The first temporary pacemaker manufactured in India was the Khalilullah-Mendez pacemaker, which was marketed in 1970. It was a single chamber fixed rate pacemaker with facility for adjustment of pacing rate and pacing current. The device was jointly developed by Prof. M. Khalilullah at G.B. Pant Hospital, New Delhi and Mendez, an engineer-entrepreneur. Khalilullah-Mendez team also manufactured an indigenous monitor-defibrillator which was known as KM monitor-defibrillator.

The first permanent pacemaker manufactured in India was from Shree Pacetronix Ltd. The pulse generator was called Ventralith-I and it was a non-programmable VVI pacemaker. First implant was on September 9th, 1994 at Kastruba Hospital, Bhopal. Subsequently Shree Pacetronix has started manufacturing multiprogrammable pacemakers as well. The first

multi-programmable pacemaker was implanted on June 6th, 1995 at Ramakrishna Mission Seva Pratishthan, Calcutta. At present single lead VDD pacemakers, multi-programmable DDD pacemakers (**Figures 1-3**) and single chamber pacing system analyzers are also being manufactured by Shree Pacetronix and they continue to be the only pacemaker manufacturer in India.



Figure 1:
Ventralith-I: VVI
Non- Programmable
Pacemaker



Figure 2: Pinnacle:
VVI, multi-
programmable
pacemaker



Figure 3: Charak: DDD,
multi-programmable
pacemaker

Invasive Cardiac Electrophysiology

G.B. Pant Hospital New Delhi has been the pioneering center in the field of Invasive Cardiac Electrophysiology in the country. Bhatia M.L et al⁹ and Khalilullah M et al¹⁰⁻¹³ were the pioneers in His bundle electrography in the country. Prof. K.K. Sethi was the first to perform catheter ablation in the country. Direct Current ablation was started in 1988 followed by Radio Frequency (RF) ablation later on. The number of centres having electrophysiology setup in the country has increased from about 10 in 1997 to around 30 in 2001 (**Figure 4**). The number of RF ablations being performed in the country has gone up from 800 to 2000 during the same period (**Figure 5**). At least 3 government aided centers are offering subsidized diagnostic and therapeutic facilities. Average cost in private hospitals is around \$ 200 for diagnostic procedures and \$ 600 for ablation. Cost containment is mainly by frequent reuse of catheters. The national board has initiated post doctoral fellowship in electrophysiology. Three national and three regional electrophysiology workshops are being conducted every year in the country. Currently there are about 50 electrophysiologists under training

Research Activities in Electrophysiology

Newer insights in the field of atrial fibrillation in rheumatic heart disease have been obtained by electrophysiological studies from the country. Atrial disease due to rheumatic carditis is an important parameter, in addition to valvular involvement in the genesis of atrial fibrillation. Multiple substrates for atrial fibrillation are present in these cases, namely: stretch, fibrosis, raised pressures, increased atrial size and increased anisotropy. Atrial fibrillation in rheumatic heart disease is generally of long duration and affects a younger population. Control of Rate versus Rhythm in Rheumatic Atrial Fibrillation Trial -'CRRAFT' conducted at Mumbai has documented the effectiveness of amiodarone in the treatment of rheumatic atrial fibrillation.¹⁴ Mapping and successful RF ablation of flutter circuits seen at initiation after cardioversion of rheumatic atrial fibrillation has been achieved.¹⁵

Surgical RF Pulmonary Vein Isolation for Rheumatic Atrial Fibrillation

Surgical RF pulmonary vein isolation using Thermaline Multi-Electrode Catheter [EP Technologies] has been done in 27 patients with rheumatic atrial fibrillation of more than one year duration. Lesions were as follows: bilateral pulmonary vein isolation, isolation of the left atrial appendage and connection lesion between left atrial appendage and pulmonary veins. The

mean left atrial diameter was 7.2 cm. 18 patients regained sinus rhythm immediately while 6 patients achieved sinus rhythm after one week. Two patients continued to be in atrial fibrillation while one went into atrial flutter. Atrial fibrillation recurred in three of the successful cases. (Figure 6)

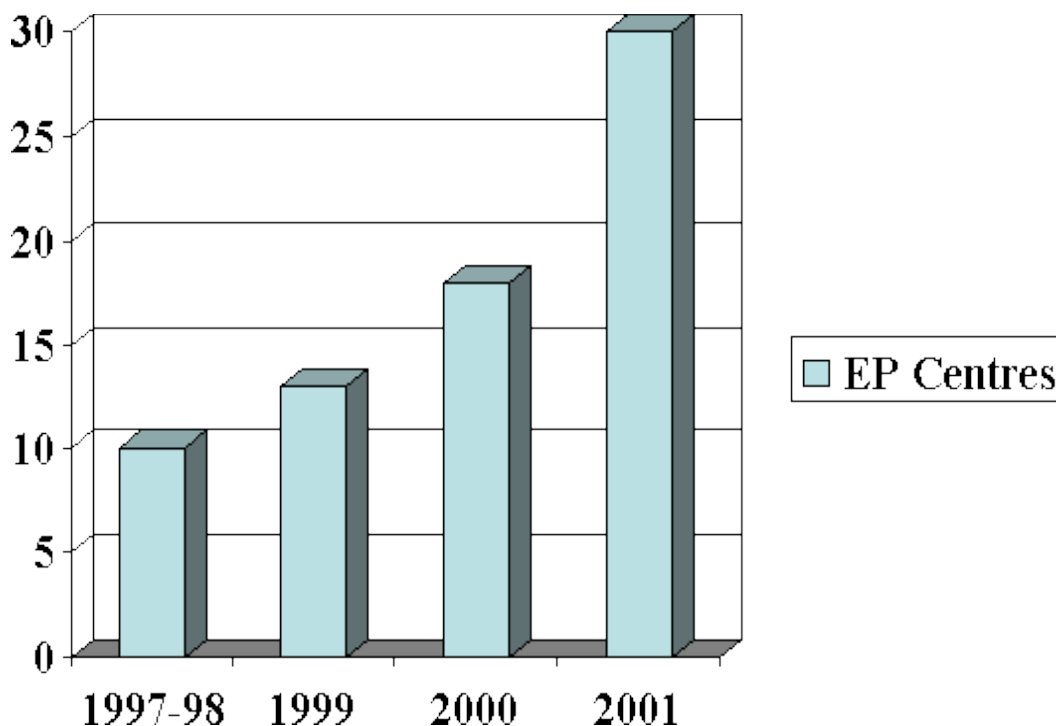


Figure 4. Number of EP Centres in India

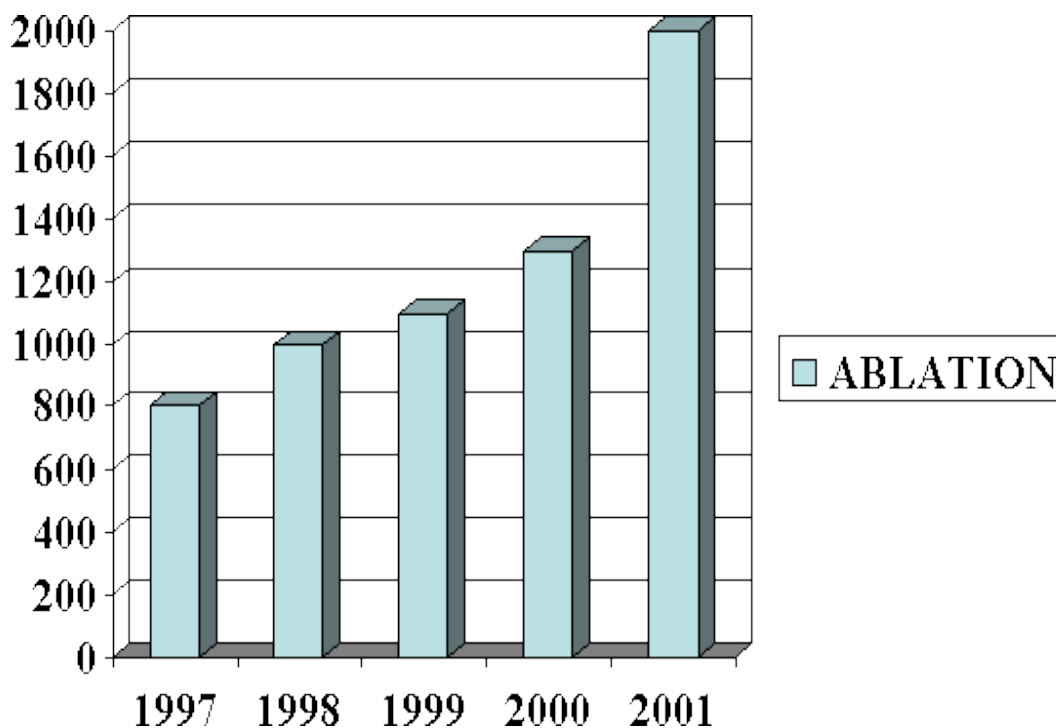


Figure 5. Number of RF Ablations in India

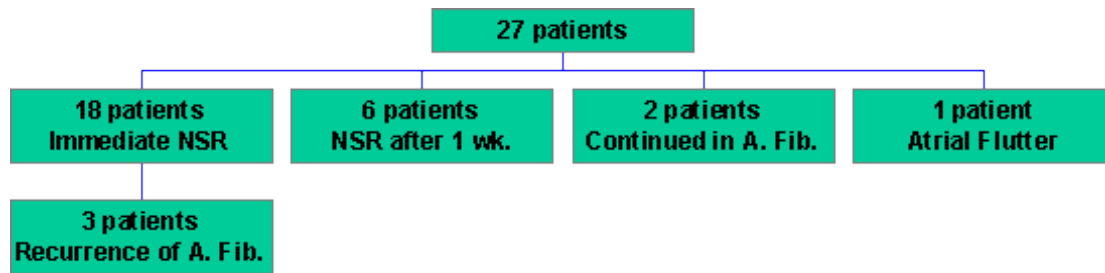


Figure 6: Surgical Pulmonary Vein Isolation: Indian Experience (Results)

Implantable Cardioverter

Prof. K.K. Talwar, AIIMS, New Delhi and Dr. T.S. Kler, Escorts Heart Institute & Research Centre, New Delhi were the first to implant Implantable Cardioverter Defibrillators (ICD) in India. Current annual ICD implantation rates stand at 60 per year.

Acknowledgement

We gratefully acknowledge the help of C. Ashokan Nambiar, MD, DM, and K. Sugathan, MD, DM, Former Professors of Cardiology, Medical College Calicut for providing the preliminary details of the first patient who has undergone permanent pacemaker implantation at AIIMS. Prof. C.C. Kar, Prof. M.L. Bhatia, Prof. M. Khalilullah and Prof. K.K. Sethi were very kind enough to respond to telephone calls and give the details of their pioneering work. Dr. Ashish Dubey, Marketing Manager, Shree Pacetronix Ltd. provided the pictures and Ramkumar, Regional representative of Medtronics Inc. has provided the details of ICD implantation and pacemaker implantation statistics. Dr. Sudipto Roy, Hony. Editor, Journal of Indian Medical Association(JIMA) deserves special thanks for providing reprints of previous articles published in JIMA.

References

1. Basu AK. Cardiac pacing in India. J Indian Med Assoc. 1980;75: 205
2. Kar CC. Problem of cardiac pacing in India. J Indian Med Assoc. 1980;75: 203-204
3. Bhatia ML - Telephone conversation with: Johnson Francis. 2002.
4. Indian Council of Medical Research (ICMR) Annual Report, 1977, p. 109
5. Roy S, Sengupta KP, Chatterjee GC. Effect of mustard oil, rapeseed oil & groundnut oil feeding on development of myocardial lipidosis & fibrosis in rats. Indian J Exp Biol 1979; 7:918
6. Kramer JK, Farnworth ER, Johnston KM, Wolynetz MS, Modler HW, Sauer FD. Myocardial changes in newborn piglets fed sow milk or milk replacer diets containing different levels of erucic acid. Lipids 1990;25:729-37
7. Kramer JK, Farnworth ER, Thompson BK, Corner AH. Testing a short-term feeding trial to assess compositional and histopathological changes in hearts of rats fed vegetable oils. Lipids 1988;23:199-206
8. Borg K. Acta Med Scand. (Suppl) 1975; 585:5

9. Bhatia ML, Ashokan Nambiar C, Shrivastava S, Roy SB. Effect of acute digitalization on His bundle intervals and corrected sinus recovery time in normal young adults. *Indian Heart J* 1977;29:78-84.
10. Khalilullah M, Venkitachalam CG, Mahapatra NK, Pais P, Padmavati S. His bundle electrogram in the disorders of conduction and impulse formation. *Indian Heart J.* 1978;30:29-38
11. Khalilullah M, Ahuja U, Padmavati S. Complete heart block with narrow QRS complexes with site of block below the His bundle. *Indian Heart J.* 1979;31:120-3
12. Sunghal NK, Khalilullah M. His bundle electrography - an analysis of first 100 consecutive studies. *J Assoc Physicians India.* 1979;27:519-24
13. Khalilullah M, Jaishankar S, Sethi KK, Singhal NK. Paroxysmal supraventricular tachycardia. Role of His bundle electrography and electrical pacing. *Indian Heart J.* 1980;32:271-8
14. Control of Rate versus Rhythm in Rheumatic Atrial Fibrillation Trial -'CRRAFT'. Presented at the Annual Conference of the Cardiological Society of India, 2001.
15. Nair M, Shah P, Batra R, Kumar M, Mohan J, Kaul U, Arora R.. Chronic Atrial Fibrillation in Patients With Rheumatic Heart Disease: Mapping and Radiofrequency Ablation of Flutter Circuits Seen at Initiation After Cardioversion. *Circulation.* 2001;104:802.