Alternating Bundle Branch Block During Sinus Rhythm

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A 68-year-old gentleman without any comorbidities presented with recurrent syncope. His baseline ECG showed sinus rhythm with right bundle branch block (RBBB) and the echocardiogram was normal. He underwent a 24-hour Holter study, one of the tracings of which is shown in Figure 1. What does it reveal and what is the underlying mechanism of the finding?

Figure 1. Holter Tracing of a Gentleman With Syncope

Commentary

The left half of Holter tracing in Figure 1 shows sinus rhythm with constant PR interval of 180 ms and RBBB. The RR interval during the RBBB is 780 ms corresponding to a heart rate of 77 beats per minute. However, in the right half of the tracing, with only very small increase in sinus rate (RR interval 740 ms), the PR interval prolongs to 240 ms and the QRS configuration changes to left bundle branch block (LBBB). These findings suggest severe disease in the infra-Hisian cardiac conduction system.

Although, we use the term bundle branch block (BBB), the same pattern may be seen if there is delay in conduction relative to the contralateral bundle branch without total “block” in conduction. In other words, total failure of conduction in a bundle branch is not necessary for a BBB pattern to occur. Another important point is regarding the site of delay or block during BBB. Although, the BBB pattern suggests delay or block in conduction in that bundle branch, the “site” of delay or block may actually lie in the His bundle itself. Studies by Narula et al demonstrated that longitudinal dissociation in the His bundle with asynchronous conduction in the fibers predestined to become left or right bundle branch is quite common. Normalization of QRS while pacing in the region of His bundle is a proof of this concept and His bundle pacing is often used nowadays as an alternative to right ventricular pacing or even cardiac resynchronization therapy to correct LBBB.

The occurrence of RBBB and LBBB in the same patient at different times indicates the following about that patient’s cardiac conduction system:

1. Severe infra-Hisian conduction system disease with disease in both bundle branches.
2. None of the bundle branches has total failure of conduction.
3. High risk of development of complete AV block in the near future.

During the RBBB pattern in the first half, the right bundle branch conduction is slower than that in the left bundle branch, whereas during the LBBB pattern, the left bundle branch conducts slower than the right bundle branch.

This uncommon phenomenon is known as alternating BBB and indicates that the time taken by the cardiac impulse from the His bundle to onset of ventricular depolarization (HV interval as measured during an electrophysiological study) is likely to be significantly prolonged compared to the normal upper limit of 55 ms. The delay in conduction in both the bundle branches results in increase in HV interval and unequal delay or asynchronous conduction in the bundle branches results in alternating BBB branch pattern. Many patients with alternating BBB, especially those who are symptomatic, will have an HV interval of greater than 100 ms. Although, less sensitive, alternating BBB has a high predictive value for progression to complete AV block in future, especially if the change in the BBB morphology occurs at nearly the same rates and with a change in the PR interval as in the present case. In this regard, the alternation occurring from beat to beat is of even more significance than that seen on different times.

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of the day or a different day. Hence, patients with alternating BBB have an indication for pacemaker implantation even if they are asymptomatic. In the setting of acute myocardial infarction, presence of alternating BBB is an ominous sign and indicates a need for temporary pacing even in the absence of symptoms or higher degree of AV block.  

It should also be emphasized that if a patient has alternating BBB, the patient should be evaluated thoroughly for underlying structural heart disease like coronary artery disease or left ventricular dysfunction. If there is underlying left ventricular dysfunction, the presence of alternating BBB suggests not only increased risk of complete AV block but also of sudden death due to ventricular tachyarrhythmias. Hence, implantation of an implantable cardioverter-defibrillator or rather a cardiac resynchronization therapy-defibrillator device may be a better option than a pacemaker in such cases.

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