An Epidemiological Assessment of Bundle-Branch Block

By Robert E. Edmands, M.D.

The clinical implications of complete bundle-branch block have long been a subject of dispute. This appears to be attributable to several factors. In the case of left bundle-branch block (LBBB), the nature of the pathological disturbance remains uncertain in any individual case. For example, one cannot readily determine from the electrocardiogram alone whether the conduction disturbance is a function of a focal lesion in the main left bundle or the result of a more diffuse myocardial disease producing a type of parietal block. Experimental and pathological-clinical studies1,2 have lent support to both hypotheses but have not assisted in clarifying the clinical dilemma. LBBB, moreover, may preclude the electrocardiographic manifestation of myocardial infarction. And this latter circumstance casts a certain stigma on the electrocardiographic diagnosis of LBBB without contributing to an understanding of its pathogenesis or portent.

The pathology of right bundle-branch block (RBBB) is similarly uncertain,3,4-5 (that is, whether it is due to a central and focal, or to a more peripheral and diffuse lesion), and its implications are, if anything, more obscure. It has long been recognized that complete RBBB may, on occasion, be a manifestation of a congenital anomaly or of pulmonary disease. As a consequence, this disturbance has been historically viewed as being of less significance and having a more favorable prognosis than LBBB.6-9

An epidemiological approach has been employed in recent years in an attempt to assess the significance of such conduction disturbances. From studies of the prevalence of such electrocardiographic changes in Air Force personnel,10 suburban communities,11,12 and nursing homes,13 it has been suggested that both LBBB and RBBB are acquired anomalies and that they are both associated with a greater than normal prevalence of manifest cardiovascular disease. Nevertheless, it has been generally observed that RBBB bears a less ominous prognosis than LBBB.

None of these investigations have considered RBBB other than as a homogeneous group, however, despite the fact that several species of RBBB may be readily identified and various pathogenetic mechanisms have been attributed to each. The common type of RBBB (Bayley's types 1-414), first described by Wilson,15 constitutes the great proportion of cases of RBBB and is the type referred to in these recent studies. The classic type of RBBB16,17 (the "mirror-image" of LBBB) has been regarded as a more serious prognostic omen, although it is uncommon in clinical experience. Of the patients with the common type of RBBB, moreover, there is a group thought by several to have a less favorable outlook.17-20 The latter is constituted by those with a leftward deviation of the mean QRS axis (Bayley's types 3-4). Wilson and associates18 have written of "electrocardiograms of an unusual type in RBBB" (Bayley's type 4); the same entity having been referred to by Massie and Walsh17 as the "RBBB variant." Both groups have considered the latter to be distinct from the common type of RBBB, with regard to both pathogenesis and prognosis. Curd and associates19 have also described RBBB with left axis deviation (Bayley's types 3-4) as frequently associated with significant underlying cardiac disease.

As a consequence, consideration was given to study of bundle-branch block in a retirement community, bearing in mind the distinctions just noted. The advantages of such a
study group are several: The prevalence of such abnormalities is much greater in an older population, and study of a community of this sort tends to avoid the danger of spurious correlations one may encounter in hospital or other institutional groups where the high prevalence of disease may suggest artifactual associations.

Methods

The U.S. Public Health Service, Heart Disease Control Program, initiated in 1962 a longitudinal investigation of health in a retirement community, Rossmoor Leisure World, Seal Beach, California. The latter is a circumscribed retirement community of about 10,000 adults, aged 52 years or more, approximately 60% female, and with a mean age of 69 years. Comprehensive medical care, except hospitalization, is provided by a central medical clinic and is financed by a fixed monthly payment plus a nominal charge per visit. On entrance into the community, a routine physical examination, chest roentgenogram, electrocardiogram, and laboratory studies are offered to each resident. Approximately 90% of the residents have availed themselves of these initial studies.

In the course of this survey, approximately 30% of randomly selected, routine electrocardiograms were interpreted by the author over a 12-month period using criteria described by Blackburn and associates. The electrocardiograms were recorded in standard fashion, employing 12 leads, and at a paper speed of 25 mm/second. Data concerning blood pressure, heart size, and medical therapy were obtained from the medical records; these data were recorded within several weeks of the electrocardiogram.

The criteria for complete LBBB consist of the following: (1) QRS duration of 0.12 second or greater in lead II; (2) an R peak duration of 0.06 second or more in any of leads I, II, aV1, V5, V6; and (3) an absent septal q in lead I and in left precordial leads with an upright R wave. The criteria for complete RBBB consisted of a QRS width of 0.12 second or greater in lead II, a wide terminal S wave in leads I and V6, and a wide R' (R prime) in V1.

The classic RBBB is readily identifiable by the following criteria: (1) a small r and broad, deep S wave in lead I; (2) taller, wide R waves in leads II and III, often preceded by a q of variable width; and (3) a tall, late R wave in V1-2, with diminishing R waves and terminal S waves of increasing depth across the left precordium. The variant form of RBBB is also easily identified from the larger group, according to the criteria of Massie and Walsh, which are consistent with the description of Wilson and associates: an rS complex in lead II (mean QRS axis deviated leftward of −30°), and an rS complex in lead aVF (terminal forces directed superiorly). RBBB with left axis deviation (Bayley's type 3) described by Massie and Walsh and Wolf conform to the same criteria as the variant type except that the QRS complex in lead aVF must be an rSr' (that is, terminal forces directed inferiorly). Those designated here as the common type of RBBB are formed by the total group less those identified as classic RBBB, the variant type, and RBBB with left axis deviation (LAD).

From those in the study group with normal electrocardiograms (that is, without QRS evidence of myocardial infarction, ST-T changes, A-V block, atrial fibrillation, or bundle-branch block), two control groups were selected using a table of random numbers. Control group I consisted of 100 individuals, age-matched and sex-matched to those with LBBB. A similar group of 100 residents (control group II) was selected as a control for those with RBBB. Selection of these control groups, identical in proportions of age and sex to the corresponding abnormal group, was thought to preclude the necessity of further consideration of age and sex as significant variables in comparing control and abnormal groups.

Results

Of 1,560 electrocardiograms so interpreted, 57 (3.7%) were identified as having complete bundle-branch block (with or without other abnormalities). Nineteen (eight men and 11 women) exhibited LBBB; 38 (24 men and 14 women) fulfilled the criteria for RBBB. The age and sex distributions of the residents with abnormal electrocardiograms (bundle-branch block) are shown in tables 1 and 2. Using the criteria previously described, 13 of the 38 instances of RBBB were classified as the variant type of RBBB, while five of the 38 fulfilled the criteria of RBBB with LAD. No cases of classic RBBB, as defined, were identified.

Hypertension

Table 3 reveals a prevalence of hypertension (blood pressure greater than either 160 mm Hg systolic or 90 mm Hg diastolic), in those with LBBB, that is greater than that found in the control group with normal electrocardiograms (53% to 43%). This difference is of no statistical significance. Demonstrated in table 4 is the prevalence of hypertension in
those with RBBB. This, too, is slightly greater than that found in the control population (42% to 37%), although the difference again is not of statistical significance.

Table 4 also presents data regarding the prevalence of hypertension in the 20 individuals with the “common” or Wilson type of RBBB and in the 18 residents with either the RBBB variant (eight of 13 had hypertension), or RBBB with left axis deviation (four of five had hypertension). These data reveal a preponderance of hypertension in the latter combined group that is greater ($P < 0.05$ by Chi-square test) than the prevalence of hypertension in the control group. In contrast, those with the “common” RBBB exhibited a prevalence of hypertension that was actually less than that found in the controls, although the two did not differ significantly in this regard.

Cardiomegaly

As shown in table 5, cardiac enlargement by x-ray (cardiothoracic ratio more than 0.5) was found in nine of 18 residents with LBBB (18 of 19 with LBBB had chest x-rays), while only 16 of 100 controls manifested cardiomegaly. This difference was found to be significant ($P < 0.005$). Table 6 reveals the prevalence of cardiomegaly in those with RBBB (10 of 38), also greater than the proportion of cardiac enlargement in the normal controls (15 of 100). This difference is of questionable significance ($P > 0.1$).

Of those with the RBBB variant and RBBB with LAD, eight of 18 demonstrated cardiomegaly (four of 13 with the variant type, four of five with RBBB and LAD). This was significantly greater ($P < 0.01$) than the prevalence of cardiac enlargement in the controls. Again, the prevalence of cardiomegaly in those with the common RBBB did not differ significantly from that found in the control group.

Digitalis Requirements

As the administration of digitalis tends to preclude the finding of a normal electrocardiogram (by way of nonspecific ST-T
Table 5
Prevalence of Cardiomegaly in Residents with LBBB and in Age-Matched and Sex-Matched Controls with Normal Electrocardiograms

<table>
<thead>
<tr>
<th>Total no. with x-rays</th>
<th>No. with cardiomegaly</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBBB</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Control group I</td>
<td>100</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 6
Prevalence of Cardiomegaly in Residents with RBBB and in Age-Matched and Sex-Matched Controls with Normal Electrocardiograms

<table>
<thead>
<tr>
<th>Total no. with x-rays</th>
<th>No. with cardiomegaly</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBBB (total)</td>
<td>38</td>
<td>10</td>
</tr>
<tr>
<td>Common RBBB</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>RBBB variant and</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>RBBB with LAD</td>
<td>100</td>
<td>15</td>
</tr>
</tbody>
</table>

changes), it was felt that the control groups previously described did not constitute a valid comparison for those with bundle-branch block, regarding the need for digitalis therapy. Among the residents with RBBB, however, a difference may be noted, as shown in table 7. Of those with the variant type and RBBB with LAD, six of 18 (four of 13 with the RBBB variant and two of five with RBBB and LAD) were maintained on digitalis therapy, while none of the 20 residents with common RBBB received digitalis (a statistically significant difference, \( P < 0.025 \)). Of the 19 residents with LBBB, four required digitalis.

Two of the 13 representations of the RBBB variant had been difficult to categorize as variant or common RBBB because the relatively low voltage QRS complexes in the limb leads made estimation of the mean QRS axis somewhat arbitrary. Neither of these two was associated with any of the parameters of cardiovascular disease employed here. Had these two cases been excluded from consideration or otherwise classified, the differences noted would have been accentuated.

Discussion

These data are in accord with the findings of others\(^9, 11-13, 24\) to the effect that LBBB is frequently associated with evidence of cardiovascular disease; although, as found by Kannel and associates\(^11\) and Ostrander,\(^12\) LBBB does not correlate significantly with hypertension. The association with cardiomegaly is quite significant, nevertheless, and this observation may be more pertinent in suggesting the ominous prognosis of this electrocardiographic abnormality. While this point may not require further emphasis, reference is made here to the studies of Messer and associates\(^9\) who found that cardiomegaly, more than any other factor studied, is related to the diminished survival time of LBBB.

These data do not suggest any specific etiology of LBBB, however. Nevertheless, the high prevalence of cardiomegaly is consistent with the hypothesis that this conduction disturbance may often be attributable to diffuse peripheral myocardial disease rather than to a central, focal dysfunction of the left bundle branch.\(^12\)

In an attempt to assess the prevalence of clinical disease associated with the common or Wilson type of RBBB, the latter was viewed apart from those with the variant type of RBBB and RBBB with LAD. Those with common RBBB were found to have significantly less hypertension, cardiomegaly, and need for digitalis therapy than did the remaining cases of RBBB. In terms of the first two parameters, the cases of common RBBB were indistinguishable from the control group with normal electrocardiograms. The group of residents with RBBB variant and RBBB with LAD was associated with clinical evidence of

Table 7
Prevalence of Digitalis Therapy in Residents with RBBB and LBBB

<table>
<thead>
<tr>
<th>Total no. receiving digitalis</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBBB (total)</td>
<td>38</td>
</tr>
<tr>
<td>Common RBBB</td>
<td>20</td>
</tr>
<tr>
<td>RBBB variant and</td>
<td></td>
</tr>
<tr>
<td>RBBB with LAD</td>
<td>18</td>
</tr>
<tr>
<td>LBBB</td>
<td>19</td>
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</table>
cardiovascular disease to a significantly greater extent. Had these distinctions in RBBB morphology not been made, this study may have concluded that RBBB was indeed associated with cardiovascular disease, but to a lesser extent than in the case of LBBB. Such findings would have merely corroborated those of numerous studies undertaken in recent years. These data suggest, in contrast, that the common RBBB may well be a relatively innocuous finding in the adult.

It should not be inferred that the variant type of RBBB and RBBB with LAD form a homogeneous group, however, despite the similarity of the QRS configurations and the fact that each appears to be frequently associated with significant cardiovascular disease. The separation of the two merely illustrates the point that, from a group of adults with RBBB, and by means of discrete electrocardiographic criteria, one may identify a substantial number with a more favorable prognosis. These results may appear in contrast to those of Lindeneg and Rasmussen\(^{14}\) who found no difference between the prognosis of the common and classic types of RBBB. That they are not irreconcilable is evident on reflecting that instances of classic RBBB were not present in the current study. The classification here involves a subdivision of what others have broadly defined as the common RBBB.

The existence of several varieties of RBBB has been recognized since Wilson and associates\(^{15}\) first accurately described the right bundle-branch block pattern. Using the precordial lead configuration as a more reliable criterion for distinguishing right from left bundle-branch disturbances, the identity of the variant type of RBBB became evident. What had previously been described as an unusual type of LBBB was then clearly established, at least electrocardiographically, as a type of RBBB. At that time, Wilson and associates\(^{18}\) and Bayley\(^{14}\) attributed the electrocardiographic pattern of the variant RBBB to an alteration of initial forces produced by left ventricular hypertrophy or myocardial infarction superimposed on an underlying RBBB.

Grisham and Scherlis\(^{20}\) have also pointed out that left axis deviation of the mean QRS axis in “atypical (common) RBBB” should arouse suspicion of associated left ventricular hypertrophy.

With the advent of vectorcardiography, however, a number of investigators have questioned the relation of the variant type to the common RBBB, suggesting that they may differ pathogenetically. Wolff\(^{23}\) distinguishes between “left ventricular hypertrophy simulated by RBBB,” which is identical to the RBBB variant pattern, and true RBBB with LAD. The former may be identified by the superior orientation of its terminal forces (rs in lead aVF). Furthermore, “left ventricular hypertrophy with terminal conduction delay,” described by Grisham and Scherlis\(^{20}\) has been occasionally found to simulate closely the RBBB variant pattern (with slight alteration of anteroposterior forces).

Thus, it is suggested that these study findings are consistent with the hypothesis that chronic, uncomplicated, or common RBBB in the adult may indeed be a type of benign bundle-branch block. The variant type of RBBB, more frequently associated with cardiomegaly and hypertension, may not represent right bundle-branch or right ventricular disease at all. RBBB with LAD, also associated with cardiomegaly and hypertension, is thought to represent a complication of underlying common RBBB. Alteration of initial forces, normal in the uncomplicated Wilson type of RBBB, is presumed to be the source of this electrocardiographic pattern. And, as described by Grant,\(^{25}\) left axis deviation is frequently a manifestation of coronary heart disease or left ventricular hypertrophy, rather than a function of altered anatomic position of the heart. In either event, RBBB with leftward deviation of the QRS axis, whatever the orientation of the terminal forces, appears to be frequently associated with significant cardiovascular disease.

**Summary**

Complete bundle-branch block was found in 57 of 1,560 (3.7%) electrocardiograms routinely recorded on members of a retirement
community. Of this number, 19 were identified as left bundle-branch block (LBBB), while 38 fulfilled the criteria for right bundle-branch block (RBBB).

Individuals with LBBB were found to have cardiomegaly more frequently than did individuals with normal electrocardiograms. Individuals with RBBB, regarded as a homogeneous group, also demonstrated a greater prevalence of cardiomegaly than did the control group, but the difference from normals was less striking than in the case of LBBB. Neither LBBB nor RBBB was significantly associated with hypertension, as defined in the text.

When the common, uncomplicated RBBB was regarded as a separate entity, the prevalences of hypertension and cardiomegaly were indistinguishable from those of a control group with normal electrocardiograms. The RBBB variant, regarded as a possible manifestation of left ventricular disease secondary to hypertrophy or myocardial infarction, was found to be frequently associated with hypertension, cardiomegaly, and the need for digitalis therapy. RBBB with left axis deviation, regarded as a complication of the common RBBB due to left ventricular hypertrophy or myocardial infarction, was similarly associated with a high prevalence of cardiovascular disease. None of the 38 cases of RBBB fulfilled the criteria for classic RBBB.

It is suggested, therefore, that the chronic uncomplicated RBBB in the adult may indeed bear a less ominous portent than has previously been ascribed to it. This is suggested only in relation to the parameters evaluated; however, prospective evaluation is clearly necessary to assess the validity of such an inference.

**Acknowledgment**

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**References**


Palpitation of the Heart and Enlarged Thyroid Gland (Graves)

A lady, aged twenty, became affected with some symptoms which were supposed to be hysterical. This occurred more than two years ago; her health previously had been good. After she had been in this nervous state about three months, it was observed that her pulse had become singularly rapid. This rapidity existed without any apparent cause, and was constant, the pulse being never under 120, and often much higher. She next complained of weakness on exertion, and began to look pale and thin. Thus she continued for a year, but during this time she manifestly lost ground on the whole, the rapidity of the heart's action having never ceased. It was now observed that the eyes assumed a singular appearance, for the eyeballs were apparently enlarged, so that when she slept, or tried to shut her eyes, the lids were incapable of closing. When the eyes were open, the white sclerotic could be seen, to a breadth of several lines, all around the cornea.

In a few months, the action of the heart continuing with unceasing violence, a tumour, of a horse-shoe shape, appeared on the front of the throat and exactly in the situation of the thyroid gland. This was at first soft, but soon attained a greater hardness, though still elastic. From the time it was first observed, it has increased little, if at all, in size, but is now about thrice the natural bulk of the fully developed gland in a female after the age of puberty.—ROBERT J. GRAVES: Clinical Lectures on the Practice of Medicine, Ed. 2, vol. 2. Dublin, Goodwin, Son, & Nethercott, Printers, 1848, p. 194.
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