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RT-3DE 评估急性心梗 PCI 术后左室收缩功能及同步性的临床价值 *

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摘要 目的:探讨实时三维超声心动图技术(realtime three dimensional echocardiography, RT-3DE)对评价急性心肌梗死(acute myocardial infarction, AMI)经皮冠状动脉介入治疗(percutaneous coronary intervention, PCI)术后左室收缩功能及同步性的临床应用价值。**方法:**选择 30 例左室急性前壁及前间壁心梗并进行急诊 PCI 术的患者和 30 例正常对照组,应用 Philips IE33 彩色多普勒超声成像仪对 PCI 术前及术后 1 个月的左心室功能指标进行二维常规超声检查及三维超声心动图检查,应用 Q-lab6.0 软件进行分析。**结果:**二维超声心动图显示 AMI 组术前左心室收缩末容量(ESV)及舒张末容量(EDV)较对照组比较明显增大($P < 0.01$),左心室射血分数(EF)较对照组明显减小($P < 0.01$);急性心肌梗死(AMI)组术后 1 个月左心室 ESV 及 EDV 较术前比较减小($P < 0.05$),左心室 EF 较术前增大($P < 0.05$);AMI 组术后 1 个月左心室 ESV 及 EDV 较对照组比较增大($P < 0.05$),左心室 EF 较对照组减小($P < 0.05$);三维超声心动图的各参数比较,AMI 组 PCI 术前梗死节段局部收缩末期容量(RESV)及局部舒张末期容量(REDV)较对照组增大($P < 0.05$),左心室梗死节段局部射血分数(REF)较对照组减小($P < 0.05$);AMI 组患者梗死节段 RESV 及 REDV 术后 1 个月较术前比较减小($P < 0.05$),梗死节段 REF 较术前比较有所增大($P < 0.05$),AMI 组术后 1 个月梗死节段 RESV 及 REDV 较对照组增大($P < 0.05$),梗死节段 REF 较对照组减小($P < 0.05$);左室 16 节段从 QRS 波起点到最小收缩容积时间的标准差和最大差值(Tmsvl6-SD、Tmsvl6-Dif)以及用 R-R 间期校正后的 Tmsvl6-SD% (左室收缩不同步指数 systolic dyssynchrony index, SDI)和 Tmsvl6-Dif% 较术前比较减小($p < 0.05$)。**结论:**PCI 手术前、后应用 RT-3DE 能够准确评价左心室 17 节段的局部收缩功能及运动同步性,对 AMI 患者心功能的研究具有重要意义。

关键词:实时三维超声心动图;急性心肌梗死;左心室功能;同步性

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Clinical Significance of RT-3DE for the Evaluation of Left Ventricular Systolic Function and Synchronicity in Patients with Acute Myocardial Infarction after PCI*

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ABSTRACT Objective: To explore the clinical significance of RT-3DE in evaluating the left ventricular systolic function and synchronicity of patients with AMI after PCI therapy. **Methods:** 30 patients performed emergency PCI treatment for Left ventricular anterior and anteroseptal myocardial infarction and 30 normal subjects as comparison were enrolled. Two-dimensional (2D) and Three-dimensional(3D) echocardiography were performed for left ventricular function indicators before and one months after treatment respectively by using Philips IE33 ultrasonography. The left ventricular function indicators were quantitatively analyzed by the Qlab (6.0) software. **Results:** 2D echocardiography displayed: the left ventricular end diastolic volume (LVEDV) and the left ventricular end systolic volume (LVESV) of AMI group were significantly increased and the left ventricle ejection fraction (LVEF) of AMI group was significantly reduced compared with those of control group before operation ($P < 0.01$); the LVESV and LVEDV of AMI group reduced and the LVEF increased one month after operation compared with that of AMI group before operation($P < 0.05$); the LVESV and LVEDV of AMI group increased and the LVEF of AMI group reduced one month after operation compared with that of control group($P < 0.05$). 3D echocardiography displayed: the regional end-systolic volume (RESV) and the regional end-diastolic volume (REDV) of infarcted segments of AMI group increased and the regional ejection fraction(REF)of AMI group reduced compared with that of the control group before operation($P < 0.05$), the RESV and the REDV of infarcted segments of AMI group reduced and the REF of infarcted segments increased one month after operation compared with that of AMI group before operation ($P < 0.05$), the RESV and the REDV of infarcted segments of AMI group increased and the REF of infarcted segments reduced one month after operation compared with that of control group($P < 0.05$). **Conclusion:** RT-3DE could accurately evaluate the left ventricular regional Systolic function and wall motion synchronism of 17 segments before and

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after PCI. RT-3DE could be a new valuable method to evaluate the cardiac function of patients with AMI

Key words: Real-time three-dimensional echocardiography; Acute myocardial Infarction; Left ventricular function; Synchronicity

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前言

AMI的发病率逐年升高,且呈年轻化趋势,AMI患者的预后与心功能的改善密切相关。AMI后局部心肌运动幅度减低甚至消失,心室整体收缩不同步,因此准确评价心肌梗死患者各节段收缩功能、运动同步性对临床的诊断、治疗、愈后及转归有非常重要的意义。二维超声心动图是目前测量左室收缩功能最常用的方法之一,传统的M型超声和二维超声心动图是根据几何模型假设来估测左心室的心功能,但大多数患者AMI后左心室结构发生较大的改变,与正常人的假设模型差距较大,结果也不准确,另外其受主观因素及检查者技术水平的影响较大,且不能显示左室各室壁立体运动情况,而RT-3DE不仅能立体显示整个心室的形状和运动状态,而且可准确计算出各个节段室壁的局部心搏量及射血分数,可为更好地治疗AMI患者和评估AMI患者的预后提供更有临床意义的检测指标。

1 资料与方法

1.1 研究对象

病例组:选取2011年9月-2014年8月在我院心内科行冠状动脉造影检查确诊为AMI患者30例为研究对象,其中男性22例,女性8例,年龄45~72岁,平均(55.4±12.7)岁,前壁AMI患者12例,前间壁梗死者8例,同时合并有前壁及前间壁梗死者10例,病例入选标准:有明确的病史,心肌酶学、心电图、和冠状动脉造影确诊为AMI,心电图排除严重的心律失常,除外心肌疾病、先天性心脏病,心脏瓣膜病、肺心病等器质性和代谢性心脏疾病;AMI发生后12小时内行PCI术治疗。于术前和术后1个月分别采集图像,选取二维图像可清晰地显示心内膜轮廓,三维全容积图像能够完整包络左心室各个室壁的优质图像作为研究对象。

对照组:选取本院行健康体检者30例,其中男性15例,女性15例。年龄41~65岁,平均年龄(51.4±7.1)岁,无心血管疾病,糖尿病、其他代谢性及免疫性疾病等病史,临床表现、心电图、超声及320排CT冠脉造影等检查均无异常。选取优质图

像做为对照组。

1.2 仪器与方法

采用Philips公司的iE33超声诊断仪,X5-l探头,频率1~3MHz。配备Q-lab6.0定量分析软件。全部患者左侧卧位,于静息状态下连接同步心电图,采集图像,存储连续四个心动周期的心尖四腔心三维全容积图像,以供脱机分析,拷贝图像,用3D-ADV插件分析图像数据,选取清晰图像,于舒张末期和收缩末期分别在心内膜上依次标记5个点,软件会自动描绘心内膜的轮廓,仔细观察图像,如果勾画线与心内膜实际轮廓吻合不佳,可以手动调节轮廓线至满意,随后软件会自动进行序列分析,可以获取以下数据:左心室的整体舒张末期容积(EDV)、收缩末期容积(ESV)、射血分数(EF);左心室16节段从QRS波起点到最小收缩容积时间的标准差和最大差值(Tmsvl6-SD、Tmsvl6-Dif),以及应用R-R间期校正后的Tmsvl6-SD%和Tmsvl6-Dif%,Tmsvl6-SD%即左室收缩不同步指数(systolic dyssynchrony index, SDI)。并可显示左室整体及节段容积时间曲线,将左室分为17个节段,继而得出节段舒张末容积(rEDV)、节段收缩末容积(rESV)、节段射血分数(rEF): $rEF = [(rEDV - rESV) / rEDV] \times 100\%$,分析、比较AMI组和对照组上述指标之间的差异。

1.3 统计学分析

应用SPSS17.0统计分析软件,计量资料以($\bar{x} \pm s$)表示,两组间参数比较采用独立样本的t检验,以P<0.05为差异有统计学意义,P<0.01为差异有明显统计学意义。

2 结果

2.1 两组左室心功能各参数的比较

二维超声心动图显示AMI组术前左心室ESV及EDV较对照组比较明显增大(P<0.01),左心室EF较对照组明显减小(P<0.01);AMI组术后1个月左心室ESV及EDV较术前比较减小(P<0.05),左心室EF较术前增大(P<0.05);AMI组术后1个月左心室ESV及EDV较对照组比较增大(P<0.05),左心室EF较对照组减小(P<0.05),见表1。

表1 AMI患者与对照组二维超声心动图测值的比较($\bar{x} \pm s$)

Table 1 Comparison of the 2D echocardiography index between AMI group and control group

Groups	ESV(mL)	EDV(mL)	LVEF(%)
Control group	34.06±10.57	92.45±17.54	67.46±4.98
Before PCI	50.57±19.45**	132.57±20.57**	49.57±7.68**
After PCI	46.45±17.85 [△] ■	124.56±20.46 [△] ■	56.46±5.76 [△] ■

Note: Before PCI compared with control group, *P<0.05, **P<0.001; Before PCI compared with after PCI, [△]P<0.05, ^{△△}P<0.001; After PCI compared with control group, [■]P<0.05.

三维超声心动图的各参数比较,AMI组PCI术前梗死节段局部收缩末期容量(RESV)及局部舒张末期容量(REDV)较对照组增大(P<0.05),左心室梗死节段局部射血分数(REF)较对照

组减小(P<0.05);AMI组患者梗死节段RESV及REDV术后1个月较术前比较减小(P<0.05),梗死节段REF较术前比较有所增大(P<0.05),AMI组术后1个月梗死节段RESV及REDV

较对照组增大 ($P<0.05$), 梗死节段 REF 较对照组减小 ($P<0.05$), 见表 2。

2.2 左室心肌运动不同步分析

AMI 组 PCI 术前左室 Tmsvl6-SD、Tmsvl6-Dif 以及 Tmsvl6-SD% (左室收缩不同步指数 systolic dyssynchrony index, SDI) 和 Tmsvl6-Dif% 较对照组增大 ($P<0.05$); AMI 组 PCI

术后左室 Tmsvl6-SD、Tmsvl6-Dif 以及 Tmsvl6-SD% (左室收缩不同步指数 systolic dyssynchrony index, SDI) 和 Tmsvl6-Dif% 较术前比较减小 ($P<0.05$), 见表 3。

表 2 AMI 患者与对照组三维超声心动图测值的比较($\bar{x}\pm s$)

Table 2 Comparison of the 3D echocardiography index between AMI group and control group

YGTSS score levels (scores)	Control group(n=30)				Before PCI(n=30)				After PCI(n=30)			
	rEDV(ml)	rESV(ml)	rEF(%)		rEDV(ml)	rESV(ml)	rEF(%)		rEDV(ml)	rESV(ml)	rEF(%)	
Basal segment												
Front wall	7.58±1.84	3.04±1.28	0.75±0.29		8.96±2.89*	3.87±2.05	0.62±0.24*		8.05±2.04 [△]	3.24±1.85	0.71±0.14 [△]	
Before the interval	5.89±1.67	3.01±0.74	0.62±0.21		7.39±2.34*	3.87±1.64	0.51±0.37		6.89±2.47 [△]	3.01±1.54	0.57±0.35	
Middle segment Front wall	6.71±2.04	1.82±1.24	0.78±0.15		7.24±2.19	3.01±1.85*	0.62±0.24*		6.49±2.30	2.45±1.64 [△]	0.71±0.20 [△]	
Before the interval	5.21±1.90	1.18±0.61	0.69±0.25		6.24±2.14*	2.45±1.84	0.62±0.31		5.87±2.01 [△]	2.01±1.71 [△]	0.64±0.27	
Apical segment Front wall	2.54±1.23	1.38±1.24	0.84±0.21		3.24±1.47	1.89±1.26*	0.64±0.30		2.89±1.29	1.46±1.15 [△]	0.74±0.28	
Before the interval	3.15±1.34	0.58±0.45	0.76±0.15		3.78±1.51	1.12±1.14*	0.63±0.24		3.04±1.35	0.98±1.12 [△]	0.69±0.25	
Apical	3.47±1.48	0.97±0.54	0.74±0.24		4.12±1.41	1.92±1.34*	0.62±0.24		3.92±1.41	1.45±1.24 [△]	0.67±0.31	

Note: Before PCI compared with control group, * $P<0.05$, ** $P<0.001$; Before PCI compared with after PCI, [△] $P<0.05$, ^{△△} $P<0.001$.

表 3 心肌梗组和正常组左室收缩同步性各参数比较($\bar{x}\pm s$)

Table 3 Comparison of the motion synchronism of left ventricular a index between AMI group and control group

Indexes	Control group	Before PCI	After PCI
Tmsvl6-SD(ms)	21.49±12.57	54.57±38.28*	38.57±19.54 [△]
Tmsvl6-Dif(ms)	80.54±39.73	265.24±189.52*	185.27±141.47 [△]
Tmsvl6-SD%	2.87±1.41	6.24±3.41*	4.25±3.24 [△]
Tmsvl6-Dif%	9.84±4.95	25.69±16.47*	19.57±10.54 [△]

Note: Before PCI compared with control group, * $P<0.05$, ** $P<0.001$; Before PCI compared with after PCI, [△] $P<0.05$, ^{△△} $P<0.001$; After PCI compared with control group, [■] $P<0.05$.

3 讨论

二维超声心动图是目前评价左室节段性收缩功能常用的方法之一, 因其受到多种因素的影响, 准确率降低。左室收缩功能通常以左室射血分数(LVEF)、左室短轴缩短率(FS)、心输出量(CO)等进行评价, 而这些指标是通过左室舒张末期容积与收缩末期容积的差值由相应公式计算得出的。因此, 准确地测量左室容积对评价左室收缩功能起着极其重要的作用。RT-3DE的诞生是超声心动图技术的重大突破, 不仅可迅速实时地显示心脏的三维解剖结构和空间毗邻关系而且对左心室容量与射血分数的测量无需依赖几何形状的假设, 测值精确度高, 优于传统的测量方法^[1-3]。另外 Collins 等^[4]1999 年就证实 RT-3DE 对局限性室壁运动异常检出率方面明显优于二维超声心动图。一些动物实验和临床研究也表明 RT-3DE 技术在评估左室容积、收缩功能及检测同步性的参数方面准确性高, 可重复性好, 通过测量左室各节段局部容积和射血分数能够比较客观地评估左室各节段的局部收缩功能, 在心血管疾病尤其是 AMI 有着极其重要的作用^[5-7]。

AMI 发生后, 根据心肌缺血发生的速度、程度、范围、以及侧支循环建立与否, 心肌细胞损伤会出现 3 种不同的结局: 坏

死心肌、冬眠心肌、顿抑心肌^[8]。冬眠心肌和顿抑心肌是心肌细胞对低血流灌注情况下进行的一种功能下调的适应现象, 是存活心肌的两种不同病理生理状态。顿抑心肌是指心肌梗死后心肌细胞发生短暂的缺血缓解后心功能延迟恢复的一种状态, 即心肌细胞缺血之后血流虽已恢复正常, 但心肌细胞的生化代谢及超微结构异常要持续存在较长的一段时间; 冬眠心肌是由于冠状动脉血流量减少导致心肌细胞能量储备减低引起心肌细胞收缩功能下降, 二者均引起左室功能障碍。由此可见, 二者都具有收缩功能的储备能力, 而在临床上这两种现象有时可同时存在, 相互影响, 共同成为可逆性心功能损伤的原因^[9,10]。最近一组研究显示在 AMI 患者大量心肌细胞坏死后, 不仅梗死节段及边缘区心肌细胞凋亡, 远离梗死节段非缺血心肌节段也出现心肌细胞显著凋亡, 从而导致左心室发生快速不良性重塑。因此, 对心肌的血运重建, 尽快、尽早的恢复其功能, 减少梗死节段及远离梗死节段的凋亡心肌细胞的数量, 是治疗和改善 AMI 患者心功能最好的方法。目前, PCI 是血运重建安全有效的方法之一, 能降低经皮冠状动脉腔内成形术后再狭窄及急性闭塞等的发生率, 其治疗目的是使不可逆的心肌坏死最小化以减低早期死亡率, 改善长期预后和心功能^[11,12]。本研究结果显示 PCI 术后 1 个月左心室 ESV 及 EDV 较术前比较减小, 左心

室 EF 较术前增大,AMI 组患者梗死节段 RESV 及 REDV 术后 1 个月较术前比较减小,梗死节段 REF 较术前比较有所增大,进一步证实了 PCI 术使梗死区域心肌获得最佳的血流灌注,减轻心肌细胞的进一步缺血坏死,促进存活心肌快速恢复收缩功能,减轻左室重塑,使心腔容积相对减小,进而提高心功能。此外,人体具有自身调节机制,心脏对慢性缺血会启动保护性调节功能,当慢性冠状动脉血流减少时,心肌会减少做功,降低耗氧,用于维持心肌细胞存活,当 PCI 术后增加了冠脉血流量,会促使心肌功能障碍得到部分或全部恢复^[13,14]。

本研究结果显示 AMI 组术后 1 个月左室 ESV 及 EDV 较对照组比较增大,术后 1 个月左室 EF 较对照组减小,梗死节段 RESV 及 REDV 较对照组增大,梗死节段 REF 较对照组减小,这是由于 AMI 以及缺血再灌注损伤对患者造成了不同程度的不可逆性损伤,与 Ruiz-Meana M 等的研究结果一致^[15]。另外,此项研究采用美国心脏病学会最新推荐的 17 节段法进行分段,该分段方法与冠状动脉供血有相关性^[16],前壁 AMI 多为前降支受累,累及范围往往较广泛,包括前壁、前间壁和心尖帽等,对整个左室心功能影响较大。此外,左室前壁心尖段是左室壁最薄弱区,曲率半径最大,AMI 后更易发生局部变形膨出,更甚者会出现室壁瘤,即使较快地恢复血流再灌注,仍易发生心尖部构型改变和心腔扩大。

超声心动图是目前检测左室收缩同步性的重要检查方法之一,其中常规 M 型、二维、组织多普勒和二维斑点追踪技术等均受到采样切面的限制,不能同时评价左室 6 个以上至 17 个节段的收缩同步性,而只有新近研发的 RT-3DE 及其定量分析软件能分析一个心动周期内左室所有节段的收缩同步性^[17,18]。本研究应用左室 VTCs、IBE、左室 Tmsvl6-SD、Tmsvl6-Dif、SDI 和 Tmsvl6-Dif% 来评价左室收缩的同步性。此外,Ypenburg C^[19]等研究表明左室收缩不同步的严重程度可用 SDI 来衡量。本研究结果表明 PCI 术后左室 Tmsvl6-SD、Tmsvl6-Dif、SDI 和 Tmsvl6-Dif% 较术前比较减小,同步性也得到提高。Mollema 等^[20]的研究表明 AMI 后收缩明显不同步,可在短时间内导致左室收缩功能减低,左室心腔内径增大,而心功能损害导致的心室扩大又会导致心电重构,加重不同步。因此,检测 AMI 后左室的收缩是否存在不同步可较好地预测心肌梗死患者的预后。AMI 组术后 1 个月左室 ESV 及 EDV 较术前比较减小,左室 EF 较术前增大;AMI 组患者梗死节段 RESV 及 REDV 术后 1 个月较术前比较减小,梗死节段 REF 较术前比较有所增大,PCI 术后 Tmsvl6-SD、Tmsvl6-Dif、SDI 和 Tmsvl6-Dif% 较术前比较减小,这进一步证实了随着冠状动脉供血功能的改善,左室心腔容积变小,左室收缩功能提高,左室 16 节段的同步性也随之提高,左室壁运动更协调。这是由于 AMI 发生后,梗死节段出现运动减低或消失,从而短时间内导致左室收缩功能减低,左室心腔扩大,左室由原来整体、迅速而同步的收缩变成节段、缓慢且不同步的收缩。AMI 发生后病变区域因心肌缺血的严重程度不同而呈现心肌收缩减弱,收缩完全消失甚至矛盾运动,非病变心肌功能相对代偿性增强,从而进一步导致左室收缩运动不同步,收缩运动不同步又会导致心腔内压力不平衡。部分血液在局部心腔内往返形成无效循环,此即所谓的心腔内分流,加速心功能恶化。收缩不同步程度越重,血流动力学

越紊乱,对心功能的损害也越严重。因此,准确检测 AMI 患者收缩不同步,即使是心功能受损不严重,如尽早采取各种治疗方法减轻收缩不同步,可避免心功能持续减低,预测心肌梗死患者的预后,提高远期治疗效果,降低死亡率。

综上,RT-3DE 经胸直接采图,无创、简便且快速,不依赖任何形态的假设,真实的反映出一个心动周期中左室整体及节段容积的变化,准确分析出左室整体、局部收缩和舒张参数及收缩同步性参数,可以定位、定量诊断 AMI 部位,对 AMI 患者的治疗、观察疗效、评估预后提供更有价值的信息。但 RT-3DE 也存在一些不足之处,如三维图像的合成受患者透声窗条件、呼吸心律及体位移动等的影响,还有金字塔全容积图像的扇面角偏小,对于心脏明显增大的患者可能出现左室心腔部分残缺,导致无法准确测量。相信随着超声和计算机技术的不断进步现有的一些不足之处将被克服,RT-3DE 必将在心血管疾病的诊断、治疗和随访中得到更广泛的应用。

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