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Beyond Known Left Bundle Branch Block: Ventricular Standstill Revealed by Ambulatory ECG Monitoring

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Abstract

A patient presented with recurrent episodes of dizziness and collapse, initially attributed to postural hypotension and benign paroxysmal positional vertigo (BPPV). Clinical examination and repeated 12-lead ECGs were unremarkable, demonstrating only the patient's pre-existing left bundle branch block (LBBB), which was considered their baseline conduction abnormality. Despite repeated ECG assessments, no acute cardiac abnormality was identified, and cardiology input was initially deferred.

However, persistent symptoms prompted further investigation with 24-hour ambulatory Holter monitoring, which revealed episodes of ventricular standstill. The patient was urgently referred to cardiology and subsequently underwent successful permanent pacemaker implantation.

This case highlights the limitations of relying solely on repeated resting 12-lead ECGs, particularly in patients with pre-existing conduction abnormalities, as intermittent and potentially life-threatening arrhythmias may remain undetected. It emphasises the importance of appropriate ambulatory cardiac monitoring and, where clinical suspicion is high or symptoms are recurrent, consideration of prolonged inpatient cardiac rhythm monitoring to facilitate timely detection of intermittent arrhythmias. A 12-lead ECG with no acute changes should not provide false reassurance. The choice, setting, and duration of monitoring should be guided by the frequency and severity of symptoms, clinical risk, and suspicion of an underlying arrhythmia.

Categories: Cardiology, Internal Medicine
Keywords: ambulatory cardiac monitoring, cardiac arrhythmia, collapses, left bundle branch block, vasovagal syncope, ventricular standstill

Introduction

Prolonged cardiac pauses and ventricular standstill are uncommon but potentially life-threatening rhythm disturbances. Ventricular standstill is characterised by the absence of ventricular depolarisation, often despite continuing atrial electrical activity, resulting in an absence of effective ventricular contraction. Depending on the duration and underlying mechanism, this may lead to cerebral hypoperfusion, dizziness, presyncope, syncope, or haemodynamic compromise. However, significant pauses may occasionally occur without associated symptoms, making clinical recognition challenging.

The detection of intermittent bradyarrhythmias can be difficult because a routine 12-lead electrocardiogram (ECG) records cardiac electrical activity over only a few seconds and may fail to capture transient rhythm abnormalities. This is particularly relevant in patients with pre-existing conduction abnormalities, such as left bundle branch block (LBBB), where repeated ECGs may remain unchanged despite significant intermittent conduction disturbances. Consequently, ambulatory cardiac monitoring, including Holter monitoring and prolonged event recording, plays an important role in establishing symptom-rhythm correlation and identifying otherwise undetected arrhythmias. In patients with recurrent unexplained syncope or suspected significant bradyarrhythmia, inpatient continuous cardiac monitoring should also be considered according to clinical risk and presentation [1-3].

Previous case reports have demonstrated that prolonged episodes of ventricular standstill may occur with variable clinical presentations, including dizziness, presyncope, and syncope. Stern and Tzivoni described episodes of atrial and ventricular standstill, including a 19-second pause associated with dizziness but without loss of consciousness, highlighting the unpredictable relationship between pause duration and clinical symptoms [4].

This case report describes an elderly patient with recurrent dizziness and unexplained collapses in whom repeated 12-lead ECGs demonstrated only established baseline LBBB. Subsequent ambulatory Holter monitoring identified a prolonged episode of ventricular standstill lasting 9.08 seconds, leading to urgent cardiology intervention and permanent pacemaker implantation. The case highlights the limitations of

relying solely on resting ECGs, the importance of appropriate prolonged cardiac rhythm monitoring, and the need to consider timely inpatient cardiac investigation in patients with recurrent unexplained collapses and suspected intermittent arrhythmias.

This case highlights the importance of prolonged cardiac rhythm monitoring in detecting intermittent and potentially life-threatening arrhythmias that may otherwise remain unrecognised. It also emphasises the need to prioritise timely inpatient cardiac investigations, including continuous rhythm monitoring, in high-risk patients presenting with recurrent unexplained collapses, rather than relying solely on deferred outpatient investigations, which may delay diagnosis and appropriate intervention.

Case Presentation

An 84-year-old female with a background of hypertension, migraine (under the care of neurology), chronic kidney disease stage 3 (CKD3), LBBB, previous non-traumatic subdural haematoma (SDH), anxiety, vertigo, Holmes-Adie syndrome, basal cell carcinoma of the left temple, ankylosing spondylitis, bicuspid aortic valve, and known breast cancer presented to the acute medical unit (AMU) following a fall with loss of consciousness (LOC) and no recollection of the events. She reported experiencing two episodes of migraine on the day before admission.

During the inpatient stay, she sustained a further fall. CT of the head demonstrated an acute right frontoparietal SDH, which showed a reduction in size on repeat CT imaging.

Blood pressure was 118/70 mmHg while lying down and 90/60 mmHg while standing, with associated light-headedness. The heart rate was 64 bpm with a regular rhythm.

Initial examination revealed no focal neurological deficits, and bedside vestibular assessment suggested possible benign paroxysmal positional vertigo (BPPV). A 12-lead ECG demonstrated LBBB, consistent with the patient's pre-existing baseline conduction abnormality (Figure *1*), with no new acute ECG changes. Blood investigations, including full blood count, renal profile, thyroid function and electrolytes, were within normal limits. In view of the postural blood pressure drop and dizziness, an initial working diagnosis of BPPV and postural hypotension was made.

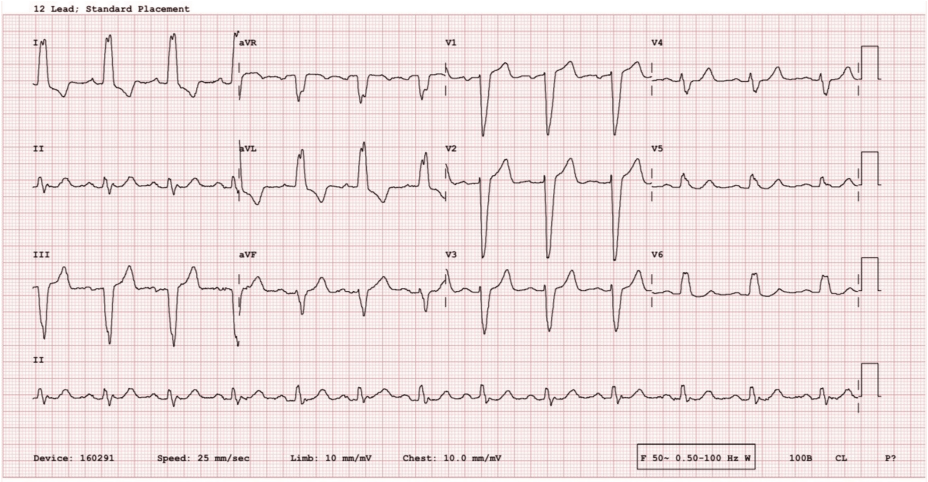


FIGURE 1: Initial 12-lead electrocardiogram.

The initial resting 12-lead electrocardiogram showed a left bundle branch block (known case). Subsequently, ambulatory ECG monitoring revealed an episode of ventricular standstill.

Given the recurrent episodes of collapse and falls, cardiology input was sought to consider inpatient cardiac rhythm monitoring. However, as the ECG remained unchanged from baseline, further cardiac investigations were initially deferred in favour of outpatient assessment. Despite this, ongoing episodes of collapse raised continued concern for an underlying intermittent cardiac arrhythmia, prompting further investigation with 24-hour ambulatory Holter monitoring.

The Holter recording revealed an episode of ventricular standstill lasting 9.08 seconds at 13:21 hours (Figure *2*), correlating with the patient's symptoms of dizziness. The patient was urgently referred to cardiology and subsequently underwent successful permanent pacemaker implantation. Following the procedure, there were no further episodes of dizziness or collapse. She was discharged home in a stable condition with outpatient cardiology follow-up.

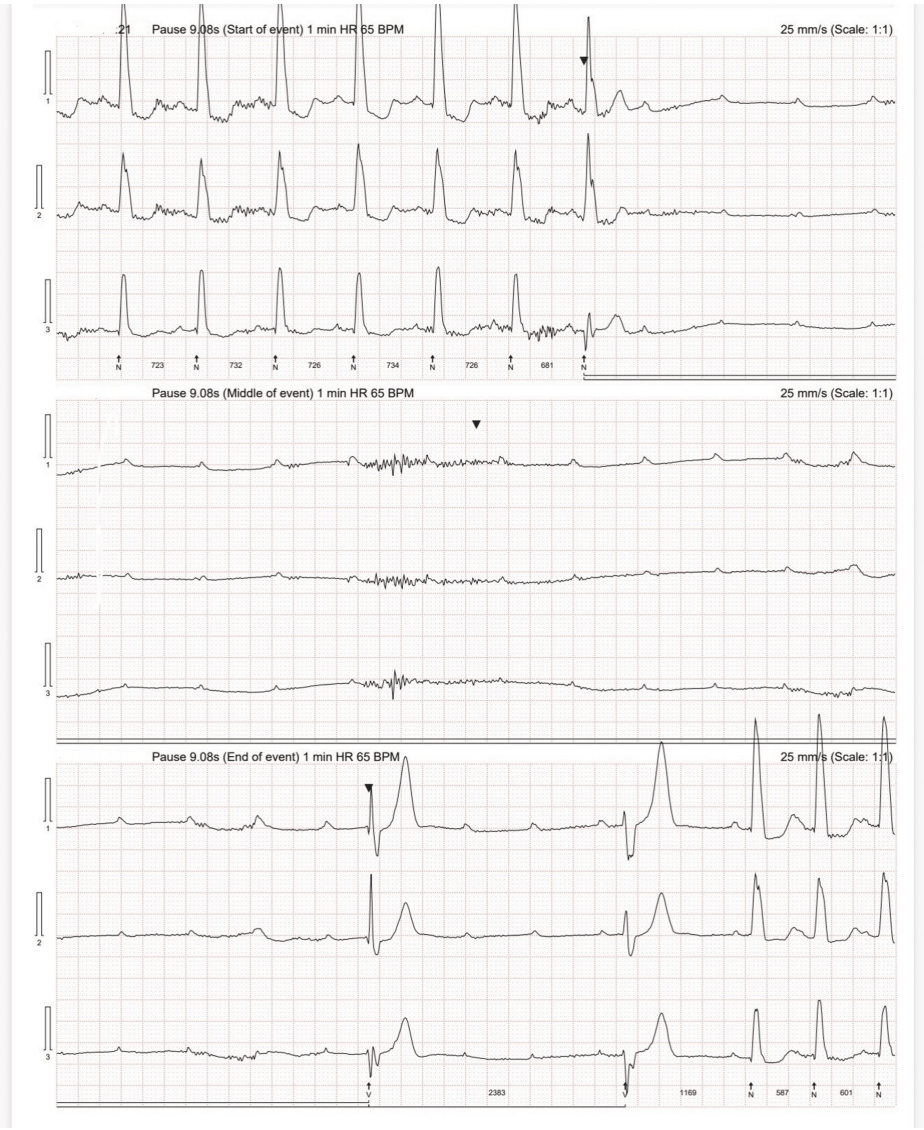


FIGURE 2: Ambulatory electrocardiographic recording demonstrating ventricular standstill.

Ambulatory electrocardiographic monitoring demonstrating an episode of ventricular standstill in a patient presenting with recurrent dizziness and collapses. The tracing illustrates the rhythm abnormality that was not detected on the initial 12-lead electrocardiogram.

Discussion

Ventricular standstill is a rare but potentially life-threatening manifestation of severe cardiac conduction disturbance. It is characterised by the absence of ventricular depolarisation, typically with ongoing atrial activity (P waves) but no corresponding QRS complexes and no effective ventricular escape rhythm. Clinical presentations range from dizziness and presyncope to syncope, haemodynamic collapse, and cardiac arrest. Its intermittent nature makes diagnosis particularly challenging, as routine resting ECGs may fail to capture these episodes.

The present case illustrates the diagnostic challenges of intermittent ventricular standstill in a patient with pre-existing LBBB. Despite recurrent episodes of dizziness, falls, and collapse, repeated 12-lead ECGs demonstrated only the patient's established LBBB, with no new changes from baseline. Initial clinical assessment suggested postural hypotension and possible BPPV, which provided alternative explanations for her symptoms. Although cardiology input was sought to consider inpatient cardiac monitoring, further investigations were initially deferred in favour of outpatient assessment. However, the persistence of unexplained episodes highlighted the importance of reconsidering an underlying cardiac cause rather than relying on unchanged resting ECG findings.

Subsequent 24-hour ambulatory Holter monitoring revealed an episode of ventricular standstill lasting 9.08 seconds, correlating with the patient's symptoms. This finding established a potentially life-threatening cardiac cause for her recurrent symptoms and led to urgent cardiology intervention and successful permanent pacemaker implantation. The absence of further episodes following pacemaker insertion further supported the clinical significance of the documented bradyarrhythmia.

Previous case reports have described ventricular standstill presenting with near-syncope, syncope, or cardiac arrest, highlighting the variable clinical presentation of this uncommon arrhythmia [1-3]. Stern and Tzivoni reported a patient in whom four-day ambulatory ECG monitoring demonstrated episodes of atrial and ventricular standstill. The longest episode lasted 20 seconds during sleep, while a 19-second episode during daily activity was associated with dizziness without loss of consciousness. Symptoms improved following pacemaker implantation [4]. This report is particularly relevant to the present case, demonstrating that significant pauses may occur intermittently and remain undetected by conventional short-duration ECG recordings.

The importance of ambulatory rhythm monitoring in patients with unexplained syncope is supported by the 2018 European Society of Cardiology (ESC) guidelines for the diagnosis and management of syncope [5]. The choice of monitoring modality should be guided by symptom frequency and clinical suspicion of an arrhythmic cause. While 24-hour Holter monitoring may be useful when symptoms occur frequently, prolonged external monitoring or implantable loop recorders may be more appropriate for infrequent episodes. Furthermore, in patients with recurrent unexplained syncope or falls and a high suspicion of significant cardiac arrhythmia, inpatient telemetry should be considered to facilitate timely diagnosis and intervention.

This case emphasises that an ECG remaining unchanged from a patient's baseline, particularly in the presence of established conduction abnormalities such as LBBB, should not provide false reassurance or exclude an intermittent arrhythmia. Repeated resting ECGs cannot reliably exclude transient high-grade conduction disturbances. Persistent clinical suspicion should prompt appropriate prolonged cardiac rhythm monitoring, with consideration of inpatient investigation where clinically indicated, rather than relying solely on deferred outpatient assessment. Early recognition is essential to prevent further episodes of syncope, associated injury, and potentially life-threatening complications.

Evidence from other clinical settings further demonstrates the value of prolonged monitoring for intermittent arrhythmias. In the CRYSTAL-AF trial, long-term monitoring with an implantable cardiac monitor detected substantially more cases of previously unrecognised atrial fibrillation than conventional follow-up in patients with cryptogenic stroke [6]. Although this study investigated atrial fibrillation rather than ventricular standstill, it supports the broader principle that intermittent arrhythmias may remain undetected when monitoring is limited to a short period. The present case similarly demonstrates the diagnostic value of extending rhythm surveillance beyond a normal resting ECG.

An additional important feature of this case was the initial attribution of the patient's symptoms to a benign vestibular cause. BPPV can produce dizziness and imbalance; however, the subsequent identification of ventricular standstill highlights the importance of reconsidering the diagnosis when symptoms persist, the clinical course is atypical, or the initial explanation does not adequately account for the presentation. This case therefore emphasises the importance of maintaining diagnostic vigilance and reassessing the differential diagnosis in patients with unexplained collapse, pre-syncope, or syncope.

The management implications are significant. The 2018 American College of Cardiology/American Heart Association/Heart Rhythm Society (ACC/AHA/HRS) guideline recommends permanent pacing for acquired Mobitz type II second-degree atrioventricular (AV) block, high-grade AV block, or third-degree AV block when these are not attributable to reversible or physiological causes, irrespective of symptoms [7]. The 2021 ESC guidelines on cardiac pacing and cardiac resynchronisation therapy similarly recommend pacing for patients with persistent or paroxysmal third-degree AV block, Mobitz type II AV block, or high-grade AV block, irrespective of symptoms [8]. These recommendations are relevant when ventricular standstill results from significant conduction disease. However, management should be individualised according to the underlying mechanism, including consideration of potentially reversible causes such as medication effects, metabolic abnormalities, myocardial ischemia, infection, or excessive vagal tone [7,8].

The importance of further cardiac investigation in patients with unexplained syncope and pre-existing conduction abnormalities is supported by the prospective B4 study, which demonstrated a high diagnostic yield using a systematic approach incorporating electrophysiological studies and prolonged rhythm monitoring [9]. These findings support early cardiology assessment and consideration of inpatient telemetry in patients with recurrent unexplained collapses, rather than relying solely on repeated resting ECGs or deferred outpatient investigations.

The present case adds to the published literature on ventricular standstill by demonstrating that a potentially serious intermittent conduction abnormality may be identified only through ambulatory monitoring despite baseline ECG and initially reassuring clinical findings. Together with previous case

reports, it supports the importance of considering intermittent bradyarrhythmia in patients with unexplained syncope or collapse and selecting an appropriate duration of rhythm monitoring when the initial assessment does not establish a cause [1-5]. Early recognition and documentation of significant ventricular standstill are essential to facilitate urgent cardiology assessment and timely intervention. Current ACC/AHA/HRS and ESC pacing guidelines support permanent pacemaker implantation in patients with acquired high-grade or complete AV block when not attributable to reversible causes, irrespective of symptoms [7,8]. This reinforces the importance of prompt rhythm diagnosis to prevent recurrent syncope and potentially life-threatening complications.

This case also highlights the distinction between the diagnostic and therapeutic roles of prolonged monitoring. Ambulatory monitoring is not simply intended to document an abnormal rhythm; it can help establish the mechanism of symptoms and identify clinically significant arrhythmias that may alter management. In patients with unexplained syncope or collapse, documentation of ventricular standstill provides important diagnostic information that a normal resting ECG obtained between episodes cannot provide. In this patient, clinical reassessment combined with prolonged rhythm monitoring was central to establishing the diagnosis.

Conclusions

Ventricular standstill is an important but potentially overlooked cause of recurrent dizziness, syncope, and unexplained collapse, particularly when initial clinical assessment and resting electrocardiography are not changed. This case demonstrates that no acute changes in resting ECG do not exclude a significant intermittent cardiac rhythm disturbance and highlights the importance of maintaining diagnostic vigilance when symptoms persist or remain unexplained. Ambulatory ECG monitoring can be instrumental in establishing the diagnosis by capturing transient rhythm abnormalities that may otherwise go undetected. Timely recognition, urgent cardiology referral, and appropriate intervention are essential to reduce the risk of further syncopal episodes and potentially serious complications. Clinicians should therefore consider prolonged rhythm monitoring in patients with recurrent unexplained symptoms, ensuring that apparently reassuring initial investigations do not delay the identification and treatment of a potentially life-threatening arrhythmia.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Rukhsana Waqqas

Acquisition, analysis, or interpretation of data: Rukhsana Waqqas

Drafting of the manuscript: Rukhsana Waqqas

Critical review of the manuscript for important intellectual content: Rukhsana Waqqas

Disclosures

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