Rate Dependent Left Bundle Branch Block with Gradual Transition between Normal Intraventricular Conduction and Complete Left Bundle Branch Block

A Case Report

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SUMMARY

A case of 70-year-old woman with ischemic heart disease is presented. The electrocardiogram showed atrial fibrillation and a tachycardia-dependent, left bundle branch block. A number of intermediate QRS patterns from normal intraventricular conduction to complete left bundle branch block were seen, and the transition was gradual. Increasing grades of aberrance were seen following a shorter preceding cycle length.

Additional Indexing Words:

Tachycardia-dependent LBBB Atrial fibrillation Aberrancy
Preceding cycle length

INTERMITTENT bundle branch block is usually seen with both slow and accerelated heart rates. When bundle branch block occurs at an accerelated heart rate and disappears when the rate decreases below a critical level, it is called a tachycardia-dependent bundle branch block[1] or phase 3 bundle branch block.[2] Conversely, when bundle branch block occurs at a slow heart rate and disappears when the rate rises above a critical level, it is called a bradycardia-dependent bundle branch block[1] or phase 4 bundle branch block.[2] These forms of bundle branch block are caused by a phasic, aberrant ventricular conduction in the presence of unequal refractory periods of the bundle branches.[3] Therefore, theoretically, the transition from bundle branch block to normal intraventricular conduction should be gradual. However, in clinical cases, the transition is usually abrupt, without any intermediate stages of incomplete bundle branch block.[4-6] In the case reported here, left bundle branch block (LBBB) occurred as heart rates were increased, and

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Received for publication June 19, 1981.

a gradual transition was observed between normal intraventricular conduction and complete LBBB.

Case Report

A 70-year-old woman was admitted to the hospital because of heart failure due to ischemic heart disease. Her symptomes improved after treatment with digitalis and diuretics. Electrocardiograms on April 17 and on June 20, 1978 showed atrial fibrillation (Fig. 1). In Fig. 1A, the normal QRS pattern and a complete LBBB pattern were seen, with an abrupt transition. In Fig. 1B, on the other hand, the QRS patterns fluctuated between incomplete and complete LBBB patterns, and the transition was gradual. These fluctuations were seen repeatedly during long continuous recordings. According to their duration and configuration, the QRS patterns were classified into 3 groups. In group A, the QRS duration was 0.08–0.10 sec; in group B, it was 0.11–0.12 sec; and in group C, the QRS duration was 0.13–0.16 sec (Fig. 2).

Vectorcardiograms of these 3 groups are shown in Fig. 3. In group A,

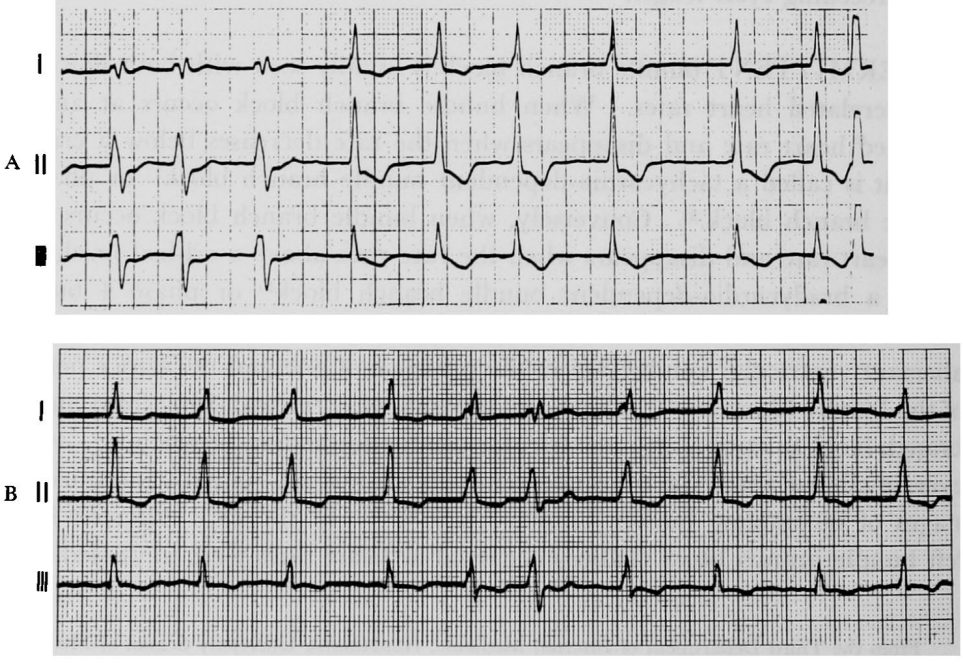

Fig. 1. Electrocardiograms recorded simultaneously from leads 1, 2, and 3 demonstrate tachycardia-dependent LBBB. The transition from normal intraventricular conduction to complete LBBB is abrupt in Fig. 1A (April 17) and gradual in Fig. 1B (June 20).

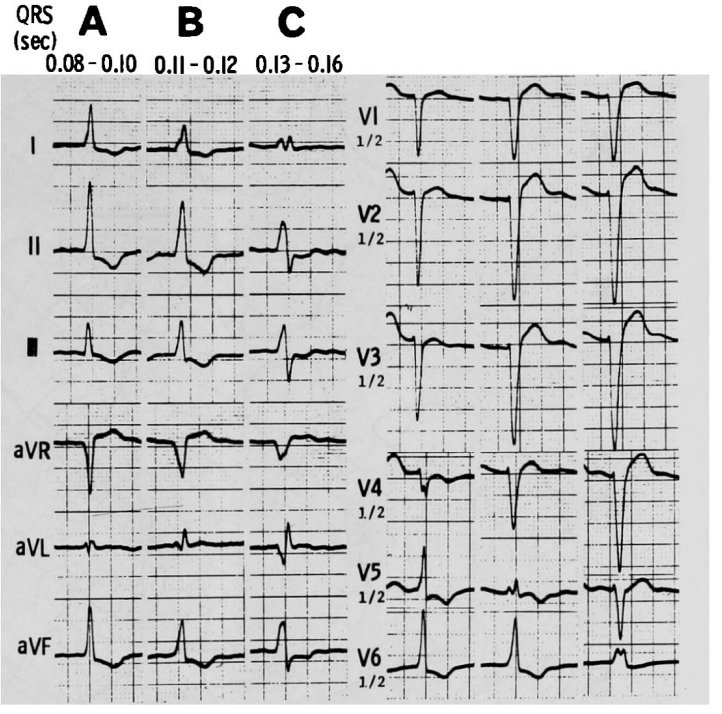

Fig. 2. Classification of QRS patterns.

the QRS loop in horizontal projection was initially inscribed to the left and anteriorly and presented a counterclockwise configuration. In group B, the QRS loop in horizontal projection presented a clockwise configuration, associated with some delay in the midportion of the loop. However, the initial vector was inscribed to the left and anteriorly as in group A. In group C, the QRS loop had a figure-eight configuration in the midportion of the loop and the conduction delay was more prominent in mid- to late portions of the loop. A number of QRS patterns with a gradual transition were observed between group A and group C (Fig. 4).

The relationship between QRS patterns and the cycle length was shown in Fig. 5. Cycle length was represented on the abscissa and the preceding cycle length was represented on the ordinate. Group A occurred after longer cycle length (0.70–1.04 sec), while group C occurred after shorter cycle length (0.42–0.60 sec). At a given cycle length, increasing QRS duration was noted as the preceding cycle length was shortened.

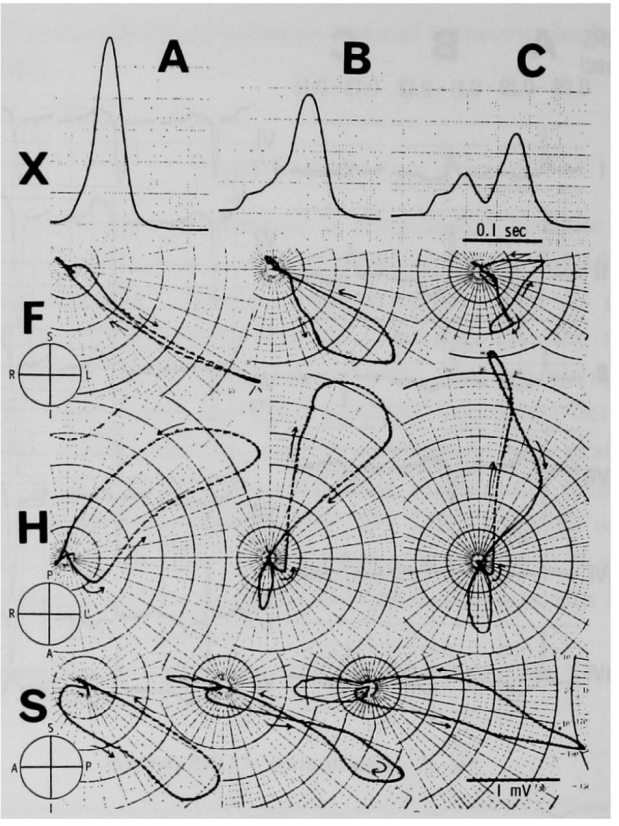

Fig. 3. Vectorcardiograms in groups A, B, and C.

Discussion

Tachycardia-dependent bundle branch block is diagnosed when the bundle branch block appears at an accerelated heart rate, and disappears when the rate decreases below a critical level. This should be differentiated from a functional bundle branch block (aberrance) which is a physiological response. Tachycardia-dependent bundle branch block differs in the following respects from the aberrance seen in the normal patient.[4] It (1) occurs at relatively slow heart rates, (2) is most often of the LBBB type, (3) appears to be much less dependent on changes in duration of the preceding cycle length, and (4) is seen almost exclusively in patients with heart disease.

Two interesting observations were noted in this case. One was the gradual transition from normal intraventricular conduction to complete LBBB. The other was that increasing grades of aberrance were seen following a shorter preceding cycle length. In most cases of rate dependent bundle branch block, the transition from normal conduction to complete bundle branch block is

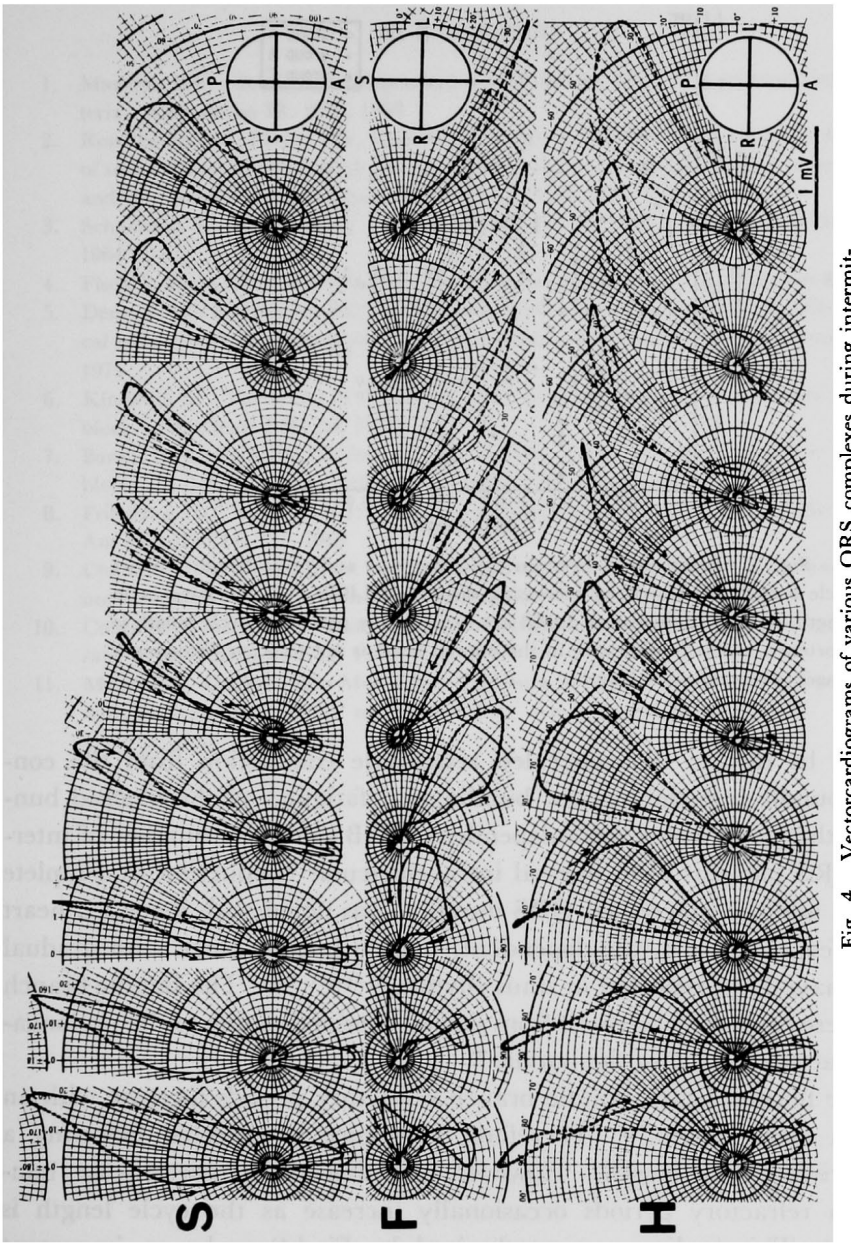

Fig. 4. Vectorcardiograms of various QRS complexes during intermittent LBBB are arranged to demonstrate the gradual transition from normal intraventricular conduction to complete LBBB. Various degrees of incomplete LBBB patterns are seen.

abrupt, without showing an incomplete bundle branch block.[4)-6)] In addition, once a bundle branch block is initiated, it almost always persists for some time, and reversion to normal conduction does not take place until the cycle length is significantly longer than that which initiates the bundle branch block.[4),6)] The mechanism responsible for the persistence of a bundle branch

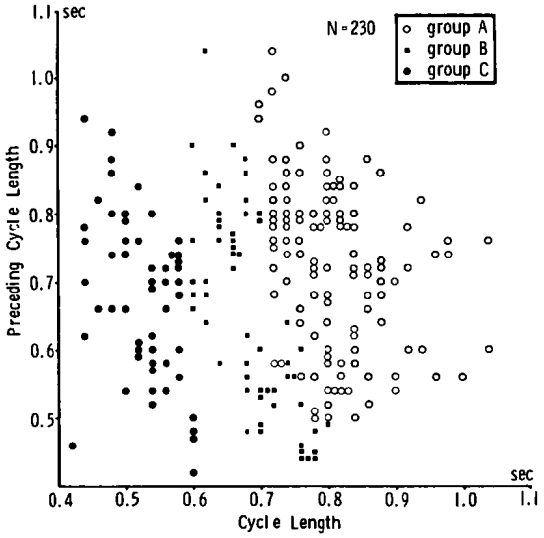

Fig. 5. Relationship between QRS patterns and cycle length. Short cycle length is followed by increasing degrees of LBBB. At the same cycle length, increasing degrees of LBBB are noted as the preceding cycle length is shortened, whereas aberrance in the normal heart is apt to occur following a longer preceding cycle length.

block may be due to the concealed retrograde conduction from the contralateral bundle into the blocked bundle, or " fatigue " of the blocked bundle.[4] In this case, tachycardia-dependent LBBB showed a number of intermediate QRS patterns from normal intraventricular conduction to complete LBBB. In addition, increased QRS duration was noted with increased heart rates. A few cases of a rate-dependent, bundle branch block with gradual transition have been reported in sinus rhythm.[3)-5),7)-10)] The bundle branch block in these cases may be result from slowed conduction due to the prolongation of refractory period in the bundle.[4]

In the normal heart, bundle branch refractory periods increase with an increase in cycle length.[11] Therefore, aberrance is expected following a longer preceding cycle length. However, in patients with heart disease, bundle branch refractory periods occasionally increase as the cycle length is shortened.[4] This finding was emphasized by Fisch[4] to be an important electrophysiological difference separating it from aberrance in the normal patient. The paradoxical observation in this case of an increasing QRS duration with a shorter preceding cycle length can be explained by this finding.

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