ELECTROCARDIOGRAM OF THE MONTH

Complete A-V Block, Dual Left Ventricular Pacemakers and Re-entry*

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A complex arrhythmia is presented, which includes atrial fibrillation, complete A-V block, and an unusual type of idioventricular rhythm. Dual ventricular pacemakers are demonstrated, apparently originating in the vicinity of the superior or inferior division of the left bundle branch, with re-entry into the opposite division.

CASE REPORT

The patient was a 62-year-old man, who was well until 1960, when he developed cough and swollen legs. He was treated successfully with digitoxin and diuretics. The history was negative except for diabetes mellitus, treated with tolbutamide (Orinase).

Atrial fibrillation had been present for several years, and the ventricular rate kept moderate by 0.1 mg of digitoxin five days a week. The drug was discontinued a month prior to hospitalization because of the appearance of heart block. Atropine and prednisone were administered, but the ventricular rate fell from 60 to 35. Immediately prior to hospitalization, the patient had a Stokes-Adams seizure. A transvenous pacemaker was inserted and the patient responded well.

Apart from the arrhythmia, the pertinent physical findings included blood pressure of 180/70, a grade 2/6 systolic blowing murmur at the apex, a few basal rales, and three finger hepatomegaly. X-ray examination of the chest showed considerable enlargement of the left ventricle, and increased hilar markings. Laboratory studies were within normal limits except for a fasting blood glucose of 220, moderate glycosuria, and slight proteinuria.

Electrocardiograms

To conserve space, selected leads are presented in the two figures. In order to simplify interpretation, Figure 1 is considered first, although this tracing was recorded eight days after Figure 2. It shows atrial fibrillation, complete A-V block, and a left bundle branch pacemaker with different degrees of RBBB morphology.

Figure 2 also shows atrial fibrillation, complete A-V block and idioventricular pacemakers on the left side. However, the ventricular complexes have a bidirectional pattern and they can be divided into two distinct types. Each type consists of a primary QRS complex followed by a secondary satellite beat after a fixed interval, which suggests re-entry. Disregarding the A-V block, resemblance to the atypical RBBB described by Rosenbaum et al. becomes apparent; and the bidirectional pattern is comparable to the bidirectional tachycardia reported by the same authors.

Since left bundle branch block pattern can be produced by a right bundle branch pacemaker, and vice versa, one can explain the sequence of events as follows: the primary QRS complex of type 1 is inscribed by an activation wave that originates in the region of the inferior division of the left bundle branch. From this zone, activation proceeds to the left and then to the right, yielding the morphology of RBBB because it originates in the left ventricle, and also a pattern of block of the superior division of the LBB. In opposite fashion, the primary QRS of type 2 originates in the myocardium which surrounds the superior division of the left bundle and the morphology presented resembles that found with RBBB and block of the inferior division of the left bundle.

The idioventricular rate is approximately 30 for each idioventricular focus. The intervals between primary complexes have a range from 1.94 sec to 2.08 sec, with an average of 2.00 sec. Inspection of Figure 2 indicates that the two foci have a similar rate. Following each primary QRS complex there is a secondary satellite re-entry beat, which occurs at an interval of 0.54 sec. The re-entry interval is quite constant. When the primary focus is in the inferior division of the left bundle, the secondary QRS represents retrograde conduction via the left bundle to the superior division. In opposite fashion, when the primary focus is in

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322
A-V BLOCK, DUAL VENTRICULAR PACEMAKERS

the superior division, there is retrograde conduction via the left bundle to the inferior division.

DISCUSSION

An arrhythmia identical with the one reported could not be found in the literature. Katz described a case of complete A-V block with dual idioven-tricular pacemakers, but he published only lead 2.

As mentioned previously, the recent work of Rosenbaum et al. is pertinent to an understanding of our case. These authors have stressed the concept of three ventricular fascicles: the right bundle branch and two divisions of the left. They have described RBBB with hemiblock on the left side, involving either the anterior or the posterior division. In bidirectional tachycardia, these authors demonstrated the presence of RBBB in every beat and a pattern of alternant left anterior hemiblock (LAH) and left posterior hemiblock (LPH). These concepts are applicable to the electrocardiogram presented in Figure 2. It is clear that an idioventricular focus will mimic a QRS pattern of block in the alternate pathway. Thus, a pacemaker in the myocardium adjacent to the right bundle branch will mimic left bundle branch block, and vice versa. It is reasonable to apply similar electrophysiology to the divisions of the left bundle.

In conclusion, an electrocardiogram has been presented, which shows complete A-V block and idioven-tricular pacemakers which have their origin in the myocardium surrounding the superior and inferior divisions of the left bundle alternately, with delayed activation of the right ventricle and of the opposite division of the left bundle and with re-entry into the latter.

REFERENCES


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