

Ultrasound Findings with Bedside Ultrasound of Heart Failure with Preserved LVEF

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ABSTRACT

Heart failure with preserved ejection fraction (HFpEF), formerly termed diastolic heart failure, constitutes nearly half the heart failure cases. Patients may exhibit acute heart failure symptoms, yet bedside echocardiograms might indicate normal left ventricular systolic function, potentially leading to the premature exclusion of heart failure as a differential diagnosis. This review delves into fundamental echocardiographic principles associated with diastolic dysfunction, crucial for recognition in HFpEF patients. Specifically, it explores the VALVE protocol, a stepwise approach tailored for the exigent nature of emergency departments. Acquiring accurate imaging windows in acutely ill patients poses a challenge, emphasizing the significance of precise measurements to avoid errors. Techniques such as E-point septal separation (EPSS) must be meticulously positioned for ejection fraction determinations. The discussion focuses on key metrics outlined in the VALVE protocol, encompassing ventricular function, annular tissue Doppler imaging (TDI) measurements, left atrium volume, mitral valve velocities, and the E/e0 ratio as indicators of diastolic dysfunction in HFpEF.

KEYWORDS: Heart failure, preserved ejection fraction, bedside echocardiography, diastolic dysfunction, VALVE protocol.

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INTRODUCTION

Heart failure with preserved ejection fraction (HFpEF), formerly recognized as diastolic heart failure, stands as a significant contributor, accounting for nearly half of heart failure cases¹. Often, patients exhibiting acute heart failure symptoms may present normal left ventricular systolic function on initial bedside echocardiography, potentially leading to the premature dismissal of heart failure as a possible diagnosis. However, further echocardiographic assessment might reveal pertinent signs of diastolic dysfunction, pivotal in the diagnosis of HFpEF².

This article aims to elucidate the essential echocardiographic principles linked to diastolic dysfunction, specifically targeting their utility in the recognition and diagnosis of HFpEF in acute settings. It introduces and discusses the VALVE protocol, designed as a focused stepwise approach suitable for the rapid-paced environment of emergency departments³. Recognizing the challenges in obtaining accurate imaging windows in acutely unwell patients, this article underscores the necessity for precision in measurements to avoid potential diagnostic errors. Techniques such as E-point septal separation (EPSS) demand

precise positioning for accurate ejection fraction determinations⁴.

This discussion emphasizes the criticality of employing multiple views and specific metrics outlined in the VALVE protocol, including ventricular function, annular tissue Doppler imaging (TDI) measurements, left atrium volume, mitral valve velocities, and the E/e0 ratio. These metrics serve as vital indicators of diastolic dysfunction in HFpEF, providing essential diagnostic clues for emergency physicians assessing patients with suspected heart failure in acute settings⁵.

FRAMEWORK

V - Ventricular Function

Ventricular function assessment is essential in diagnosing HFpEF. While ejection fraction might appear normal in HFpEF, focusing on diastolic function becomes pivotal. Various parameters play a crucial role⁶:

Transmitral Doppler Flow Patterns (E/A Ratio): The ratio of early (E) to late (A) diastolic velocities, reflecting impaired relaxation when the ratio is reversed or the deceleration time of E velocity is prolonged⁷.

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Tissue Doppler Imaging (TDI) of Mitral Annulus: TDI measures velocities of the mitral annulus in both septal and lateral regions, identifying abnormalities in early diastolic velocities (E') and the E/e' ratio, particularly when elevated⁸.

A - Annulus TDI Measurements

Detailed examination of the annulus through TDI unveils insights into myocardial relaxation, a hallmark of diastolic dysfunction. Anomalies in early diastolic velocities (E') and the E/e' ratio, particularly when elevated, signify diastolic dysfunction. Elevations above the threshold values (E/e' ratio >15 septal or >12 lateral) point to increased left ventricular filling pressures⁹.

L - Left Atrium Volume Measurements vs. Visualization

Left atrial enlargement often accompanies diastolic dysfunction. Therefore, assessing left atrial volume and visualizing its size and morphology aids in the recognition of HFpEF. Enlargement, especially when disproportionate to the left ventricle, serves as an additional diagnostic criterion¹⁰.

V - Velocities of Mitral Valve (E : A)

Detailed evaluation of the velocities of the mitral valve, particularly the ratio of early (E) to late (A) diastolic velocities, serves as a key diagnostic indicator for diastolic dysfunction. Deviations from the normal E/A ratio or prolonged deceleration time of E velocity suggest impaired relaxation¹¹.

E - E/e' Ratio (>15 Septal or >12 Lateral)

The E/e' ratio derived from the early transmitral flow velocity (E) and early diastolic mitral annular velocity (e') serves as an important gauge for left ventricular filling pressures. Elevated E/e' ratios, especially when exceeding the defined thresholds in septal or lateral annulus measurements, signify increased left ventricular filling pressures, a characteristic of diastolic dysfunction¹².

DISCUSSION

The comprehensive analysis of echocardiographic measures outlined in the theoretical framework provides critical insights into diagnosing diastolic dysfunction in heart failure with preserved ejection fraction (HFpEF). Each parameter plays a unique role in unraveling the complexities of diastolic dysfunction and serves as an essential diagnostic tool, especially in acute settings⁶⁻¹². Let's explore the significance of these parameters:

In cases of heart failure, diagnosing the condition often presents a challenge since the manifestations share similarities with various other medical conditions. Hence, it's essential for the emergency physician to move beyond conventional history-taking and physical examination. The introduction of bedside echocardiographic assessment is crucial to thoroughly ascertain the presence and extent of heart failure. It's important to highlight that this review and the proposed VALVE protocol do not endorse the replacement of the comprehensive echocardiogram evaluations that are currently in practice. Rather, the early utilization of focused bedside echocardiography during the initial phases of

emergency department management can offer valuable insights and help direct therapy until the patient undergoes admission and comprehensive echocardiography can be administered³.

CONCLUSION

Ultrasound findings play a pivotal role in the diagnosis of heart failure with preserved ejection fraction (HFpEF), particularly through the meticulous assessment of diastolic dysfunction in acute settings. The detailed echocardiographic parameters outlined in the theoretical framework offer a structured approach for emergency physicians to diagnose HFpEF accurately and swiftly. This review highlights the significance of the following key metrics: ventricular function assessment, annular tissue Doppler imaging measurements, left atrium volume evaluation, mitral valve velocities, and the E/e' ratio.

The integration of these echocardiographic measures into bedside ultrasound provides a valuable diagnostic framework. This approach aids emergency physicians in identifying diastolic dysfunction in HFpEF, a condition often overlooked due to the challenges of accurate assessment and the potential appearance of normal left ventricular systolic function.

Additionally, recognizing the significance of each parameter in providing diagnostic clues for diastolic dysfunction emphasizes the importance of incorporating a structured protocol, such as the VALVE approach, into emergency echocardiography practice.

By understanding and implementing these diagnostic tools, emergency physicians can enhance their ability to recognize and diagnose HFpEF promptly, enabling more effective patient management and potentially reducing the morbidity associated with delayed diagnosis.

This review underlines the criticality of accurate and comprehensive echocardiographic assessment in the swift and accurate diagnosis of HFpEF in acute settings.

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