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早产儿超声心脏几何形态学与血流动力学的相关性分析 *

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摘要 目的:探讨与分析早产儿超声心脏几何形态学与血流动力学的相关性。**方法:**研究时间为 2018 年 8 月到 2020 年 6 月,选择本院收治的早产儿 150 例(早产组)和足月儿 150 例(足月组)作为研究对象,两组新生儿都给予超声检查,记录、左心室舒张期内径(Left ventricular diastolic diameter,LVDd)、左心室收缩期内径(Left ventricular systolic diastolic,LVDs)、左房内径(Left atrial diameter,LAD)、左心室相对厚度 (Left ventricular relative wall thickness,LVRWT)、左心室心肌质量 (Left ventricular myocardial mass,LVM)、左室后壁舒张期厚度(Left ventricular posterior walldepth,LVPWd)、左心室舒张末期容积(Left ventricular end diastolic volume,LVDV)、左心室收缩末期容积(Left ventricular end systolic volume,LVSV)、每搏输出量(Stroke volume,SV)、左心室射血分数(Left ventricular ejection fraction,LVEF)、左心室缩短分数(Left ventricular fractional shortening,LVFS)等指标并进行相关性分析。**结果:**早产组的 LVDd、LVDs、LAD、LVPWd、LVRWT、LVM 值都显著低于足月组(P<0.05)。早产组的 LVDV、LVSV、SV 值低于足月组 (P<0.05), 两组 LVEF、LVFS 值对比差异无统计学意义 (P>0.05)。在早产组中,Pearson 相关性分析显示 LVDd、LVDs、LAD、LVPWd、LVRWT、LVM 值与 LVDV、LVSV、SV 值存在正相关性(P<0.05)。Cox 比例风险回归模型显示早产儿的出生体重、身长为影响 LVDd、LVDV 值的主要因素(P<0.05)。**结论:**早产儿超声心脏几何形态学指标与血流动力学指标呈正相关,提示超声能准确记录和监测早产儿的心脏几何形态学与血流动力学,可作为评估早产儿心功能的一种可靠方法。

关键词:超声;早产儿;心脏;几何形态学;血流动力学

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Correlation Analysis of Ultrasound Cardiac Geometry and Hemodynamics in Premature Infants*

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ABSTRACT Objective: To explore and analysis the correlation between ultrasound cardiac geometry and hemodynamics in premature infants. **Methods:** From August 2017 to June 2020. 60 cases of premature infants (premature group) and 60 cases of term infants (term group) who were selected in our hospital were selected as the research objects. All the cases were given ultrasound examination, recorded cardiac geometric morphology, hemodynamic indicators(LVDd, LVDs, LAD, LVPWd, LVRWT, LVM and LVDV, LVSV, SV, LVEF,LVFS) and were given correlation analysis. **Results:** The LVDd, LVDs, LAD, LVPWd, LVRWT and LVM values of the preterm group were significantly lower than those of the term group (P<0.05). The LVDV, LVSV, and SV values of the preterm group were lower than those of the term group (P<0.05), and there were no significant difference in the LVEF and LVFS values compared between the two groups (P>0.05). In the preterm group, Pearson correlation analysis showed that LVDd, LVDs, LAD, LVPWd, LVRWT, LVM values were positively correlated with LVDV, LVSV, and SV values (P<0.05). The Cox proportional hazard regression model showed that the birth weight and length of premature infants were the main factors affected the LVDd and LVDV values(P<0.05). **Conclusion:** The ultrasound cardiac geometric morphology indexes and hemodynamic indexes of premature infants are positively correlated, suggesting ultrasound can accurately record and monitor the cardiac geometry and hemodynamics of premature infants, and they can be used as a reliable methods to evaluate the cardiac function of premature infants.

Key words: Ultrasound; Premature infant; Heart; Geometric morphology; Hemodynamics

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前言

新生儿期是宫内胎儿至婴幼儿的过渡阶段,早产儿生后早

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期处于由心肺循环向正常循环的复杂过渡阶段，肺血管压力仍然较高，并常伴有肺动脉高压，导致容易出现各种心血管疾病[1,2]。加之早产儿的肾上腺皮质功能发育不全，常合并严重的感染，在分娩后突然体循环阻力，更容易出现血流动力学不稳定与心血管功能障碍[3,4]。心血管疾病是早产儿入住重症监护病房的重要原因，也是导致早产儿死亡的主要原因。早期对早产儿的心脏形态和功能异常进行诊断，能显著提高早产儿生存率、降低致死率[5,6]。临床上早产儿心血管疾病的诊断主要依据临床症状、呼吸频率、心率、X线等，缺乏定量分析指标[7,8]。超声具有无创、方便、重复性良好等特点，能对早产儿发育情况进行观察，能清晰显示心腔、瓣膜、血管等形态[9,10]。有研究认为超声可对早产儿的心血管血流灌注情况进行评估，也能对循环系统血流动力学进行全面监测[11]。同时早产儿胸壁薄弱，超声波可以很好的穿透，从而获得更为清晰的图像[12,13]。本文探讨与分析了早产儿超声心脏几何形态学与血流动力学的相关性，希望为临床早期监测、早期发现、早期干预早产儿心血管疾病提供参考。现总结报道如下。

1 资料与方法

1.1 研究对象

研究时间为2018年8月到2020年6月，选择在本院儿科收治的早产儿150例(早产组，胎龄≤ 30周~33+6周)和足月儿150例(足月组，胎龄36~40周)作为研究对象，纳入标准：单胎活产；新生儿家长知情同意本研究；本院伦理委员会批准了此次研究；非死亡新生儿。排除标准：染色体疾病新生儿；临床资料不全者；先天性遗传代谢疾病者；胎龄<28周或>42周者；超声采集图像质量较差者；神经系统疾病或生后有严重窒息者。

两组新生儿的性别对比差异无统计学意义(P>0.05)，早产组的出生体重、分娩方式、身长、1 min Apgar评分、心率等与足月组对比有差异(P<0.05)，见表1。

表1 两组新生儿一般资料对比

Table 1 Comparison of general information of the two groups of newborns

Groups	n	Gender (M/F)	Birth weight(g)	Mode of delivery (cesarean section / smooth delivery)	Heigh (cm)	1 min Apgar Score (score)	Heart rate (sub/min)
Premature birth	150	78/72	1652.35± 225.91*	122/28*	43.52± 5.98*	8.02± 0.15*	146.91± 12.49*
Full term group	150	76/74	2374.98± 233.98	52/98	48.28± 6.14	9.42± 0.87	133.09± 10.99

Note: *P<0.05 compared with full term group.

1.2 超声方法

采用GE ViVidE9和飞利浦EPIQ7c彩色多普勒超声诊断仪，探头频率为3.0~5.0 MHz，应用小儿心脏专用模式进行检查。患儿取平卧位，在安静状态下，同步记录超声特征并获取4~5个连续心动周期动态图像存储。

1.3 观察记录

取标准胸骨旁左室长轴切面，记录LVDd、LVDs、LAD、LVRWT、LVM、LVPWd等心脏几何形态学指标。在超声监测下，成像模式下于心尖四腔切面和心尖两腔切面，采用双平面Simpson法分别测量血流动力学相关指标，包括LVDV、LVSV、SV、LVEF、LVFS等。

1.4 统计方法

应用SPSS23.00，符合正态分布的计量资料用$\bar{x}\pm s$表示(对比为t检验)，分类资料采用n(%)表示、计数资料以百分比和率来表示(对比为x^2检验或确切概率法)，相关性分析采用Pearson相关分析与Cox比例风险回归模型，P<0.05有统计学意义。

2 结果

2.1 心脏几何形态学指标对比

早产组的LVDd、LVDs、LAD、LVPWd、LVRWT与LVM值都显著低于足月组(P<0.05)，见表2。

表2 两组心脏几何形态学指标对比($\bar{x}\pm s$)

Table 2 Comparison of cardiac geometric morphology indexes between the two groups ($\bar{x}\pm s$)

Groups	n	LVDd(mm)	LVDs(mm)	LAD(mm)	LVPWd(mm)	LVRWT(mm)	LVM(g)
Premature birth	150	11.21± 1.32*	6.19± 0.14*	5.87± 0.17*	2.30± 0.14*	0.37± 0.03*	5.52± 0.11*
Full term group	150	13.09± 1.11	7.40± 0.22	6.87± 0.22	2.65± 0.13	0.42± 0.04	6.28± 0.14

Note: *P<0.05 compared with full term group.

2.2 血流动力学指标对比

早产组的LVDV、LVSV、SV值低于足月组(P<0.05)，两组LVEF、LVFS值对比差异无统计学意义(P>0.05)，见表3。

2.3 相关性分析

在早产组中，Pearson相关性分析显示LVDd、LVDs、LAD、LVPWd、LVRWT、LVM值与LVDV、LVSV、SV值存在正相关性(P<0.05)，见表4。

2.4 影响因素分析

在120例新生儿中，以心脏几何形态学及血流动力学等特征指标-LVDd、LVDV作为因变量，以早产儿的一般资料作为自变量，Cox比例风险回归模型显示早产儿的出生体重、身长为影响LVDd、LVDV值的主要因素(P<0.05)，见表5。

表 3 两组血流动力学指标对比($\bar{x}\pm s$)

Table 3 Comparison of hemodynamic indexes between the two groups ($\bar{x}\pm s$)

Groups	n	LVDV(mL)	LVSV(mL)	SV(mL)	LVEF(%)	LVFS(%)
Premature birth	150	5.98± 0.23*	1.67± 0.32*	4.30± 0.22*	71.98± 2.11	38.88± 1.64
Full term group	150	7.65± 0.88	2.10± 0.11	5.58± 0.29	72.00± 1.47	39.00± 1.11

Note: *P<0.05 compared with full term group.

表 4 早产儿超声心脏几何形态学与血流动力学的相关性(n=150)

Table 4 Correlation between ultrasound cardiac geometry and hemodynamics in premature infants (n=150)

Index	LVDV	LVSV	SV
LVDd	0.521	0.387	0.452
LVDs	0.663	0.502	0.533
LAD	0.482	0.442	0.511
LVPWd	0.512	0.522	0.394
LVRWT	0.499	0.526	0.577
LVM	0.599	0.498	0.601

表 5 影响早产儿超声心脏几何形态学与血流动力学特征指标的多因素分析(n=150)

Table 5 Analysis of multi-factors affecting the geometric morphology and hemodynamic characteristics of premature infants (n=150)

Variable	RC	SE	Wald	OR	95% confidence interval	P
LVDd-birth weight	0.555	0.219	6.309	1.587	1.387-0.894	0.014
Height	0.742	0.356	4.503	1.476	1.240-0.945	0.034
LVDV-birth weight	0.335	0.117	8.302	1.389	1.112-1.789	0.004
Height	0.356	0.136	6.487	1.410	1.080-1.843	0.015

3 讨论

早产儿由于心脏和内分泌相关功能没有发育完善，容易受内外在因素影响，从而出现心功能损伤[12,13]。早产儿分娩后由宫内到宫外的循环呼吸发生了很大改变，主要表现为左心前负荷增加、肺血管阻力下降、体循环阻力增加[14]。并且早产儿的心肺发育不成熟，对前列素的敏感性较高，对氧的敏感性较低，延长了早产儿动脉导管关闭的时间，加重了早产儿心脏的负荷加重，诱发心血管疾病的发生[15,16]。

本研究显示早产组的 LVDd、LVDs、LAD、LVPWd、LVRWT 与 LVM 值都显著低于足月组，表明早产儿的超声心脏几何形态学与血流动力学多伴有异常状态。不过在研究中，很少对比早产儿与足月儿的超声心动图，一般都是探究不同早产周期与超声的关系，如张亚娟[17]的研究，探究应用超声心动图及新技术研究早产新生儿的心脏功能，依据胎龄分 3 组，≤29+6 周，30 周 ~33+6 周，34 周 ~36+6 周组，结果显示二维超声心动图所测 LVDd、LVDs、LAD、LVPWd 等指标，在不同胎龄组之间有统计学差异。说明超声具有早期诊断、床边动态观察、无创无射线、简单易行等特点，可反映周围血管和肺血管阻力的变化，可实时监测心功能及血流动力学情况[9]。不过单独依据临床表现不易判断早产儿心血管疾病情况，为此加强影像学诊断具有重要意义。同时心脏几何形态学与血流动力学指标很难能够全面、真实地反映心脏整体功能，比如心功能不全患儿的收缩功能与舒张功能减低在一定程度上是同时存在的[18,19]；并且部分患者舒张功能减退时会出现假性正常化现象，在临床诊断中容易导致误判而漏诊，为此建立在临床上联合检查新生儿的心脏几何形态学与血流动力学指标具有重要意义[20,21]。

近年来，随着辅助生殖技术发展和二胎政策的推广，早产儿的出生率越来越高，其中极低出生体重儿及超低出生体重儿的出生率也较前两年有增加趋势[22]。与此同时，新生儿危重症治疗技术的提高也给极低出生体重儿及超低出生体重儿带来了福音，明显提高了生存率，但此类早产儿更易发生严重并发症[23,24]。本研究显示早产组的 LVDV、LVSV、SV 值低于足月组，两组 LVEF、LVFS 值对比差异无统计学意义。与郭少青[25]的研究类似，探讨早产儿与足月儿血流动力学指标的差异及影响因素，结果显示早产儿组与足月儿组速度峰值 (velocity peak，Vpk)，校正流动时间(corrected flow time，FTc)，心脏指数(cardiac index，CI)差异均无统计学意义，早产儿组心输出量(cardiac output，CO)和每博输出量(stroke volume，SV)低于足月儿组，外周血管阻力(systemic vascularresistance，SVR)高于足月儿组。从机制上分析，早产儿生后早期处于胎内循环向正常循环的复杂过渡阶段，出生后胎盘循环阻力下降，肺尚未完全膨胀，使得肺循环阻力下降[26]。超声检查能掌握新生儿循环系统变化，特别是早产儿被疑似诊断为心功能损害时，其心脏结构、血流动力

学指标能作为参照进行判断[27]。同时新生儿胸壁薄且透声好，早期对早产儿心脏进行超声评估不仅可早期辅助筛查心脏先天性缺陷以及排除新生儿心血管疾病，而且对早产儿的预后评估均有重要价值[28,29]。

本研究 Pearson 相关性分析显示早产儿的 LVDd、LVDs、LAD、LVPWd、LVRWT、LVM 值与 LVDV、LVSV、SV 值存在正相关性；Cox 比例风险回归模型显示早产儿的出生体重、身长为影响 LVDd、LVDV 值的主要因素。从机制上分析，人们生活环境的改变与诊断水平的提高，早产儿心功能异常的发病率有明显增加的趋势。患有该疾病的早产儿抵抗力以及生长发育能力都比较差，在一定情况下会出现口唇青紫的现象，其中有 1/3 左右的危重患儿得不到及时准确诊断而延误治疗，甚至死亡[30,31]。超声具有无创、无放射损害等优势，能够全面、准确评估早产儿的心血管畸形和进行心功能判断。LVDd、LVDV 是传统的评价心脏几何形态学与血流动力学的指标，也为常用的超声参数。其不仅能进行形态学方面信息进行评估，还能对心脏功能信息进行评价。但是部分早产儿可合并周围大血管病变，超声受其透声条件、声窗等限制，容易出现漏诊情况[32]。主要机制在于 LVDd、LVDV 由早产儿的体重和身长所决定，因此上述指数会伴随早产儿体重及身长的变化而发生变化，可作为判断心脏的发育及成熟程度的重要指标[33]。目前临床还没有探究早产儿超声心脏几何形态学与血流动力学的相关性，本研究创新性的探究了二者的相关性，得出早产儿超声心脏几何形态学指标与血流动力学指标呈正相关，可以为后续早产儿的心脏的发育及成熟程度的判断提供诊断方向。不过本研究也存在一定的不足，调查的样本数量较少，且相关性分析还不够深入，将在后续研究中进行探讨。

总之，早产儿超声心脏几何形态学指标与血流动力学指标呈正相关，提示超声能准确记录和监测早产儿的心脏几何形态学与血流动力学状况，可作为评估早产儿心功能的一种可靠方法。

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