Cardiac pacing at TU Teaching Hospital - Changing perspective

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Abstract

Life-saving procedures like cardiac pacing have been restarted in the TU Teaching Hospital. In this study, various aspects of cardiac pacing are described. In a period of 27 months, 36 permanent pacemaker implantation and 60 temporary pacemaker implantation procedures were performed by this group. All the procedures were successful and no serious complications were observed. Pacing parameters, and complications are discussed and compared with the earlier studies which clearly demonstrates betterment of the pacemaker situation. The first pediatric pacemaker implantation in Nepal is described. Problems and improvement aspects are highlighted.

Keywords: Permanent pacemaker; Temporary pacemaker; Pacemaker implantation; fluoroscopy; syncopal attacks; CHB, SSS.

Introduction

We have been successful in restarting the pacemaker implantation programme in Nepal after a long gap of two years. Bir Hospital cardiac pacemaker programme is said to be stalled due to technical reasons and Tribhuvan University Teaching Hospital pacemaker programme had a hitch of couple of years due to shortage of manpower of technical know-how. December 1995 sets an indelible mark when our team started permanent pacemaker implantation. We had implanted permanent pacemaker in 3 patients in December 1995 alone. Then a Japanese expert came in under JICA technical collaboration under whom a team of doctors and nursing staff were trained to make the programme well sustainable. Presently three groups of doctors are involved in the pacemaker implantation programme, which is running smoothly and making the needful patients at ease and preventing the temporary migration of people for treatment abroad.

We are presenting the experience of our group in pacemaker implantation, presently at the only centre of cardiac peacemaking in Nepal and compare the data published from TUTH earlier.1

The artificial cardiac pacemaker is an electronic device that delivers electric stimuli to the heart to treat bradycardias and tachycardias. The essential elements of a pacemaker include a power source, usually a battery, which supplies energy for the stimuli and circuitry, an electrical circuit to regulate the timing and characteristics of the stimuli, a lead, composed of electrodes on a catheter or insulated wire to connect the battery and circuit to the heart.2 At first, pacemakers were external units that provided temporary pacing by delivering stimuli to the skin3 or to the heart through a lead and with the electronics and power source remaining outside the body. For many clinical situations temporary pacemakers are still needed. The use of external pacemakers with extrathoracic electrodes for electric stimulation to the heart and even the use of balloon-tipped semi-floating temporary endocardial lead will make emergency cardiac pacemaking easier which could also be done inside the ambulance. In our series, we had used balloon-tipped semi-floating temporary pacing endocardial lead in two cases.

The first totally implantable pacemaker device was reported in 1958. Advances in technology have been rapid regarding pacemaker systems, and pacemakers themselves have changed dramatically from the 250 grams asynchronous devices of the early 1960s to 22 gms today. The present day systems provide minimally invasive programmable and communicable single and dual chamber pacemakers, which weigh typically 22 grams to 35 grams respectively, last an estimated 6-10 years and are highly reliable. So are the endocardial pacing lead systems which are atrial or ventricular, unipolar or bipolar, with tined fixing system or screw-in-fixing system and even single lead system capable of pacing dual chambers.

Material, Methods and Techniques

Patients who attended the emergency medical service, medical outpatient department, patients admitted in ICU, CCU & medical wards of TUTH, patients referred from Bir Hospital, Kanti Children's Hospital and private medical clinics who were admitted either from medical outpatient department or emergency room of TUTH formed the source of the subjects. Confirmation of the diagnosis was done by repeating the standard 12-lead ECG. Explanation of the procedure, possible complications, benefits and needs for pacing and the cost involved were discussed with the patient and/or the relatives. Written consent was obtained in all the cases except in dire emergency situation.

Detailed technique of pacemaker implantation procedure have been described in many textbooks an would not be covered here. All the procedures were performed under local anaesthesia and mild sedation as and when required except in one paediatric case where intravenous ketamine was used with the help of an anesthesiologist.

In this group of patients, transvenous right ventricular endocardial pacing was done in all the cases. The pacing lead was inserted by Seldinger's technique.4 For temporary pacing, right internal jugular vein or right femoral venous approaches were chosen in most of the patients for the reason of saving the subclavian vein which was used or might have to be used for permanent pacing. Four temporary transvenous endocardial pacing was done using right subclavian vein.

Temporary pacing was done in most of the cases except in patients planned for permanent pacing & were under continuous monitoring in CCU and were relatively stable.

Six permanent pacing and seven temporary pacing procedures were performed in the procedure room of Radiology Department under fluroscopic control taking optimum care to prevent infection. One temporary pacing was done in Emergency Room and One in CCU without fluroscopy using balloon-tipped semi-floating endocardial lead and their endocardial leads were repositioned under fluroscopic control to achieve better and safe pacing. Rest of the cardiac pacing procedures were performed in the general O.T. initially and later in the Cath Lab when CCU acquired its own fluroscopy-machine.

In all but three of the permanent pacemaker cases, who had temporary endocardial lead for initial stabilization, temporary endocardial leads were removed after securing optimum permanent pacing and achieving satisfactory pacing parameters under fluroscopic control. Those patients who had had both temporary and permanent endocardial lead in situ for 48 hours post-implant were pacemaker-dependent patients and their temporary pacing lead was removed 48 hours after the permanent pacemaker implant (PPI) under fluroscopic control.

Table II illustrates the details of pacemakers used and Table III gives details of leads. Pacing system analyzer used in this group of patients is Medtronic 5311 (USA).

Table I:

Case No.	*Age/Sex*	*Diagnosis*	*Month/Year*	*Pacemaker details*	*Threshold*	*Current*	*Impedance*
1.	61/M	SSS	Dec, 1995	XLP 01 S. No. 85153340 TIR 60 UP S. No.: 30256937	0.8 V	N A	582 ohms
2.	67/F	CHB	Dec, 1995	PIKOS XLPE 01 S. No. 85181865 TIR 60 UP S. No.: 30256933	0.4 V	N M	465 ohms

3.	70/F	CHB	Dec, 1995	PIKOS XLP 01 S. No.: 85153339 TIR 60 UP S. No.: 30251950	0.2 V	N M	417 ohms
4.	56/M	CHB	Dec, 1995	Legend II 8424 S. No. 2P1037724H CapSure 4024 S. No.: LAJ 185937 V	0.6 V	N M	666 ohms
5.	55F	SSS	June, 1996	PIKOS LXP 01 S. No.: 85153348 TIR 60UP S. No.: 30257109	0.6 V	0.5 m A	512 ohms
6.	76/M	SSS	July, 1996	PIKOS XLP 01 S. No.: 85153336 TIR 60 UP S. No.: 30260924	0.5 V	0.6 m A	612 ohms
7.	68/F	CHB	Nov. 1996	PIKOS XLPE 01 S. No.: 85181613 TIR 60 UP S. No.: 30250222	0.6 V	1.1 m A	622 ohms
Table I contd							
8.	74/M	CHB	Nov, 1996	PIKOS XLP 01 S. No.: 85155607 TIR 60 UP S. No.: 30291139	0.5 V	0.8 m A	512 ohms
9.	70/M	CHB	Nov, 1996	PIKOS XLP 01 S. No.: 85159105 Polyrox 60 UP S. No.: 30289523	0.7 V	0.6 m A	482 ohms
10.	78/F	CHB	Dec, 1996	PIKOS XLP E 01 S. No.: 85182708 TIR 60 UP S. No.: 30256933	0.3 V	0.3 m A	667 ohms
11.	60/M	CHB	Jan, 1997	PIKOS XLP E 01 S. No.: 85103708 TIR 60 UP S. No.: 30294044	0.8 V	1.4 m A	538 ohms
12.	81/M	CHB	Jan, 1997	PIKOS XLP E 01 S. No.: 85182712	0.6 V	N.A.	633 ohms

				Polyrox PX 60 UP S. No.: 30289522			
13.	70/M	CHB, Pacemaker failure	May, 1997	PIKOS 01 S. No.: 83647102 TIR 60 UP S. No.: 30298700	0.6 V	N M	522 ohms
14.	56/M	CHB	June, 1997	PIKOS E 01 S. No.: 83514977 Polyrox 60 UP S. No.: 30288058	0.2 V	0.4 m A	333 ohms
15.	60/M	CHB	June, 1997	PIKOS E 01 S. No.: 83514839 Polyrox 60 UP S. No.: 30288053	N A	N A	N A
16.	83/M	CHB	May, 1997	PIKOS XLP E 01 S. No.: 85104733 Polyrox 60 UP S. No.: 30288046	0.4 V	1.4 m A	587 ohms
17.	65/M	CHB	June, 1997	PIKOS XLP 01 S. No.: 8516972 Polyrox 60 UP S. No.: 30287218	0.7 V	1.2 m A	518 ohms
18.	66/M	CHB	July, 1997	PIKOS XLP E 01 S. No.: 85104726 PX 60 UP S. No.: 30288045	0.5 V	1.1 m A	512 ohms
19.	69/F	CHB	July, 1997	PIKOS XLP 01 S. No.: 85159418 Polyrox 60 UP S. No.: 30288111	0.5 V	1.5 m A	622 ohms
20.	63/M	CHB	Aug, 1997	PIKOS XLP 01 S. No.: 85159431 PX 60 UP S. No.: 30288040	0.4 V	0.4 m A	523 ohms
21.	73/F	SSS	Sep, 1997	PIKOS E 01 S. No.: 83514978 Polyrox PX 60 UP S. No.: 30324293	0.4 V	0.5 m A	800 ohms

22.	73/M	Trifascicular block with intermittent CHB	Oct, 1997	PIKOS XLP E 01 S. No.: 3032492 Polyrox 60 UP S. No.: 30324292	0.4 V	0.5 m A	625 ohms
23.	65/M	CHB	Oct, 1997	PIKOS XLP 01 S. No.: 85159429 Polyrox 60 UP S. No.: 30288041	0.4 V	0.8 m A	524 ohms
Table I contd							
24.	76/F	Bifascicular block with intermittent Mobitz II block	Nov, 1997	PIKOS XLP E 01 S. No.: 85106481 Polyrox PX 60 BP S. No.: 23390327	0.3 V	0.4 m A	668 ohms
25.	66/M	CHB	Nov, 1997	PIKOS XLP E 01 S. No.: 85104512 Polyrox 60 UP S. No.: 30288046	0.4 V	1.4 m A	587 ohms
26.	75/M	CHB	Dec, 1997	PIKOS XLP E 01 S. No.: 85106721 Polyrox PX 60 UP S. No.: 30331073	0.5 V	0.7 m A	750 ohms
27.	64/M	Symptomatic trifascicular block	Dec, 1997	PIKOS 01 S. No.: 83653815 Polyrox PX 60 UP S. No. 30331072	0.5 V	0.8 m A	578 ohms
28.	60/M	CHB	Jan, 1998	PIKOS XLP E 01 S. No.: 85106722 Polyrox PX 60 UP S. No.: 30335672	0.3 V	1.4 m A	573 ohms
29.	58/M	High grade Mobitz II 2o HB with intermittent CHB	Feb, 1998	PIKOS 01 S. No. 83653960 PX 60 UP S. No.: 30352230	0.4 V	0.6 mA	550 ohms
30.	59/F	CHB	Feb, 1998	PIKOS XLP 01 S. No.: 85166142 Polyrox 60 UP S. No.: 3035224	0.5 V	0.5 m A	661 ohms
31.	6/M	Congenital CHB	Jan, 1998	Premier 8081 PBM 210667 M	0.4 V	0.4 m A	453 ohms

				CapSure 4003 M S. No.: LAX 061167 V			
32.	76/M	CHB	Feb, 1998	Premier S. No.: PBM 209258 M CapSure 4003 M S. No.: LAX 059302	0.6 V	0.7 m A	573 ohms
33.	77/M	Betablocker induced persistent CHB	Feb, 1998	PIKOS 01 S. No.: 83653819 Polyrox 60 UP S. No.: 30331071	0.4 V	0.5 m A	450 ohms
34.	45/M	LBBB with intermittent Mobitz II (2o HB)	Mar, 1998	METROS TC 01 S. No.: 56226425 Polyrox 60 UP S. No.: 30331068	0.2 V	0.4 m A	333 ohms
35.	56/F	SSS	Nov, 1997	PIKOS XLP E 01 S. No.: 85106720 Polyrox 50 UP S. No.: 30335727	0.4 V	0.6 m A	660 ohms
36.	50/F	SSS	Mar, 1998	PIKOS E 01 S. No.: 83514977 Polyrox 60 UP S. No.: 30351166	0.3 V	0.3 m A	1000 ohms

Table II*

Specification	*PIKOS*	*PIKOS E 01*	*PIKOS XLPE 01*	*METROS ST 01*	*Premier*	*Legend II*
Mode	VVI	SSI	VVI	SSI	VVI	SSI
Basic Rate	70 min-1	70 min-1	70 min-1	72 min-1	60 min-1	70 min-1
Basic interval	860 ms	860 ms	860 ms	838 ms	NA	
Hysteresis Rate	off	off	off	off	off	off
Pulse Amplitude	4.8 V	4.8 V	4.8 V	5.0 V	3.3 V	4.2 V
Sensitivity	2.5 mV	2.5 mV	2.5 mV	2.4 mV	2.5 mV	2.5 mV

Pulse Width	0.5 ms	0.5 ms	0.5 ms	0.5 ms	0.42 ms	0.48 ms
Refractory Period	300 ms	300 ms	300 ms	300 ms	325 ms	325 ms
Polarity Sense	Unipolar	Unipolar	Unipolar	Unipolar	Unipolar	Unipolar
Polarity Pace	Unipolar	Unipolar	Unipolar	Unipolar	Unipolar	Unipolar
Magnet Effect	Async	Async	Async	Async	Async	Async
Async Magnet Rate	90-1/10 Cycles then basic rate	90-1/10 Cycles then basic rate	90-1/10 Cycles then basic rate	90-1/10 Cycles then basic rate	100 min-1	70 min-1
Replacement indication	Basic Rate - 11%	Basic Rate - 11%	Basic Rate - 11%	Async. Magnet Rate 82 min-1	Magnet Rate 80 min-1	Basic Rate - 10%
Maximum Available battery Capacity	1.3 Ah	2.0 Ah	2.0 Ah	1.3 Ah	1.1 Ah	1.1 Ah

* PIKOS and METROS series of pacemakers are manufactured by BIOTRONIK, Germany & Premier and Legend II pacemakers are manufacture by MEDTRONIC, USA. All the data given here are based on the technical manual supplied by the manufacturer.

Table III**

Specifications	*Biotronik TIR 60*	*Polyrox 60 UP*	*CapSure 4003 M*	*Capsure SP 4024*
Connection	IS-1 UNI	IS-1 UNI	IS-1 UNI	IS-1 BI
Polarity	Unipolar	Unipolar	Unipolar	Bipolar
Fixation	4 Tines	4 Tines	4 Tines	4 Tines
Length	60 cm	60 cm	58 cm	58 cm
Max. Diameter	3 mm (9F)	3 mm (9F)	N M	N M
Tip Electrode				
Surface Area	3.5 mm2	3.5 mm2	8 mm2	5.8 mm2
Shape	Lenticular	Lenticular	N M	N M
Material	Titanium	Titanium	Platinum	Platinum alloy
Surface, Structure	Ir, fractal	Ir, fractal	Polyurethane	Polyurethane
Conductor				
Insulation	1.7 Silicone	1.7 Silicone	Polyurethane	Polyurethane
Lead Body Diameter	1.7 mm (5F)	1.7 mm (5F)	1.7 mm	1.9 mm
Material	MP 35N®	MP 35N®	MP 35N®	MP 35N®
No. of Filaments	4	4	N M	N M
Resistance	1.2 ohms/cm	1.2 ohms/cm	37 ohms at 58 cm	82 ohms at 58 cm
Connector Material	AISI 316L®	AISI 316L®	N M	N M

** TIR 60 UP, Polyrox series of endocardial leads are manufactured by BIOTRONIK, Germany & Capsure series of endocardial leads are manufactured by MEDTRONIC, USA. All the data given here are based on the technical manual supplied by the manufacturer.

Observations

Indications for temporary cardiac pacing in this group of patients were post-myocardial infarction conduction blocks (Mobitz Type II second degree heart block and CHB, Sotalol induced CHB. Stokes-Adams attack & prophylactic pacing in extensive MI) and mostly for stabilization prior to PPI for various

conditions listed below:

- acquired CHB (23 cases);
- congenital CHB with Torsades de pointes (1 case);
- Sick Sinus Syndrome (6 cases);
- bifasicular block with intermittent CHB (1 case);
- trifascicular block (2 cases);
- LBBB with intermittent Mobitz Type II second degree heart block (1 case);
- Mobitz Type II second degree heart block with intermittent CHB (1 case) and
- Atenolol induced persistent CHB (1 case).

All the patients were symptomatic. Symptoms were: syncope, giddiness, exertional fatigue, light headedness and excessive long deep sighs - all related to low cardiac output owing to reduced chronotropy.

Table I illustrates details of observations.

In a period of 27 months (December 1995 to March 1998) 36 patients received permanent pacemakers and 60 received temporary pacemaker therapy. All procedures were successful. The youngest patient is a six-year boy, the first pediatric case of permanent pacemaker in Nepal. The oldest is an 83-year gentleman.

We are analyzing the permanent pacemaker group data in this presentation.

Mean age of the patient in the PPI group is 64.8 years. 70% (25) were males 30% (11) were females.

All the cases of PPI were first implants, except two (Case No. 9 & 12). In the two re-implant cases, one was the case of battery depletion as suggested by his first permanent pacemaker, which had reached End of Life (EOL) as a result he had syncopal attacks. In the second case of re-implant, the endocardial lead implanted 3 years ago in Bir Hospital was displaced and was floating in the right ventricular cavity and patient was having recurrent syncopal attacks.

In the first case of re-implant, an entire new set of pacemaker and endocardial lead were used. The old endocardial lead was truncated and its proximal end was fixed tightly using Prolene hypoallergenic sutures in the deltopectoral fascia to prevent migration into the cardiac chambers after explanting the old pulse-generator.

In the second case of re-implant, the patient was stabilized with temporary pacing support and manipulation of the old endocardial lead was tried, hoping to reposition the lead tip in the right ventricular endocardium. But the lead could not be loosened due to extensive fibrosis. The new lead supplied by the manufacturer's agent was not matching the pulse generator, then the old lead was also truncated as described above and his old permanent pacemaker was explanted. Then a new pacemaker set, used only for three days by a female patient of the other team, who expired of electro-mechanical dissociation (non-pacemaker related), was implanted in this patient. That set was resterilized as per the specifications laid down by the manufacturer using ethylene oxide gas and procedure. Written consent was obtained explaining the pros and cons of the use of such a set. The new endocardial lead brought by the patient was kept with the team as agreed by the patient and his relatives in condition that if the manufacturer's agent replaces the lead he should get the refund from the agent or replacement. But as the agent of the manufacturer refused to replace the lead on grounds of defective implant, the same new lead

was later donated and used by the team for a poor needful patient. (Identities of both donor and recipient are withheld due to social and ethical reasons.)

Pacemaker implantation in the six-year boy deserves special mention. He was treated earlier as a case of epilepsy, and later in Kanti Children's Hospital, ECG showed CHB. When he was referred to us he had frequent episodes of syncopal attacks and by that time he already had had Torsades de pointes. He received temporary pacing support immediately after the referral, and later, the PPI was done using the pulse generator on VVI mode as there was economic constraints in using pulse generator with VVIR mode (rate-responsive or adaptive). Taking in view of the growth spurt of the child, the loop of the endocardial lead was left larger than usual so that there should be no traction to the fixed lead tip during the growth of the child.5 Basic rate of 60 bpm was increased to 80 bpm with the help of the programmer in an attempt to match the child's metabolic need. As the smaller sized pulse generator was expensive and not available, the pacemaker used for adults was used. Because of small physique of the child, large pacemaker dimensions and small pacemaker pocket size, there was mild increase in the tension of the sutures due to small hematoma, as a result few stiches gaped at the time of suture removal. Hematoma was pressed out and there was no evidence of infection. When the conservative treatment of dressing, local and systemic antibiotics and apposition of wound edges failed, it was decided to enlarge the pacemaker pocket, push the pacemaker down into the enlarged pocket, infiltrate antibiotic solution into the pocket and do a secondary suturing after trimming the wound edges under ketamine anaesthesia. Strict aseptic precautions were applied in doing so. The wound healed well and the child is doing excellent on follow-up.

In one female patient whose PPI was done by the other team, there was near-extrusion of the pulse generators due to pacemaker pocket infection three months after the PPI. There are two schools of thought6 for treating such a case. One strongly supports explantation of the pacemaker and the lead if possible and reimplantation from the other site. Others say conservative treatment employing dressing, antibiotics and secondary suturing when the infection is under control. In this case, as the permanent pacemaker set was donated by a Japanese expert during the extensive training period and the patient could not afford a new set, conservative management was given a trial after ruling out septicemia (persistent or intermittent), endocarditis or abscess formation. Daily intensive dressing using regular insulin (as growth factor, for epidermal growth factor is not available in Nepal). The pacemaker pocket infection healed and wound closed spontaneously. She is doing fine on follow-up.

In one case, the right subclavian artery was punctured thrice by the physician and twice later by the surgeon. Access to the right subclavian vein was secured through dissection with the help of the surgeon which was found to be in a deeper plane than usual.

Reimplantation of an entirely new set of permanent pacemaker supplied by the agent of the manufacturer was done in one patient as reliable pacing was not observed on the third day of implant. His follow-up is also regular and there is no pacemaker related problem.

Inter-team cooperation was maintained. A patient whose temporary pacing failed by a team was successfully performed by our team and later his PPI was done.

In one patient who had inferior wall MI with posterior extension, who presented in the emergency room with Stokes - Adams attack, temporary pacing was secured using right internal jugular vein prior to intravenous infusion of streptokinase.

Patient No. 14 of the PPI group had carcinoma cervix (in situ) who underwent total abdominal hysterectomy post-PPI and later radiotherapy after proper shielding. She is totally asymptomatic and excellent in one year follow-up.

Two patients in this series received rate-responsive permanent pacemakers.

Mean pacing threshold is 0.468 Volts and mean current is 0.727 mA at pulse width of 0.5 ms, and 0.533 Volts and 0.4 mA (in one case) at pulse width of 0.42 ms; this is significantly lower than what was achieved in the study cited above where mean threshold was 0.688 Volts. Mean impedance (resistance) in

our series of PPI is 576.71 ohms measured at 5 Volts, continuous pacing by PSA during implantation, which is again significantly lower compared to the earlier data where it was 878.5 ohms.1

Discussion

Pacemakers are employed to treat patients who have symptomatic bradycardias and tachycardias and also as a diagnostic tool in sorting out the exact mechanism of tachycardia or heart-blocks. The nature of arrhythmia and how likely it will persist or recur determine whether pacing, either temporary or permanent is indicated.1

The indications for temporary pacing and permanent pacing are well described in the literature and this does not fall under the purview of this study.

All the patients are followed-up in the medical outpatient department with standard 12 lead (with and without magnet) ECG, chest Roentgenograph as and when deemed necessary. Longest follow-up period has been for 2 years and 3 months.

As the benefit of modern time, permanent pacemakers weigh 22 to 30 grams as compared with 40-50 grams of 1970s and the size of the permanent pacemakers are also palpably smaller. All the pulse generators (pacemakers) used in this series are communicable to a designated programmer or telemetry unlike in the earlier series1 so that at needful times on follow-up different pacing parameter could easily be altered.

There was no unsuccessful procedure.

Difficulties and complications

Difficulties in the introduction of temporary pacing lead and permanent pacing lead was not a problem in our series. Complications like pneumothorax and cardiac perforation did not occur like in earlier series.1

Indications for AAI mode pacemakers with atrial lead would have been a better choice for patients with SSS. But for the lack of technical expertise and unavailability of atrial lead, pacemakers with VVI mode were used.

To overcome logistic problems for poor and needy patients, various organizations inside the country and abroad were contacted but to no avail.

Lack of technical support in the Cath Lab is intriguing during the implantation procedure. The operators had to operate the fluroscopy machine themselves and because there is no remote control device to operate that machine, implantation time was sometimes longer than 90 mins.

Patient No. 4 in our series had pacemaker syndrome on day-one post-PPI which was fortunately a temporary phenomenon.6 He is doing well on a 27-month follow-up.

Patient No. 9 is doing well on a 2-year follow-up period. His magnet rate is 89 bpm as opposed to 90 bpm at BOL (EOL is - 11% of BOL rate). Since his basic rate is
70 bpm and his pulse generator is not a
rate responsive or rate adaptive one,
he complained of some light-headedness
on heavy exertion. That is easily understandable. He had recurrent syncopal attacks and after temporary pacing became pacemaker dependent. During the PPI, in the process of switching over to permanent pacemaker after disconnecting the PSA patient-cable, he had three episodes of syncope. During the period of heavy exertion his basic rate of pacemaker is inadequate to meet the metabolic demand. Hence, he was advised not to exert heavily and if the symptoms become disturbing, was planned for an increase in the basic rate with the help of the programmer.

At many occasions, the nursing staff noted the ECG monitor showing decreased heart rate than the basic

rate of the pacemaker causing anxiety. But after the telephonic consultation, the pulse rate of the patient was found to be consistent with the basic rate of the pacemaker. This certainly justifies further training of the staff and need for telephonic-telemetry system which is not very expensive.

As the number of patients with permanent pacemakers is increasing day by day, and their follow-up needs a special setting, dealing with them in a crowded medical OPD has become a real problem, and hence the need for a separate follow-up clinic is felt.

Logistic problems, dissemination of information regarding the pacemaker implantation programme for wider availability for the needy people and prevention of migration to other countries for PPI form a separate agenda to be discussed.

Conclusion

Feasibility of cardiac pacing, follow-up and problem management has become a reality and a routine procedure is now done in TUTH. Fear about "cardiac operation" regarding the PPI and its complications would be gradually eased out. The "pacemaker highway" never ends. There is enough room left for technical improvements, logistic support, manpower training and institutional support for better equipment and follow-up facilities to make the pacemaker programme sustainable.

Abbreviations

AAI - Pacing/sensing function in atrium, pulse inhibited (NBG Code)

VVI - Pacing/sensing function in Ventricle, pulse inhibited (NBG Code)

VVIR - Pacing/sensing function in Ventricle, pulse inhibited, rate adaptation (NBG Code)

SSI - Pacing/sensing single chamber, pulse inhibited (NBG Code)

UNIP - Unipolar

BIP - Bipolar

MI - Myocardial Infarction

BOL - Beginning of life

EOL - End of life

bpm - beats per minute

NA - data not available

NM - not mentioned in the technical data supplied by the manufacturer

CHB - Complete heart block

SSS - Sick Sinus Syndrome

PSA - Pacing System Analyzer

PPI - Permanent Pacemaker Implantation

CCU - Coronary Care Unit

ICU - Intensive Care Unit

TUTH - Tribhuvan University Teaching Hospital

ECG - Electrocardiogram

JICA - Japan International Cooperation Agency

OT - Operation Theatre

TPI - Temporary Pacemaker Implantation

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