

Mitral Valve Doppler E/e' as a Prognostic Marker in Acute Myocardial Infarction

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Abstract

Background: The early diastolic tissue Doppler velocity of the mitral valve annulus (e') reflects the rate of myocardial relaxation. In combination with measurement of the early transmitral flow velocity (E), the resultant ratio (E/e') correlates well with mean left ventricular end diastolic pressure (LVEDP). In particular, an E/e' ratio >15 is a valuable predictor of an elevated mean LVEDP. We proposed that an E/e' ratio >15 would predict lower survival after acute myocardial infarction (MI).

Materials and Methods: Transthoracic echocardiograms were obtained in 50 consecutive patients immediately after admission for MI. The patients were followed up until their hospital discharge. The end point was all-cause mortality.

Results: E/e' had a strong correlation in predicting death as an outcome of the total of 16 patients with an E/e' ratio of >15 suggestive of elevated LV filling pressures 0.6 of these patients did not survive to hospital discharge amounting to a mortality rate of 37.5% in that group (average mortality 14%). In contrast in patients who had an E/e' ratio of <15 the mortality rate was low at 2.94%.

Conclusions: Thus, E/e' ratio can be used as a surrogate marker of elevated LV filling pressure and hence can be reliably used as a prognostic marker to risk stratify patients admitted in coronary care units over and above other non-invasive tools already available.

Key words: Acute myocardial infarction, E/e' ratio, Left ventricular filling pressure, Non-invasive marker

INTRODUCTION

Variable degrees of systolic dysfunction is prevalent after a myocardial injury and the pathophysiological principles underlying this dysfunction and its effect on the outcomes of the patient has been the subject of several path breaking studies which have contributed to modification in therapeutic strategies in a radical manner.¹⁻⁷

Moreover, heart failure demonstrated by clinical or radiographic evaluations over and above decreased systolic function is strong predictor of prognosis after myocardial infarction (MI). Seemingly benign myocardial damage

can lead on to signs of pulmonary congestion indicating elevated ventricular end diastolic pressure.

This has been attributed to impaired active relaxation of the myocardium and increased chamber stiffness leading onto abnormal diastolic function.

This has to be determined by invasive cardiac catheterization studied with the use of micromanometer catheters such an invasive strategy is not practical for use on a daily basis.⁸⁻¹⁸

Effect of Elevated End Diastolic Pressures on the Prognosis After MI

Since direct measurements of diastolic ventricular pressures are difficult to obtain, non-invasive evaluation of ventricular diastolic pressures using E/Vp or E/e' could come in handy. This was recently shown in a retrospective study of a group of patients with MI where an elevated E/e' ratio accurately predicted mortality in addition to ejection fraction (EF), age, and a restrictive filling.¹⁹ More

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importantly, E/e' was used for risk stratification in patients groups with normal as well as abnormal ventricular systolic function. The patients with pseudonormal filling (moderate increase in filling pressures) despite preserved LV systolic function have worse outcomes, and this finding concurs with the results of studies in which the E/V_p ratio was used.^{20,21}

Left Ventricular (LV) Diastolic Pressure and its Prognostic Value in Acute MI (AMI)

Elevated ventricular diastolic pressures are associated with a high incidence of death after AMI.²²⁻²⁵ Higher ventricular diastolic pressures suggest larger area of myocardial damage with more severe systolic dysfunction.²⁶⁻²⁹ Moreover, ventricular pressure overload predisposes to ventricular, which would portend a worse outcome.

Apart from its prognostic value, the evaluation of ventricular diastolic pressures requires invasive measurements. On the other hand, Doppler echocardiographic assessment of mitral flow provides us with a non-invasive method of pinpointing patients with elevated left atrial pressures. Mild degrees of diastolic dysfunction is shown by impaired relaxation.

Advanced diastolic dysfunction is a poor prognostic indicator portending with a worse outcome after AMI, exemplified by abbreviated deceleration time (DT) which is very specific. They support the well-established prognostic value of clinical indicators of ventricular diastolic pressures, such as Killip class.

Value of E/e' as a Prognostic Indicator

The study by Hillis *et al.* shows that, in the setting of AMI, elevated E/e' reasonably correlated with conventional transmitral Doppler evidence of elevated ventricular diastolic pressure. Moreover, it is a better prognostic indicator. This is in consonance with studies that demonstrated that E/e' better correlated with invasive measurement of LVEDP.¹⁹ E/e' was also better correlated with Killip class on admission but, emerged to be a better predictor of survival. An E/e' ratio >15 was the most useful predictor of a worse outcome, regardless of EF, the presence or absence of ST-segment elevation, or drug treatment on hospital discharge.

The E/e' ratio was superior to all known measures of LV systolic function, such as EF and Wall motion scores, for prediction of prognosis. However, it is prudent to understand that measurement of E/e' provides only additional prognostic data, with the greatest knowledge obtained by combining this information with clinical, systolic, and conventional diastolic parameters.^{23,30}

MATERIALS AND METHODS

Study Center

Coronary Care Unit of the Department of Cardiology, Government General Hospital (GGH), Chennai.

Study Design

Prospective, observational and cross-sectional study.

Study Sample

Consecutive patients admitted in Coronary Care Unit between January 2014 and March 2014 at the Department of Cardiology, GGH, Chennai with a diagnosis of, ST-elevation MI ($N = 50$).

Study Methods

Detailed history and cardiovascular examination was done with informed consent from the patient.

Patients were followed-up from admission to hospital discharge. Echocardiography with color Doppler and tissue Doppler imaging of mitral valve (MV) will be done. The following echocardiographic parameters were studied in detail within 24 h of admission by a single operator.

1. EF
2. LV dimensions
3. Mitral E and A velocity (m/s)
4. Mitral e' velocity
5. Mitral E wave DT
6. E/e' ratio.

Statistical Analysis

All the statistics were analyzed using the SPSS version 17 software and the tests used were mean and standard deviation, Chi-square test, independent t -test, and other relevant tools.

RESULTS AND DISCUSSION

E/e' Ratio, its Distribution and Correlation

About 34 of the total 50 patients had an E/e' ratio of <15 and the remaining 16 patients had an E/e' of >15 . This constituted 68% and 32% of the total study participants respectively (Table 1).

A majority of patients (68%) in the study group had an E/e' of <15 indicating normal LV filling pressures.

Among the patients with elevated filling pressures as manifested by an E/e' ratio of >15 nearly 88% of the patients had an abbreviated DT at <140 ms (Table 2).

Whereas in the group with normal E/e' ratio of <15 , only 6% had an shortened DT at <140 ms. Both these

Table 1: Distribution of E/e'

E/e'	
<15	>15
34	16
68%	32%

Table 2: E/e' and DT

DT	E/e'	
	<15	>15
>140	32	2
<140	2	14

DT: Deceleration time

Table 3: E/e' and EF

EF	E/e'	
	<15	>15
<45	9	16
>45	25	0

EF: Ejection fraction

Table 4: E/e' and death

Deaths	E/e'		P
	>15	<15	
N	6/16	1/34	0.001
%	37.5	2.94	

findings suggest that there is a strong correlation between an elevated E/e' and shortened DT.

E/e' and EF

None of the patients with an EF of >45 had an elevated E/e' ratio. But in the patient group with a reduced EF. The E/e' ratio was elevated at >15 in 64% of the total of 25 patients and was normal in the remaining 36% of the patients with reduced EF group (Table 3).

E/e' and Mortality

E/e' had a strong correlation in predicting death as an outcome of the total of 16 patients with an E/e' ratio of >15 suggestive of elevated LV filling pressures 0.6 of these patients did not survive to hospital discharge amounting to a mortality rate of 37.5% in that group (average mortality 14%) (Table 4).

In contrast in patients who had an E/e' ratio of <15 the mortality rate was low at 2.94%.

Thus, E/e' was an independent predictor of hospital mortality in all patients admitted with AMI irrespective of baseline characters, risk factors and EF of the patient.

CONCLUSIONS

E/e' Ratio

Among the three Doppler indices which reliably predicted the in-hospital outcomes in patients, E/e' ratio was the most consistent. E/e' reliably predicted in-hospital mortality, correlated better with the patient's EF and also with the MV DT.

Patients with higher E/e' ratio (>15) had an higher hospital mortality (37.5%). The hospital mortality rate was low at 3% in the patient groups with low E/e' ratios (<15). In addition, 6 out of 7 patients who dies in the hospital had an increased E/e' ratio (>15) and only one patient had a reduced E/e' ratio. The E/e' ratio also reliably predicted the EF.

None of the patients with an EF of >45% had an E/e' ratio of >15. While in the group with an EF of <45% nearly 64% of patients had an E/e' of >15.

This indirectly predicted that patients with elevated E/e' (>15) had a lower EF, elevated LV filling pressures as a result of larger area of LV myocardium that has been damaged.

This is turn predicted poorer patients outcomes with greatly increased in-hospital mortality rates.

Thus, E/e' ratio can be used as a surrogate marker of elevated LV filling pressure and hence can be reliably used as a prognostic marker to risk stratify patients admitted in coronary care units over and above other non-invasive tools already available.

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