

三维超声心动图对法洛四联症患者术后右心室功能的评估

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【摘要】目的:探讨实时三维超声心动图(RT-3DE)在评价法洛四联症(TOF)患者手术后右心室功能中的意义。**方法:**应用RT-3DE对23例TOF患者术前、术后6个月右心室收缩末期容积(RVESV)、右心室舒张末期容积(RVEDV)及右心室射血分数(RVEF)进行检测。并将TOF患者术后6个月的RVEF与心电图QRS间期进行相关分析。**结果:**与术前比较,TOF患者术后6个月RT-3DE所测RVEDV、RVESV无显著增加($P>0.05$);RVEF明显减低($P<0.05$)。TOF患者术后6个月RT-3DE超声所测RVEF与QRS间期呈负相关($r=-0.697$, $P<0.05$)。**结论:**RT-3DE能准确评价TOF患者术后右心室功能,可以早期发现术后右心室功能不全,对TOF患者预后评估有重要意义。

【关键词】实时三维超声心动图;法洛四联症;右心室;心功能

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Evaluation of right ventricular function in patients after tetralogy of Fallot repair using three-dimensional echocardiography

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Abstract: Objective To explore the value of real-time three-dimensional echocardiography (RT-3DE) in the evaluation of right ventricular function in patients after repair of tetralogy of Fallot (TOF). **Methods** The right ventricular end systolic volume (RVESV), right ventricular end diastolic volume (RVEDV) and right ventricular ejection fraction (RVEF) in 23 TOF patients before and 6 months after TOF repair were detected by RT-3DE. The correlation analysis was performed between RVEF and QRS interval of electrocardiogram which were obtained 6 months after the TOF repair. **Results** No significant increases were found in RVEDV and RVESV between preoperation and 6 months postoperation ($P>0.05$), while RVEF detected 6 months after TOF repair was significantly decreased ($P<0.05$). Six months postoperatively, RVEF detect by RT-3DE was found to be negatively correlated with QRS interval ($r=-0.697$, $P<0.05$). **Conclusion** RT-3DE can accurately evaluate the right ventricular function in patients after TOF repair and achieve the early detection of postoperative right ventricular dysfunction, which is of great significance for the evaluation of the prognosis of TOF patients.

Keywords: real-time three-dimensional echocardiography; tetralogy of Fallot; right ventricle; ventricular function

前言

在我国所有发绀型先天性心脏病中,法洛四联症(Tetralogy of Fallot, TOF)是最常见的类型,虽然绝大部分患者外科手术治疗预后良好,但是仍有一部分TOF患者术后逐渐出现右室扩张、右心功能不全、

室性心律失常,甚至猝死等预后不良的表现^[1]。研究发现,TOF术后右心室功能的状况是患者术后长期预后的独立预测因素,因此评估TOF患者术后右心室功能十分重要^[2]。然而,由于右心室本身特殊的解剖结构和TOF右心室的病理改变使得常规超声心动图无法准确评估TOF患者术后右心室功能,如何应用超声技术准确评估TOF患者术后右心室功能是临床上亟待解决的难题。近年来,随着超声影像技术的进步,临床研究发现,与传统超声方法相比,实时的三维超声心动图(Real-Time Three-Dimensional Echocardiography, RT-3DE)逐步显现出对形态不规则的心腔(尤其是右心室)测量的优越性,被认为是

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可靠的右心室功能超声检测技术^[3]。本研究利用RT-3DE检测TOF患者术后右心室功能,以探讨RT-3DE在评价TOF患者手术后右心室功能中的意义。

1 资料与方法

1.1 研究对象

2016年1月~2017年7月在中南大学湘雅医院确诊为TOF的23例患者,完善术前准备后,均在我院心脏大血管外科行体外循环下根治术,其中女6例,男17例,年龄1~31岁,平均 (10.51 ± 8.25) 岁。所有患者术后均无临床症状,均未服用心血管相关药物,心电图检查均为窦性心律,无心律失常。

1.2 仪器与测量方法

采用Philips EPIQ7C彩色多普勒超声诊断仪,连接心电图,利用X5-1实时三维探头(探头频率为1~5 MHz)。静息状态下,患者左侧卧位,将探头置

于心尖处,将右心室置于图像中场充分显示右心室腔,启动全容积(Full volume)显像方式,嘱患者屏气,经过6个心动周期采集金字塔形全容积右心室实时三维图像。将收集的所有患者术前及术后6月的三维容积图像资料导入德国TomTec超声工作站,在软件中打开右心室三维全容积图像文件,启动三维右心室功能分析软件包,调整图像后确定三尖瓣环中心、二尖瓣环中心及左室心尖等标志点,手动勾画右室收缩末期及舒张末期时间帧右心室内膜缘的轮廓,软件自动生成右心室腔的动态立体图像,计算出右心室整体的容积和收缩功能参数(图1),其中包括右心室舒张末期容积(Right Ventricular End Diastolic Volume, RVEDV)、右心室收缩末期容积(Right Ventricular End Systolic Volume, RVESV)、右心室射血分数(Right Ventricular Ejection Fraction, RVEF)。

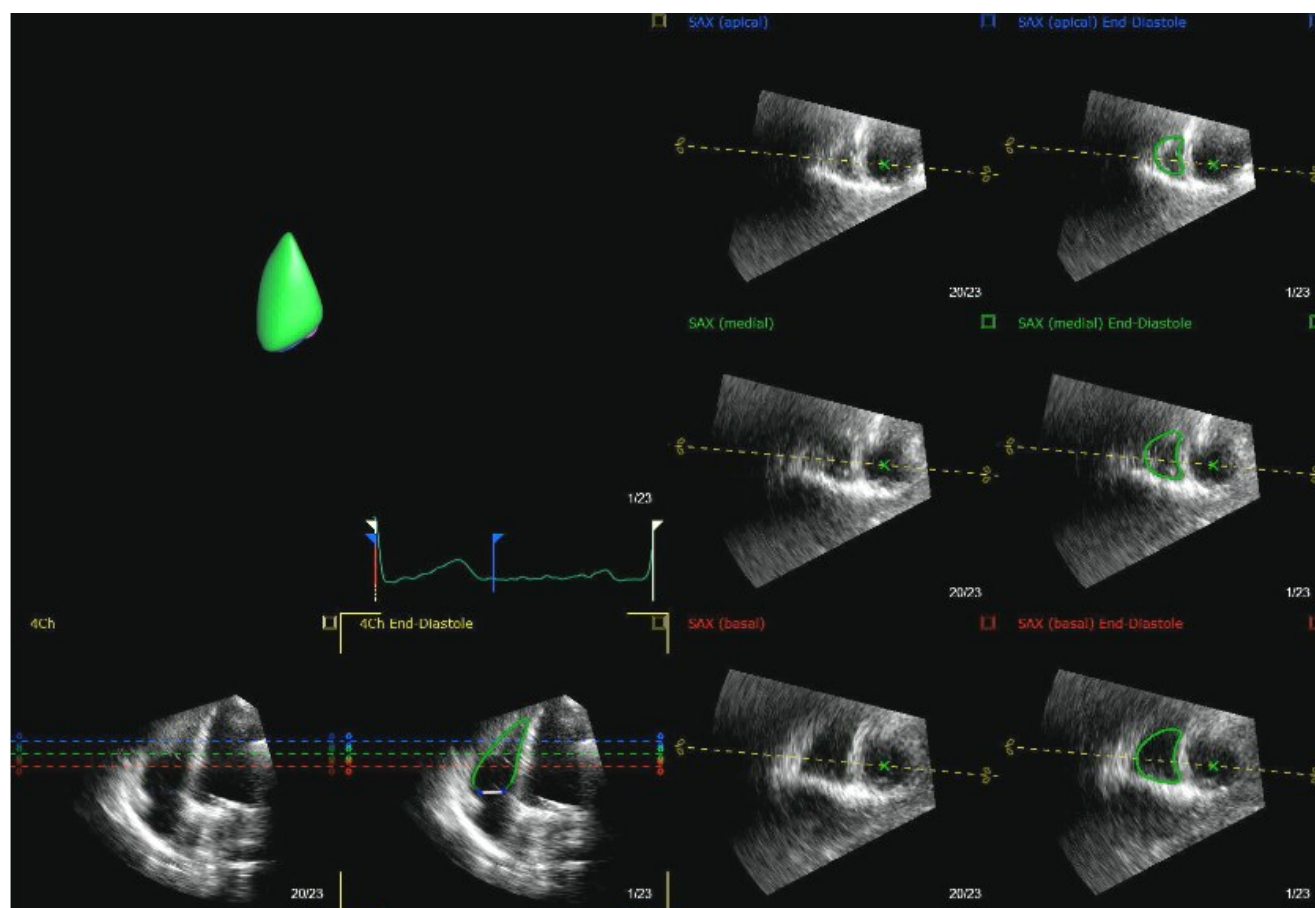


图1 描绘右心室内膜面及右心室三维图像

Fig.1 Right ventricular endocardium and right ventricular three-dimensional images

所有患者在术后6月采用12导联心电图,并选择II导联心电图来计算QRS间期(从Q波起始点到S波终末点的时间)。

1.3 统计学分析

所有数据运用SPSS 19.0软件进行分析。计量资料采用均数 \pm 标准差表示,运用独立样本 t 检验的方法对两组间计量资料进行比较。采用Pearson相关分析术后6个月RVEF与QRS间期的相关性。 $P < 0.05$

表示差异有统计学意义。

2 结果

2.1 TOF 患者手术前、术后6个月RVEDV、RVESV及

RVEF 的比较

与术前比较,TOF 患者术后6个月RT-3DE所测RVEDV、RVESV无明显改变($P>0.05$);RVEF明显减低($P<0.05$),见表1。

表1 TOF 患者手术前、术后6个月RVEDV、RVESV及RVEF的比较($n=23, \bar{x} \pm s$)

Tab.1 Comparison of RVEDV, RVESV and RVEF in TOF patients before and 6 months after TOF repair ($n=23, Mean \pm SD$)

Group	RVEDV/mL	RVESV/mL	RVEF/%
Preoperation	47.37±14.70	20.37±6.90	57.18±5.34
Six months after operation	50.27±14.60	24.32±7.15	51.41±3.26
P value	0.506	0.064	0.000

RVEDV: Right ventricular end diastolic volume; RVESV: Right ventricular end systolic volume; RVEF: Right ventricular ejection fraction; TOF: Tetralogy of Fallot

2.2 TOF 患者术后6个月RVEF与QRS间期的相关性分析

采用Pearson相关分析性显示,TOF 患者术后6个月RVEF与QRS间期呈负相关($r=-0.697, P=0.000$),见图2。

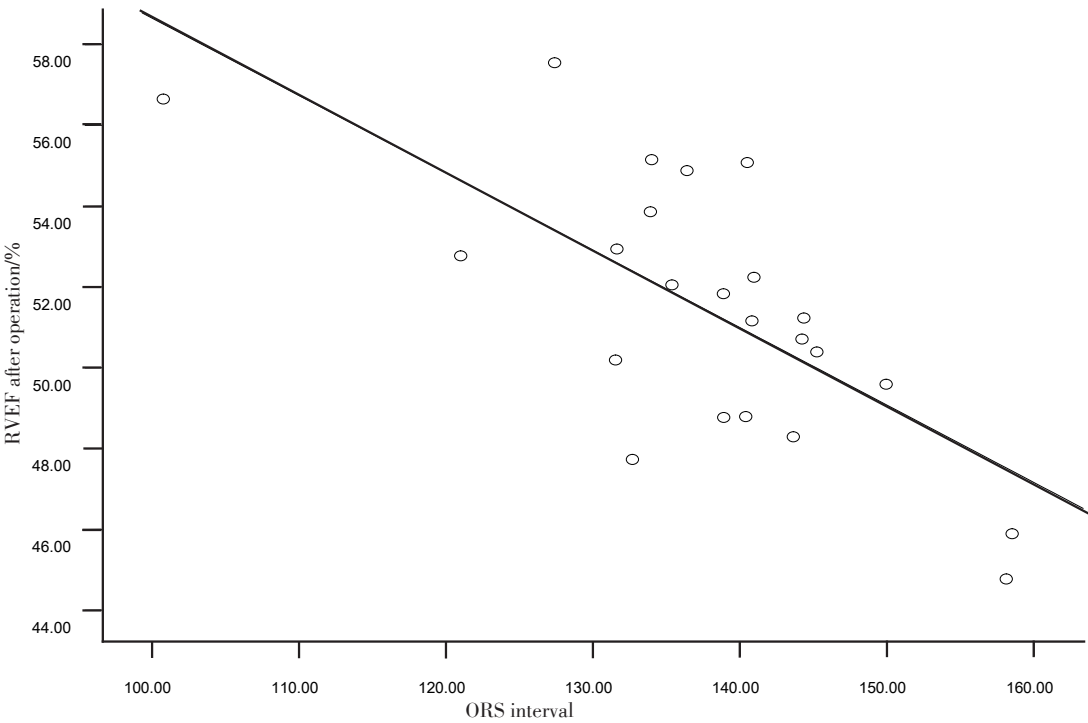


图2 TOF 患者术后6个月RVEF与QRS间期的相关性分析

Fig.2 Correlation analysis of RVEF and QRS interval in TOF patients at 6 months after TOF repair

3 讨论

随着心脏外科技术的进展,86%的TOF 患者术后均可生存30年以上^[4-5]。然而,TOF 根治术后大多数患者会出现右心室功能减退^[6-7]。研究证实,右心室功能减退与患者术后远期的活动耐力降低、死亡率密切相关^[8, 9-10]。临床上及时发现右心功能的改变并

积极干预,是提高TOF 患者术后生活质量和远期生存率的重要方法。因此,对TOF 根治术后患者右心室功能进行长期评价具有重要意义。

然而,如何评估TOF 患者的右心室功能一直是临床上亟待解决的难题。右心室位于胸骨后方,超声透声窗小,常规显像质量差^[11]。右心室呈不规则新

月形,其流入部、体部和流出部不在同一平面上。由于右心室心内膜面存在粗大的肌小梁导致右心室心内膜边缘极不规则,从而影响临床上对右心内膜边缘的描画。而且TOF患者右心室肥厚扩大,手术的影响会改变右心室几何形态以及增加解剖结构的复杂程度。这些因素严重影响常规二维超声心动图对TOF患者右心室容积测量和右心功能评估,导致不同操作者检测结果差异非常明显,甚至相互矛盾。因此目前认为,无论是否改良,二维超声心动图技术参数无法反映TOF患者右心室功能的客观变化^[12-13]。虽然,临床上有学者提出心脏MRI检测右心室容积以及收缩功能的重复性好且测量误差小,可以真实地反映右心室容积测量和右心功能的客观变化,被称之为临床上检测右心室的“金标准”,但其固有的操作过程相对复杂、检查时间相对过长、加之价格偏贵等缺点,限制了心脏MRI检测右心室容积以及收缩功能在临床的广泛开展^[14-15]。近年来研究证实,在评价右心功能方面,RT-3DE与心脏MRI具有良好的相关性,而且RT-3DE具有相对操作简单,耗时短,费用低的优点^[16-17]。

RT-3DE的优势在于能够快速、准确、实时地显示心室腔的三维结构,无需数学模型,可以直接定量真正的心腔容积,特别是对不规则右心室腔的检测,与传统超声检测方法相比较有明显的优越性^[11]。在本研究中,与术前相比,TOF患者术后6个月RT-3DE所测RVEDV、RVESV虽然无显著性差异,但有增加趋势,这是由于TOF根治术后肺动脉瓣反流导致的右心室容量负荷增加所致。TOF根治术后肺动脉瓣反流由以下因素引起:①跨肺动脉瓣环补片破坏了肺动脉瓣环和肺动脉瓣的完整性;②术中疏通右心室流出道切除肥厚的隔束和壁束损伤右心室肌并在一定程度上扩大了右心室漏斗部,而且肥厚的隔束和壁束的切除导致其对肺动脉瓣环的支持消失,进一步加重肺动脉瓣反流^[18]。国外研究也证实,右心室的容量会随着TOF术后肺动脉瓣反流加重而明显增加;虽然右心室可以很好地耐受慢性容量超负荷,但是由于右心室慢性容量超负荷引起的慢性游离壁扩张和室间隔向左室侧移位使室间隔功能不全,导致右心室收缩功能逐渐下降^[16]。当右心室收缩功能下降到RVEF<45%时,患者才出现临床症状^[19]。本研究中,虽然TOF患者术后6个月均无临床症状,但其RVEF较术前明显减低,提示TOF患者术后右心室收缩功能的降低早于临床症状的出现。因此,RT-3DE可以早期发现TOF患者术后右心室收缩功能降低,使得临床可以尽早采取干预措施,从而改善TOF患

者术后右心室收缩功能、提高术后远期生活质量和预期寿命,利用RT-3DE评估TOF患者术后右心室收缩功能在TOF术后随访中尤为重要。

研究已经证实,TOF术后QRS间期的延长与RVEF减低显著相关^[20]。在本研究中,我们将TOF患者术后6个月的RVEF与其心电图的QRS间期进行相关分析,发现其RVEF与QRS间期呈负相关。由于QRS间期延长被认为是TOF患者术后发生心律失常和猝死敏感而特异的预测指标^[21],因此,我们认为TOF患者术后RVEF的下降与QRS间期延长有关,利用RT-3DE监测RVEF对TOF患者术后的预后评估有重要意义。

综上所述,RT-3DE能准确评价TOF患者术后右心室功能,可以早期发现术后右心室功能不全,对TOF患者预后评估有重要意义。

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