

Clinical problems with temporary pacemakers prior to permanent pacing

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In the United Kingdom, patients who need a permanent pacemaker often arrive at a hospital where this facility is not available. It is common practice to insert a temporary pacemaker before transferring such patients to a cardiac centre for permanent pacing. We describe the problems encountered in 145 consecutive patients who received a temporary pacemaker before implantation of a permanent device.

Patients and methods

Between 1 March 1984 and 28 February 1985, 266 patients were referred to the John Radcliffe Hospital, Oxford, for insertion of a permanent pacemaker. A temporary pacemaker insertion preceded implantation of the permanent device in 158 patients, and the records of 145 of these were available for retrospective review. The mean age of the patients was 74.4 years (range 43–88 years) and 81 were men. The initial temporary pacemaker lead was inserted in 116 patients at a district general hospital prior to referral to the regional centre. The remaining 29 patients had their temporary pacemaker lead inserted at the regional cardiac centre.

One hundred and seventy temporary pacemaker procedures were carried out consisting of 145 first insertions, 15 when the pacemaker wire was repositioned, and 10 when the wire was replaced by another. Twenty patients had more than one procedure and 4 of them underwent three or more procedures. The first insertion was made via the subclavian vein in 135 patients (120 on the right). The internal jugular vein was used in 5 patients and an arm vein in 3 patients; the site of entry was not recorded in 2 patients.

Of 110 patients who were paced for atrioventricular block, 65 had suffered syncope, 42 had dizziness or symptoms of heart failure, and 3 were asymptomatic; 5 had had recent myocardial infarction. Of the 35 patients paced for sinoatrial disease or slow atrial fibrillation, 29 gave a history of syncope.

Problems associated with the temporary pacing procedure were classified as 'major' or 'minor' as follows.

Major problems

- Failure to pace: either pacing could not be established or, after insertion of a temporary pacemaker lead, episodes of failure to capture the ventricle occurred.
- Systemic infection: infection at the site of insertion accompanied by pyrexia and/or clinical evidence of septicaemia.
- Pericarditis: pacemaker tip in a site suggesting a pericardial location, accompanied by a pericardial rub or pericardial pain.
- Haemothorax: pleural effusion shown on aspiration to consist of blood, and known to have developed after insertion of the temporary pacemaker.
- Intolerable pacing of the diaphragm.
- Axillary vein thrombosis.
- Pacemaker in the left ventricle.

Minor problems

- Difficulty with venous access: more than one site of entry attempted, or subclavian artery punctured and cannulated.
- Suboptimal although effective lead position: pacemaker electrode lying in a position other than the apex of the right ventricle (eg coronary sinus, pericardium).
- Local infection: frank clinical signs of local sepsis at site of insertion, without evidence of systemic infection.

Results

Clinical problems related to the temporary pacemaker procedure were documented in 74 (51%) patients. At least one major problem was recorded in 52 (36%) patients, and 22 (15%) had minor problems only (Table 1). A major clinical problem occurred in 50 (43%) of the patients who received a temporary pacemaker at one of the district general hospitals, and in 2 (7%) of the patients whose first procedure was at the regional cardiac centre.

There was clinical evidence of systemic infection in 9 patients, and this was confirmed by blood culture in

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5 cases. There were 6 episodes of pericarditis, all accompanied by a rub, with characteristic pain in 3 and loss of pacing in 2 cases. The pacemaker tip was thought to be in a pericardial site on 12 occasions in 11 patients (8%), and associated with failure to pace on 5 occasions. No cases of cardiac tamponade were seen. Haemothorax occurred in 2 patients: on the left side in one, associated with pericarditis and probable right ventricular perforation, and on the right in the other, following difficulty with access to the subclavian vein on that side. No episodes of pneumothorax occurred.

One patient suffered extreme discomfort from pacing of the diaphragm, requiring withdrawal of the pacemaker electrode from its position in the pericardium. In another patient the temporary pacemaker lead was placed inadvertently within the left ventricle, via the right subclavian artery; this was not recognised until withdrawal of the wire caused acute arterial obstruction, necessitating urgent surgery. One patient, who presented with asymptomatic atrioventricular block, had multiple problems, including repeated episodes of failure to pace. He underwent four separate pacing procedures (three insertions and one repositioning), developed septicaemia, acute renal failure, right axillary vein thrombosis, and eventually died from multiple pulmonary emboli. He was the only patient in the series who died during the same hospital admission as the temporary pacemaker procedure.

Failure to pace

In 2 patients, a temporary pacemaker could not be inserted at all, and no further action was taken. In another 38 patients, a temporary pacemaker was successfully inserted but subsequently failed to pace the heart correctly. A total of 44 episodes of failure of the pacing system occurred; these were attributed to displacement of the lead into the right atrium (9), the pericardium (5) or another site (8), to accidental removal of the pacemaker lead (6), and to loose connections (2). The cause of failure was not identified in the remaining episodes. On 30 occasions, action was taken to re-establish pacing, by replacing or repositioning the wire (23), by increasing the output of the pacemaker box (5) or by tightening the connections (2). On the remaining 14 occasions, corrective action was not taken, and in 5 cases the temporary pacemaker lead was removed and not replaced. Of the 116 patients transferred to the cardiac centre after a temporary pacemaker procedure, 20 (17%) arrived without a functioning temporary pacemaker system.

Factors affecting the incidence of problems

Table 2 shows the ten district hospitals listed in a hierarchy according to the number of patients that each contributed to the series, broadly reflecting annual experience with the procedure. The incidence of problems is inversely related to this hierarchy ($p < 0.05$; Spearman's rank correlation test). The incidence

Table 1. Pacemaker problems (categories defined in text), and type of hospital where the initial temporary pacemaker procedure was carried out.

	General hospital	Cardiac centre
Number of patients:-	116/145 (80%)	29/145 (20%)
<i>Major problems</i>		
1. Failure to pace	44	2
2. Systemic infection	9	0
3. Pericarditis	6	0
4. Haemothorax	2	0
5. Pacing of diaphragm	1	0
6. Axillary vein thrombosis	1	0
7. Pacemaker in the left ventricle	1	0
<i>Total</i>	64/66 (97%)	2/66 (3%)
<i>Minor problems</i>		
1. Difficulty with access	9	6
2. Suboptimal but effective position:		
(a) Right ventricular outflow tract	3	0
(b) Coronary sinus	2	0
(c) Pericardium	2	1
(d) Other	3	0
3. Local infection	7	0
<i>Total</i>	26/33 (79%)	7/33 (21%)

of problems was also related to the length of time that the temporary pacemaker was in position. Problems occurred in 35% of patients whose leads were in place for less than 3 days, 58% when the period was 3-4 days, 48% for 5-6 days, 54% for 7-8 days, and 89% for periods of 9 days or more ($p = 0.05$; Spearman's rank correlation test).

Table 2. Number of patients contributed to the series by each hospital.^a

Hospital	Total of patients	Patients with pacemaker problems
A	34	15 (44%)
B	18	9 (50%)
C	16	9 (60%)
D	15	9 (60%)
E	10	8 (80%)
F-J	23	17 (74%)
District hospitals total:	116	67 (58%)
Regional cardiac centre	29	7 (24%)

^aA to J are district general hospitals, ranked in descending order according to the number of patients each contributed to the series. Hospitals F to J contributed fewer than 10 patients each.

Discussion

This study emphasises that temporary pacing may be ineffective and can result in serious complications in a significant proportion of patients. Tancredi *et al.*, reporting early experience with transvenous temporary pacemakers at the Mayo Clinic, observed complications in 35% of patients, including intermittent failure to pace due to malposition of the electrode in 25% of cases [1]. In subsequent studies, episodes of pacemaker malfunction have been distinguished from complications (defined as adverse clinical events attributable to the device), with failure to capture or sense the impulse reported in 18–43% of cases, and complications in 14–20% [2–4]. We have attempted to classify the problems arising from temporary pacemaker therapy in a way that will give meaningful information to a clinician deciding on its use. Thus, any period of failure to pace is regarded as a major problem in a patient for whom this procedure has been deemed necessary. By contrast, perforation of the right ventricle, with the wire taking a pericardial position, may be a minor event in the absence of pericarditis or tamponade, and with no interruption of pacing.

There are important differences between this series and those reported previously [1–4]: (1) The previous studies were exclusively concerned with procedures carried out in specialist cardiac units and supervised by cardiologists. (2) They were based in coronary care units and included many patients who received temporary pacemakers as part of the management of acute myocardial infarction; this probably explains why tachyarrhythmias were common complications in these series. (3) The preferred sites of venous access have changed with time. Femoral and brachial venipunctures predominate in the early series, and only that of Hynes *et al.* [4] includes a significant number of insertions via the subclavian vein (19%) and internal jugular vein (12%). The subclavian vein was clearly the preferred site in our patients (93% of first insertions), and this may account for some of the differences in the complications observed.

Our study shows an inverse relationship between the frequency of problems with temporary pacemakers and local experience with the procedure. A similar relationship between outcome and the number of procedures carried out in different hospitals has been reported for cardiac catheterisation [5] and some surgical operations [6]. For central vein catheterisation [7] there is a strong relationship between the complication rate and the experience of the individual operator. Our findings clearly emphasise the need for appropriate training and supervision of those doctors who may be required to insert a temporary pacemaker.

Many district general hospitals do not have a physician with specialist training in cardiology to assume this responsibility [8].

Once it has been decided that a permanent pacemaker is indicated, the optimum management would be to proceed to immediate insertion. Logistical problems prohibit this course for many patients, especially those diagnosed away from a cardiac centre. The decision to insert a temporary pacemaker in this situation must be based on an assessment of risk versus benefit in each case. Our findings suggest that in some cases temporary pacing may be ineffective and may carry risks that outweigh the benefits.

Sinoatrial disease (the sick sinus syndrome) has a good prognosis, and permanent pacemaker implantation does not appreciably reduce mortality, even in patients with symptoms [9]. In this condition, the hazards of temporary pacing for a brief period before permanent pacemaker insertion might reasonably be avoided. The prognosis in untreated atrioventricular block is more grave, but temporary pacing may not be justified in some cases, especially in the absence of syncope, and in a hospital with limited experience of the procedure.

Acknowledgements

We are grateful to Professor P. Sleight and Dr B. Gribbin for permission to report on patients under their care.

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