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NATURAL HISTORY OF "HIGH-RISK" BUNDLE-BRANCH BLOCK

Final Report of a Prospective Study

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Abstract We conducted a prospective study in which 554 patients with chronic bifascicular and trifascicular conduction abnormalities were followed for an average of 42.4±8.5 months. Heart block occurred in 19 patients, and 17 were successfully treated. The actuarial five-year mortality from an event that could conceivably have been a bradyarrhythmia was 6 per cent (35 per cent from all causes). Of the 160 deaths, 67 (42 per cent) were sudden; most of these were not ascribable to bradyarrhythmia but to tachyarrhythmia and myocardial infarction. Mortality was higher in patients with coronary-artery disease ($P<0.01$) and congestive heart failure ($P<0.05$).

Patients in whom syncope developed before or after entry into the study had a 17 per cent incidence of heart block (2 per cent in those without syncope)($P<0.05$); however, no single variable was predictive of which patients were at high risk of death from a bradyarrhythmia. The predictors of death were increasing age, congestive heart failure, and coronary-artery disease; the predictors of sudden death were coronary-artery disease and increasing age.

The risks of heart block and of death from a bradyarrhythmia are low; in most patients, heart block can be recognized and successfully treated with a pacemaker. (N Engl J Med. 1982; 307:137-43.)

A PROSPECTIVE evaluation of the natural history of chronic bifascicular and trifascicular conduction abnormalities was initiated in December 1973 to determine the frequency of heart block, death, sudden death, and death due to bradyarrhythmias and to establish the value of clinical, electrocardiographic, and electrophysiologic indexes as prognostic indicators of these major clinical events. Our preliminary results have been presented previously.[1]

METHODS

The methodology of the study has been described in detail[1] and has not been changed since the beginning of the project. In brief, all electrocardiograms obtained at the University of Oregon Medical School from December 1973 to December 1979 and at the Portland Veterans Administration Hospital from December 1976 through December 1979 were reviewed, and patients with evidence of bifascicular and trifascicular conduction-system disease were identified. Attempts were made to contact as many of these patients as possible, and those agreeing to participate were enrolled in this long-term research project. An investigational intracardiac electrophysiologic study was performed in those consenting.[1,2] Each patient was seen in a special cardiac-conduction research clinic at least every six months.[1]

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Exclusions from the Study

Patients with terminal noncardiac disease, such as cancer or end-stage renal or pulmonary disease, were excluded. Those with bundle-branch block who first presented at the institutions with symptoms that were documented as due to a bradyarrhythmia were excluded[1]; these patients were treated with pacemakers.

Definitions

The criteria used for the diagnosis of electrocardiographic abnormalities and the associated heart disease, clinical findings, and clinical events have been described.[1,3] Syncope was defined as a sudden, complete loss of consciousness with rapid recovery. Congestive heart failure was diagnosed in patients with cardiomegaly on a chest x-ray film and symptoms of dyspnea on exertion, or with evidence of an S3 gallop sound and rales at the lung bases on physical examination, or both. Heart block was diagnosed when Mobitz II, advanced, or complete heart block was documented on the electrocardiogram or monitor tracing. Sudden death was defined as death occurring within 24 hours of the onset of terminal symptoms, according to the accepted criteria at that time.[1,4,5]

Special events were defined as any deaths that could possibly have been due to a bradyarrhythmia and thus might have been prevented if a permanent pacemaker had been inserted when the bundle-branch block was first recognized. They included deaths documented as due to bradyarrhythmias, sudden deaths of unknown causes, and deaths in which the circumstances of the fatal event were unknown or, if known, were inadequate to allow classifying death as sudden or non-sudden.

Data Storage and Analysis

All clinical, electrocardiographic, and electrophysiologic data were entered on a CDC Cyber 70/73 computer at Oregon State University. A data-management system, Scientific Information Retrieval,[6] was used to update patients' files every six months. Routine statistical analysis of the data was performed with the Statistical Package for the Social Sciences.[7] Specific analyses of survival were performed according to the method of Kaplan and Meier.[8] P values above 0.05 were not considered significant.

Results

Patients' Characteristics

In the 6½ years of the study 554 patients were enrolled as participants (Table 1); 351 underwent investigational electrophysiologic studies ("studied"). Two hundred three agreed to participate in the project but refused the electrophysiologic study ("not studied").

Electrophysiologic Data

The HV interval (conduction time through the His–Purkinje system) was 58.8±14.8 msec (mean ±S.E.) (the normal value[9] is ≤55). Forty-six per cent of the group had a normal HV interval, and 54 per cent had a prolonged HV interval; 11 per cent had a greatly prolonged HV interval (>75 msec). No subgroup based on electrocardiographic or etiologic findings or on symptoms had a significantly greater incidence of associated HV prolongation. Block below the His bundle with atrial pacing occurred in nine patients (2.6 per cent). The mean AH interval (conduction time through the atrioventricular node) was 95±1.8 msec, and the sinus-node recovery time at an atrial cycle length of 545 msec was 1100±193 msec.

Table 1. Characteristics of the Patients.

	Patient Group		Total
	"Studied"	"Not studied"	
Group total	351	203	554
Age (yr, mean ±S.D.)	63.2±13.9	66.2±13.8	64.3±13.9
Sex (per cent of group)			
Men	70	59 *	66
Women	30	41	34
Clinical characteristics (per cent of group)			
Syncope ever	31	15 *	25
Recurrent syncope	11	3	8
Congestive heart failure	31	16 *	25
Cause of block (per cent of group)			
Coronary-artery disease			
Previous infarction	25	18 *	23
No previous infarction	19	12 *	16
Primary conduction disease	21	34 *	26
Other disorder	35	36	35
Electrocardiographic pattern (per cent of group)			
Bundle-branch block			
Left	36	41	38
Left, with left-axis deviation	9	7	8
Right, with left-axis deviation	32	28	31
Right, with right-axis deviation	17	18	17
Other	6	6	6
First-degree atrioventricular block	15	9	13
Premature ventricular contractions (>3 per electrocardiogram)	4	2	3

*Significantly different from value for studied patients (P<0.05).

Follow-up

The mean follow-up period (±S.E.) was 42.4±0.85 months with a range of six to 78 months. Only 15 patients, 2.7 per cent of the total study group, were lost to final follow-up (June 1980): eight (2.3 per cent) of those "studied," and seven (3.4 per cent) of those "not studied." At least six months of follow-up information was available for all but one living patient.

Table 2. Actuarially Determined Incidence of Deaths in All 554 Patients.

	Incidence (No. at Risk) *		
	At 1 yr	At 3 yr	At 5 yr
	per cent — mean ±S.E.		
All deaths			
"Studied" group	8±1.5 (321)	21±2.2 (221)	35±3.0 (69)
"Not-studied" group	7±1.7 (188)	24±3.1 (122)	38±4.3 (28)
Total	8±1.1 (509)	22±1.8 (343)	35±2.4 (97)
Sudden deaths			
"Studied" group	4±1.0	10±1.5	18±3.1
"Not-studied" group	3±1.0	10±2.1	17±3.6
Total	3±1.0	10±1.5	17±2.1
Special events			
"Studied" group	2±0.5	4±1.0	7±1.5
"Not-studied" group	1±1.0	3±1.5	5±2.1
Total	1±0.5	4±0.5	6±1.5

*Number of patients who have been followed for the designated period of time. The numbers of patients at risk in the "sudden deaths" and "special events" categories are the same as those for "all deaths."

Clinical Events (Table 2)

The incidences of major clinical events (Table 2) and of heart block (4 per cent and 2.5 per cent) in the "studied" and "not-studied" groups were not significantly different. Because of this, the 554 patients were considered as a single group in evaluating the events in greater detail (Tables 3 and 4; Fig. 1 to 6).

Deaths (Table 3)

One hundred sixty patients (28.9 per cent of the group) died during the study. The mortality at five years was 35 per cent. Eighty-six deaths (54 per cent) were non-sudden. The most frequent cause of death was chronic congestive heart failure; other causes included chronic pulmonary disease and chronic renal failure. Sixty-seven deaths (42 per cent) were sudden; 49 of these 67 (73 per cent) were demonstrated to have been due to causes other than bradyarrhythmias, most often acute myocardial infarctions or tachyarrhythmias (24 patients and 12 patients, respectively). In seven patients the circumstances of death are not sufficiently known to allow proper classification.

Special events occurred in 25 patients. Sixteen of these 25 died suddenly and the circumstances of death were not known; two died with documented bradyarrhythmias, and the remaining seven were those in

Table 3. Events in All 554 Patients.

	No. of Patients
Death	160
Non-sudden	86
Sudden	67
Secondary to bradyarrhythmias	(2)
Secondary to other cause	(49)
Unknown cause	(16)
Unknown	7
Complete heart block	19
Permanent	17
Transient	2
Permanent pacemaker implantation	30
Syncope (after entry into study)	47
Secondary to bradyarrhythmia	19
Recurrent	12

whom the circumstances and cause of death could not be determined.

Heart Block (Fig. 2)

Heart block was documented in 19 patients an average of 24 months after entry into the study (range, two to 67 months). The cumulative incidence of heart block at five years was 4.9 per cent — a rate of about 1.0 per cent per year. Eighteen of the 19 patients had symptoms, but only nine presented with syncope; the other nine had fatigue, dyspnea, or chest pain. Sixteen of these patients received permanent pacemakers. Two patients died before permanent pacemakers were inserted: one died before a temporary wire could be implanted, and the other because of failure of a temporary transvenous pacemaker wire. One patient had transient heart block at the time of a subsequent inferior myocardial infarction and was not given a permanent pacemaker; he had no recurrences of heart block in four years of subsequent follow-up. An additional patient had heart block when he was receiving quinidine for control of tachyarrhythmias; he was given a pacemaker. During follow-up of the 16 patients given permanent pacemakers, five died — one of them suddenly; none had a special event during the time of follow-up.

Need for Permanent Pacemakers

Permanent pacemakers were inserted in 30 patients. Sixteen were those described above in whom documented complete heart block developed. Nine received a pacemaker because of symptomatic bradyarrhythmias resulting from sinoatrial disease,[2] and two because of a slow ventricular response to atrial fibrillation. One patient received a pacemaker for a presumed but never documented bradyarrhythmia (symptoms persisted after pacemaker insertion). One received a pacemaker at the time of aortic-valve replacement; the decision to do this was made by physicians looking after the patient because of a previously documented prolonged HV interval. In one patient a pacemaker was inserted at another hospital for unclear reasons.

Syncope

Forty-seven patients (8.5 per cent) had syncope after entry into this study. Eight had also had syncope at some time before entry. The syncope was documented as secondary to bradyarrhythmias in 19; sinoatrial disturbances were the cause in 10, and heart block was the cause in nine. Syncope was demonstrated to have been caused by tachyarrhythmias in five patients and was of uncertain cause in 23. Syncope recurred after entry into the study in 12 patients; heart block was the documented cause in two of these 12, and ventricular fibrillation in one.

Identification of High-Risk Subgroups

Electrocardiographic Findings (Table 4)

There were no significant differences in deaths, sudden deaths, or special events in comparisons of patients with different electrocardiographic patterns. A prolonged PR interval (found in 13 per cent) was associated with an increased chance ($P<0.05$) of all death, sudden death, and special events. There was no significant difference in the incidence of documented complete heart block between patients with a normal PR interval and those with a prolonged one. A higher percentage of patients with a prolonged PR interval had congestive heart failure (37 per cent) or were taking digitalis (53 per cent) ($P<0.05$).

The presence or number of premature ventricular beats on the initial electrocardiogram was not helpful in predicting which patients were at risk of death, special events, or heart block.

Cause of Heart Disease

The incidences of death, sudden death, and special events were not significantly different among patients with valve disease, hypertensive disease, cardiomyopathy, or congenital heart disease. Therefore, all these diagnoses were included under "other" heart

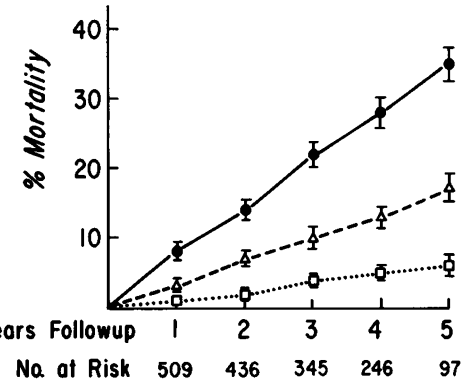

Figure 1. Actuarially Determined Cumulative Incidence (Mean ±S.E.) of All Deaths (Circles), Sudden Deaths (Triangles), and "Special Events" (Squares).

The number at risk refers to the number of patients who were followed for the designated period of time (for example, 509 patients who completed one year of follow-up).

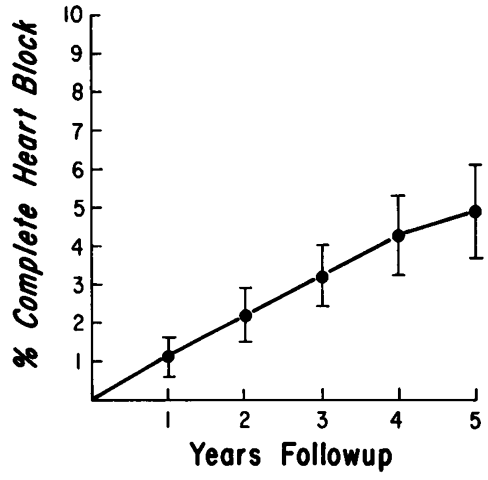

Figure 2. Cumulative Incidence (Mean ±S.E.) of Complete Heart Block.

disease. Survival in this group was not significantly different from that in the group with primary conduction-system disease. The cumulative incidence of death and sudden death was significantly lower ($P<0.01$) in patients with "other" heart disease or primary conduction-system disease than in those with coronary-artery disease (Fig. 3). There were no significant differences in the incidences of special events in these groups. Among patients with coronary-artery disease there was no significant difference in the incidences of death, sudden death, or special events when those who had had a myocardial infarction before entry into the study were compared with those who had not had a previous infarction.

Clinical Status

Patients with a history of syncope or with recurrent syncope were at no increased risk of death, sudden death, or special events, as compared with patients with no syncope (Fig. 4). A higher percentage of patients with syncope were eventually shown to have development of complete heart block (17 per cent) as compared with patients without syncope (2 per cent)($P<0.05$).

Table 4. Actuarially Determined Cumulative Incidence of Deaths and Special Events at Five Years, According to Electrocardiographic Feature.

	Incidence		
	ALL DEATHS	SUDDEN DEATHS	SPECIAL EVENTS
	per cent — mean ±S.E.		
Bundle-branch block			
Left	36±4.6	17±4.1	7±2.6
Left, with left-axis deviation	38±9.2	13±7.1	6±5.1
Right, with left-axis deviation	39±4.6	16±4.1	1±1.0
Right, with right-axis deviation	28±4.6	14±4.1	8±3.1
PR interval			
≤0.20 sec	32±3.6	15±2.6	4±1.0
>0.20 sec	50±8.1	32±7.4	20±7.6
All patients	35±2.4	17±2.1	6±1.5

Patients with congestive heart failure had an increased overall incidence of death and sudden death, as compared with those without congestive failure ($P<0.05$), but there was no significant difference in the incidence of special events between the two groups (Fig. 5).

Intracardiac Electrophysiologic Data

The PA and AH intervals were not useful in predicting death. Patients with a prolonged (>55 msec) or a greatly prolonged (>75 msec) HV interval did not have a statistically increased risk of death, sudden death, special event, or heart block, as compared with patients with a normal HV interval (Fig. 6). The incidence of heart block was 4.9 per cent in patients with a prolonged HV and 1.9 per cent in those with a normal HV; the difference was not statistically significant. Of the nine patients in whom block developed below the

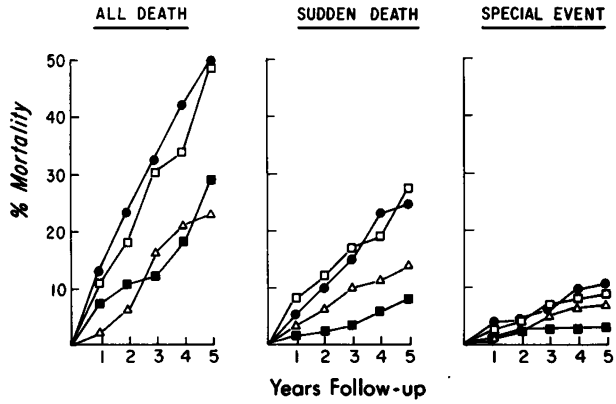

Figure 3. Cumulative Mortality, According to Underlying Heart Disease.

Circles denote patients with coronary-artery disease and previous myocardial infarction, open squares those with coronary-artery disease but no infarction, solid squares those with primary conduction-system disease, and triangles those with other cardiac disorders.

Patients with coronary-artery disease with or without myocardial infarction at the time of entry into the study had a significantly higher cumulative incidence of death and sudden death ($P<0.01$).

His bundle during atrial pacing, four died during the follow-up period; one had sudden death, and none of these patients had a special event. None of the nine had been treated with a permanent pacemaker.

Relative Predictors of Events

Increasing age, heart failure, and coronary-artery disease (in that order) were the most predictive of all deaths. Coronary-artery disease and increasing age (in that order) were most predictive of sudden death. Only a prolonged PR interval was predictive of a special event.

Discussion

Our study shows that in patients with chronic "high-risk" bundle-branch block, the cumulative inci-

dences of all deaths and sudden deaths at five years were 35 per cent and 17 per cent, respectively. Patients with coronary-artery disease (with or without previous myocardial infarction) and those with congestive heart failure had a significantly higher mortality. The cumulative incidence of recognized heart block at five years was 4.9 per cent; 17 of the 19 patients with this arrhythmia were successfully treated. Seventeen per cent of patients with syncope eventually had heart block, in contrast to 2 per cent of patients without syncope. The cumulative incidence of a special event (a death conceivably due to a bradyarrhythmia) at five years was 6 per cent. Except for a prolonged PR interval, a special event could not be predicted from any clinical, electrocardiographic, or electrophysiologic finding or any combination of such findings.

The mortality in our patients was high; however, sudden deaths accounted for only 42 per cent of these deaths, and 73 per cent of the sudden deaths were accounted for by causes other than bradyarrhythmia. This important finding shows that sudden death in these patients cannot be assumed to have been caused by a bradyarrhythmia. Death in these patients was

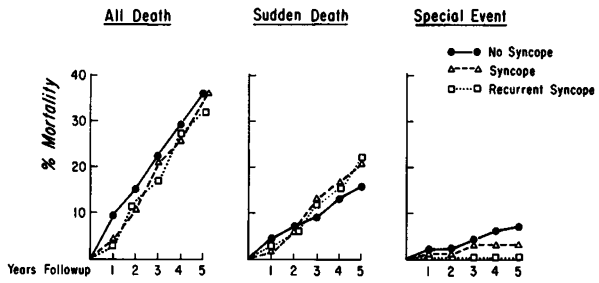

Figure 4. Cumulative Mortality, According to Presence or Absence of Syncope after Entry into the Study.

related to their underlying disease. Most patients with bundle-branch block have associated heart disease[3,10]; in our study the rate was 74 per cent. The total mortality among patients who did not have clinically recognizable heart disease was similar to that among patients without coronary heart disease (29 per cent vs. 23 per cent), but it was significantly lower than that among patients with coronary-artery disease. The total mortality in patients with coronary-artery disease and a previous myocardial infarction was 49 per cent at five years and 45 per cent in those with coronary-artery disease but without a previous myocardial infarction. The total mortality at five years of those in heart failure was 56 per cent, in contrast to 28 per cent in those without heart failure. The incidence of sudden death was also significantly higher in patients with coronary-artery disease and in those with heart failure. Thus, it appears that the major determinants of total mortality and of sudden death in these patients were their underlying cardiac disease (particularly coronary-artery disease) and the status of their cardiac function rather than the bundle-branch block. Patients with a greatly prolonged HV interval or a pro-

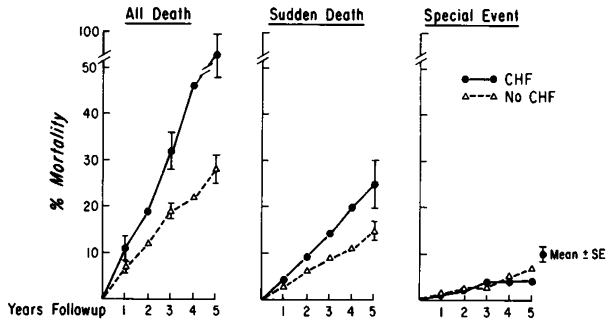

Figure 5. Cumulative Mortality, According to Presence or Absence of Congestive Heart Failure (CHF).

Patients with congestive heart failure had a higher cumulative incidence of all deaths (56 per cent) and sudden deaths.

longed PR interval were also shown to have a high mortality. A greatly prolonged HV interval is more frequently associated with heart failure[10,11] (the problem of evaluating a prolonged PR interval is discussed below).

Our prospective study shows that the "high-risk" patients were not at high risk for the development of heart block, even though this development was thought likely on the basis of isolated observations and retrospective studies.[3,12-18] Heart block developed in 19 of our patients, spontaneous transient block in one, and nonspontaneous transient block in only one (5 per cent); the overall incidence of heart block was about 1.0 per cent per year. The incidences of these events were higher in a prospective study at the University of Illinois; a nonspontaneous cause occurred in 33 per cent of the patients with heart block, which occurred in 2 per cent of patients per year.[19] In our study, special events occurred at a rate of 1.2 per cent per year. The incidences of heart block and of special events were very low in these patients; therefore, it is important to identify high-risk subgroups in whom the number of events will be high enough to yield definitive results about the possible protective benefit of pacemakers.[1]

Identification of High-Risk Subgroups

We evaluated a large number of variables in an effort to determine which patients were at high risk for

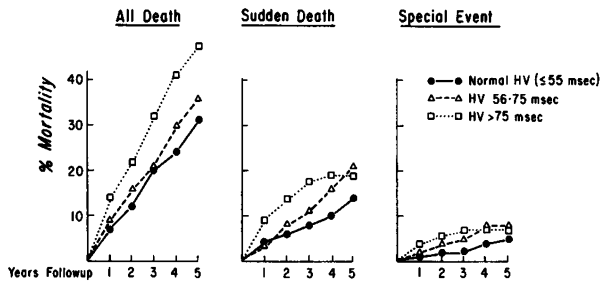

Figure 6. Cumulative Mortality, According to Length of HV Interval.

Patients with a prolonged HV interval did not have a significantly higher cumulative incidence of all deaths, sudden deaths, or special events. The incidence of all deaths in those with HV intervals longer than 75 msec was 52 per cent.

heart block or a special event, but no clear-cut subgroup emerged. Patients with syncope or even with recurrent syncope were not at higher risk for death, sudden death, or special events than those without syncope. Dhingra et al. have also demonstrated that patients with syncope are at no higher risk for death.[20] Although the incidence of heart block was significantly higher at an average follow-up time of 42 months in those with syncope than in those without it (17 per cent vs. 2 per cent), this incidence is low and therefore does not justify prophylactic pacemaker insertion in all such patients. Moreover, permanent pacemaker implantation is associated with certain risks,[21,22] and our study shows that once heart block occurs, it can be successfully treated in most patients. It is notable that syncope is not recurrent in most patients — a finding also presented in other reports.[10,20,23] The incidences of special events and heart block were similar in patients with heart disease of various causes; this was also true of patients with heart block in the study of Dhingra et al.[24] The various types of bundle-branch block were also not predictive of which patients were at higher risk, as documented previously.[1,3,10,24-26] Patients with a prolonged PR interval were at higher risk, but there are several problems in using this interval alone to predict risk: only 13 per cent of our patients had this abnormality; patients with a prolonged PR interval had significantly higher rates of heart failure and use of digitalis therapy; the PR interval is an unreliable indicator of distal conduction-system disease as manifested by a prolonged HV interval[27,28]; and PR prolongation was not associated with an increased incidence of heart block.

It had been hoped that data obtained from intracardiac electrophysiologic studies would be useful in predicting which patients with bundle-branch block would be at increased risk for the development of complete heart block.[1,11,29] The HV interval would seem to be most useful because it is the most direct reflection of conduction in the distal portion of the specialized conducting tissue. Our study shows that the HV interval cannot be used to determine which patients will have heart block or a special event. The data from the University of Illinois[10] show a significantly higher incidence of heart block in patients with a prolonged HV interval (4.5 per cent), as compared with those with a normal HV interval (0.6 per cent) ($P<0.05$); in our study these incidences were 4.9 per cent and 1.9 per cent, respectively — a difference that was not statistically significant. However, the Illinois study and ours have not demonstrated that a prolonged HV interval is an independent marker for the development of heart block or for dying of heart block. In both studies the incidence of heart block was low in patients with a normal or prolonged HV interval. Moreover, in most patients heart block can be successfully treated with pacemakers, as shown by our study. Of some clinical interest are the observations that only half the patients with heart block in our study presented with syncope and that the rest presented with symptoms that were compatible with a low cardiac output. We have previously demonstrated that patients with His-bundle block but without demonstrated bradyarrhythmia are also not at high risk for sudden death.[30]

Induction of atrioventricular block below the His bundle with atrial pacing may predict which patients will have complete heart block.[31] In our study atrioventricular block developed in only 3 per cent of the patients, and these patients were not significantly different from the other study patients in terms of subsequent events.

Critique of the Study

A detailed critique has already been presented.[1] Additional points are worthy of consideration. The patients involved in this study included inpatients and outpatients seen at a large university medical center; the prevalence of chronic bundle-branch block in patients who had electrocardiograms at our institution was about 1 per cent.[1,3] We were initially concerned that this figure would represent an overestimate of the prevalence in the general population; however, subjects evaluated in the Framingham Study (outpatients) were subsequently shown to have a similar prevalence of these electrocardiographic findings.[32,33]

Initially, we followed the group of patients who refused the electrophysiologic invasive study (the "not-studied" group) because we wanted to determine whether they differed in any way from the patients who agreed to undergo this study (the "studied" group). This was important because in our experience with patients who were asked to undergo the investigational electrophysiologic study, only 60 per cent consented,[1] and the "studied" patients represented only approximately 25 per cent of the patients whom the screening process identified as having electrocardiographic abnormalities.[1] There were some base-line differences; those agreeing to undergo the study had higher incidences of symptoms and of clinically detectable heart disease. Nevertheless, it is of interest that during follow-up there was no significant difference between the two groups in the incidences of death, sudden death, or special events. Those who were "studied" did have a higher incidence of subsequent heart block, but this observation was not statistically significant. These findings suggest that the results of our study may be applicable to most patients with these electrocardiographic findings.

The problem of precisely determining the cause of death in some patients has been discussed previously.[1] Syncope is the most alarming symptom in patients with bundle-branch block. In spite of our best efforts, it was difficult at times to be certain whether a symptom was syncope or not. In addition, it is possible that other transient neurologic events, such as episodes of lightheadedness and dizziness, could be potentially more specific for complete heart block than the event focused on in this study.

Some variables were evaluated at only one time. For example, the electrophysiologic variables were measured only on entry into the study. The measured intervals could have been different at other times or in other

physiologic states. Although there is little hour-to-hour variation in HV-interval measurements,[34] the HV interval may increase over time; data from a cooperative study that included patients from our study showed that 32 per cent of patients with bundle-branch block who were restudied at an average of 30 months, usually because of a clinical event, had an increase in their HV interval of at least 8 msec.[35]

Final follow-up study was possible in almost 98 per cent of the study population; all but one living patient were followed for at least six months, and for many of those eventually lost to follow-up there were several years of follow-up information available. Although 100 per cent follow-up would have been desirable, the 98 per cent follow-up assures us that a large number of our patients did not die, have symptoms, or receive pacemakers without our knowledge.

Clinical Implications

Bundle-branch block is a common disorder; it occurred in approximately 1 per cent of patients who had electrocardiograms at our institution over a 10-year period[1,3] and also in subjects in the Framingham Study.[32,33] Our study provides the following guidelines: Patients who are asymptomatic require no special evaluation or treatment for bundle-branch block. However, since most of these patients have serious heart disease and a high five-year mortality, particularly if they have coronary-artery disease or heart failure or both, appropriate investigation and treatment of their underlying heart disease is advisable. In addition, patients with bundle-branch block and symptoms suggestive of a bradyarrhythmia should be evaluated to determine the cause of the symptoms and should undergo intensive efforts to document bradyarrhythmia.

If a bradyarrhythmia is documented, permanent pacemaker implantation is indicated. If a bradyarrhythmia is not documented, pacemaker insertion is not recommended. If symptoms are recurrent (this occurs in a minority of patients), extensive investigations are indicated in order to determine the cause of the symptoms and to treat it. It should be remembered, of course, that there may be individual exceptions to the application of these guidelines.

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