Misleading ECG appearance of AV block due to concealed AV nodal conduction caused by interpolated ventricular ectopic beats

İnterpole ventriküler ektopik atıma bağlı gizli ileti nedeniyle elektrokardiyografide yanıltıcı AV blok görünümü

Hasan Arı, M.D., Selma Arı, M.D., Vedat Koca, M.D., Tahsin Bozat, M.D.

Department of Cardiology, Bursa Postgraduate Hospital, Bursa

Concealed conduction commonly occurs when a retrogradely conducted interpolated ectopic impulse enters the atrioventricular (AV) node; thus, the next sinus beat is not conducted to the ventricle or conducted with a prolonged PR interval because of increased refractoriness of AV conduction system. A 67-year-old man had complaints of exertional fatigue and palpitations at rest. His blood pressure was 110/70 mmHg and heart rate was 78 beats/min, Auscultation revealed a mild systolic murmur at the apex and an irregular rhythm. His electrocardiogram was normal, except for the presence of frequent premature ventricular complexes (PVC) of right bundle branch block morphology. Echocardiographic examination showed only grade-1 mitral regurgitation. Further evaluation with 24-h Holter monitoring showed frequent interpolated PVCs in bigeminal rhythm. Progressive prolongation of the PR interval was observed after each PVC, which ended with Mobitz type I AV block. The patient was treated with metoprolol which resulted in immediate and marked improvement in the symptoms. Control Holter recording showed very rare PVCs, without PR prolongation or AV block.

Key words: Atrioventricular node; electrocardiography; ventricular premature complexes/physiopathology.

Gizli ileti genellikle, atriyoventriküler (AV) düğüme retrograd olarak giren interpole ektopik atım nedeniyle oluşur; bu durumda, bir sonraki sinüs vuruşu AV ileti sistemindeki artmış refrakterlik nedeniyle venriküle iletilemez ya da uzamış PR aralığı ile iletilir. Altmış yedi yaşında erkek hasta, hareket sonrası bitkinlik ve istirahatte çarpıntı yakınmalarıyla başvurdu. Kan basıncı 110/70 mmHg, kalp hızı 70 atım/dk idi. Oskültasyonda apeks üzerinde hafif derecede sistolik üfürüm duyuldu, ritmi düzensiz idi. Elektrokardiyogramı, sağ dal bloku morfolojisi gösteren sık ventrikül erken atımları (VEA) dışında normaldi. Ekokardiyografik değerlendirmede sadece derece 1 mitral yetersizlik saptandı. İleri tetkik amacıyla 24 saatlik Holter ile izlenen hastada, bigeminal ritim gösteren sık interpole VEA görüldü. Her bir VEA arkasından PR intervalinde Mobitz tip 1 AV blok ile sonlanan belirgin uzama vardı. Uygulanan metoprolol tedavisi hastanın semptomlarında hızlı ve belirgin iyileşme sağladı. Tedavi sonrası yapılan Holter kaydında birkaç adet VEA görülürken, PR mesafesinde uzama veya AV blok yoktu.

Anahtar sözcükler: Atriyoventriküler düğüm; elektrokardiyografi; ventrikül erken kompleksleri/fizyopatoloji.

Concealed conduction refers to a non-recordable event that modifies the expected behavior of the recorded event. The concealment is most frequently localized in the atrioventricular (AV) node during antegrade or retrograde propagation of impulse that fails to complete its passage across the AV junction due to increased refractoriness of the AV node. The concealed presence of such an impulse can be deduced from the unexpected changes in conduction, refractoriness, excitability, or automaticity of the subsequent impulse.[1-3]

CASE REPORT

A 67-year-old man presented to the cardiology policlinic with complaints of exertional fatigue, palpitations at rest, and giddiness of two-month duration. On admission, his blood pressure was 110/70 mmHg and heart rate was 78 beats/min, Auscultation revealed

Received: April 22, 2008 *Accepted:* July 16, 2008

Correspondence: Dr. Hasan Arı. Bursa Yüksek İhtisas Eğitim ve Araştırma Hastanesi, Kardiyoloji Kliniği, 16320 Yıldırım, Bursa, Turkey. Tel: +90 224 - 360 50 50 e-mail: hasanari03@yahoo.com

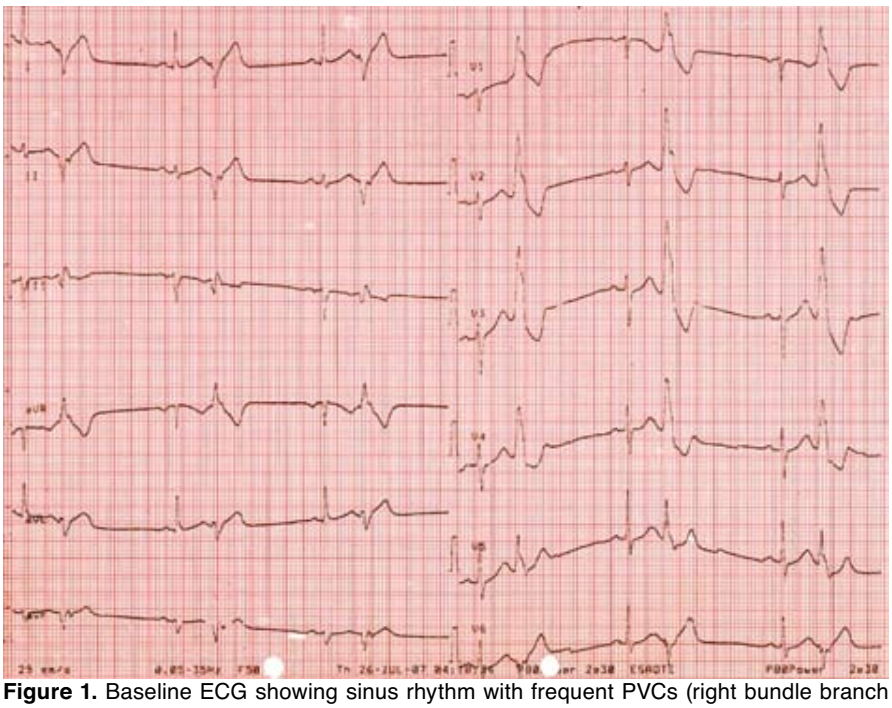

Figure 1. Baseline ECG showing sinus rhythm with frequent PVCs (right bundle branch block morphology).

a mild systolic murmur at the apex and an irregular rhythm. His electrocardiogram (ECG) was normal, except for the presence of frequent premature ventricular complexes (PVC) of right bundle branch block morphology (Fig. 1).

On two-dimensional echocardiographic examination, the dimensions of the heart chambers were normal, there was grade-1 mitral regurgitation, and left ventricular ejection fraction was 58%. We obtained a 24-h Holter recording for further evaluation, which showed frequent interpolated PVCs in bigeminal rhythm. Progressive prolongation of the PR interval was observed after each PVC, which ended with Mobitz type I AV block (Fig. 2). In addition, blocked P waves were noted following PVCs while the rhythm was sinus rhythm with bigeminal PVCs (Fig. 3).

The patient was treated with metoprolol resulting in immediate and marked improvement in the

Figure 2. First and second narrow QRSs are followed by PVCs with progressive prolongation of the PR interval and the blockage of the third sinus beat (Mobitz type I AV block). The third sinus beat is obscured by the T wave. The third and fourth narrow QRSs are also followed by PVCs and PR interval shows progressive prolongation. Since the fifth narrow QRS is not followed by a PVC, this prolongation does not end with the blockage of the next (7th) P wave, which is conducted with a normal PR interval. First, third, fourth, and fifth PVCs are interpolated.

Figure 3. Sinus rhythm and bigeminal PVC. P waves which follow PVC are blocked.

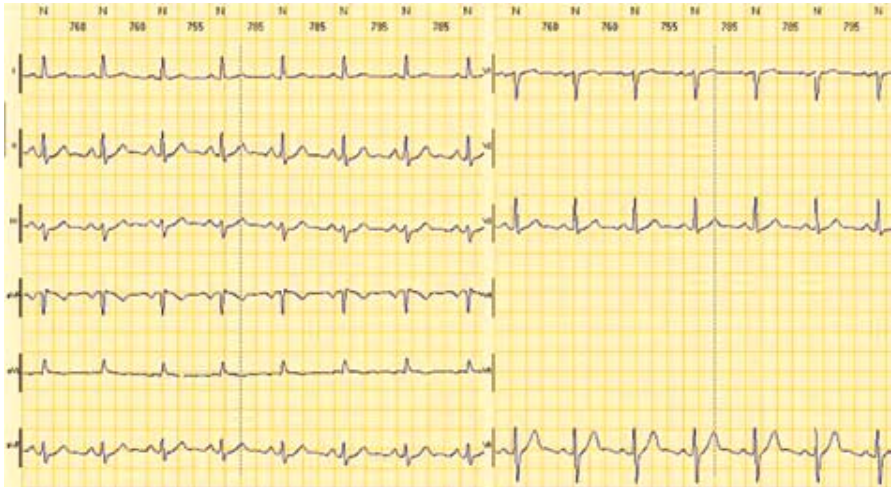

Figure 4. Holter recording after metoprolol treatment.

symptoms. Post-therapy Holter recording showed very rare PVCs, without PR prolongation or blockage (Fig. 4).

DISCUSSION

When a retrogradely conducted interpolated ectopic impulse reaches the AV junction, its refractoriness is prolonged, resulting in concealment and failure to complete its passage to the atria.[3-5] This slows down the conduction of the postextrasystolic sinus impulse to the invaded and incompletely recovered AV junction, and results in the prolongation of the PR interval. A similar explanation is suggested for the occurrence of an alternating sinus beat following a PVC that results in bigeminal rhythm.[1]

Because AV conduction is slower and blocked with PVCs in the nontransmitted sinus beat, the coupling interval of a nontransmitted sinus beat is significantly longer than that of a transmitted sinus beat.

In the presented case, Holter recording showed prolonged PR interval, AV block following PR interval prolongation, or an altered AV block that could have developed due to concealed conduction after a PVC. Observation of these rhythms on the surface ECG of the same patient has been very rarely reported in the literature.[2]

Misinterpretation of ECG changes that develop due to concealed conduction and AV block can lead to inappropriate treatment.[6-9] The ECG should be carefully interpreted in such cases, keeping in mind that delayed conduction may occur due to concealed conduction and AV block.

REFERENCES

1. Chou TC. Atrioventricular block, concealed conduction, gap phenomenon. In: Surawicz B. Knilans TK, editors. Chou's electrocardiography in clinical practice. Adult and pediatric. 5th ed. Philadelphia: W. B.

Saunders; 2001. p. 438-64.
2. Josephson ME. Miscellaneous phenomena related to atrioventricular conduction. . In: Clinical cardiac electrophysiology. Techniques and interpretations. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2002. p. 140 -57.
3. Amasyalı B, Işık E. Sinüs ve AV nod anatomisi ve fonksiyonları . In: Oto A, Aytemir K, Köse S, editörler. Klinik kardiyak elektrofizyoloji. Ankara: Hacettepe Üniversitesi Hastaneleri Basımevi; 2004. s. 74-82.
4. Langendorf R, Pick A. Concealed conduction. Further evaluation of a fundamental aspect of propagation of the cardiac impulse. Circulation 1956;13:381-99.
5. Surawicz B. Electrophysiology of the atrioventricular node. In: Electrophysiologic basis of ECG and cardiac arrhythmias. Baltimore: Williams & Wilkins; 1995. p. 280-301.
6. Prystowsky EN, Klein GJ, editors. Electrocardiographic consequences of atrial and ventricular ectopy. In: Cardiac arrhythmias: an integrated approach for the clinician. New York: McGraw-Hill; 1994. p. 27-47.
7. Barold SS, Hayes DL. Second-degree atrioventricular block: a reappraisal. Mayo Clin Proc 2001;76:44-57.
8. Wang K, Salerno DM. Pseudo AV block secondary to concealed premature His bundle depolarizations. Am Heart J 1991;121(4 Pt 1):1236-7.
9. Luzza F, Oreto G. Pseudo-atrioventricular dissociation caused by interpolated ventricular extrasystoles in the presence of dual atrioventricular nodal pathway. Chest 1994;105:1587-9.