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Aetiology of Bundle-branch Block*

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During the past five years 161 cases of bundle-branch block have been seen in the Cardiac Department of St. Vincent's Hospital. These patients have been evaluated clinically in an attempt to identify all possible associated and causative factors. This communication deals with these various factors and attempts to identify their relative importance in the genesis of both types of conduction defect. Reference is also made to some clinical features noted in these patients.

Criteria and Patients

The following criteria were adopted in the diagnosis of bundle-branch block.

Left bundle-branch block: QRS complex of 0·12 sec. or greater duration in at least one of the twelve conventional leads, with delayed left ventricular activation and absence of a septal Q wave in the left ventricular surface leads.

Right bundle-branch block: QRS complex prolonged to 0·12 sec. or more in at least one of the twelve conventional leads, with delayed right ventricular activation in the right ventricular surface leads.

Patients with bundle-branch block which did not conform to these criteria were rejected for the purpose of this study. In our experience very few such atypical cases were encountered except in the terminal stages of coronary heart disease or in other terminal cardiopathies. Patients with transient bundle-branch block associated with cardiac infarction and those with such block associated with atrio-ventricular dissociation or following open-heart operations were also rejected.

This study includes 100 patients with left bundle-branch block and 61 with right (Table I). There was an equal sex distribution in left and a ratio of more than three men to one woman in right bundle-branch block.

The Figure shows the age distribution of the patients. The mean age of patients with left bundle-branch block was 61·5 years; and with right branch block it was 63·5 years. The age range was considerable and was 36 to 87 in left and 18 to 87 in right branch defects.

This Figure also shows the age distribution of 774 patients with classical coronary heart disease seen by us during the same period. The mean age of these patients was 56·6 years. In contrast with both forms of bundle-branch block, classical ischaemic disease tends to occur, at least in patients reaching hospital, in younger people and in a more restricted age-group, so that the patients tend to aggregate about the sixth decade, while our patients with bundle-branch block tend to aggregate around the seventh decade.

Results

The presenting symptoms in our patients were variable. Typical cardiac pain was present in 48 per cent with left and 34 per cent with right bundle-branch block. Respiratory symptoms including dyspnœa and cough were present in 9 per cent with left and 26 per cent with right bundle-branch block. Of patients with left bundle-branch block defects, 16 (16%), and of patients with right bundle-branch block, 12 (17%), presented with cardiac failure.

Other less common symptoms included atypical chest pain, Adams–Stokes attacks, and cerebrovascular symptoms. In 34 patients (22 left and 12 right branch defects) who were asymptomatic, the lesion was discovered accidentally.

TABLE I

SEX DISTRIBUTION OF PATIENTS WITH LEFT AND RIGHT BUNDLE-BRANCH BLOCK

	Left bundle-branch block	Right bundle-branch block	Total
Men	50	47	97
Women	50	14	66
Total	100	61	163
M:F Ratio	1:1	3·4:1	1·5:1

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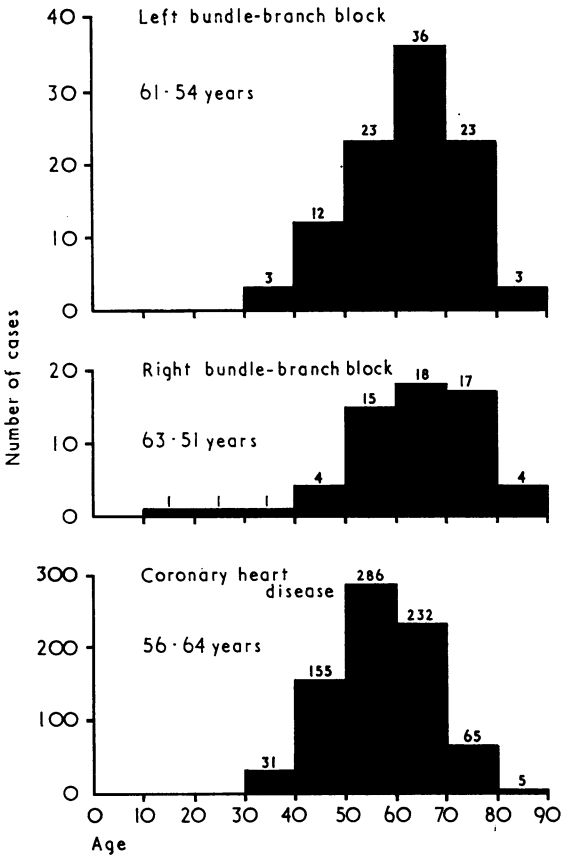

FIG.—Age distribution of patients with bundle-branch block and with classical coronary heart disease.

Table II summarizes the conditions associated with left bundle-branch block in 100 patients: 82 per cent had hypertension or coronary heart disease, alone or in combination; of the remaining 18 patients no obvious associated factors were noted in 8, chronic respiratory disease only was present in 4, aortic valve disease in 3, a history of diphtheritic carditis in 2, and isolated diabetes mellitus in one.

The presence of coronary heart disease was accepted when patients complained of typical cardiac pain or when the cardiogram during periods of normal conduction showed typical infarct or ischaemic changes, or when positive enzyme changes were detected. The diagnosis of hypertension was made when a diastolic pressure of 90 mm. Hg or more persisted after 3 days' rest in hospital. In many such cases other objective changes of hypertension were present.

Table II lists the conditions associated with right bundle-branch block in 61 patients. In general, ischaemia, hypertension, and emphysema occurred with about equal frequency in these patients, and they were found alone or in various combinations in 49 (81%) of the group. Eight patients had isolated right bundle-branch block and the remaining four, who were the youngest patients in the group, had congenital or rheumatic heart disease.

The diagnosis of emphysema was accepted in the presence of dyspnoea on exertion (without heart failure), with or without other respiratory symptoms, associated with one or more objective signs of emphysema, such as impaired peak flow, a vertical P axis in the cardiogram, absent heart and liver dullness, impaired chest expansion, and radiological evidence, among other things.

Five patients with left and 3 with right bundle-branch block had frank diabetes mellitus. In all but one case diabetes mellitus was associated with overt coronary heart disease. This high incidence of diabetes mellitus corresponds to our experience of patients with classical coronary heart disease.

Of the 153 non-diabetic patients, 107 had a glucose tolerance test performed. In general the variations in glucose tolerance did not differ significantly from those that may be found in the normal population of the same age-group (Mulcahy, Hickey, and Maurer, 1967). The mean serum cholesterol of patients with bundle-branch block, their cigarette smoking experience, and the frequency of a positive family history of coronary heart disease were significantly less than those of patients with classical coronary heart disease, as previously reported by us (Hickey, Mulcahy, and Maurer, 1966).

Most of our patients had a fixed conduction defect, but a minority were classified as transient or intermittent (Table III). We can confirm the findings of Bauer (1964a) and others that left bundle-branch block, and less frequently right bundle-branch block, may revert to normal conduction, particularly when the heart rate falls or when high blood pressure or cardiac failure are adequately

TABLE II

CONDITIONS ASSOCIATED WITH RIGHT AND LEFT BUNDLE-BRANCH BLOCK

Conditions	Per cent of cases with left bundle-branch block (100 cases)	Per cent of cases with right bundle-branch block (61 cases)*
Post-mitral valvotomy	—	1·6 (1)
Aortic valve disease	3	1·6 (1)
Diabetes mellitus	5	3·3 (2)
Diphtheritic carditis	2	— —
Pulmonary stenosis and atrial septal defect	—	3·3 (2)
Isolated	8	13 (8)
Emphysema	16	44 (27)
Coronary heart disease	52	50 (31)
Hypertension	56	45 (28)

* Number of cases in parentheses.

TABLE III

DIVISION OF LEFT AND RIGHT BUNDLE-BRANCH BLOCK INTO FIXED AND UNSTABLE VARIETIES

	Per cent of cases with left bundle-branch block (100 cases)	Per cent of cases with right bundle-branch block (61 cases)*
Fixed	79	87 (53)
Transient	15	8 (5)
Intermittent	6	5 (3)

* Number of cases in parentheses.

treated. The fall in heart rate in response to carotid sinus pressure may eliminate the conduction defect. The appearance of normal conduction will facilitate the identification of hypertensive or coronary changes in the electrocardiogram and may provide a valuable clue to aetiology. It may be that unstable conduction defects might be detected more frequently if patients with apparently fixed defects were under more constant surveillance.

The high frequency of unstable cases of bundle-branch block supports the contention that the mechanism of these disorders is a more subtle one and the site of the lesion more peripheral than the often held view of a simple division or interruption of one of the main bundles. Also, under experimental conditions and following main bundle interruption at heart operation, the conduction pattern in the electrocardiogram is different and certainly more bizarre in appearance than the pattern noted in conventional left and right bundle-branch block.

Table IV shows the mean heart size of 78 patients with left and 36 with right bundle-branch block, and contrasts these findings with the same information from 200 successive patients with classical coronary heart disease. A feature here is the significantly greater heart size of patients with left bundle-branch block, where cardiomegaly (cardiothoracic ratio in excess of 50%) is the rule, in contrast to classical coronary heart disease where cardiomegaly is in our experience the exception.

Table V illustrates the frequency of a past or present history of cardiac failure in the patients when first seen by us. One is impressed by the frequency of failure in bundle-branch block, and particularly in left branch defects, a high frequency that contrasts with the lesser frequency of chronic heart failure in classical coronary disease. Heart failure in right bundle-branch block is in our experience evenly divided between chronic cor pulmonale and heart failure associated with coronary or hypertensive heart disease.

TABLE IV

MEAN HEART SIZE (CTR) OF PATIENTS WITH LEFT AND WITH RIGHT BUNDLE-BRANCH BLOCK, AND CLASSICAL CORONARY HEART DISEASE

	No. of cases	Mean	S.E.
Left bundle-branch block	78	0·5394	±0·0079
Right bundle-branch block	36	0·5091	±0·0119
Coronary heart disease	200	0·4868	±0·0049

The difference between left bundle-branch block and coronary heart disease is significant ($p < 0·001$).
The difference between left and right bundle-branch block is significant ($0·05 < p > 0·02$).
The difference between right bundle-branch block and coronary heart disease is not significant ($p > 0·05$).

TABLE V

INCIDENCE OF CARDIAC FAILURE IN LEFT AND RIGHT BUNDLE-BRANCH BLOCK

	Per cent of cases with left bundle-branch block (100 cases)	Per cent of cases with right bundle-branch block (61 cases)*
Past or present failure	26	18 (11)
No history of failure	72	77 (47)
No data available	2	5 (3)

* Number of cases in parentheses.

Discussion

The reported frequency of left and right bundle-branch block varies. Bauer (1964b) reported that the latter was 1·6 times as common as the former. Levine (1958) had a similar experience. In studying the population of Tecumseh, Ostrander (1964) found 36 cases of bundle-branch block amongst 8641 subjects, equally divided between left and right. Kannel *et al.* (1962) reported 50 cases of right and 43 cases of left block in the Framingham population.

Our series shows an unusual predominance of left bundle-branch block. This experience cannot be readily explained. It is possible that there may be a greater emphasis on left branch defects in our series because most patients are derived from the wards of a hospital which is particularly concerned with the study and treatment of patients with classical coronary heart disease and hypertension.

The ratio of left to right bundle-branch block will vary according to the type of patient population under study. The sex distribution of patients with such conduction defects will also differ under such different circumstances. The reports from studies cited above suggest, however, that left and right block have roughly the same prevalence in the population at large.

In our experience the sex ratio in the two types of block differs considerably. Left bundle-branch

block is equally common in men and women, whereas the incidence of right bundle-branch block in men is more than three times greater than in women. It is worth speculating on the factors that may influence this sex distribution. The excess of men with right block may be explained by the high frequency of chronic lung disease and coronary heart disease in this conduction defect, while the important role of hypertension in left block may at least partially account for the equal distribution of this defect between men and women.

The mean age of our patients is approximately the same in both groups, but left bundle-branch block was not encountered under 35 years, and it is exceedingly rare in such younger age-groups (Scott, 1965). Our youngest patient with left block was a 36-year-old man who suffered from hypertension, and our 4 youngest patients with right block had associated congenital or rheumatic heart disease. This experience conforms to that of Bauer (1964b).

This series therefore confirms that bundle-branch block has multiple associations and is probably of multifactorial origin. In more than 80 per cent of patients, left bundle-branch block is associated with hypertension, ischaemia, or a combination of both. Chronic lung disease is not uncommon but is not often an isolated finding. Other causes are relatively rare and no evidence of overt heart or lung disease was found in 8 per cent.

In right bundle-branch block hypertension and coronary heart disease are also commonly found but right bundle-branch block is frequently associated with chronic lung disease, and in 7 patients (12%) it was an isolated finding.

Sudden overloading of the right ventricle, such as occurs in pulmonary embolism, may cause the appearance of right bundle-branch block. It might be postulated that the same mechanism may also be involved on the right side in chronic lung disease, if a causative association exists. With this hypothesis in view, 6 of our 27 patients with emphysema were subjected to right heart catheterization. With one exception, a man of 47 years with a right ventricular systolic pressure of 42 mm. Hg, all showed normal right-sided systolic and diastolic pressures.

No ready explanation exists, therefore, for the association of right bundle-branch block with emphysema, though the possibility of a common factor such as cigarette smoking, which might account for the respiratory disease on the one hand and occult coronary heart disease causing right block on the other, cannot be excluded. It is well recognized that chronic lung disease may present with partial right bundle-branch block in the electrocardiogram, but its association with complete right block is not so widely known.

Summary

A study has been made of 161 cases of bundle-branch block over a period of five years. Details of age, sex, and aetiological background of both types of bundle-branch block are presented.

Coronary heart disease and hypertension are closely associated with both forms of block. An unusually high incidence of chronic respiratory disease is noted, particularly in subjects with right bundle-branch block. This association with chronic respiratory disease is briefly discussed.

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