EMERGENCY TRANSVENOUS PACING AT THE BEDSIDE AN EXPERIENCE WITH 61 PATIENTS

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SYNOPSIS

In Singapore it has been standard practice to carry out emergency transvenous endocardial cardiac pacing using fluoroscopy. Over a period of 14 months 61 patients had emergency transvenous pacing done at the bedside in the Coronary Care Unit of Tan Tock Seng Hospital, using the balloon flotation bipolar electrode catheter and the intracardiac electrocardiogram. The aim of the study was to show that it was a convenient alternative to pacing with fluoroscopy. The method used is described below. The basis for interpretation of the intracardiac electrocardiogram is explained. Results are tabulated with special emphasis on the time taken for the procedure, the threshold attained, and complications encountered, the advantages and disadvantages of the procedure are discussed and the requirements for such a procedure in any hospital are outlined.

INTRODUCTION

The ability to activate the heart via a transvenous endocardial thermode was known as far back as 1905 (1). Temporary cardiac pacing is highly effective in patients with bradyarrhythmias and may even be life saving. The techniques for the transvenous placement of temporary electrodes for cardiac pacing have been well described. One of the 4 sites of entry into the venous system generally is used - a subclavian vein, a jugular vein, a brachial or a femoral. In our series the commonest used site of entry was the subclavian and less often the femoral vein. The advantage of using one of these two sites is the greater catheter stability, which is especially important during relatively prolonged temporary pacing when loss of pacing may have critical consequences for the patient and also because significant catheter movement may result in perforation of the heart (2). There is an incidence of thrombophlebitis associated with catheter electrode placement at any site (3). We have observed that in a high proportion of cases with bradyarrhythmias due to myocardial infarction, there is return of normal sinus rhythm in a few days to weeks. The maintenance of cardiac rhythm in our patients with the aid of a temporary pacemaker helped to 1) Maintain a satisfactory cardiac output 2) Prevented the emergence of malignant 'escape' ventricular arrhythmias and 3) Allowed us to use antidysrrhythmic agents without the fear of aggravating the bradyarrhythmia.

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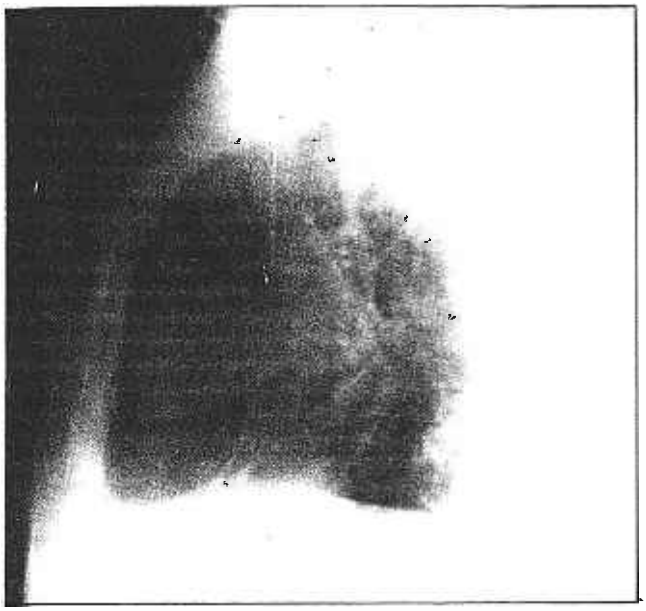
MATERIALS AND METHODS

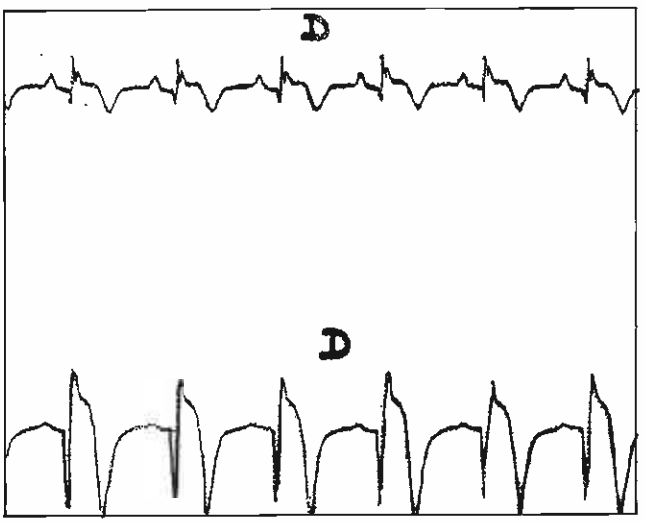
During a 14-month period 61 patients aged 13 years to 83 years had temporary bedside pacing done, using the intracardiac electrocardiogram and the bipolar balloon pacing catheter electrode (Table 1).

TABLE 1 -INDICATIONS FOR TEMPORARY CARDIAC PACING

Indications	No. of Patients Paced		Survivors	Total No. of Patients
	Admitted to TTSH	Transferred from other hospitals		
1. Inferior/Posterior myocardial infarction with hypotension/ cardiac failure/unacceptably low heart rate	15	10	22	25
2. Anterior myocardial infarct with complete heart block/ bifas cicular block	9	3	5	12
3. Sick sinus syndrome	6	2	8	8
4. Lenegres's disease	2	-	2	2
5. Stokes-Adams attack	5	-	5	5
6. Ischaemic cardiomyopathy with recurrent ventricular fibrillation and bifascicular block	2	-	2	2
7. Viral myocarditis	-	1	1	1
8. Peripartum cardiomyopathy with intractable junctional tachycardia (atrial overdrive pacing)	1	-	1	1
9. Diagnosis of coronary artery disease (atrial pacing)	2	-	2	2
10. Malfunction of permanent pacemaker	1	-	1	1
11. Hyperkalaemia, acute renal failure and complete heart block	2	-	-	2

Interpretation Of The Intracardiac Electrocardiogram
The negative pole of the electrode catheter is connected to an unipolar chest lead usually lead V1. The use of the intracardiac electrocardiogram in bedside pacing relies on the fact that its morphology is sufficiently characteristic in the various chambers of the heart, to permit localisation of the electrode tip during transvenous pacing (4). The P waves are inverted high in the right atrium (Fig. 1 A), biphasic in the mid right atrium (Fig. 1 B) and positive in the low right atrium (Fig. 1 C). The direction of the current away from the sinus node results in a negative deflection high in the atrium. When the electrode approaches the sinus node as in the mid and low atrium the deflection becomes more positive. When the catheter enters the right ventricle the voltage of the QRS complex increases and the pattern of injury (ST elevation) is seen (Fig. 1 D). In the intraventricular recording the P waves are inconspicuous. All procedures were carried out by a trained medical operator in the Coronary Care Unit of Tan Tock Seng Hospital. Using a strictly aseptic technique and local anaesthesia, a catheter introducer (Fig. 2) was inserted percutaneously into the right subclavian vein. The core was withdrawn and a balloon pacing electrode (Fig. 2) catheter was introduced into the vein through the sheath with the balloon deflated. The intracardiac ECG was used to guide the electrode tip into the lower right atrium at which point the balloon was inflated with ½-¾ cc of air, and floated into the right ventricle. The position in the ventricle was considered optimal when consistent ventricular pacing occurred at a threshhold of 1 milliampere or less (5). The balloon was deflated and the sheath gradually withdrawn. The catheter was sutured securely to the skin and sterile dressing applied. The electrode was connected to an external pacemaker which was set at demand mode at the required rate at a current two to three times the threshhold obtained. A chest x-ray (portable) was obtained to verify catheter position (Fig. 3) and a post pacing 12 lead ECG was done in all cases. Broad spectrum antibiotics were routinely used for 5-7 days post pacing.

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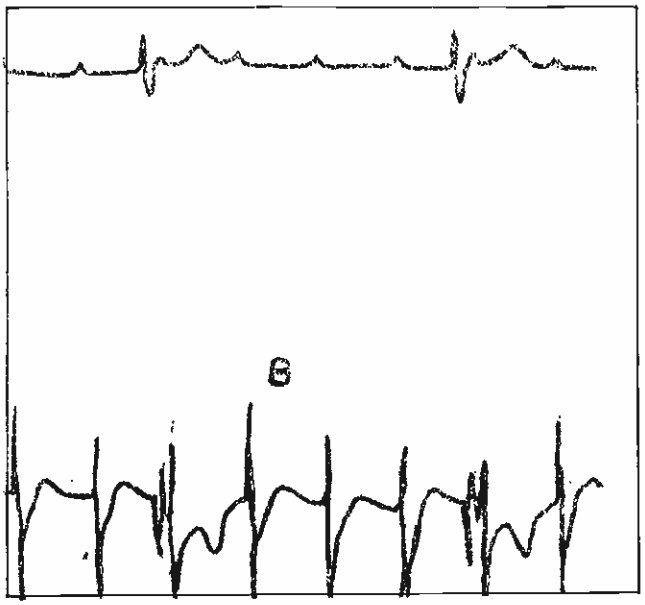
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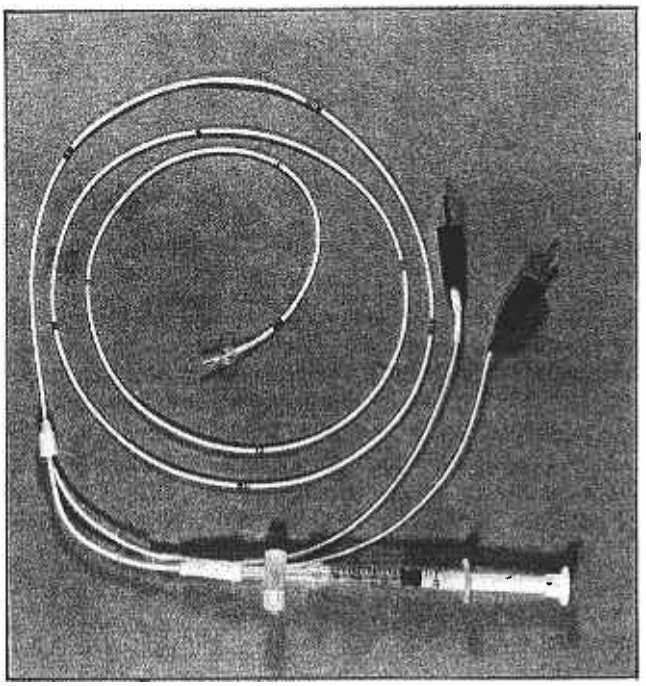

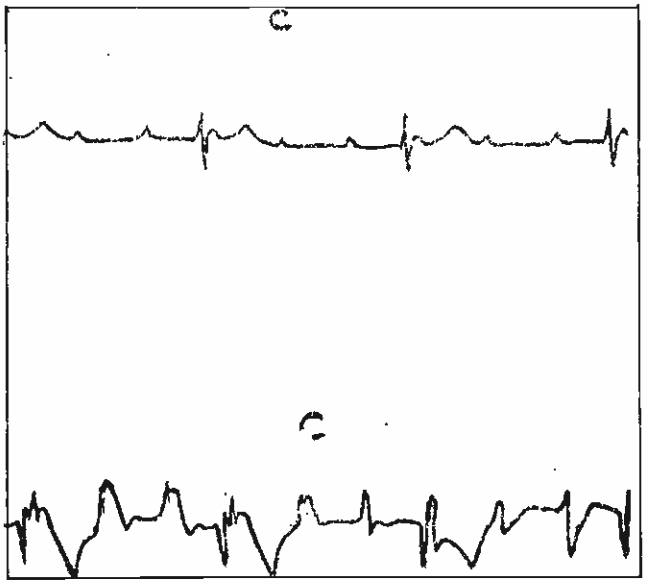
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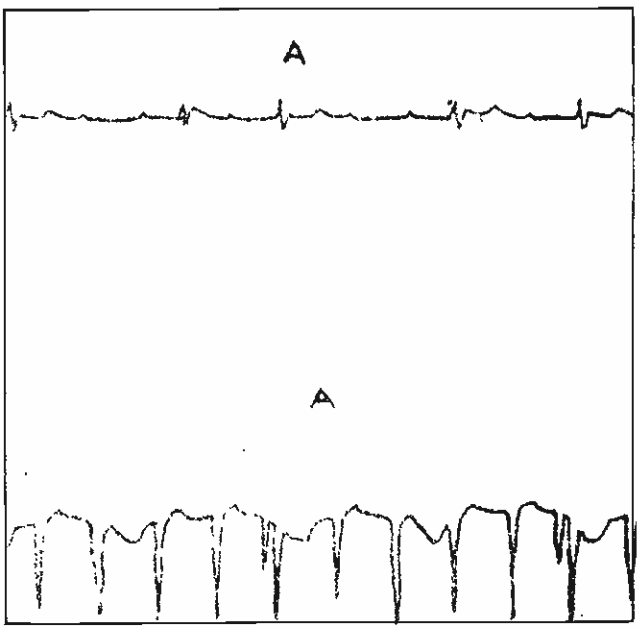
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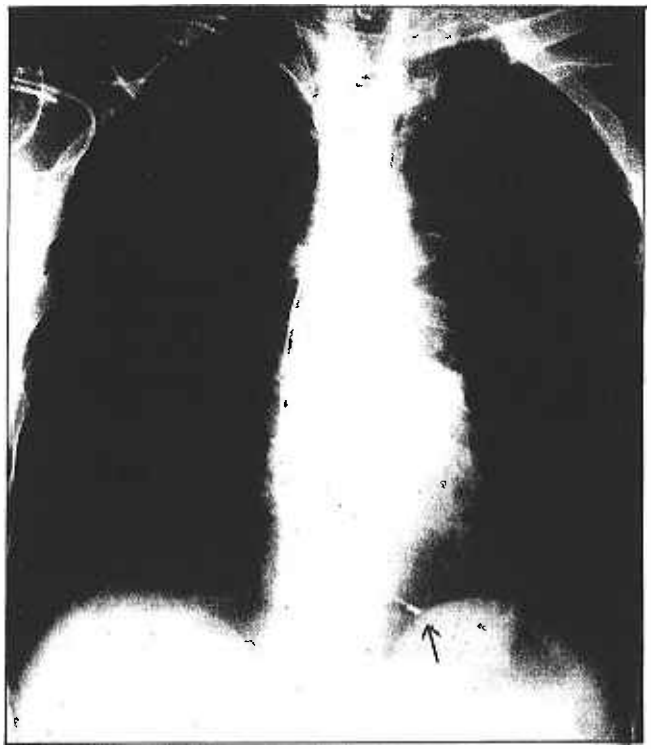

RESULTS

When fluoroscopy was used a minimum of 30 minutes was spent awaiting fluoroscopic space, assembling personnel and equipment, transportation of the patients and equipment to the fluoroscopy room and setting up of equipment before the procedure could be started. The fluoroscopy room was also used for other radiological procedures like Barium enemata and achievement of strict asepsis was doubtful. Transfer of patients from outlying hospitals took a further 45 minutes to one hour, depending on traffic conditions. Hence, an average time of 18 minutes to establish pacing at the bedside in our series was deemed as satisfactory (Table 2).

TABLE 2 - TIME TAKEN FOR STABLE PACING AFTER VENEPUNCTURE

	Minutes	No. of Patients
Average time	18	61
Shortest time	10	3
Longest time	60	2

Threshhold

The maximum threshhold set by Rosenberg et al (5) was 1.5 milliamps. In our series the average threshhold was 0.5 milliamp. (Table 3).

TABLE 3 - THRESHHOLD DURING PACING

	Threshhold in milliamperes	No. of Patients
Average	0.5	61
Lowest	0.1	6
Highest	1	1

Duration of Pacing

The 2 patients in whom the pacemaker was in situ for two weeks were unable to decide on a permanent pacemaker. Finally consent was obtained and the temporary electrodes were removed under fluoroscopy after the permanent pacemaker was placed (Table 4).

TABLE 4 - DURATION OF TEMPORARY PACING

	D a y s	Patients
Average	3	61
Shortest	1	3
Longest	14	2

Complications

I would like to stress that the complications which occurred were not attributable to the fact that fluoroscopy was not used, but are expected complications of transvenous pacing (3, 5) (Table 5).

TABLE 5 - COMPLICATIONS

Type	No. of Patients
Arterial puncture	4
Ventricular fibrillation	1
Pulmonary embolism	1
Pneumothorax	Nil
Perforation	Nil
Air embolism	Nil
Infection	Nil

Arterial puncture responded to manual pressure. Ventricular fibrillation occurred in one patient when the electrode entered the right ventricle. An immediate defibrillatory shock of 200 watts converted the rhythm to sinus rhythm, and pacing was successfully completed. The patient progressed satisfactorily and the electrode was removed after three days. It is conceivable that when the pacemaker stimulus of sufficient intensity and duration falls during the vulnerable phase of the relative refractory period of the preceding beat ventricular arrhythmias may result (6). We believe that in our patient the threshhold for ventricular fibrillation was lowered due to myocardial ischaemia and was an important contributory factor to ventricular fibrillation. Pulmonary embolism occurred in one patient who was paced through the femoral vein. On the 4th post implantation day he developed clinical and radiological features of pulmonary infarction. The pacemaker was removed and he was treated with anticoagulants and he remains well. In 5 patients (Table 6) there was intermittent failure to pace in the absence of battery failure or loose electrical connections. The catheter position was seen to be free floating on the chest x-ray (5 cases). Bedside repositioning was successful in all five. All 4 patients requiring fluoroscopic repositioning were initially paced at the bedside through the femoral vein as subclavian entry was unsuccessful. In all four stable pacing was achieved after fluoroscopic repositioning.

TABLE 6 - ROUTE OF PACING/REPOSITIONING/FLUOROSCOPY

Route used	No. of Patients	No. requiring bedside re-positioning	No. requiring fluoroscopy
Subclavian			
Right	51	5 (successful)	Nil
Left	3		
Femoral			
Right	6		4
Left	1	Nil	

DISCUSSION

Bedside pacing without fluoroscopy is used by us as the standard method of emergency pacing in the Coronary Care Unit of Tan Tock Seng Hospital. The femoral route is used only in children or if subclavian puncture is unsuccessful. It is our practice now to use intravenous Lignocaine 50 mg. in patients with acute myocardial infarction first prior to advancing the electrode into the right ventricle. Apart from the rapidity and convenience with which bedside pacing can be done, the procedure also minimises exposure of doctors, patients and nurses to radiation. Transfer of patients in the acute unstable stage of myocardial infarction is extremely hazardous. Training of senior doctors to perform pacing does not require more than six months. The main disadvantage of the procedure is the higher cost of the balloon electrode ($180/= per catheter) in contrast to the electrode without the balloon which cost about $148/60 each. The essential requisites for the procedure are tabulated (Table 7) and we advocate that it be made available in all hospitals treating patients with acute myocardial infarction.

TABLE 7 - ESSENTIAL REQUISITES FOR TEMPORARY EMERGENCY BEDSIDE CARDIAC PACING

1. Trained medical operator
2. Coronary Care Unit
3. intracardiac electrocardiogram
4. Bipolar balloon flotation pacing electrode
5. Introducer with sheath

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REFERENCES

1. Warthorne J W: Historic milestones of electrotherapy and cardiac pacing. Progress in Cardiovascular Diseases 1981; 23: 389-92.
2. Waldo A L, Wells J L, Cooper T B, MacLean W A H: Temporary cardiac pacing: Applications and techniques in the treatment of cardiac arrhythmias. Progress in Cardiovascular Diseases 1981; 23: 451-66.
3. Farman S, Escher D J W: Principles and techniques of cardiac pacing. New York, Harper & Row 1970: 18-9.
4. Bertrand C A, Zohman L R, Williams M H: Intracardiac electrocardiography in Man. Am J Med 1959; 26: 534-42.
5. Rosenberg A S, Grossman J I, Escher D J W, Farman S: Bedside transvenous cardiac pacing. Am Heart J 1969; 77: 697-703.
6. Thind G S, Musbaum F, Blakemore W S, Bellet S: Ventricular arrhythmias in a patient with artificial pacemakers. Am J Cardiology 1967; 20: 730-4.