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BRIEF REPORT

Can Junior Emergency Physicians Use E-Point Septal Separation to Accurately Estimate Left Ventricular Function in Acutely Dyspneic Patients?

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Abstract

Objectives: The authors determined if E-point septal separation (EPSS) as measured by junior emergency physicians (EPs) correlated with visual estimation of left ventricle ejection fraction (LVEF) by senior EPs and cardiologists in acutely dyspneic patients presenting to an adult emergency department (ED).

Methods: Acutely dyspneic patients were enrolled in a prospective, observational study. EPSS was measured using bedside ultrasonography by junior EPs (PGY 3 and PGY 4 residents) with variable ultrasound experience. M-mode measurements of EPSS were recorded in the parasternal long-axis orientation and were calculated during diastole by measuring distance from the tip of the anterior mitral valve leaflet to the septal wall. LVEF was visually estimated at the bedside by emergency medicine (EM) ultrasound fellows and an EM ultrasound fellowship-trained attending physician and was subsequently visually estimated by two cardiologists reviewing video clips obtained by the junior EPs. The correlation between EPSS and visually estimated LVEF was calculated.

Results: Of the 58 patients, the median age was 63 years (range = 28 to 90 years) and 66% were women. Interobserver reliability between EPs and cardiologists for the visual estimation of LVEF was excellent ($\kappa = 0.75$). The correlation between measurements of EPSS by junior EPs and visual estimations of LVEF by the senior EPs was $\rho = -0.844$ ($p < 0.001$).

Conclusions: In this study, junior EPs were able to obtain measurements of EPSS that correlated closely with visual estimates of LVEF by clinicians with extensive point-of-care and comprehensive echocardiography experience.

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Congestive heart failure is a major and growing public health problem in the United States: heart failure accounts for 12 to 15 million office visits and 6.5 million hospital days each year. Failure to diagnose congestive heart failure increases mortality, increases treatment costs, and delays hospital discharges.[1,2]

Dyspneic patients with acute decompensated heart failure (ADHF) often present to the emergency department (ED), and emergency physicians (EPs) must act quickly and accurately to evaluate and diagnose patients with ADHF. Traditionally, key components of the patient's history, physical examination, electrocardiography, and chest radiography are used to diagnose ADHF. However, no single test is highly accurate, and even with the incorporation of B-type natriuretic peptide levels, the diagnosis of ADHF in a dyspneic patient in the ED can be a challenge.[3] Additional modalities that allow prompt and accurate diagnosis of ADHF would be of clinical utility, and estimation of left ventricle ejection fraction (LVEF) using point-of-care ultrasound has been the focus of prior research.

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Past studies have demonstrated that experienced EPs with additional training in bedside echocardiography can assess LVEF accurately in ED patients with acute dyspnea.[4–6] Given the time constraints of the ED, these studies have appropriately focused on visual estimation of LVEF, rather than calculations involving measurement of LV chamber dimensions throughout the cardiac cycle. Unfortunately, it is unknown how many examinations an EP must perform before he or she is qualified to visually estimate LVEF accurately.

An alternate measurement that also reflects left ventricular function is the mitral valve E-point septal separation (EPSS).[7] EPSS is measured as the minimum distance in millimeters between the anterior leaflet of the mitral valve and the interventricular septum, as visualized in a parasternal long-axis during early diastole using M-mode (Figure 1). EPSS has a strong negative correlation with angiographic ejection fraction and echocardiographic estimation of LVEF (Simpson's method) and is useful in patients with coronary artery disease, in whom regional wall motion abnormalities are commonly observed.[8,9] EPSS measurements of >7 mm indicate poor left ventricular function.

E-point septal separation has not been studied previously in ED patients and may represent an attractive alternative to visual estimation of LVEF for novice clinicians who wish to determine LVEF. We hypothesized that novice EPs should be able to obtain EPSS measurements and that these measurements would correlate to echocardiographic visual estimation of LVEF by experienced EPs.

METHODS

Study Design

This was a prospective observational study of the correlation of EPSS to visual estimation of ejection fraction in patients who present to the ED with acute dyspnea. The study protocol was approved by the institutional review board.

Study Setting and Population

A convenience sample of 70 subjects was enrolled in the ED of a 400-bed teaching hospital with approximately 65,000 ED visits per year. The treating physician performed an initial screening examination. Patients recognized to have a chief complaint of dyspnea were referred to an investigator via pager from the hours of 9 AM to 4 PM Monday through Friday. Criteria for enrollment included an age >18 years, chief complaint of dyspnea, ED length of stay < 2 hours, no history of trauma, and normal mental status. Patients were excluded if they had a known history of mitral valve repair or replacement, aortic insufficiency, or mitral stenosis.

All echocardiographic examinations were performed using a 5-1 MHz phased array transducer (Model HD11XE, Philips, Andover MA). Examinations were stored on an internal hard drive and later archived to compact disc for subsequent review.

Study Protocol

Twelve senior residents (PGY 3 and PGY 4) in our department's EM residency program with variable levels of ultrasound experience (having performed between 70 to 150 total ED ultrasound examinations) performed limited transthoracic echocardiograms. On average, residents had performed fewer than 25 cardiac examinations and had been instructed on measurement of EPSS through informal hands-on bedside teaching with faculty and fellows from the Emergency Ultrasound Division of the Department of Emergency Medicine and as interns during their day-long Introduction to emergency ultrasound course. The echocardiographic examination included subcostal, parasternal long axis, parasternal short axis, and apical four chamber views. Six-second video clips were obtained in parasternal short and long axes. M-mode measurements of EPSS were recorded in the parasternal long axis orientation after all video clips had been obtained and were calculated during diastole by measuring the minimum distance from the tip of the anterior mitral valve leaflet to the septal wall. Examinations were performed independently, without the experienced EPs present at the bedside. At the conclusion of the examination, one of two investigators (MAS, MBS) reviewed the stored video on the ultrasound system and visually estimated LVEF. Two board-certified noninvasive cardiologists subsequently reviewed one-half of these video clips after export to a compact disc and estimated

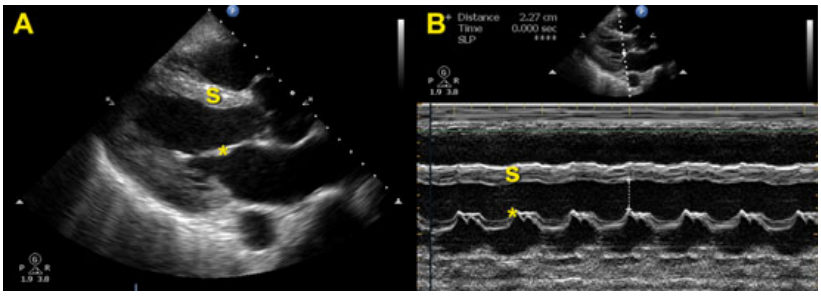

Figure 1. Parasternal long-axis view of the heart (A) and a M-mode measurement of EPSS (B). (A) B-Mode image of parasternal long-axis view clearly demonstrates the interventricular septum (S) and anterior mitral valve leaflet (*). (B) M-Mode image demonstrates the motion of the septum (S) and valve over time. EPSS is the distance between the septum (S) and the anterior leaflet of the mitral valve (*) denoted by the caliper measurement. In this example, the EPSS measurement is 22.7 mm. EPSS = E-point septal separation.

LVEF, blinded to both junior EPs' EPSS measurements and the LVEF estimations by EPs.

Data Analysis

Statistical analysis was performed using SPSS Version 11 (IBM, Armonk, NY). Based on the R coefficient > 0.4 with a power of 80%, we determined that a sample size of 53 patients would be required for enrollment to demonstrate a correlation between EPSS and LVEF performed by EPs. To test the concordance between EPSS and LVEF measurements interpreted by ED physicians versus cardiologists, we randomly selected 50% of scans obtained by EPs and had them reviewed by a cardiologist blinded to the measurements of the ED operator. To calculate kappa, we dichotomized the interpretations for EPSS to ''normal'' or ''depressed'' and for LVEF to ''normal'' or ''abnormal.'' Spearman's correlation was used to show the correlation between EPSS and visual estimation of ejection fraction by EPs.

RESULTS

Seventy subjects were enrolled from July 2008 to July 2009. Fifty-eight subjects had complete echocardiographic studies recorded. Thirty-eight of 58 subjects (66%) were female, mean age was 63 years (range = 28 to 90 years), and multiple comorbidities were common: hypertension (85%), diabetes (51%), congestive heart failure (51%), and chronic obstructive pulmonary disease (19%). ADHF was the final diagnosis in 27 of 58 patients (47%).

The concordance rates between measurements reported by EPs and cardiologists for LVEF were acceptable, with kappa of visual LVEF at 0.75 (95% CI = 0.48 to 1.00).[10] Spearman correlation analysis revealed significant correlation ($\rho = -0.844$, $p < 0.001$) between novice physicians' measurements of EPSS and visual estimations of LVEF by the experienced EPs (Figure 2).

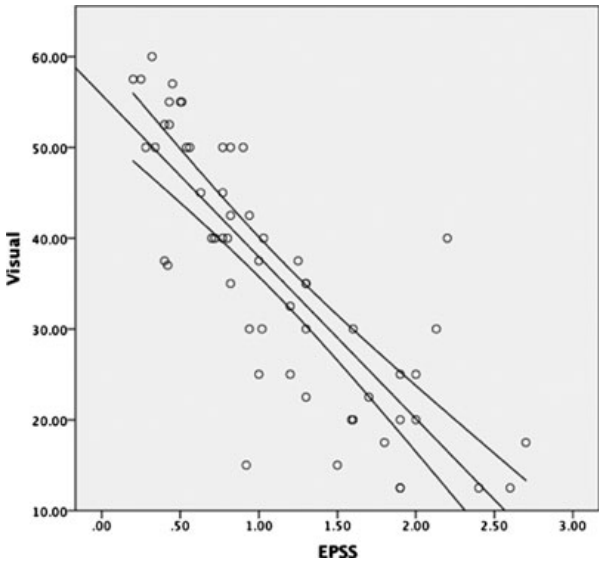

Figure 2. Spearman correlation between junior EPs' measurements of EPSS and visual estimations of LVEF by the senior EPs' ($\rho = -0.844$, $p < 0.001$). EPSS = E-point septal separation.

DISCUSSION

E-point septal separation is an underutilized, easily performed marker of left ventricular function that can be obtained rapidly using a single view of the heart and a single linear distance measurement. Despite prior research demonstrating good correlation with LVEF, EPSS is not commonly taught as part of an emergency ultrasound curriculum, nor is it commonly reported during comprehensive echocardiography exams. Our results suggest that EPSS as performed by junior EPs also correlates well with LVEF, as prior research on EPSS suggests. As with all two-dimensional echocardiographic measurements, however, it has limitations that must be discussed: there are several conditions that may over- or underestimate EPSS. Valvular diseases that restrict anterior mitral leaflet motion, such as mitral stenosis and aortic insufficiency, can exaggerate EPSS. Asymmetric septal hypertrophy, severe left ventricular hypertrophy, and discrete proximal septal thickening (sigmoid septum) can lead to factitiously small estimates of EPSS. In addition, failure to obtain a true parasternal long-axis view may result in falsely elevated EPSS measurements due to a tangential measurement from mitral valve leaflet to septal wall; directional M-mode can minimize this effect, but is not routinely available on most portable ultrasound systems and we elected to avoid its use in this study for that purpose.

It is important to mention that accurate estimation of LVEF, whether visually or through a surrogate marker such as EPSS, does not necessarily identify the etiology of a given ED patient's dyspnea: patients with poor LVEF may suffer from a myriad of other comorbid conditions such as pneumonia, chronic obstructive pulmonary disease, or pulmonary embolism. The identification of poor LVEF by no means independently identifies the acute disease process in a dyspneic patient. However, incorporation of this information into the overall clinical and radiographic assessment of a patient may yield important clues as to the etiology of his or her acute shortness of breath.

LIMITATIONS

Data were successfully collected on only 58 of 70 subjects (83%). Examinations were judged incomplete when all four standard cardiac views could not be obtained. However, junior EPs were able to obtain EPSS measurements in all patients, and although incomplete studies were not analyzed for accuracy of EPSS, the ability to obtain EPSS values in patients with limited transthoracic windows is another potentially attractive quality of this measurement. Additional limitations of the study include its convenience sampling design. This was chosen due to investigator availability for patient enrollment and ensured that investigators could be present during study examinations to estimate LVEF at the conclusion of the residents' examinations. This should have little effect on the correlation of nov-

ice physicians' measurements of EPSS to experienced clinicians' visual estimation of LVEF, however, as the junior EPs conducted their examinations in full without any input from the experienced EPs. Additionally, the experienced EPs were not blinded to the EPSS measurements. Although this could theoretically affect their visual estimates of LVEF, having been biased by the junior EPs' EPSS measurements, it does not appear that this occurred, given the excellent agreement between the EPs and the two noninvasive cardiologists who subsequently estimated LVEF while blinded to all ED measurements.

CONCLUSIONS

In this study, junior EPs were able to obtain measurements of E-point septal separation that correlated closely with visual estimates of left ventricle ejection fraction by clinicians with extensive point-of-care and comprehensive echocardiography experience.

Bedside measurement of E-point septal separation is an alternative to visual estimation of left ventricular ejection fraction that could provide EPs with an additional technique for the determination of left ventricular ejection fraction in dyspneic ED patients.

References

1. Hobbs RE. Management of decompensated heart failure. Am J Ther. 2004; 11:473–9.
2. Wang CS, Fitzgerald JM, Schulzer M, et al. Does this dyspneic patient in the emergency department have congestive heart failure? JAMA. 2005; 294:1944–56.
3. Wuerz RC, Meador SA. Effects of prehospital medications on mortality and length of stay in congestive heart failure. Ann Emerg Med. 1992; 21:669–74.
4. Randazzo MR, Snoey ER, Levitt MA, Binder K. Accuracy of emergency physician assessment of left ventricular ejection fraction and central venous pressure using echocardiography. Acad Emerg Med. 2003; 10:973–7.
5. Pershad J, Myers S, Plouman C, et al. Bedside limited echocardiography by the emergency physician is accurate during evaluation of the critically ill patient. Pediatrics. 2004; 114:e667–71.
6. Moore CL, Rose GA, Tayal VS, Sullivan DM, Arrowood JA, Kline JA. Determination of left ventricular function by emergency physician echocardiography of hypotensive patients. Acad Emerg Med. 2002; 9:186–93.
7. Silverstein JR, Laffely NH, Rifkin RD. Quantitative estimation of left ventricular ejection fraction from mitral valve E-Point to septal separation and comparison to magnetic resonance imaging. Am J Cardiol. 2006; 97:137–40.
8. Massie BM, Schiller NB, Ratshin RA, Parmley WW. Mitral-septal separation: new echocardiographic index of left ventricular function. Am J Cardiol. 1977; 39:1008–16.
9. Ahmadpuour H, Shah AA, Allen JW, Edmiston WA, Kim SJ, Haywood LJ. Mitral E point septal separation: a reliable index of left ventricular performance in coronary artery disease. Am Heart J. 1983; 106(1 Pt 1):21–8.
10. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977; 33:159–74.