Wenckebach phenomenon in the bundle-branch system

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Left bundle-branch block characterized by ventricular complexes with varying patterns, leading on to a Wenckebach-type second-degree atrioventricular block, is reported.

The different electrocardiographic patterns of left bundle-branch block may reflect a more or less complete block in this system owing to the alternate functioning of the two main divisions. The subsequent appearance of second-degree right bundle-branch block accompanied by third-degree left anterior division block revealed the presence of Wenckebach phenomenon in the posterior division.

A Wenckebach type of block may occur at various points in the conducting system other than the atrioventricular node. Wenckebach phenomenon has been experimentally produced in the two branches (Scherf and Shookhoff, 1925) and in the left bundle-branch divisions (Kretz and Da Ruos, 1972). Descriptions of tracings in which Wenckebach phenomenon occurs in one bundle-branch are uncommon. Recent studies of His bundle electrograms have shown Luciani-Wenckebach periods occurring distal to the His deflection (Narula and Samet, 1970; Puech *et al.*, 1970; Ranganathan *et al.*, 1972).

In the present study we describe a case of left bundle-branch block presenting varying patterns and a series of beats interpreted as a 'concealed' Wenckebach phenomenon in the left bundle-branch system. The subsequent appearance of a 3:2 type of right bundle-branch block reveals the presence of a Wenckebach phenomenon in the posterior division.

Case report

A 58-year-old man presented with an atypical thoracic pain, which led to repeated electrocardiographic observations. Since 1964 he had shown left bundle-branch block with left axis deviation (about -40°), and a QRS interval of 0.14. In 1965 the left bundle-branch block showed a slight increase in the QRS interval (0.16), with a little less pronounced axis deviation. In 1967, the tracing (Fig. 1) shows two alternate patterns. One (second beat in D2 and first in D3) is characterized by an RS

FIG. 1 Left bundle-branch block with two different and repetitive patterns (see text).

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FIG. 2 Left bundle-branch block with three different and repetitive patterns (see text).

complex in D2 and an rS complex in D3, the other (first beat in D2 and second in D3) by a positive notched complex in D2 and an rs with a small slurred s in D3. The former pattern corresponds to an axis deviation of about -30° and is similar to the one recorded in the 1964 electrocardiogram. The latter, which is similar to the one observed in the 1965 electrocardiogram, shows a much reduced axis deviation (about 0°). The RR intervals are constant (660 msec). Similarly, the 1968 tracing (Fig. 2) shows sequences formed by three different patterns, which repeat regularly and are clearly differentiated, above all in D2 and D3. Two of the three patterns can be clearly seen to overlap with that recorded in 1967, while the third (first complex in D2–D3) shows a more pronounced left axis deviation (about -45°). The tracings show constant PR and RR intervals.

The 1970 electrocardiogram (Fig. 3) shows the presence of a Wenckebach type second-degree atrioventricular block ($PR=0.16-0.20$). The pattern of the first ventricular complex of the series is of the left anterior 'hemiblock' type ($QRS=0.11$; $\hat{A}QRS=\text{about } -78^\circ$; intrinsicoid deflection in V6= 0.04 ; Rs pattern in V6). The pattern of the second QRS is typical of a complete right bundle-branch block and a left anterior hemiblock ($QRS=0.14$; $\hat{A}QRS=\text{about } -80^\circ$; intrinsicoid deflection in V1= 0.08).

In this period brief episodes of third-degree atrio-

ventricular block appeared; in 1972 a demand pacemaker had to be implanted.

Discussion

The 1967 and 1968 tracings appear to be of particular interest, if we consider the different aspects characterizing the left bundle-branch block observed in our case. These tracings show sequences of two or three different ventricular patterns, repeating regularly, all of the complete left bundle-branch block type. The changes observed in the ventricular complexes should not be attributed to respiratory movements or to variations in heart rate. It is possible that these changes in the shape of the QRS result from the fact that the complex structures of the left bundle-branch are not involved to the same degree, nor are they consistently involved, thus leading to a varying trend in the order of ventricular activation. The ventricular complexes with a more or less marked left axis deviation could reflect different degrees of completeness of the divisional bundle-branch block (Rosenbaum, Elizari, and Lazzari, 1970; Cannom, Goldreyer, and Damato, 1972). The more conspicuous deviation could, on

FIG. 3 Second-degree atrioventricular block (3:2) showing the Wenckebach phenomenon. The QRS complexes show two different and repetitive forms (see text).

the other hand, result from the possible concomitant conduction disturbances in the distal divisions and in the main trunk (Pryor and Blount, 1966).

The 1970 electrocardiographic sequence could be interpreted as a result of the involvement, even though of different degree, of the three divisions of the specific intraventricular conduction system. In fact, the first beat, showing the characteristics of a left anterior hemiblock, is followed by a complete right bundle-branch block type of complex, which occurs together with the preceding divisional block. This is shown by the persistent, obvious left axis deviation. Under these circumstances the atrial stimulus is conducted through the left posterior division. The increased PR interval suggests that conduction along this pathway is progressively slower, and in fact the atrial impulse is blocked at the third beat of the series, the atrioventricular ratio being 3:2. It is therefore a second-degree atrioventricular block, which takes place owing to the combination of a posterior division Wenckebach phenomenon, a 3:2 second-degree right bundle-branch block, and a third-degree left anterior division block.

Clinical evidence of Wenckebach phenomenon confined to one of the divisions of the left bundle-branch has seldom been reported. Rosenbaum *et al.* (1970) suggested this hypothesis for some types of trifascicular block (P_3 , P_5 , P_7 , according to their classification). Among the clinical examples published to our knowledge is a case reported by Puech *et al.* (1970) showing atrioventricular block, right bundle-branch block, and left anterior hemiblock. His bundle electrograms show progressively increasing HQ intervals and normal PH intervals. The latter workers reach the conclusion that Wenckebach phenomenon probably occurs in either the distal His bundle division or in the left bundle-branch. Friedberg and Schamroth (1972) rightly quote this case as a clinical example of Wenckebach phenomenon confined to the posterior division of the left bundle. However, in the case described by Puech *et al.*, the presence of a divisional block cannot be ascertained by means of the surface electrocardiogram, since both the PR intervals and the pattern of the ventricular complexes remain constant. In the case described by Cerqueira-Gomes and Vasconcelos Teixeira (1971), an incomplete left anterior hemiblock was accompanied by a right

bundle-branch block and the presence of a Wenckebach phenomenon in the posterior division was suggested on the grounds of an axis deviation and of a prolonged PR interval which, we should however like to point out, was not progressively increasing. In our case not only is there a progressively increasing PR, but the ventricular pattern varies, owing to the simultaneous presence of an intermittent right bundle-branch block. This conduction defect and the concomitant left anterior hemiblock may allow the Wenckebach phenomenon in the posterior division, probably expressed as a 'concealed' form by the 1967 and 1968 tracings, to become 'manifest'.

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