doi: 10.13241/j.cnki.pmb.2021.08.037

心脏超声在卵圆孔血流受限胎儿中的筛查分析 *

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摘要 目的：分析与探讨心脏超声在卵圆孔血流受限胎儿中的筛查价值。**方法：**2019 年 1 月 -2020 年 9 月在本院进行产前心脏超声筛查的孕妇 58 例，都给予常规超声与组织多普勒成像，记录影像学特征并判断诊断价值。**结果：**58 例胎儿判断为卵圆孔处血流受限 18 例，占比 31.0 %。受限组的卵圆孔大小、卵圆瓣长度、继发隔长度都少于未受限组(P<0.05)。受限组的 D-FOC 值低于未受限组(P<0.05)，Vm-PV、Vm-FOC 值高于未受限组(P<0.05)。受限组的左心室 E、A、E'、A' 值都低于未受限组(P<0.05)。**结论：**心脏超声作为检出胎儿心脏畸形的有效手段，可通过观察胎儿卵圆孔血流频谱与形态来鉴别诊断卵圆孔血流受限，是孕期诊断卵圆孔血流受限的最有效方法之一。

关键词：心脏超声；卵圆孔血流受限；胎儿；心脏畸形；卵圆瓣

中图分类号：R714.5；R540.45 **文献标识码：**A **文章编号：**1673-6273(2021)08-1568-04

The Screening Analysis of Cardiac Ultrasound in Foramen Ovale Blood Flow Restriction Fetus*

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ABSTRACT Objective: To analysis and explore the values of cardiac ultrasound in screening fetuses with restricted foramen blood flow. **Methods:** A total of 58 pregnant women, who underwent prenatal cardiac ultrasound screening in Northwest Women and Children's Hospital from January 2019 to September 2020, were given conventional ultrasound and tissue Doppler imaging. Their imaging characteristics were recorded and the diagnostic value was determined. **Results:** Among the 58 feti, there were 18 cases of restricted blood flow at the foramen ovale, accounting for 31.0 %. The size of the foramen ovale, the length of the oval valve, and the length of the secondary septum in the restricted group were less than those in the unrestricted group (P<0.05). The D-FOC value of the restricted group was lower than that of the unrestricted group (P<0.05), and the Vm-PV and Vm-FOC values were higher than those of the unrestricted group (P<0.05). The left ventricle E, A, E', A' values of the restricted group were lower than those of the unrestricted group (P<0.05). **Conclusion:** Cardiac ultrasound is an effective means to detect fetal heart malformations. It can be used to differentiate and diagnose foramen ovale blood flow limitation by observing the blood flow spectrum and morphology of the foramen ovale, which is one of the most effective methods to diagnose foramen ovale blood flow limitation during pregnancy.

Key words: Echocardiography; Foramen ovale blood flow limitation; Fetus; Heart malformation; Oval valve

Chinese Library Classification(CLC): R714.5; R540.45 Document code: A

Article ID: 1673-6273(2021)08-1568-04

前言

卵圆孔(foramen ovale，FO)是存在于胚胎时期房间隔中央部的左右房的交通孔，是胎儿期沟通左右心房的重要血流循环通道[1]。卵圆瓣是位于房间隔左心房侧的膜样结构，胎儿期可在左心房内自由摆动，分娩后卵圆孔闭合[2,3]。卵圆孔提前闭合是胎儿发育过程中的生理异常，它可导致胎儿心力衰竭与胎死宫内等[4]。胎儿卵圆孔处血流受限(restricted foramen ovale，RFO)为卵圆孔提前闭合的基础，但是卵圆孔血流受限胎儿目前尚无明确的诊断标准[5,6]。胎儿心脏畸形的产前诊断是当前超声领域的热点，也是其唯一首选的安全可靠的影像学检查方法[7]。超声能清晰显示胎儿心脏的细微结构与解剖结构，可并实时诊断胎儿心脏异常[8,9]。组织多普勒成像只提取来自心肌运动的多普勒频移信号，可直接观察胎儿房室瓣的运动状况，也具有重复性强、测量方法简单可靠等优点[10,11]。本文具体探讨了心脏超声在卵圆孔血流受限胎儿中的筛查价值，使得胎儿的卵圆孔血流受限能够尽早发现。现总结报道如下。

1 资料与方法

1.1 研究对象

* 基金项目：陕西省科技厅一般项目(2020SF-237)

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(收稿日期：2020-11-05 接受日期：2020-11-27)

2019 年 1 月 -2020 年 9 月在本院进行产前心脏超声筛查的孕妇 58 例，纳入标准：中晚孕胎儿超声心动图检查首次发现卵圆孔 <3 mm；医院伦理委员会批准了此次研究；孕妇孕周 20~32 w；孕妇知情同意本研究；孕妇均身体健康，无吸烟、嗜酒史；单活胎；超声图像质量良好；胎儿无其他心内及心外畸形；对胎儿心脏检查时无明显心律不齐。排除标准：孕妇具有先天性心脏病生育史及家族史；孕妇存在水肿及贫血症状；双胎妊娠者；临床资料缺乏者。

1.2 心脏超声方法

使用 GE(Voluson E8 和 Voluson 730)彩色多普勒超声诊断仪，配有 1~6 MHz 和 2~7 MHz 两探头。嘱孕妇平卧位，采用胎儿整体扫查程序除外各种心外畸形。然后选取全方位筛查胎儿心脏，由右向左依次扫查胎儿腔静脉长轴切面、主动脉弓切面及动脉导管弓切面等矢状切面。常规测量头围、腹围、肱骨、双顶径、小脑横径、股骨等指标，记录胎心率、脐动脉、大脑中动脉 PI。测量胎儿卵圆孔通道内径(D-FOC)、右上肺静脉向心血流峰值流速 (Vm-PV)、卵圆孔通道处右向左过隔血流峰值流速(Vm-FOC)，以上指标都测量 3 次取平均值。

在胎儿心脏模式下进入组织多普勒成像程序，超声束与室壁夹角 <10°，频谱扫描 100 mm/s。于心尖四腔心切面将取样容积置于二、三尖瓣尖水平，测量左心室舒张早期峰值 E、舒张晚期峰值 A，测量 3 个心动周期取平均值，计算 E'、A' 等值。当获取最清晰的横位四腔心切面时，于心室收缩末冻结图像，记录卵圆孔大小(D1)、卵圆瓣长度(L)、继发隔长度(A)等指标。

1.3 胎儿卵圆孔处血流受限判定

胎儿卵圆孔处血流受限判定：卵圆孔直径 <3 mm，卵圆孔处血流速度 >120 cm/s[12]。

根据胎儿卵圆孔处血流受限情况分为受限组和未受限组。

1.4 统计方法

采用 SPSS 19.00，计量数据以 $\bar{x}\pm s$ 表示，对比为 t 检验，计数数据以%表示，对比为卡方分析，P<0.05 有显著性意义。

2 结果

2.1 卵圆孔处血流受限情况

58 例胎儿判断为卵圆孔处血流受限 18 例，占比 31.0 %。受限组的孕妇年龄、孕周、估测体重、脐动脉 PI、大脑中动脉 PI 等与未受限组对比无差异(P>0.05)，见表 1。

表 1 两组一般资料对比

Table 1 Comparison of general data between two groups

Groups	n	Age (years)	Week of pregnancy (weeks)	Fetal Weight (g)	PI of umbilical artery	PI of middle cerebral artery
Limited group	18	28.13± 1.48	27.33± 1.47	2874.52± 356.98	1.09± 0.14	1.60± 0.14
Unlimited group	40	28.44± 1.67	27.87± 1.22	2887.90± 400.71	1.11± 0.17	1.61± 0.17

2.2 卵圆孔形态参数对比

受限组的卵圆孔大小、卵圆瓣长度、继发隔长度都少于未受限组(P<0.05)，见表 2。

表 2 两组卵圆孔形态参数对比(mm，$\bar{x}\pm s$)

Table 2 Comparison of morphological parameters of foramen ovale between two groups (mm, $\bar{x}\pm s$)

Group	n	Ovary size	Ovary size	Length of secondary septum
Limited group	18	5.20± 0.08	8.11± 0.37	4.08± 0.28
Unlimited group	40	6.28± 0.13*	9.38± 0.46*	5.08± 0.33*

Note: Compared with the limited group, *P<0.05.

2.3 卵圆孔血流参数对比

受限组的 D-FOC 值低于未受限组(P<0.05)，Vm-PV、Vm-FOC 值高于未受限组(P<0.05)，见表 3。

表 3 两组卵圆孔血流参数对比($\bar{x}\pm s$)

Table 3 Comparison of blood flow parameters of foramen ovale between two groups ($\bar{x}\pm s$)

Groups	n	D-FOC(mm)	Vm-PV(cm/s)	Vm-FOC(cm/s)
Limited group	18	2.48± 0.32	53.87± 9.83	39.87± 3.42
Unlimited group	40	5.12± 0.44*	33.10± 4.87*	29.76± 4.40*

Note: Compared with the limited group, *P<0.05.

2.4 组织多普勒成像参数对比

受限组的左心室 E、A、E'、A' 值都低于未受限组(P<0.05)，见表 4。

3 讨论

胎儿心功能存在静脉导管、卵圆孔、动脉导管，右室的输出

量比左室高[13]。右室血液主要供应机体下半部分及胎盘循环；左室血液主要供应冠脉循环及身体上半部分[14,15]。在正常胎儿中，脐动脉血流呈高速低阻状态，大脑中动脉血流阻力高于脐动脉阻力，胎盘脐动脉血流呈高速低阻状态，保障胎儿与胎盘之间养分的交换[16]。但是在卵圆孔血流受限胎儿中，由于缺氧，胎儿常出现脑保护效应，使得供应胎盘的血液绝对量及相对量呈现减少状态[17,18]。

表 4 两组组织多普勒成像参数对比(cm/s，$\bar{x}\pm s$)

Table 4 Comparison of Doppler imaging parameters between two groups (cm/s, $\bar{x}\pm s$)

Groups	n	E	A	E'	A'
Limited group	18	35.20± 4.10	52.84± 5.09	3.67± 0.32	6.65± 0.81
Unlimited group	40	38.76± 3.44*	55.68± 4.15*	6.09± 0.87*	9.91± 0.76*

Note: Compared with the limited group, *P<0.05.

来自下腔静脉的高含氧量血液约 80 %经卵圆孔进入左房，卵圆孔作为胎儿时期特有的解剖结构，是胎儿血液循环的重要通道[19]。卵圆孔提前闭合后，致使右心血流增加，右心负荷加重，导致上、下腔回流的血全部进入右房、右室，使得胎儿出现水肿，严重者胎死宫内[20,21]。本研究显示 58 例胎儿判断为卵圆孔处血流受限 18 例，占比 31.0 %；受限组的卵圆孔大小、卵圆瓣长度、继发隔长度都少于未受限组。不过当前卵圆孔处血流受限的具体发生机制还不明确，较轻的卵圆孔血流受限并不导致胎儿严重的血流动力学改变；较重的卵圆孔血流受限可严重会严重威胁胎儿的生命，需要及时选择剖宫产进行处理[22,23]。

卵圆孔邻近下腔静脉入口，位于房间隔中下部，主要收集来自静脉导管和肝左静脉的氧饱和度高的血液[24]。胎儿期卵圆孔的开放有利于左心发育，胎儿期卵圆孔处的分流是维持左右心血流动力学平衡的关键[25]。超声医师若不能诊断卵圆孔处相关病变，将不利于胎儿的发育。本研究显示受限组的 D-FOC 值低于未受限组，Vm-PV、Vm-FOC 值高于未受限组。从机制上分析，卵圆瓣开放受限与卵圆孔孔径小是引起卵圆孔处血流受限的重要原因，可导致左右心房压力不平衡，从而导致卵圆孔、卵圆瓣发育不良[26]。当前也有学者采用心脏超声分析肺静脉血流频谱评价左心房压力， 若肺心房收缩期出现高速逆向频谱，则卵圆孔处血流受限程度较轻；若舒张期静脉样频谱消失，则卵圆孔处血流受限程度较重[27]。不过当卵圆瓣发育不良，如卵圆瓣活动度下降时，常规超声征象存在回声失落的现象，无法清晰观察左心房血流状态，使得诊断效果不佳[28,29]。

传统多普勒超声通过瓣口血流速度来评价心脏功能，容易受被检查者特征与超声设备的影响。组织多普勒成像通过低频滤波器保留了心脏结构的低速高振幅运动信号，可直接观察房室环的运动，去除了心腔内血流产生的高速、低振幅的频移信号，从而能对胎儿心功能进行直接评估[30]。本研究显示受限组的左心室 E、A、E'、A' 值都低于未受限组。从机制上分析，上述指标都可反映心室舒张功能与血流速度状态。卵圆孔血流受限多为继发孔狭窄，常发生于晚孕期，从而导致心室舒张功能与血流速度受限[31]。当卵圆孔通道血流受限时，左房处于低压，可出现肺静脉向心流速增高[32]。本研究也存在一定的不足，筛查胎儿的数量比较少，同时当前对于卵圆孔血流受限无一个明确的诊断标准，将在后续研究中进行分析。

总之，心脏超声作为检出胎儿心脏畸形的有效手段，可通过观察胎儿卵圆孔血流频谱与形态来鉴别诊断卵圆孔血流受限，是孕期诊断卵圆孔血流受限的最有效方法之一。

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