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斑点追踪技术评价冠心病患者 PCI 术前后左室心肌力学改变 *

王翠翠¹ 薛莉^{1△} 梁凤梅² 罗春英³ 李卫天¹ 李学奇¹ 王谦谦¹

(1 哈尔滨医科大学附属第四医院心内科超声室 黑龙江 哈尔滨 150001;

2 哈尔滨市第二医院心内科 黑龙江 哈尔滨 150056; 3 哈尔滨市胸科医院超声科 黑龙江 哈尔滨 150056)

摘要 目的:探讨斑点追踪成像(speckle tracking imaging, STI)技术评价经皮冠状动脉介入(percutaneous coronary intervention, PCI)术对冠状动脉严重狭窄患者左室心肌力学改变。**方法:**病变组(冠状动脉左前降支狭窄>75%患者)30例,分别于PCI术前1天和术后3天、术后3个月接受超声心动图检查,测量的常规指标包括:左室射血分数(LVEF)、左室舒张末内径(LVDd)、左室舒张末容积(LVEDV),同时应用 STI 技术测量缺血心肌节段收缩期峰值应变参数:纵向、径向、圆周应变 LS、RS、CS。体检健康者 30 例为对照组进行比较分析。**结果:**①与对照组比较,病变组 PCI 术前缺血心肌应变值(LS、RS、CS)均呈不同程度减低,差异均有统计学意义($P<0.05$);术后3天与术前比较均无统计学差异($P>0.05$);PCI 术后3个月病变组 LS、RS、CS 较术前均不同程度提高,差异均有统计学意义($P<0.05$),与对照组比较,差异无统计学意义($P>0.05$);②病变组 PCI 术前后不同时间点与对照组比较, LVEF、LVDd、LVEDV 均无统计学差异($P>0.05$)。**结论:**STI 技术可定量敏感的评价冠状动脉严重狭窄患者缺血心肌力学改变,为评价 PCI 术对冠心病患者的疗效提供了客观依据。

关键词:斑点追踪成像技术;冠心病;经皮冠状动脉介入治疗;应变

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Assessment of Changes in Left Ventricular Myocardial Mechanics by Speckle Tracking Imaging in Patients with Coronary Heart Disease before and after PCI *

WANG Cui-cui¹, XUE Li^{1△}, LIANG Feng-mei², LUO Chun-ying³, LI Wei-tian¹, LI Xue-qi¹, WANG Qian-qian¹

(Ultrasound Room, Department of Cardiology, The Fourth Affiliated Hospital of Harbin Medical University, Harbin, Heilongjiang, 150001, China; 2 Department of Cardiology, The Second Hospital of Harbin, Harbin, Heilongjiang, 150056, China;

3 Department of Ultrasound, Chest Hospital of Harbin, Harbin, Heilongjiang, 150056, China)

ABSTRACT Objective: To assess the efficacy of percutaneous coronary intervention (PCI) on left ventricular myocardial mechanics changes in patients with severe coronary artery stenosis using speckle tracking imaging (STI) technique. **Methods:** Thirty enrolled patients with left anterior descending coronary artery stenosis (>75%) were assigned into the lesion group, and 30 healthy volunteers were included into the control group for comparative analysis. Both groups received echocardiography 1 day before PCI, 3 days and 3 months after PCI, respectively, including routine measurements of left ventricular ejection fraction (LVEF), left ventricular end-diastolic dimension (LVDd) and left ventricular end-diastolic volume (LVEDV). In addition, STI technique was performed for both groups to obtain peak systolic strain parameters of longitudinal strain (LS), radial strain (RS) and circumferential strain (CS) in the ischemia segments. **Results:** ① 1 day before PCI (pre-PCI), the lesion group exhibited a significantly statistical ($P<0.05$) reduction in all myocardial ischemic strain values (LS, RS, CS) compared with the control group; while 3 days after PCI, compared to pre-PCI, there was no statistically significant difference ($P>0.05$); but 3 months after PCI, a significantly increased myocardial ischemic strain value (LS, RS, CS) was observed in the lesion group compared to pre-PCI ($P<0.05$), however, there were no statistically significant differences compared to the control group ($P>0.05$); ② Moreover, no statistical differences of the LVEF, LVDd and LVEDV values were found among the three time points (before and after PCI) between the lesion group and the control group ($P>0.05$). **Conclusions:** STI technique can be used for quantitative and sensitive assessment of myocardial mechanics change in patients with severe coronary artery stenosis and provide the objective basis for evaluating the effect of PCI therapy on patients with coronary heart disease.

Key words: Speckle tracking imaging; Coronary heart disease; Percutaneous coronary intervention; Strain

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作者简介:王翠翠(1984-),女,硕士研究生,主要研究方向:心血管超声诊断

△通讯作者:薛莉,电话:0451-85939596, E-mail: toxueli@163.com

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前言

随着冠状动脉严重狭窄引起的不良心血管事件发生率及死亡率的逐年上升,临床积极开展经皮冠状动脉介入(percutaneous coronary intervention PCI)术使严重狭窄的冠状动脉扩张,对缺血心肌实现再灌注^[1]。常规超声心动图对缺血心肌的检测常为阴性结果,检测敏感性差。斑点追踪成像(speckle tracking imaging STI)技术是近年来业内研究的热点,此技术可避免主观因素、心脏平移的影响,且不受声束角度限制,可以实时跟踪心肌回声斑点的空间运动轨迹,从多个方向敏感检测各心肌节段的应变值^[2-3]。目前国内外学者应用 STI 技术在冠心病方面已做了相关研究,但对冠状动脉严重狭窄支架放置术后疗效评价的研究尚少。本研究旨在探讨应用 STI 技术评价 PCI 术对单支冠状动脉严重狭窄患者左室心肌力学的影响。

1 资料与方法

1.1 一般资料

病变组 30 例,选取 2013 年 5 月~2014 年 9 月在我院确诊的冠心病患者,其中男 18 例,女 12 例,年龄 40~66 岁,平均(48.5±8.7)岁。入选标准:1)患者均经冠状动脉造影证实为左前降支 LAD 狭窄>75%,其他冠脉狭窄<30%,均成功实施 PCI;2)均有心电图示 ST 段压低,T 波减低、变平或倒置等心肌缺血的客观依据;3)常规超声心动图检查:左室室壁运动正常,左室射血分数 LVEF>50%。排除心肌梗死、心律失常及不能配合检查、采集图像不满意的患者。所有患者均于 PCI 术前 1 天及术后 3 天、术后 3 个月完成经胸超声心动图检查。随机选取同期我院体检健康者 30 例为对照组,其中男 20 例,女 10 例,年龄 38~60 岁,平均(42.1±6.6)岁。

1.2 仪器与方法

1.2.1 仪器 采用 Philips iE33 彩色多普勒超声诊断仪,S5-1 探头,频率 1-5 MHz,配有 Qlab 分析软件。

1.2.2 方法 受检者左侧卧位或平卧位,平静呼吸,同步记录胸导联心电图。常规测量左室舒张末内径 LVDd、左室舒张末容积 LVEdV,并采用 Simpson 双平面法测量 LVEF。嘱受检者呼气末屏气,分别采集心尖四腔心、两腔心、左室长轴切面以及左室短轴二尖瓣环、乳头肌、心尖水平连续 4 个稳定的心动周期二维灰阶动态图像,存储后进入 Qlab 工作站供数据分析。选取心内膜显示清晰的图像,使用 TMQ 插件分析图像,软件自动生成包络心肌的感兴趣区 ROI,手动勾画调节 ROI 边缘的位置使其与心内、外膜尽量贴合,宽度与心肌厚度保持一致,系统自动将心肌按左室短轴切面分为前间隔、前壁、侧壁、后壁、下壁及后间隔,按左室长轴切面分为基底段、中间段及心尖段,共计 17 个心肌节段^[4],自动计算出各节段的在三维方向上的应变值,进而自动生成各节段随心动周期的应变-时间曲线,根据心肌节段与冠状动脉供应关系^[5],超声 STI 技术检测由 LAD 支配的缺血心肌(即左室前间隔及前壁的基底段、中间段和心尖段)收缩期峰值纵向、径向、圆周应变值 LS、RS、CS,取前间隔及前壁基底段、中间段及心尖段的平均值。

1.3 统计学分析

应用 SPSS17.0 统计学软件,计量资料均以均数±标准差($\bar{X} \pm S$)表示,多组间比较用单因素方差分析,两两比较用 LSD-t 检验, $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 病变组 PCI 术前后与正常对照组常规心脏超声参数比较

病变组 PCI 术前后不同时间点与对照组比较,LVEF、LVDd、LVEdV 均无统计学差异($P > 0.05$)。见表 1。

表 1 病变组 PCI 术前后与正常对照组常规心脏超声参数的比较($\bar{X} \pm S$)

Table 1 Comparison of routine echocardiography parameters before and after PCI in the lesion group and the control group($\bar{X} \pm S$)

Parameters	Control group	Lesion group		
		Before PCI	3 d after PCI	3 m after PCI
LVEdD(mm)	47.8±6.1	50.8±7.2	51.3±8.8	48.5±6.1
LVEdV(mL)	78.2±10.6	80.7±10.6	83.8±12.5	79.9±9.6
LVEF(%)	62.8±3.0	61.7±3.7	60.8±4.7	62.1±4.2

Note: There were no statistical differences of LVDd, LVEdV and LVEF before and after the PCI in the lesion group and the control group, $P > 0.05$.

2.2 病变组 PCI 术前后缺血心肌与正常对照组应变-时间曲线比较

正常对照组应变曲线的整体趋势为单峰曲线,排列整齐;PCI 术前缺血心肌应变曲线低平,排列紊乱;PCI 术后 3 个月缺血心肌应变曲线趋向整齐(图 1)。

2.3 病变组 PCI 术前后缺血心肌与正常对照组 STI 参数比较

与对照组比较,病变组 PCI 术前缺血心肌应变值(LS、RS、CS)均呈不同程度减低,差异均有统计学意义($P < 0.05$);PCI 术后 3 个月缺血心肌应变值(LS、RS、CS)与术前比较均无统计学差异($P > 0.05$);PCI 术后 3 个月缺血心肌应变值(LS、RS、CS)较术前均不同程度提高,差异均有统计学意义($P < 0.05$),与对照

组比较,无统计学意义($P > 0.05$)。(见表 2)。

3 讨论

冠状动脉严重狭窄可因冠状动脉血流量减少引起冠状动脉支配区域心肌缺血,进而因心肌能量不足致心肌收缩功能损伤。常规超声心动图对心肌缺血早期改变的检测敏感性差,对其评价存在局限性。STI 技术是近年来业内研究的热点,此技术可避免主观因素、心脏平移的影响且不受声束角度限制,可多方向定量敏感检测局部心肌收缩功能。

本研究应用 STI 技术检测冠脉左前降支狭窄>75%的冠心病患者缺血心肌 LS、RS、CS 及支架放置后上述参数的变化,

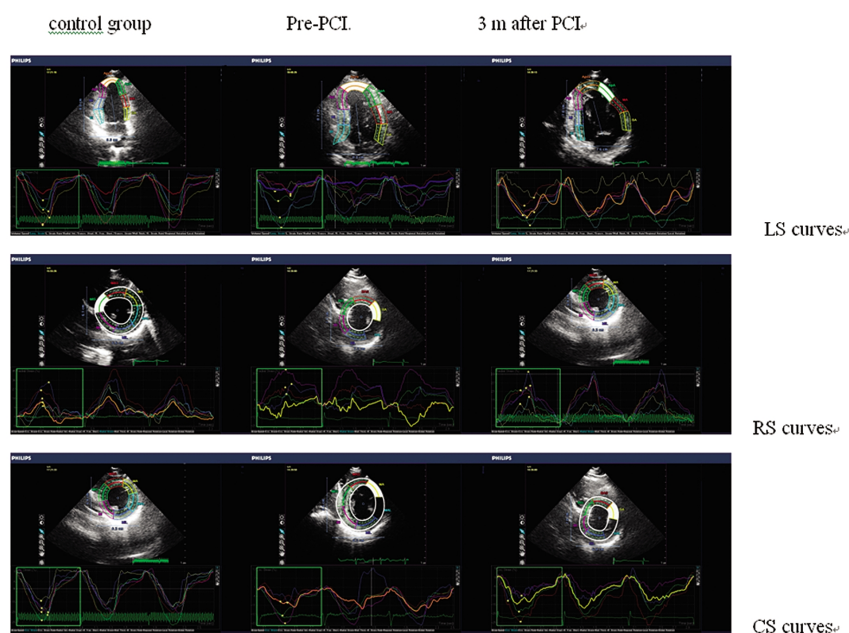


图 1 病变组 PCI 术前后与对照组 STI 应变 - 时间曲线分析图

Fig. 1 STI strain - time curve graph before and after the PCI in the lesion group and the control group

表 2 病变组 PCI 术前后缺血心肌与对照组 LS、RS、CS 的比较(%, $\bar{X} \pm S$)Table 2 Comparison of LS, RS, CS of myocardial ischemia before and after PCI in the lesion group and the control group(%, $\bar{X} \pm S$)

Parameters	Control group	Lesion group		
		pre-PCI	3 d after PCI	3 m after PCI
LS	-21.5 $\pm$ 6.2	-16.4 $\pm$ 7.0**	-15.5 $\pm$ 6.9**	-20.0 $\pm$ 6.7▲
RS	34.4 $\pm$ 8.1	30.2 $\pm$ 7.4*	29.6 $\pm$ 8.9*	34.0 $\pm$ 4.0▲
CS	28.1 $\pm$ 6.5	24.5 $\pm$ 6.5*	23.6 $\pm$ 6.3 *	27.8 $\pm$ 7.6▲

Note : * P<0.05, ** P<0.01, versus control group; ▲ P<0.05, versus Pre-PCI group.

其结果显示:与对照组比较,病变组 PCI 术前缺血心肌 LS、RS、CS 均呈不同程度减低,此结果与 Liang HY^[6]及李燕^[7]等学者报道趋于一致。这可能是由于冠状动脉严重狭窄时,其支配区域血流量减少,心肌的长期低血流灌注可引起一定程度的心肌纤维化,致心肌形变能力下降,局部收缩功能减低。文献报道:左室有内外两层螺旋形肌束及中间环形肌束^[8],LS 主要由心内膜下纵行心肌纤维收缩引起,RS 取决于心内膜下(58%)、中层(25%)、心外膜(17%)心肌的收缩;CS 主要由中层环形肌束收缩引起^[9],说明左室的多方向的形变能力可相互影响。关于冠状动脉狭窄程度与其支配区域心肌各应变值的相关性,各学者报道不同,王其海^[10]等学者研究结果表明:冠脉狭窄程度与缺血心肌各收缩期峰值应变值均有良好的相关性,与收缩期径向应变相关性最大;Winter R^[11]等学者研究发现冠脉狭窄 >50% 时,缺血心肌圆周应变的减低程度较径向应变显著,认为圆周运动对心肌缺血更敏感。目前较公认的观点是,心肌受累程度与心肌血流灌注特点相关联^[12],供应左室心内膜下心肌的血管为主干型分支,而供应心外膜 2/3 层的为树枝型分支,心脏在收缩时对心肌内的血管产生压迫,使心内膜下心肌血供阻力明显增大,因此当冠脉血流量减少时,心内膜下纵行心肌最容易受损^[13-15]。

本研究结果还显示,病变组 PCI 术后 3 天,缺血心肌 LS、

RS、CS 与术前比较均无统计学差异,说明此时局部心肌功能仍未明显改善,虽然血管得以再通,但血运重建后缺血心肌的改善需要一段时间,这与术后短期内缺血心肌水肿、细胞出血、心肌硬度增加有关;也可能由于 PCI 术中球囊多次扩张造成短时限血管闭塞,之后球囊释放引起心肌缺血 - 再灌注损伤,使部分心肌出现顿抑现象^[16,17];除此之外,支架放置过程中可能造成局部斑块脱落引起微循环栓塞。本研究病变组 PCI 术后 3 个月,缺血心肌 LS、RS、CS 均较术前不同程度升高,这说明开通严重狭窄冠状动脉可使处于低灌注状态的缺血心肌细胞功能改善,这可能与处于低灌注适应状态的冬眠心肌和缺血 - 再灌注后顿抑心肌的心肌活性逐渐恢复有关,心肌收缩力增强,应变也相应增加^[18]。

另外本研究结果显示,病变组 PCI 术前后不同时间点与对照组比较,LVEF、LVDD、LVEDV 均无统计学差异,说明常规超声检测的整体心功能参数不能很好的反映缺血心肌 PCI 前后的变化,故本研究体现了 STI 技术对于检测心肌缺血的敏感性和优越性。随着三维 STI 技术的不断成熟与发展,在左室心力学方面的评价将会有更广阔的前景^[19,20]。

综上所述,STI 技术能够定量敏感的评价冠状动脉严重狭窄患者缺血心力学改变,为评价 PCI 术对冠心病患者的疗效提供了客观依据。

参 考 文 献(References)

- [1] 刘楠楠, 蒋苏齐, 周微微, 等. 斑点追踪技术研究冠状动脉介入术对左室心功能的影响[J]. 临床军医杂志, 2012, 40(4): 780-781
Liu Nan-nan, Jiang Su-qi, Zhou Wei-wei, et al. Speckle tracking study on the impact of percutaneous coronary interventions on left ventricular function[J]. Chin J Med Office, 2012, 40(4): 780-781
- [2] Blessberger H, Binder T. Two dimensional speckle tracking echocardiography: basic principles[J]. Heart, 2010, 96(9): 716-722
- [3] Biswas M, Sudhakar S, Nanda NC, et al. Two-and three-dimensional speckle tracking echocardiography: clinical applicational and future directions[J]. Echocardiography, 2013, 30(1): 105981-105988
- [4] 周永昌, 郭万学. 超声医学[M]. 6版. 北京: 人民军医出版社, 2011: 622-623
Zhou Yong-chang, Guo Wan-xue. Ultrasonic medicine [M]. 6th Edition. Beijing: People's Military Medical Press, 2011: 622-623
- [5] 杨永宾, 赵永波, 赵志勇, 等. 山羊冠状动脉的分布及前、后乳头肌血供的研究[J]. 中国胸心血管外科临床杂志, 2011, 18(6): 540-542
Yang Yong-bin, Zhao Yong-bo, Zhao Zhi-yong, et al. Coronary Artery Distribution and Vascular Network in Anterior and Posterior Papillary Muscles in Goat [J]. Chin J Clin Thorac Cardiovasc Surg, 2011, 18(6): 540-542
- [6] Liang HY, Cauduro S, Pellikka P, et al. Usefulness of two-dimensional speckle strain for evaluation of left ventricular diastolic deformation in patients with coronary artery disease [J]. Am J Cardiol, 2006, 98(12): 1581-1586
- [7] 李燕, 吕清, 王新房, 等. 纵向、径向及周向二维应变评价冠心病患者左心室局部收缩功能异常[J]. 中华超声影像学杂志, 2009, 18(4): 277-280
Li Yan, Lv Qing, Wang Xin-fang, et al. Longitudinal, radial and circumferential 2-dimensional strain for quantitative analysis of regional left ventricular systolic dysfunction in patients with coronary artery disease [J]. Chinese Journal of Ultrasonography, 2009, 18(4): 277-280
- [8] Torrent-Guasp F, Koeiea MJ, Corno AF, et al. Towards new understanding of the heart structure and function [J]. Eur J Cardiothoracurg, 2005, 27: 191-201
- [9] Mizuguchi Y, Oishi Y, Miyoshi H, et al. The functional role of longitudinal, circumferential, and radial myocardial deformation for regulating the early impairment of left ventricular contraction and relaxation in patients with cardiovascular risk factors: A study with two-dimensional strain imaging [J]. Am Soc Echocardiogr, 2008, 21(10): 1138-1144
- [10] 王其海, 汪太平, 徐岩, 等. 斑点追踪成像技术评价缺血心肌短轴方向径向及圆周应变[J]. 中国医学影像技术, 2009, 25(8): 1411-1414
Wang Qi-hai, Wang Tai-ping, Xu Yan, et al. Speckle tracking imaging evaluation of radial strain and circumferential strain from the left ventricular short axis views in myocardial ischemia [J]. Chin J Med Imaging Technol, 2009, 25(8): 1411-1414
- [11] Winter R, Jussila R, Nowak J, et al. Speckle tracking echocardiography is a sensitive tool for the detection of myocardial ischemia: a pilot study from the catheterization laboratory during percutaneous coronary intervention [J]. J Am Soc Echocardiogr, 2007, 20(8): 974-981
- [12] 孙辉, 赵宝珍, 杨斌. 速度向量成像技术评价正常人左室心室壁形变分布特征[J]. 中国医学影像技术, 2010, 26(9): 1700-1703
Sun Hui, Zhao Bao-zhen, Yang Bin, et al. Distribution features of left ventricular deformation in normal persons assessed with vector velocity imaging technique [J]. Chin J Med Imaging Technol, 2010, 26(9): 1700-1703
- [13] Zhang Q, Fang F, Liang YJ, et al. A novel multi-layer approach of measuring strain and torsion by 2D speckle tracking imaging in normal subjects and patients with heart disease[J]. Int J Cardiol, 2011, 147(1): 32-37
- [14] Liu YW, Tsai WC, Su CT, et al. Evidence of left ventricular systolic dysfunction detected by automated function imaging in patients with heart failure and preserved left ventricular ejection fraction [J]. J Card Fail, 2009, 15(9): 782-789
- [15] 王丽萍, 夏红梅, 蒋演, 等. 斑点追踪成像评价冠心病患者 CABG 或 PCI 术治疗前后左室收缩功能[J]. 第三军医大学学报, 2012, 34(8): 776-780
Wang Li-ping, Xia Hong-mei, Jiang Yan, et al. Assessment of left ventricular systolic function in patients with coronary heart disease before and after PCI or CABG with speckle tracking imaging [J]. J Third Mil Med Univ, 2012, 34(8): 776-780
- [16] 吴楠, 薛继平, 王健, 等. 二维应变超声心动图评价冠心病血运重建前后左心室局部功能特征[J]. 实用医技杂志, 2010, 17(1): 22-24
Wu Nan, Xue Ji-ping, Wang Jian, et al. Quantitative assessment of left ventricular myocardial function before and after revascularization with coronary artery disease by two dimensional strain echocardiography [J]. Journal of Practical Medical Techniques, 2010, 17(1): 22-24
- [17] Frank A, Bonney M, Bonney S, et al. Myocardial ischemia reperfusion injury: from basic Science to clinical bedside [J]. Semin Cardiothorac Vasc Anesth, 2012, 16(3): 123-132
- [18] Chen M, Wang J, Xie MX, et al. Real-time three-dimensional echocardiographic assessment of left ventricular remodeling index in patients with hypertensive heart disease and coronary artery disease [J]. J Huazhong Univ Sci Technolog Med Sci, 2009, 29(1): 122-126
- [19] Zhai H, Mu Y, Guan L, et al. The value of aneurysm volume and myocardial strain rate for evaluating cardiac function of ischemia-related left ventricular aneurysm in a rabbit model using real time three-dimensional echocardiographic imaging combined with speckle tracking imaging[J]. Echocardiography, 2013, 30(7): 837-842
- [20] Badano LP, Cucchini U, Muraru D, et al. Use of three-dimensional speckle tracking to assess left ventricular myocardial mechanics: inter-vendor consistency and reproducibility of strain measurements [J]. Eur Heart J Cardiovasc Imaging, 2013, 14(3): 285-293