

Significance of Mitral E/Ea Estimation in Cases of Coronary Heart Disease with Different Left Ventricular Ejection Fractions

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Abstract

Object: To understand the changes and clinical meanings of mitral E/Ea in cases of coronary heart disease (CHD) with different systolic functions of left ventricle. **Methods:** According to LVEFs measured by echocardiography, 107 patients with CHD diagnosed by coronary arteriography were divided into three groups: 62 cases of LVEF >50% in group I, 24 cases of LVEF 45%~50% in group II and 21 cases of LVEF < 45% in group III. Indications to be observed mainly included LVEF, ratio of mitral diastolic early flow velocity E to mitral late flow velocity A (E/A), diastolic early velocity wave of mitral annulus (e, Ea), ratio of E/Ea and levels of plasma Brain-type natriuretic peptide (BNP). **Results:** Diameters of left ventricle in group III were larger than those in group I, while LVEFs in group III were lower than those in group I and group II, with LVEFs in group II being lower than that in group I, too (all $p < 0.05$). Differences of E/A among the three groups and of E/Ea between group II and group III were not obvious (all $p > 0.05$), but ratios of E/Ea in group II and group III were higher than those in group I (both $p < 0.05$). The mean value of BNP in all the 107 cases was at a higher level, among which values of BNP in group II and group III were higher than those in group I, and the value of BNP in group III was also higher than that in group II (all $p < 0.05$). Based on analysis of all the 107 cases, there was a positive correlation between E/Ea and BNP, but there were negative correlations between BNP and LVEF and between E/Ea and LVEF (all $p < 0.05$). The similar linear correlations to those in all the 107 cases were also seen in group I, however these correlations, including between E/Ea and BNP, BNP and LVEF as well as E/Ea and LVEF could not be found in group II and group III. **Conclusions:** Although there were clear correlations between E/Ea and both LVEF and BNP in analysis of a larger sample, there were some unidentical changes between E/Ea and LVEF, which showed that the lesions of systolic dysfunction could be inconsistent with those of diastolic dysfunction in some cases of CHD, and that the unidentical changes needed to be diagnosed by the clinical and laboratory data of the patients.

Keywords

Coronary Heart Disease, Left Ventricular Ejection Fractions, Mitral E/Ea

冠心病患者不同左心室射血分数二尖瓣口E/Ea的观测意义

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摘 要

目的: 了解冠心病患者不同心室收缩状态下二尖瓣口E/Ea的变化及观测意义。资料与方法: 107例经冠状动脉造影确诊的冠心病按超声心动图测定的LVEF大小分为3组: LVEF > 50% 62例为I组, LVEF 45%~50% 24例为II组, LVEF < 45% 21例为III组。观测指标主要包括: 超声心动图心脏常规测量计算LVEF、二尖瓣口血流E/A比值、二尖瓣环舒张早期运动速度e波(Ea)、计算E/Ea比值及BNP。结果: III组的左心室内径明显大于I组、而其LVEF明显低于I组、II组, II组的LVEF也低于I组(p 值均 < 0.05); 3组之间的E/A差异不显著, II组、III组之间的E/Ea差异不大(p > 0.05), 但是与I组比较则均有明显差异(p 值均 < 0.05); 107例的BNP平均值较高, 其中II组、III组明显高于I组, III组也高于II组; 以107例为分析样本, E/Ea与BNP呈正相关, BNP与LVEF、E/Ea与LVEF则呈负相关(p 值均 < 0.05); 在I组中也基本保持了这样的相关关系, 而在II组、III组中, 不论是E/Ea与BNP、BNP与LVEF, 还是E/Ea与LVEF之间均未呈现明显的线性相关。结论: 在较大的样本中E/Ea与LVEF及BNP表现出较为明确的线性相关, 但也存在着E/Ea的变化程度与LVEF不一致的情况, 说明冠心病患者可存在着左心室收缩障碍与舒张功能减低程度的不一致, 需要结合患者临床和相关实验室检查加以综合判断。

关键词

冠心病, 左室射血分数, 二尖瓣口E/Ea

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1. 引言

冠心病不仅影响心室收缩功能, 对舒张功能亦有明显影响, 即心室收缩功能受损经常伴随着舒张功能异常, 而临床上舒张功能障碍性心衰与常见的充血性心衰的治疗方法不同, 如为单纯性舒张功能障碍性心衰却按收缩性功能障碍性心衰来治疗, 疗效可能会不明显甚至病情加重; 随着临床对心衰机制认识加深和治疗方案的改进, 同时有收缩和舒张功能障碍的心衰与以舒张功能不全为主的心衰的最佳治疗方案的差异也很大, 应加以鉴别[1]。常规超声心动图可对左心室功能做出评估, 其中舒张早期二尖瓣血流峰速度(E)与舒张早期二尖瓣环速度(Ea)的比值(E/Ea)被欧洲心脏病协会(ESC)推荐为评估左心室舒张末压的有效指标

[2][3]。本文通过分析 1 组冠心病患者 E/Ea 值的改变, 了解其在不同左心室收缩状态下的观测价值。

2. 资料与方法

观察对象 本组 107 例为我院 2007 年 9 月~2015 年 1 月住院患者, 纳入观察标准: 均为经冠状动脉造影确诊为冠心病者。根据超声心动图测定左心室射血分数(LVEF)分为 3 个组: LVEF > 50% 62 例为 I (左心室收缩功能正常或射血分数正常组 nEF)组, LVEF 45%~50% 24 例为 II (左心室收缩功能保留或射血分数保留性心衰 HF with preserved ejection fractions, HF-pEF)组, LVEF < 45% 21 例为 III (左心室收缩功能减低或射血分数减低性 heart failure with reduced ejection fraction, HF-rEF)组。排除指征: 检查期间有房颤、频发早搏、起搏心律、二尖瓣环钙化、人工二尖瓣/主动脉瓣、二尖瓣、主动脉瓣明显关闭不全者不纳入观察对象。

方法: 超声心动图检查用 GE vivid7 超声仪, 探头频率为 3.5 MHz, 可同步进行 M 型、2D 动态显示。常规测量心脏各腔室大小, 计算 LVEF。心尖四腔心切面上频谱 Doppler 测量二尖瓣口血流, 组织 Doppler (TDI)测量二尖瓣环室间隔和左室侧壁 2 个位点的运动速度。二尖瓣口血流测量包括舒张早期血流速度 E 峰、舒张晚期血流速度 A 峰、E/A 比值及 E 峰下降时间 DTEV (deceleration time of E velocity); 二尖瓣环测量包括舒张早期运动速度 e 波、舒张晚期运动速度 a 波、e/a 比值; 利用二尖瓣环 2 个位点的 e 波均值 Ea 计算 E/Ea 比值(图 1)。

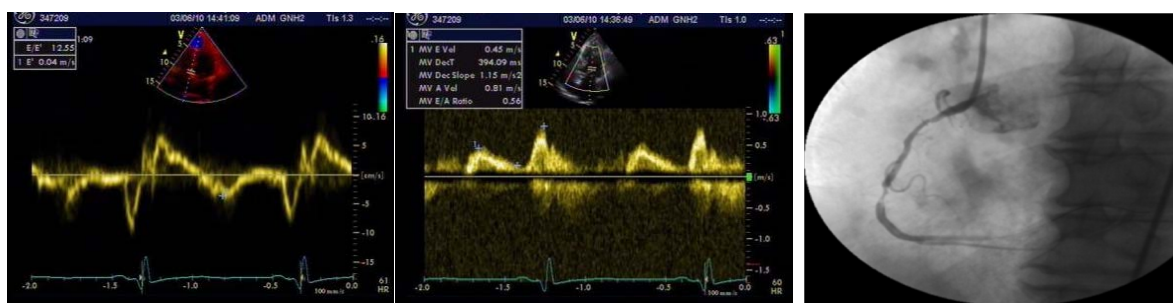


Figure 1. Male, 60 y, inferior myocardial infarction of left ventricle, LVEF 51.09%, BNP 155.4 ng/L, E/Ea 12.55 at ventricular septal site of mitral annulus

图 1. 男, 60 岁, 下壁心梗, LVEF 51.09%, BNP 155.4 ng/L, 二尖瓣环室间隔位点 E/Ea 12.55

血浆脑型利钠肽(BNP)测定采用酶联免疫吸附法, 所用仪器为美国产 BIO-TEKELX800 型酶标仪, 试剂盒由美国 TPI Inc.公司提供, 单位 ng/L, 灵敏度为 5 ng/L。

统计学处理: 计量数据采用均数±标准误($\bar{x} \pm s$)表示。应用 *t* 检验和配对 *t* 检验进行统计分析, *p* < 0.05 为统计学有差异。

3. 结果

临床一般资料: 3 组患者的一般临床状况, 包括年龄、性别比例、高血压、糖尿病、高脂血症患病率、冠状动脉介入史、搭桥史、脑卒中史、心肌梗死病史等的比较见表 1。3 组患者的年龄、性别比例、基础疾病等差异不明显, 但是 I 组以往的心梗和心功能不全的发病率均低于 II 组与 III 组, I 组中的冠脉多支病变率也明显低于 III 组。

超声心动图指标中, III 组的左心室内径明显大于 I 组、而其 LVEF 明显低于 I 组、II 组, II 组的 LVEF 也低于 I 组; 反映左心室舒张功能指标中, 3 组之间的二尖瓣口 E/A 差异不显著, II 组、III 组之间的 TDLe、E/Ea 差异不大, 但是与 I 组比较则均有明显差异, 而 III 组的 DTEV 较 I 组有延长。107 例的 BNP 平均值较高, 其中 II 组、III 组明显高于 I 组, III 组也高于 II 组(见表 2)。

Table 1. Clinical data of 107 cases**表 1.** 107 例一般临床资料的比较

项目	全部病例(107 例)	I 组(62 例)	II 组(24 例)	III 组(21 例)
年龄($\bar{x} \pm s$)岁	61.3 ± 11.6	58.2 ± 13.6	61.4 ± 12.6	63.2 ± 10.3
女性 例(%)	36 (34)	20 (32)	9 (37)	7 (35)
高血压 例(%)	72 (67)	41 (66)	17 (71)	14 (68)
糖尿病 例(%)	33 (31)	17 (27)	8 (34)	8 (38)
高血脂症 例(%)	44 (41)	25 (41)	9 (39)	10 (47)
冠脉多支病变 例(%)	48 (45)	26 (43)	11 (46)	11 (53)*
脑卒中史 例(%)	28 (26)	16 (27)	6 (23)	6 (28)
心梗史 例(%)	36 (34)	17 (27) [#]	10 (41)	9 (44)
心功能不全史 例(%)	41 (38)	20 (32) [#]	11 (47)	10 (48)
PCI 史 例(%)	36 (34)	18 (29)	10 (41)	8 (37)
CABG 史 例(%)	12 (11)	6 (10)	4 (15)	2 (10)

注: PCI: percutaneous coronary intervention; CABG: coronary artery bypass grafting surgery; *III 组与 I 组比较, $p \leq 0.05$; #I 组与 II 组、III 组比较, $p \leq 0.05$ 。

Table 2. Comparison of the data of echocardiography and BNP in 107 cases**表 2.** 107 例超声心动图、BNP 资料比较

项目	全部病例(107 例)	I 组(62 例)	II 组(24 例)	III 组(21 例)
超声心动图				
LVEDD (mm)	50.7 ± 4.8	46.5 ± 4.2	49.6 ± 4.5	52.5 ± 5.4 [*]
LVESD (mm)	35.8 ± 5.4	29.8 ± 3.7	32.7 ± 3.9	37.7 ± 5.9 [*]
LVEF (%)	48.8 ± 8.2	59.8 ± 9.5	47.6 ± 2.6 [*]	33.9 ± 7.9 [#]
Mitral E/A	0.88 ± 0.42	1.02 ± 0.31	0.80 ± 0.61	0.81 ± 0.31
DTEV (ms)	205.3 ± 67.7	186.7 ± 48.8	197.5 ± 67.5	215.8 ± 77.8 [*]
TDIe (cm/s)	7.6 ± 4.5	10.8 ± 5.9	6.2 ± 1.7 [*]	5.2 ± 2.6 [#]
E/Ea	14.1 ± 6.2	12.8 ± 4.5	14.5 ± 3.9 [*]	15.9 ± 6.8 [*]
BNP (ng/L)	353 ± 44.5	148.6 ± 34.8	390.7 ± 48.4 [*]	481.7 ± 40.2 [#]

注: *与 I 组比较, $p \leq 0.05$; #与 I 组、II 组比较, $p \leq 0.05$ 。

以 107 例为分析样本, E/Ea 与 BNP 呈正相关, BNP 与 LVEF、E/Ea 与 LVEF 则呈负相关(图 2~4), 在 I 组中也基本保持了这样的相关关系; 而在 II 组、III 组中, 不论是 E/Ea 与 BNP、BNP 与 LVEF, 还是 E/Ea 与 LVEF 之间均未呈现明显的线性相关, 见表 3。

Table 3. Correlative comparison among the parameters of echocardiography and BNP in 107cases**表 3.** 107 例超声心动图、BNP 参数各组的相关性比较

项目	全部病例(107 例)	I 组(62 例)	II 组(24 例)	III 组(21 例)
E/Ea 与 BNP				
Y =	30.52x - 167.9	6.492x + 49.0	29.00x - 106.3	33.13x - 107.9
R ² =	0.489	0.459	0.255	0.267
p	0.001	0.001	0.50	0.50

Continued

BNP 与 LVEF				
Y =	-0.046x + 62.4	0.121x + 72.2	0.005x + 49.9	-0.027x + 50.1
R ² =	0.617	0.310	0.272	0.298
p	0.001	0.02	0.20	0.20
E/Ea 与 LVEF				
Y =	-2.056x + 78.18	-1.484x + 73.8	0.245x + 51.6	-1.774x + 66.5
R ² =	0.628	0.501	0.142	0.315
p	0.001	0.001	0.50	0.20

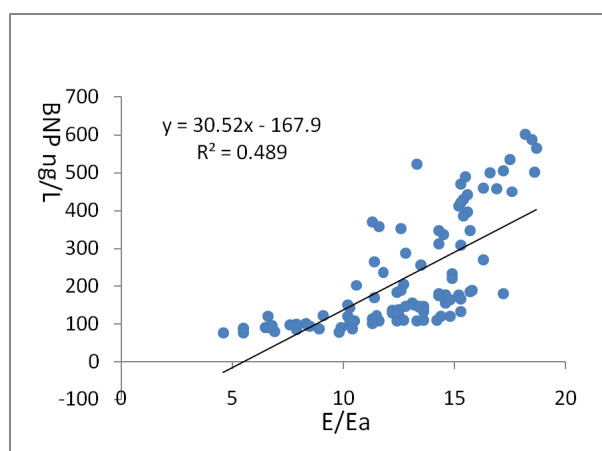


Figure 2. Correlation of BNP and E/Ea

图 2. BNP 与 E/Ea 的相关图

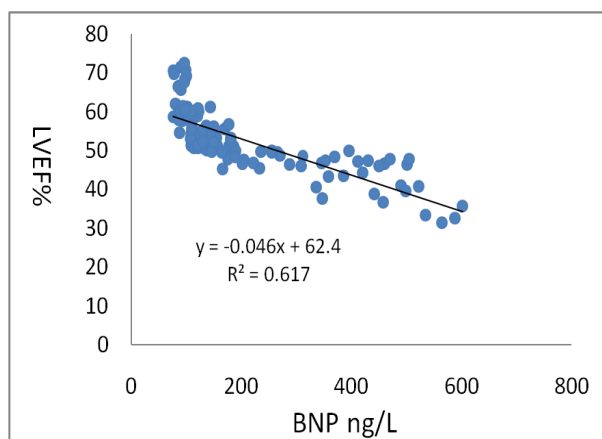


Figure 3. Correlation of LVEF and BNP

图 3. LVEF 与 BNP 相关图

4. 讨论

心力衰竭是包括冠心病在内的多数器质性心脏病患者中常见的危重症，主要表现为心脏收缩及/或舒张功能障碍，不能排出足量的血液以满足机体代谢需要的一种病理状态。根据基本的心脏病变、临床表现和实验室检查，心衰一般不难作出诊断，但是，不论收缩性或舒张性功能障碍引起的心衰均可表现为

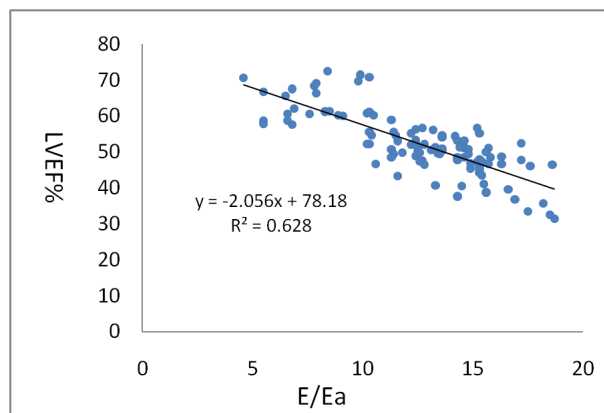


Figure 4. Correlation of LVEF and E/Ea

图 4. LVEF 与 E/Ea 相关图

体循环和/或肺循环淤血,从症状和体征上难以区别二者[4]。从本组 107 例的检查结果看,在年龄、性别和基础病变基本相同的情况下,随着左室功能不全加重,相应于 LVEF 测值的降低,可定量评定心衰进程和判断预后的 BNP 因心室扩张、心肌应力增加迅速合成释放入血而水平升高[5] [6],提示左室舒张末期充盈压(LVDP)的变化 E/Ea 也有明显的增大,两者均与 LVEF 呈负性相关(表 1~3,图 2~4),表明冠心病患者可同时存在心脏收缩和舒张功能损伤。

在 LVEF 测定正常的 I 组,其平均 E/Ea 为 12.8 ± 4.5 ,高于正常人群 $E/Ea < 8$ 的水平[7],其变化与 BNP、LVEF 呈线性相关,说明在左心室整体收缩尚未出现异常时便可能存在局部或整体舒张功能减退的变化引起了 LVDP 的升高;而该组既反映左室收缩功能障碍、又可反映左室舒张功能障碍的 BNP 平均值达 148.6 ± 34.8 ng/L,较临床作为常规排除急性心衰切点的 $BNP < 100$ ng/L 水平高,也与冠心病常出现节段性局部室壁功能异常的病理生理特点相符合,提示尽管 DTEV 延长和 TDIE 减低没有 III 组、II 组明显,也有着年龄、性别和体重对 E/Ea 和 BNP 测量的干扰,但仍预示着该组患者有着舒张功能障碍加重的风险[4] [5] [7]。

II 组患者的 LVEF 轻度减低,舒张功能指标及 BNP 与 I 组即有差异,有着射血分数正常的心力衰竭(HFNEF 或 HF-pEF)的特点,升高的 E/Ea 表明左室处在必须用提高左室充盈压的途径来获得正常的心室充盈和心搏量的一种代偿状态,但该组病例的 BNP、E/Ea 并没有呈现出随着 LVEF 减低而升高的线性相关关系,提示左心室收缩功能轻度下降或近乎正常 LVEF 的冠心病患者的舒张功能即可有明显障碍,与 Morris [8]等观察的 HFNEF 患者的左心室心肌收缩、舒张做功能力降低、心功能分级高、心输出量减低及左心室充盈压升高的结果相符。III 组的左心室扩大、容量负荷增加、BNP 和 E/Ea 升高明显,有与 LVEF 变化线性相关的趋势,却并不显著,与 I 组和全部 107 例的结果显示不一致,推测可能与 III 组样本量较少有关,但异常升高的 BNP、E/Ea 仍不失为该组病例心功能不全较为严重的反映[9]。

基于本组资料的分析表明,在较大的样本中 E/Ea 与 LVEF 及 BNP 表现出较为明确的线性相关,但也存在着 E/Ea 的变化程度与 LVEF 不一致的情况,除了受到样本大小、病史背景差异、心室负荷和 E/Ea 主要反应左心室长轴功能变化等因素的影响外,也说明冠心病患者可存在着左心室收缩障碍与舒张功能减低程度不一致或非同步性,需要结合患者临床和相关实验室检查如 BNP 等加以综合判断[10]。

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