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三维斑点追踪技术评价左束支起搏、右室间隔部起搏的心室起搏依赖患者左心室收缩功能

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[摘要] 目的: 采用三维斑点追踪成像(three-dimensional speckle tracking imaging, 3D-STI)技术对左束支起搏、右室间隔部起搏的心室起搏依赖患者左心室收缩功能进行对比研究。方法: 将2018年6月至2019年6月因II度II型、高度、III度房室传导阻滞接受心脏永久起搏器植入术[要求术前左心室射血分数(left ventricular ejection fraction, LVEF)大于50%, 在术后6个月完成了超声心动图随访且程控心室起搏比例大于40%]的65例患者纳入本研究, 按起搏部位分为左束支起搏(left bundle branch pacing, LBBP)组($n=32$)和右室间隔部起搏(right ventricular septum pacing, RVSP)组($n=33$), 采用3D-STI技术获取左心室整体纵向应变(global longitudinal strain, GLS)、整体环向应变(global circumferential strain, GCS)、整体径向应变(global radial strain, GRS)、整体面积应变(global area strain, GAS)。结果: LBBP组和RVSP组的LVEF均正常, 两组间差异无统计学意义($P>0.05$); RVSP组术后6个月随访时较术前有轻微的下降趋势, 但差异无统计学意义($P>0.05$)。两组间GLS、GCS、GRS、GAS于术前、术后6个月比较, 差异均无统计学意义(均 $P>0.05$)。与术前相比, LBBP组术后6个月随访时GLS和GCS明显降低; RVSP组术后GLS、GCS、GRS、GAS均明显降低, 差异均有统计学意义(均 $P<0.05$)。结论: 在术前心功能正常的心室起搏依赖患者中, LBBP对心功能的影响虽然在术后短期内并不明显优于右室间隔部起搏, 但从生理性起搏、长远心功能保护的角度看, LBBP是值得优先选择的起搏方式。

[关键词] 三维斑点追踪; 左束支起搏; 心室起搏依赖; 左心室; 收缩功能

Left ventricular systolic function between left bundle branch pacing and right ventricular septum pacing in patients with pacemaker dependence by three-dimensional speckle tracking imaging

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ABSTRACT

Objective: To compare the left ventricular systolic function between the left bundle branch pacing (LBBP) and right ventricular septum pacing (RVSP) in patients with pacemaker dependence by three-dimensional speckle tracking imaging (3D-STI).

Methods: A total of 65 patients with atrioventricular block (AVB) (Mobitz type II second-degree AVB, high-degree AVB, or third-degree AVB), who underwent permanent cardiac pacing implantation including 32 patients receiving LBBP (LBBP group) and 33 patients receiving RVSP (RVSP group) from June 2018 to June 2019, were enrolled in this study. These patients met the following inclusion criterion: pre-operative left ventricular ejection fraction (LVEF) > 50% and ventricular pacing rate > 40% at 6-month programming follow-up; and the patients underwent echocardiography at pre-operation and 6 months after operation. The 3D-STI was used to obtain global longitudinal strain (GLS), global circumferential strain (GCS), global radial strain (GRS), and global area strain (GAS).

Results: All the patients in the LBBP group and the RVSP group had normal LVEF, there was no significant difference between the 2 group ($P > 0.05$). The LVEF was slightly decreased at 6-month follow-up in the RVSP group, but there was no significant change compared with pre-operation ($P > 0.05$). There were no significant difference in LVEF, GLS, GCS, GRS and GAS at pre-operation and 6-month after operation between the LBBP group and the RVSP group (all $P > 0.05$). Compared with pre-operation, the GLS and GCS were significantly decreased in the LBBP group; while the GLS, GCS, GRS and GAS in the RVSP group were also significantly decreased at 6-month follow-up (all $P < 0.05$).

Conclusion: For patients with pacemaker dependence and normal LVEF at pre-operation, the cardiac function in the LBBP group is not significantly better than that in the RVSP group in short term follow-up. But in terms of physiologic pacing and long-term cardiac function protection, the left bundle branch pacing is an optimal pacing mode.

KEY WORDS

three-dimensional speckle tracking imaging; left bundle branch pacing; ventricular pacemaker dependence; left ventricular; systolic function

长期以来,右室心尖部是起搏器心室电极安置的经典部位,但临床研究^[1]证实大于40%的右室心尖部起搏会增加心力衰竭、心房颤动的发生率。相对于右室心尖部,目前在临床广泛开展的右室间隔部起搏(right ventricular septum pacing, RVSP)使心室激动顺序相对符合生理规律,但起搏信号仍然不是通过患者自身的传导系统进行传导,可导致传导延迟。希浦系统起搏[包括希氏束起搏和左束支起搏(left bundle branch pacing, LBBP)]利用自身传导系统进行传导,尽可能地保持了相对正常的心室电激动顺序和心室收缩的同步性,可实现真正的生理性起搏,因此作为一种新兴的起搏方式,希浦系统起搏疗效和安全性是近年起搏领域研究的热点^[2]。LBBP克服了希氏束起搏阈值高、房室交叉感知、操作难度大等不足^[2-4],是希浦系统起搏的重要创新,理论上这一起搏方式对维持患者心功能有较好的临床效果。

减少不必要的心室起搏是生理性起搏的重要内容,但当患者因各种原因依赖心室起搏时,心室电极起搏位点的选择就变得尤为重要。2018年美国《心动过缓和心脏传导延迟患者的评估和管理》^[5]建议:对符合永久起搏器适应证的房室传导阻滞患者,若左心室射血分数(left ventricular ejection fraction, LVEF)为36%~50%,预计心室起搏比例>40%,相对右室起搏,可选择维持生理性心室激动的起搏技术(如再同步治疗或希氏束起搏)。而对于术前心功能正常、预计心室起搏比例>40%的患者,是否也优选希浦系统起搏,该指南未做推荐。三维斑点追踪成像(three-dimensional speckle tracking imaging, 3D-STI)是实时三维超声和斑点追踪原理相结合的前沿心脏超声诊断技术,可分析左心室所有节段及整体的应变参数,准确评估心肌运动、心脏功能^[6-8]。本研究拟采用3D-STI对术前心功能正常的LBBP和RVSP的

心室起搏依赖患者左心室收缩功能进行对比分析, 以期为此类患者心室起搏位点选择提供更多的理论依据。

1 对象与方法

1.1 对象

将2018年6月至2019年6月因II度II型、高度、III度房室传导阻滞接受心脏永久起搏器植入术(要求术前LVEF>50%), 在术后6个月完成了超声心动图随访且程控心室起搏比例>40%的65例患者纳入本研究。起搏器植入前, 充分告知两种术式的风险、获益、费用等情况, 患者及家属自主选择, 分为LBBP组和RVSP组。其中LBBP组32例, 男20例, 女12例, 年龄47.00~83.00(63.84±9.33)岁; RVSP组33例, 男20例, 女13例, 年龄42.00~80.00(62.42±10.25)岁。LBBP的电学特征要求: 1)术中电极头端记录到左束支电位; 2)术后即刻采集心电图, V1导联起搏QRS图形呈现不完全或完全右束支阻滞且起搏QRS宽度小于130 ms, 脉冲-左心室达到峰值的时间(即起搏脉冲到V5~V6导联R波顶峰的时间)<80 ms。RVSP无特殊的电学特征要求。排除标准: 年龄<18岁患者; 心脏明显增大(左心室内径>55 mm)患者; 持续性房颤患者; 合并有严重肝肾功能不全患者; 过度肥胖、超声透声窗差等所致图像质量不符合3D-STI技术要求的患者。所有受检者均对本研究知情同意。

1.2 仪器

GE vivid E95彩色多普勒超声诊断仪购自美国General Electric公司, 配备M5S经胸探头(2.0 MHz)及4V经胸探头(2.5 MHz)。Echo PAC工作站购自美国General Electric公司, 可对图像进行脱机分析。

1.3 方法

所有患者于术前1周、术后6个月采集二维及三

维超声心动图, 检查时连接同步心电图。二维超声心动图操作如下: 使用M5S经胸探头在胸骨旁左心室长轴切面测量左心房内径(left atrium, LA)、左心室内径(left ventricle, LV), 在心尖四腔心切面采用双平面 Simpson 法测量左心室舒张末容积(left ventricular end-diastolic volume, LVEDV)、左室收缩末容积(left ventricular end-systolic volume, LVESV)及LVEF。三维超声心动图操作如下: 使用4V经胸探头在左心室心内膜轮廓显示满意后, 连续采集4个心动周期, 获取左心室三维全容积图像。应用Echo PAC工作站进行图像分析, 程序自动勾画出左心室心内膜轮廓, 必要时可手动调节边界曲线以优化追踪效果, 3D-STI技术获得左心室壁整体的应变值, 记录左心室整体纵向应变(global longitudinal strain, GLS)、整体环向应变(global circumferential strain, GCS)、整体径向应变(global radial strain, GRS)和整体面积应变(global area strain, GAS)。

1.4 统计学处理

采用SPSS 22.0统计学软件进行统计分析, 定性资料采用 χ^2 检验, 定量资料以均数±标准差($\bar{x}\pm s$)表示, 同组术前、术后比较采用配对 t 检验, 两组间比较采用独立样本 t 检验。 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 一般临床特征的比较

两组患者的身高、体重、体表面积的差异均无统计学意义(均 $P>0.05$)。LBBP组术后起搏QRS宽度为(110.03±9.92) ms, 符合LBBP心电图图形及时限要求, 与RVSP组起搏QRS宽度[(142.55±10.01) ms]相比, 差异有统计学意义($P<0.05$, 表1)。

表1 LBBP组与RVSP组一般临床特征比较($\bar{x}\pm s$)

Table 1 Comparison of general clinical characteristics between the LBBP group and the RVSP group ($\bar{x}\pm s$)

组别	<i>n</i>	身高/cm	体重/kg	体表面积/m ²	起搏QRS/ms
LBBP组	32	166.81±6.42	65.56±9.79	1.77±0.15	110.03±9.92
RVSP组	33	165.52±8.07	62.15±8.97	1.71±0.15	142.55±10.01*

与LBBP组比较, * $P<0.05$ 。

2.2 心功能指标的比较

LBBP组和RVSP组术前、术后LA、LV、LVEDV、LVESV均无明显变化(均 $P>0.05$), 两组间

差异亦均无统计学意义(均 $P>0.05$)。LBBP组和RVSP组LVEF均正常, 差异无统计学意义($P>0.05$)。RVSP组术后6个月随访时LVEE较术前有轻微的下趋势

势, 但差异无统计学意义($P>0.05$)。

术前、术后6个月两组间GLS、GCS、GRS、GAS差异均无统计学意义(均 $P>0.05$)。与术前相比, LBBP组术后6个月随访时GLS和GCS明显降低,

RVSP组术后GLS、GCS、GRS、GAS也明显降低, 差异均有统计学意义(均 $P<0.05$, 表2)。两组术前、术后GAS示意图见图1。

表2 LBBP组与RVSP组术前、术后二维及三维超声指标比较($\bar{x}\pm s$)

Table 2 Two-dimensional and three-dimensional ultrasound indexes at pre-operation and post-operation in the LBBP group and the RVSP group ($\bar{x}\pm s$)

组别	n	LA/mm	LV/mm	LVEDV/mL	LVESV/mL	LVEF/%
LBBP组 术前	32	34.16±4.57	46.47±4.01	100.59±20.17	38.63±8.22	61.41±5.24
术后6个月	32	33.78±4.40	46.13±3.78	98.75±20.23	38.47±8.79	60.97±5.03
RVSP组 术前	33	34.70±3.99	46.73±4.26	94.58±21.78	35.30±8.08	62.03±5.24
术后6个月	33	34.52±4.32	46.76±3.62	94.58±20.94	37.09±10.19	60.21±5.04

组别	GLS/%	GCS/%	GRS/%	GAS/%
LBBP组 术前	-15.47±2.94	-22.66±4.77	36.68±12.53	-32.86±6.65
术后6个月	-14.14±2.90*	-19.80±6.42*	31.96±8.80	-30.74±6.96
RVSP组 术前	-16.22±3.08	-20.52±4.80	37.29±13.90	-32.76±6.83
术后6个月	-14.19±2.64*	-17.93±5.54*	32.16±10.30*	-28.09±5.96*

与同组术前比较, * $P<0.05$ 。LBBP: 左束支起搏; RVSP: 右室间隔部起搏。LA: 左心房内径; LV: 左心室内径; LVEDV: 左心室舒张末容积; LVESV: 左室收缩末容积; LVEF: 左心室射血分数; GLS: 整体纵向应变; GCS: 整体环向应变; GRS: 整体径向应变; GAS: 整体面积应变。

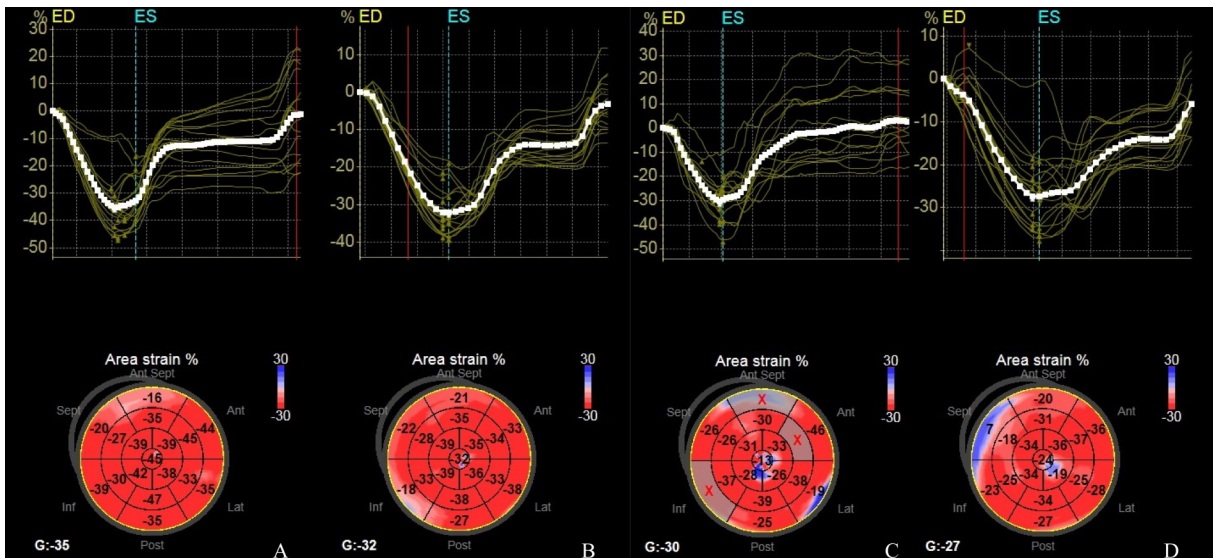


图1 LBBP组和RVSP组术前、术后GAS示意图

Figure 1 Representative images of GAS at pre-operation and post-operation in the LBBP group and the RVSP group

A: GAS curve and Bull's eye diagrams in the LBBP group (pre-operation); B: GAS curve and Bull's eye diagrams in the LBBP group (post-operation); C: GAS curve and Bull's eye diagrams in the RVSP group (pre-operation); D: GAS curve and Bull's eye diagrams in the RVSP group (post-operation). GAS is decreased in the 2 groups. GAS: Global area strain; ED: End diastole; ES: End systole.

3 讨论

新近开展的LBBP可以跨越传导阻滞部位, 起搏

左束支区域, 已有临床研究^[4, 9-11]证实LBBP术后起搏参数良好且稳定、左室电-机械同步性改善, 具有良好的临床应用前景。保持心室电-机械同步性, 对心

室起搏依赖患者维持心功能、减少心力衰竭发生具有重要意义。

3D-STI技术是实时三维超声和斑点追踪技术相结合的前沿心脏超声诊断技术,可在三维超声基础上连续追踪同一位置心肌的声学斑点,以此对心肌在心动周期中纵向、径向、圆周方向上的形变进行定量分析,可区分心肌主动运动和被动运动,早期发现心肌运动障碍,是临床评价左室心肌局部及整体收缩功能新的定量分析手段^[6-8],其结果和磁共振方法高度一致^[12-13],且具有方便起搏器术后随访、价格相对低廉、可重复性好等优点。

本研究采用3D-STI技术对LBBP和RVSP心室起搏依赖患者左室收缩功能进行评价,发现术后6个月随访时两组LVEF均正常,RVSP组LVEF较术前有轻微的下落趋势,但差异无统计学意义。作为经典的心功能评价指标,LVEF仅从心脏容量变化的角度来评价心功能,由于心脏本身的代偿作用,LVEF对于心肌收缩功能变化的评估往往是滞后的。心肌应变是反映心肌收缩性直接客观的指标,包括沿左室长轴方向、短轴方向的GLS、GRS和沿左室短轴圆周走行的GCS,以及3D-STI特有的代表心内膜面积变化率的GAS^[14]。本研究发现:尽管两组LVEF和各应变参数比较均无差异,但与术前相比,右室间隔起搏组术后6个月随访时左室GLS、GCS、GRS、GAS较术前均明显降低,同样也观察到LBBP组术后6个月随访时上述三维应变参数均有降低,其中左室GLS、GCS降低差异有统计学意义。RVSP没有夺获自身传导系统,激动在心肌间扩散慢,左右心室间、左室内收缩均不同步,而LBBP激动可沿束支下传,保持了左室收缩同步。同时值得注意的是,与自身正常传导途径不同,LBBP呈右束支阻滞,放弃了右束支下传,因此也存在左右心室间不同步。本研究结果初步验证:心室起搏依赖患者心功能较术前都有不同程度的受损,与RVSP相比,LBBP对心室起搏依赖患者左室心功能的损伤更小,这与林碧琴等^[15]采用二维斑点分层显像技术得到的研究结果一致,也说明心肌三维应变参数(尤其是GLS、GCS)是较LVEF更敏感的反映心肌收缩功能真实情况的指标^[16-17]。另外,LBBP组术后6个月随访时左室GAS的降低差异并无统计学意义,理论上GAS综合了GLS、GCS的变化,应该更为敏感、更具参考价值,但本研究并未观察到这样的结果,这可能与心肌三维螺旋结构的复杂性、心电激动顺序对心肌运动的影响以及本研究样本量偏小、随访时间尚短等因素有关。

QRS波宽度是心室同步性的重要指标,有研

究^[18-19]表明随着QRS增宽,心力衰竭的发生概率增高。本研究中LBBP组术后起搏QRS宽度显著小于RVSP组,虽然在术后6个月的组间比较中,LBBP组各项心功能指标并未明显优于RVSP组,但与RVSP组相比,LBBP组对心室起搏依赖患者左室心功能的损伤更小。因此,从长远心功能保护的角度来看,对预计心室起搏比例高的患者,即使术前心功能正常,也可考虑优先选择LBBP。但LBBP在临床上开展的时间尚短,远期疗效和安全性仍有待进一步验证。

本研究的局限性包括本研究样本量偏小,随访时间较短,只能得出初步结论,尚需扩大样本、延长随访时间,以观察心室起搏依赖患者两种起搏方式对左室收缩功能的影响。

综上所述,本研究的结果初步表明:在术前心功能正常的心室起搏依赖患者中,LBBP对心功能的影响虽然在术后短期内并不明显优于RVSP,但从生理性起搏、长远心功能保护的角度来看,LBBP是值得优先选择的起搏方式。

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