Prognosis of patients paced for chronic atrioventricular block

WILLIAM GINKS, AUBREY LEATHAM, AND HAROLD SIDDONS

From the Department of Cardiology, St George's Hospital, Hyde Park Corner, London

SUMMARY Between the years 1960 and 1974, 839 patients were paced for chronic complete atrioventricular block.

Analysis of survival compared with the general population showed that 170 deaths were expected according to standard mortality tables and 288 actually occurred, giving a ratio of actual to expected deaths of 1.7:1.

Patients with a definite history of myocardial infarction showed a higher than average mortality when paced. Mortality was not influenced whether heart block was constant or intermittent, whether the ventricular rate was below or above 40/minute, or whether QRS duration was greater or less than 0.1 second.

Analysis of the age groups paced disclosed the most important correlations. Between the ages of 80 and 89 years paced patients could expect to survive as long as others of the same age without heart block. There was, however, a very high mortality ratio of 4.5:1 for 90 patients in the age group 50 to 59 years. The reason for the high mortality ratio was uncertain but it may have been the result of a greater incidence of underlying coronary artery disease.

In 1974, Siddons analysed the survival of patients paced for chronic complete heart block. The comparison was made of 649 paced patients and 113 patients who were unpaced despite chronic atrioventricular block, and the comparison was also made with the survival pattern of the general population. Survival of the paced patients was much better than that of the unpaced group, despite the fact that the unpaced patients were selected as 'good risk cases' in the early 1960's before pacing had become a standard procedure. It was noted that in the first year after the start of pacing the mortality was higher than in subsequent years. It was also noted that survival rate after this first year of pacing was very close to that of the general population matched for age and sex, and for these reasons a more detailed statistical study of the survival of paced patients was undertaken.

Methods

The records of all patients with complete heart block, paced on a long-term basis, were analysed with regard to age and symptoms on initial pre-

sentation. In each case attention was drawn to a previous history of syncope, angina, myocardial infarction, and cardiac failure, though in a number of instances some features of the previous history were inadequately documented and analysis of all 839 patients was, therefore, incomplete. Examination of the electrocardiogram was also undertaken in patients where a complete 12 lead electrocardiogram before pacing was available for review. Patients were categorised according to the type of idioventricular rhythm; patients with complete heart block and an idioventricular rhythm with left anterior hemiblock had a mean frontal QRS of greater than -30° ; those with an idioventricular rhythm of right bundle-branch block type had a QRS duration of 0.12 s or greater and an rSR' in lead V1; those with an idioventricular rhythm of left bundle-branch block type had a QRS of 0.12 s or greater and a broad monophasic R wave in lead V6 (New York Heart Association, 1969).

Patients paced for other conditions such as sinuatrial disease without atrioventricular block were excluded. In addition, patients with acute infarction block with early return to sinus rhythm were excluded but we have included a few cases who continued in complete heart block after in-

Table 1 *Analysis of survival of paced patients compared with the general public matched for age and sex*

		No. of patients	Years of exposure	Actual deaths	Expected deaths	Mortality ratio
Duration	Total	839	2872.5	288	169.9	1.7:1
	1st year	839	793.5	114	43.8	2.6:1
	2nd year	640	597.5	56	34.7	1.6:1
	3rd-5th year	504	1039.5	90	64.1	1.4:1
	6th year and up	200	442	28	27.3	1:1
Sex	Male	504	1653	177	107.5	1.7:1
	Female	335	1219.5	111	62.5	1.8:1
Age first paced	50-59	90	404	29	6.5	4.5:1
	60-69	270	1026	90	34.4	2.6:1
	70-79	350	1090.5	119	79.0	1.5:1
	80-89	129	352	50	50.1	1:1
	1960-1965	105	568.5	73	25.4	2.9:1
Calendar year of first pacing	1966-1974	734	2304	215	144.5	1.5:1
Syncope	Syncope	703	2490	243	147.8	1.7:1
	No syncope	132	367	41	21.4	1.9:1
	No record	4				
Angina	Angina	197	730.5	77	38.4	2.0:1
	No angina	599	1996	191	121.4	1.6:1
	No record	43				
Infarction	Infarct	77	245.5	34	11.8	2.9:1
	No infarct	670	2339	214	140.6	1.5:1
	No record	92				
Cardiac failure	Failure	198	533.5	79	39.5	2.0:1
	No failure	545	1996	140	111.8	1.3:1
	No record	96				
Intermittent block	Intermittent	225	889	84	45.6	1.8:1
	Established	614	1983.5	204	124.3	1.6:1

farcion. In order to make the series homogeneous and suitable for comparison with the general population we excluded patients under 50 and over 89 years, cases previously paced at other hospitals, patients not living in the United Kingdom, those patients with post-surgical block, and cases paced immediately before operation for carcinoma or severe peripheral vascular disease.

A detailed statistical analysis of the mortality of paced patients was made by the Swiss Re-Insurance Company's Statistical Department. The figures for the general population are taken from the Registrar General's report of 1968 for the South East of England from which the paced patients were drawn.

Results

There were 839 patients paced for chronic atrioventricular block with a presenting symptom of syncope in nearly all cases. The average observation period was 3.4 years and the follow-up to 31 December 1974 was 98 per cent complete. There were 504 men and 335 women.

The analysis of survival compared with the general population is shown in Table 1. In the general population 169.9 deaths were expected according to the standard mortality tables but 288 deaths actually occurred. The ratio of actual over expected deaths of the population of the same age and sex was therefore 1.7:1. This is the average

mortality ratio for the whole of the paced series. In the first year of pacing, there was an extra mortality amounting to a ratio of 2.6:1, with 114 deaths when 43.8 were expected in the general population. The outlook for patients who were paced for 5 years matched almost exactly that of the general population. In the first 5 years of our experience (1960 to 1965) during which 105 patients were paced, the outlook was worse than since that date.

As expected those patients with a previous history of myocardial infarction showed a higher than average mortality.

A history of syncope occurred in 703 cases and may have been expected to carry a higher mortality than in the 132 cases without syncope, but there was little difference. Whether the atrioventricular block was constantly present or intermittent, or whether the ventricular rate was below or above 40 did not influence mortality. Though the mortality of women is lower than that of men in the general population, in the age groups considered, a similar mortality ratio between the two sexes was seen in the paced series.

It was hoped that analysis of the electrocardiogram before pacing was instituted might give some indication of prognosis but there was no significant difference when we analysed groups consisting of complete heart block with an idioventricular rhythm of right bundle-branch block type, complete heart block with a QRS of 0.1 s or less, or

Table 2 *Electrocardiographic findings related to long-term prognosis**

	No. of patients	Actual deaths	Expected deaths	Mortality ratio
Complete block with RBBB	437	150	94.8	1.6:1
Complete block with LBBB	151	49	30.8	1.6:1
Complete block QRS 0.1 s or less	99	26	16.3	1.6:1
Complete block QRS more than 0.1 s	640	225	134.6	1.7:1
Complete block with LAD	324	120	68.6	1.8:1

*Of the 839 patients reviewed in this series the pre-pacing electrocardiogram was not available for analysis in 61 patients and 39 patients had normal conducted sinus rhythm.

Table 3 *Mortality in 128 unpaced patients*

Age when first seen (y)	No. of patients	Actual deaths	Expected deaths	Mortality ratio
50-69	67	30	7.3	4.1:1
70-89	61	37	15.4	2.4:1

complete heart block with left axis deviation (Table 2).

The most important correlations were found when analysing the age groups paced (Table 1). These figures suggest that patients between the ages of 80 and 89 years when paced can expect to live as long as others of the same age and sex without heart block. There was, however, a very high mortality ratio of 4.5:1 for the 90 patients in the age group 50 to 59 years. This higher mortality ratio was also apparent in the very much smaller series of unpaced patients (Table 3). This analysis was based on 128 patients observed unpaced for a minimum period of 6 months. Of the 128 patients, 52 were subsequently paced and are thus included in both the unpaced and paced series.

Discussion

The higher mortality in the first year of pacing compared with subsequent years is similar to that reported by Sowton (1967) and Edhag (1969) and is largely the result of underlying myocardial or coronary disease, the complications of the surgical procedure, and sudden death sometimes known to be caused by ventricular fibrillation; it also includes a few deaths from technical failure of the pacing system. In addition, the high mortality in the early years of our pacing experience (before 1965) is similar to that of others when pacing was undertaken by the epicardial route. A detailed study of reports from this period suggests that a

significant number of deaths were directly related to thoracotomy and were the result of chest complications and postoperative sepsis. Our own postoperative mortality with methods using thoracotomy was 8 in 59 patients (Harris *et al.*, 1965) as opposed to 1 in 49 patients with pacemaker implants associated with endocardial electrodes (Bluestone *et al.*, 1965).

Since a proportion of deaths are sudden despite pacing, we reviewed a variety of pre-pacing features including syncope, previous myocardial infarction, heart failure, and the electrocardiographic appearances in relation to eventual prognosis. As noted by Cosby *et al.* (1965) the presence or absence of previous myocardial infarction was the critical factor in determining prognosis and none of the other clinical or electrocardiographic indices were significantly related to long-term survival.

The most interesting feature of this study was revealed when survival was correlated with the age at which the patient was first paced. During the course of follow-up, in the group as a whole, approximately 1 in 3 patients had died irrespective of the age when first paced (Table 1). The poor prognosis of the patients under 60 years only becomes apparent when compared with patients of the same age in the general population without heart block. The relatively poor prognosis in the younger patient paced for complete heart block is presumably the result of the presence of additional heart disease such as coronary artery disease or congestive cardiomyopathy, whereas in the older patient heart block is commonly associated with idiopathic bundle-branch fibrosis without additional cardiac pathology (Davies, 1971).

Previous reports from our group have shown how difficult it is in life to determine the aetiology of atrioventricular block because once left bundle-branch block or complete heart block has developed the electrocardiogram is usually unhelpful (Harris *et al.*, 1969; Chatterjee *et al.*, 1970). In a recent communication (Siddons, 1974) we have analysed the causes of death in 145 long-term paced patients: 33 per cent of deaths were attributed to cardiovascular complications such as congestive heart failure, myocardial infarction, and cerebrovascular accidents; in 31 per cent of cases death was the result of unrelated causes such as malignancy and pneumonia; late sudden death occurred in 23 per cent of patients, and death was attributed to pacing in 8 per cent of the series. Unfortunately standard necropsy procedures rarely provide definite evidence of the aetiology of atrioventricular block or of the mechanisms of death. A detailed necropsy including coronary angiography and a study of serial sections of the conducting tissue has been carried out in

130 patients at our institution paced for chronic atrioventricular block (M. J. Davies, 1978, personal communication). The pathology of the underlying atrioventricular block was considered to be a result of idiopathic bundle-branch fibrosis in 43 per cent of cases; 24 per cent of patients had severe coronary artery disease, and block was associated with diffuse cardiomyopathy in 11 per cent of cases. The incidence of coronary artery disease as a cause of death in paced chronic heart block varies widely. Robboy *et al.* (1969) recorded 7 necropsies, in 3 of which acute myocardial infarction was considered the cause of death. Donmoyer *et al.* (1967) reported 17 deaths, 4 of which were attributable to myocardial infarction with necropsy confirmation in 3. Edhag (1969) reviewed the mode of death in 62 of 260 patients paced for complete heart block. Myocardial infarction was shown at necropsy in 23 (44%) of the 52 patients coming to necropsy, and infarction was estimated to be less than 2 weeks old in 17 of the 23 patients.

Although we are uncertain at the present time as to the cause of the high mortality ratio in patients paced for complete heart block in middle age, the increased risk of death may reflect a higher incidence of ischaemic heart disease as the cause of the atrioventricular block and this possibility needs further investigation. When considering the prognosis of paced chronic heart block it is therefore important to consider the age group involved. For those patients who have none of the adverse features, that is those who are aged 60 to 89 years, first paced after 1965, and with no previous history of myocardial infarction, the expectation of life if paced does not differ from that of the general population of the same age and sex without heart block.

References

- Bluestone, R., Davies, G., Harris, A., Leatham, A., and Siddons, H. (1965). Long term endocardial pacing for heart block. *Lancet*, **2**, 307-312.
- Chatterjee, K., Harris, A., Patrick, J., Alpern, H., and Davies, M. (1970). The electrocardiogram in chronic heart block. *American Heart Journal*, **80**, 47-55.
- Cosby, R. S., Cafferky, E. A., Lau F. T. K., and Rohde, R. A. (1965). Electrocardiographic and clinical features in the prognosis of complete heart block (abstract). *American Journal of Cardiology*, **15**, 128.
- Davies, M. J. (1971). *Pathology of Conducting Tissue of the Heart*. Butterworths, London.
- Donmoyer, T. L., De Sanctis, R. W., and Austen, W. G. (1967). Experience with implantable pacemakers using myocardial electrodes in the management of heart block. *Annals of Thoracic Surgery*, **3**, 218-227.
- Edhag, O. (1969). Long-term cardiac pacing. *Acta Medica Scandinavica*, Suppl. 502, 65-70.
- Harris, A., Bluestone, R., Busby, E., Davies, G., Leatham, A., Siddons, H., and Sowton, E. (1965). The management of heart block. *British Heart Journal*, **27**, 469-482.
- Harris, A., Davies, M., Redwood, D., Leatham, A., and Siddons, H. (1969). Aetiology of chronic heart block. A clinico-pathological correlation in 65 cases. *British Heart Journal*, **31**, 206-218.
- New York Heart Association (1969). *Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Blood Vessels*. Little Brown, Boston.
- Registrar General (1968). *Decennial Supplement for England and Wales 1961: The English Life Tables*, No. 12. H.M.S.O., London.
- Robboy, S. J., Harthorne, J. W., Leinbach, R. C., Sanders, C. A., and Austen, W. G. (1969). Autopsy findings with permanent percutaneous pacemakers. *Circulation*, **39**, 495-501.
- Siddons, H. (1974). Deaths in long-term paced patients. *British Heart Journal*, **36**, 1201-1209.
- Sowton, E. (1967). Cardiac pacemakers and pacing. *Modern Concepts of Cardiovascular Disease*, **36**, 31-36.

Requests for reprints to Dr William Ginks, Department of Cardiology, St George's Hospital, Hyde Park Corner, London SW1X 7EZ.