Challenges in Clinical Electrocardiography

Electrocardiographic Risk Factors for a Common Cardiac Condition

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Case Presentation

A patient in their 60s experienced a several-month history of recurrent dizziness and light-headedness. The spells were occasionally preceded by palpitation, nausea, and coning of the visual fields, prompting the patient to sit down. On the day of admission, the patient had an episode of frank syncope resulting in facial contusion. By the time of arrival to the emergency department, full consciousness was regained without postictal symptoms.

On presentation, the heart rate was 88 beats/min and slightly irregular, and the blood pressure was 138/84 mm Hg. Except for obesity and a distant first heart sound, findings of physical examination and results of routine blood tests, including electrolyte, thyrotropin, and cardiac troponin levels, were normal. The 12-lead electrocardiogram (ECG) is presented in the **Figure**, A. A subsequent echocardiogram showed moderate left ventricular hypertrophy without wall motion abnormalities. All chamber sizes, including the left atrial transverse diameter and left atrial volume index, were within normal limits. The estimated left ventricular ejection fraction was 60% to 65%. Because of dysrhythmia, evaluation of diastolic function was inconclusive.

Questions: On the basis of the findings on the presenting ECG (Figure, A), what common cardiac condition should one worry about? What is the importance of pursuing the suspected diagnosis?

Interpretation

The ECG on presentation (Figure, A) showed sinus rhythm with frequent premature atrial complexes (PACs). Arrowheads point to premature P waves. The PR interval was 240 milliseconds (upper limit of normal, 200 milliseconds). The sinus P waves were 140 milliseconds wide (upper limit of normal, 110 milliseconds) and were bifid (umbilicated), best seen in the inferior leads (Figure, A, inset). Except for the listed abnormalities, the ECG was normal. First-degree atrioventricular block; wide, bifid P waves; and frequent PACs are important ECG risk factors for atrial fibrillation and stroke.[1-3]

Clinical Course

Initially, cardiac telemetry continued to demonstrate sinus rhythm with PACs. Two days after admission, the patient experienced another episode of palpitation and light-headedness. The monitor showed a modestly rapid irregular rhythm. The 12-lead ECG re-

Figure. Electrocardiograms of a Patient With Palpitation and Syncope

A | Electrocardiogram at presentation
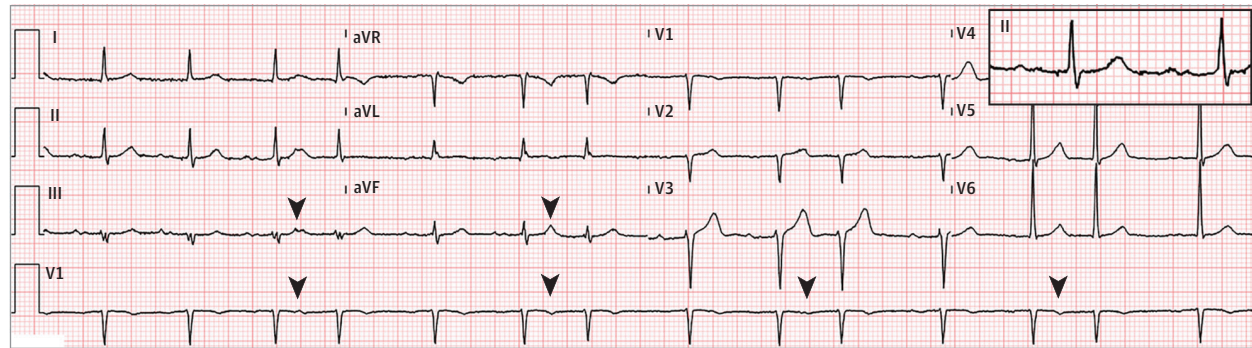
B | Electrocardiogram 2 d later
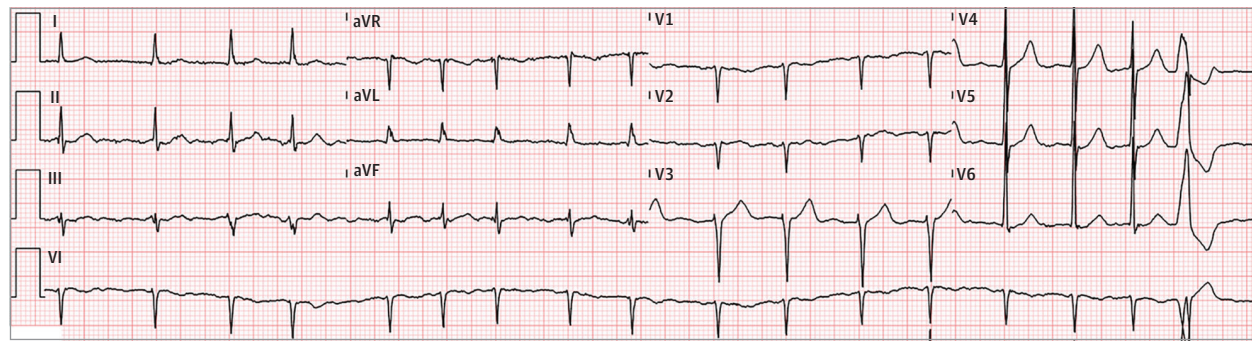
A, Arrowheads point to premature P waves. The inset is an enlargement of lead II demonstrating wide, bifid P waves. B, Electrocardiogram 2 days later showed atrial fibrillation.

vealed atrial fibrillation with a ventricular rate of approximately 100 beats/min and a premature ventricular complex (Figure, B). Magnetic resonance imaging of the brain showed punctuate multivessel embolic strokes.

The patient was treated with metoprolol and underwent anticoagulation with apixaban, a factor Xa inhibitor. Two weeks later, another episode of syncope occurred. Cardiac telemetry revealed paroxysmal atrial fibrillation with episodes of profound sinus bradycardia of 30 to 40 beats/min. A dual-chamber pacemaker was implanted. Subsequent ECGs and pacemaker interrogation revealed both atrial paced rhythm and atrial fibrillation with a ventricular paced rhythm. After a few months, all ECGs showed atrial fibrillation.

Discussion

Atrial fibrillation is the most common sustained arrhythmia. Its prevalence increases with age and in the presence of structural heart disease.[4] The most dreaded consequence of atrial fibrillation is stroke, which is often devastating. Unfortunately, even patients with silent, unrecognized atrial fibrillation are at risk of stroke.[4,5] Today, prolonged ECG monitoring of patients with cryptogenic stroke (ie, those patients for whom detailed evaluation did not find a cause for the cerebrovascular event) is emerging as standard of care.[6] There is less robust evidence that widespread monitoring of older adult patients with clinical risk factors but no prior cerebrovascular events is a cost-effective approach.[7] In such patients, recognizing ECG risk factors for atrial fibrillation appears to be a crucial task.

Several ECG parameters have been associated with increased risk of atrial fibrillation and stroke.[8] Of those, the 3 most important ones include prolonged P-wave duration, prolonged PR interval, and frequent PACs.[1-3] Widened, bifid P waves, usually best seen in the inferior leads, are considered to reflect intra-atrial block associated with atrial ischemia, infiltration, or fibrosis.[2] Advanced intra-atrial block is characterized by terminal negativity of the bifid P waves in the inferior leads.[9] This, too, is a marker of risk for atrial fibrillation

(Bayés syndrome).[9] In such cases, a prolonged PR interval usually reflects slow conduction within the atrial myocardium rather than atrioventricular nodal conduction delay.[1] Frequent PACs are indicators of electrophysiological remodeling of the atria and may also be triggers of atrial fibrillation.[3] Although these ECG signs, singularly and especially in combination, have been demonstrated to be associated with high risk of atrial fibrillation and stroke, interpretation software never conveys this important fact. Therefore, it is the clinicians' responsibility to actively search for and recognize such ECG markers and, if present, to strongly consider evaluating for episodes of silent atrial fibrillation. This is especially true in older adult patients and in those with additional clinical risks, such as structural heart disease and sleep apnea.

The ECG, a simple and inexpensive tool, appears to be a more reliable indicator of subsequent atrial fibrillation than the echocardiogram.[10] The echocardiogram helps determine left atrial size but not the abnormal mechanical and electrical properties of the atrial myocardium. It is important to emphasize that intra-atrial conduction abnormality (intra-atrial block) reflects left atrial structure rather than left atrial size or conduction. As in the case presented, ECG risk factors can predict atrial fibrillation even when the echocardiographic left atrial size is normal.

Take-home Points

- Wide, bifid P waves; prolonged PR intervals; and frequent PACs are important electrocardiographic risk factors for both atrial fibrillation and stroke.
- Interpretation software does not indicate these findings as atrial fibrillation risks.
- Clinicians are encouraged to routinely check all ECGs for such abnormalities.
- Once recognized, aggressive search for subclinical (silent) atrial fibrillation appears to be warranted, and, if found, anticoagulation should be considered.

REFERENCES

1. Cheng S, Keyes MJ, Larson MG, et al. Long-term outcomes in individuals with prolonged PR interval or first-degree atrioventricular block. *JAMA*. 2009;301(24):2571-2577. doi:10.1001/jama.2009.888

2. Jung M, Kim JS, Song JH, et al. Usefulness of P wave duration in embolic stroke of undetermined

source. *J Clin Med*. 2020;9(4):1134. doi:10.3390/jcm9041134

3. Wallmann D, Tüller D, Wustmann K, et al. Frequent atrial premature beats predict paroxysmal atrial fibrillation in stroke patients: an opportunity for a new diagnostic strategy. *Stroke*. 2007;38(8):2292-2294. doi:10.1161/STROKEAHA.107.485110

4. Morin DP, Bernard ML, Madias C, Rogers PA, Thihalolipavan S, Estes NA III. The state of the art: atrial fibrillation epidemiology, prevention, and treatment. *Mayo Clin Proc*. 2016;91(12):1778-1810. doi:10.1016/j.mayocp.2016.08.022

5. Lin HJ, Wolf PA, Benjamin EJ, Belanger AJ, D'Agostino RB. Newly diagnosed atrial fibrillation and acute stroke: the Framingham Study. *Stroke*. 1995;26(9):1527-1530. doi:10.1161/01.STR.26.9.1527

6. Schnabel RB, Haeusler KG, Healey JS, et al. Searching for atrial fibrillation poststroke: a white paper of the AF-SCREEN International Collaboration. *Circulation*. 2019;140(22):1834-1850. doi:10.1161/CIRCULATIONAHA.119.040267

7. Steinhubl SR, Waalen J, Edwards AM, et al. Effect of a home-based wearable continuous ECG monitoring patch on detection of undiagnosed atrial fibrillation: the mSToPS randomized clinical trial. *JAMA*. 2018;320(2):146-155. doi:10.1001/jama.2018.8102

8. Aizawa Y, Watanabe H, Okumura K. Electrocardiogram (ECG) for the prediction of incident atrial fibrillation: an overview. *J Atr Fibrillation*. 2017;10(4):1724. doi:10.4022/jafib.1724

9. Baranchuk A, Torner P, de Luna AB. Bayés syndrome: what is it? *Circulation*. 2018;137(2):200-202. doi:10.1161/CIRCULATIONAHA.117.032333

10. Ariyarajah V, Apiyasawat S, Fernandes J, Kranis M, Spodick DH. Association of atrial fibrillation in patients with interatrial block over prospectively followed controls with comparable echocardiographic parameters. *Am J Cardiol*. 2007;99(3):390-392. doi:10.1016/j.amjcard.2006.08.043