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Letter to the Editor

Accuracy of the isovolumic relaxation time in the emergency diagnosis of new-onset congestive heart failure with preserved left ventricular systolic function in the setting of B-type natriuretic peptide levels in the mid-range

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Abstract

Despite the fact that B-type natriuretic peptide (BNP) is a useful diagnostic complement to clinical and radiographic data in the emergency diagnosis of acute congestive heart failure, levels of BNP in the mid-range (100–500 pg/ml) are acknowledged to be inconclusive for the diagnosis. We assessed the diagnostic value of the pulsed Doppler-derived isovolumic relaxation time (IVRT) by bedside Doppler echocardiography in the emergency diagnosis of new-onset congestive heart failure with preserved systolic function in 43 patients presenting with acute severe dyspnea and inconclusive BNP levels. A short IVRT <50 ms was a good predictor of acute congestive heart failure in this clinical setting, with a positive predictive value of 94%.

Keywords: Diastolic heart failure; B-type natriuretic peptide; Isovolumic relaxation time; Emergency diagnosis

B-type natriuretic peptide (BNP) is an active neurohormone that is secreted by ventricles in response to myocardial stretch and volume overload [1]. Assuming that it indirectly reflects left ventricular (LV) filling pressures beyond global myocardial dysfunction, this biomarker is widely utilized as the first-line diagnostic complement to clinical and radiographic data for differentiating congestive heart failure (HF) from noncardiac cause of acute dyspnea in the emergency care setting [1]. A BNP level <100 pg/ml is helpful for excluding the diagnosis of acute congestive HF and a value of >400–500 pg/ml is a strong predictor for this condition [1]. Nevertheless, this biomarker is reported to be inconclusive at levels in the mid-range [1], particularly for patients without history of congestive HF [2]. Severe symptoms at admission are most likely associated to a worse short-term prognosis [3], and bedside Doppler echocardiography is mandatory for such patients in the setting of intermediate BNP levels to give additional diagnostic information and improve medical treatment. Two recent studies have produced clinical evidence that LV ejection fraction <40–45% readily identifies acute congestive HF in patients presenting with acute dyspnea [4,5]. However, assessment of LV filling pressures is most commonly required for patients with preserved LV systolic function [6]. Several studies have also produced convincing evidence of a significant, inverse relation of the pulsed wave Doppler-derived isovolumic relaxation time (IVRT) with pulmonary capillary pressure in patient populations with heart diseases [7,8] as well as in critically ill patients [9–11]. The aim of the present study was to investigate the accuracy of IVRT in the emergency diagnosis of new-onset congestive HF with preserved LV systolic function in patients presenting with acute severe dyspnea and inconclusive BNP levels.

43 consecutive patients presenting with acute dyspnea at rest, BNP concentration in the mid-range (100 to 500 pg/ml)

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and preserved LV systolic function (LV ejection fraction >50%) were prospectively enrolled after the informed consent was obtained. Exclusion criteria were prior history of HF, severe left-sided valve disease and acute coronary syndromes. BNP concentration was measured at the time of admission and all the patients underwent bedside Doppler echocardiography within 3 h, before therapy. At discharge, 2 cardiologists and 1 chest physician, who were blinded to the results of BNP and IVRT, established either new-onset congestive HF or noncardiac cause as the primary etiology of dyspnea according to all the data. Particularly, unequivocal clinical response to loop diuretics was required, along with other data, for establishing the diagnosis of congestive HF.

Blood samples were collected in EDTA tubes for the purpose of measuring BNP concentration at the time of admission with a Triage Meter Plus® system (Biosite Inc., San Diego, California; range of 5 to 5000 pg/ml).

All Doppler echocardiography studies were performed by a single experienced cardiologist blinded to the data with an ALOKA SSD 5500 PHD® ultrasound system (Aloka CO., LTD., Tokyo, Japan). LV ejection fraction was measured with the Simpson's biplane method; a visual estimate associated with the Teichholz' method was used in patients with inadequate apical views. After placing the 5 mm pulsed Doppler sample volume between the mitral valve and the LV outflow in an apical 5-chamber view, IVRT was measured from the end of aortic flow to the onset of mitral inflow (Fig. 1). Three consecutive measures were averaged in sinus rhythm and 5 consecutive cycles in atrial fibrillation. Intra- and inter-observer variability are 8±4 and 15±8%, respectively, for IVRT in our laboratory, with a feasibility ≥95% in the acute care setting [12]. The spectral tissue Doppler-derived septal *E*/Ea ratio was used as a simple and reliable surrogate for LV diastolic pressures regardless of rhythm.

Table 1
Baseline characteristics at admission according to the diagnosis at discharge

Variable	Congestive heart failure (n=20)	Noncardiac cause (n=23)	p value
Age (years)	79±10	79±9	0.9
Male	10 (50%)	13 (56%)	0.9
Body mass index (kg/m^2)	26±6	25±5	0.4
Systolic blood pressure (mm Hg)	159±32	138±24	0.017
Sinus rhythm	14 (70%)	17 (74%)	0.9
Heart rate (/min)	89±16	91±15	0.6
Score of Boston criteria	9.3±2.3	7.5±2.2	0.01
BNP concentration (pg/ml)	253±96	218±95	0.2
Left ventricular ejection fraction (%)	65±9	68±8	0.3
Septal *E*/Ea ratio	17.9±5.1	10.9±3.2	<0.0001
Isovolumic relaxation time (ms)	46±20	74±21	<0.0001
Prior history of chronic pulmonary disease	5 (25%)	12 (52%)	0.1
Prior history of systemic hypertension	15 (75%)	11 (48%)	0.1
Prior history of diabetes mellitus	5 (25%)	5 (22%)	0.9
Prior history of coronary artery disease	5 (25%)	4 (17%)	0.7
Radiographic pulmonary edema	15 (75%)	6 (26%)	0.004
Pulmonary rales at auscultation	13 (65%)	7 (30%)	0.05
Chronic use of diuretics	11 (55%)	11 (48%)	0.9

Descriptive data are given as mean±SD. Intergroup comparison for continuous variables used the analysis of variance test. For dichotomous parameters, the chi-square test and the Fisher exact test with bilateral formulation were used. Logistic regression analysis was used to evaluate the predictive value of radiographic pulmonary edema, the score

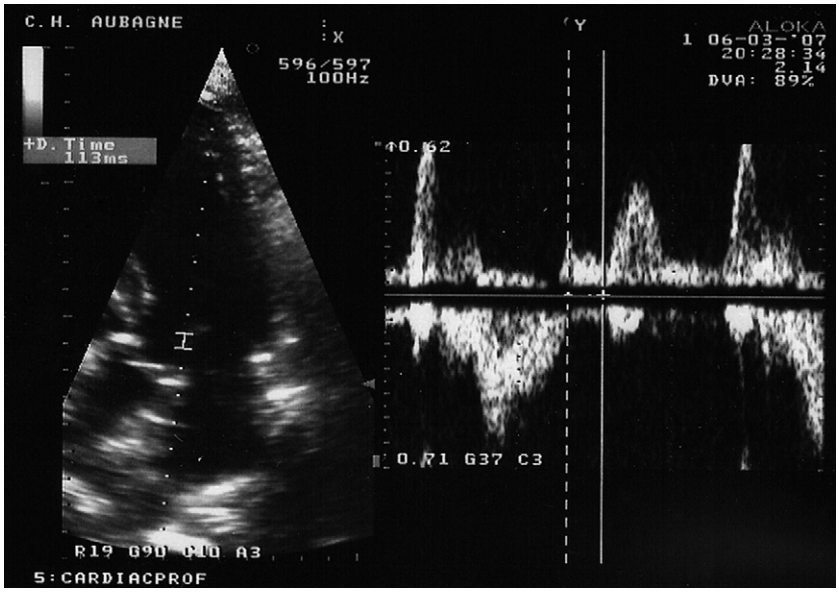

Fig. 1. Measure of IVRT by pulsed Doppler, from the end of aortic flow (click of aortic closure) to the onset of mitral inflow, placing the pulsed wave Doppler sample volume between the mitral valve and the left ventricular outflow in a 5-chamber apical view.