

ISUOG 胎儿心脏超声检查指南(修订版)

ISUOG

湖北省妇幼保健院 赵胜 翻译

临床标准委员会

国际妇产超声协会(ISUOG)是一家致力于促进妇产科影像安全应用及高质教育的科学机构。ISUOG 临床标准委员会(CSC)专职负责起草影像诊断的临床应用指南,发表 ISUOG 认定当前最优秀的操作指南。尽管 ISUOG 尽最大努力确保指南发表时是准确的,但是 ISUOG 及其雇员不为该指南的任何错误或误导数据负责。CSC 并非要确立一个法律标准,任何个人及组织都可以在 ISUOG 许可下自由发表临床操作指南。(info@isuog.org)

1 简介

本文件包括过去 ISUOG 发表过的中孕期胎儿心脏超声检查指南^[1]的修订版及当前产前诊断先天性心脏病(CHD)的最新知识。参考循证医学的结果及其他指南,这个新的指南将心脏流出道切面增加到原来仅有四腔心切面的常规筛查内容之中^[2-5]。

先天性心脏病是导致儿童死亡的首要原因,发生率约为 4%~13%^[6-8]。1950~1994 年期间,约 42%报告至 WHO 的儿童死亡病例是由于心脏畸形导致的^[9]。结构性心脏异常也是产前超声诊断中最容易漏诊的畸形之一^[10,11]。虽然产前诊断出先天性心脏病可以改善部分心脏畸形的预后^[12-16],但是不同机构的产前诊出率差异很大^[17]。这些差异部分是由于检查者经验、孕妇肥胖、探头频率、腹部瘢痕、孕周、羊水量以及胎位不同所造成的^[18,19]。医学继续教育以及经常与胎儿心脏超声专家交流则有助于提高诊断水平^[8,20]。例如,英国北部一所医疗机构在经历了 2 年系统培训后,主要心脏畸形检出率提高了一倍^[21]。

胎儿心脏超声检查的目的是在中孕期最大限度地发现胎儿心脏畸形^[22]。这个指南可用于低危人群中

并为产前咨询、产科处理及多中心合作治疗提供临床资料。如果怀疑心脏畸形,应该进行系统的胎儿心脏超声检查^[26]。

2 检查前准备

尽管四腔心切面和流出道切面已经广为人知,检查者仍应知道影响检查准确性的主要因素^[27-29]。通过以下方法可以明显提高检出率:认识到四腔心切面不仅仅是计数心腔的数目,了解到部分先天性心脏病在晚孕期才能被发现,知道部分特殊类型的先天性心脏病(如大动脉转位、主动脉缩窄)四腔心切面是正常的。四腔心切面加上流出道切面是改善先天性心脏病检出率的重要方法。

3 孕周

胎儿心脏检查的最佳时间是孕 18~22 周,部分心脏结构需要到孕 22 周以后才能清晰显示。部分心脏畸形可能在早孕晚期或中孕早期被发现,特别是同期已发现颈项透明层增厚^[30-35]。尽管多数孕妇要求尽早知道胎儿是否患有先天性心脏病,但是通常在孕 20~22 周才能诊断先天性心脏病,此后无须再复查^[36]。

4 技术因素

4.1 超声探头 高频探头可以提高分辨率,但是会减低穿透力。在了解分辨率与探测深度的相关关系后,尽量选择高频率的探头。谐波可以改善图像,特别是晚孕期腹壁厚度的孕妇^[37]。

4.2 图像参数 二维图像始终是胎儿心脏检查的基础。应注意调整仪器设置保证高帧频、高对比度、高分辨率,调低叠加,只用一个焦点,尽量采用小视野成像。

4.3 放大及视频回放 应尽量放大图像,使心脏占

据整个图像的 1/3~1/2。使用视频回放功能实时显示正常心脏结构,确认整个心动周期中瓣膜的运动是否正常。图像放大和视频回放有助于识别心脏畸形。

5 心脏检查

根据近期文献报道的结果,流出道切面已被加入到胎儿心脏超声检查范畴之内^[38-46]。

5.1 四腔心切面 四腔心切面不仅仅是计数胎儿心腔的数目,表 1 及图 1、2 包含了四腔心需要观察的主要内容。首先应该确定胎儿的左右方位,从而判断心脏的位置是否正常,胃泡和心脏是否均位于左侧。正常心脏大小不超过胸腔横断面积的 1/3。心脏周围有时可见窄的环形低回声区,容易被误认为是心包积液^[47,48]。

心脏主要位于左侧胸腔,心轴 $45^{\circ} \pm 20^{\circ}$ ^[49](图 1)。即使四腔心显示不满意,也应该重点观察心轴及心脏位置^[50]。发现心脏或胃泡不在左侧时,应怀疑内脏位置异常。心轴异常时心脏畸形的风险增高,特别是流出道畸形,并与染色体异常有关。膈疝、胸腔占位病变如肺囊腺瘤样畸形常常导致心脏位置异常,肺发育不良或肺缺如也可引起心脏位置异常。心轴左偏也可能是由于腹裂或脐膨出造成的。

表 1 胎儿内脏位置关系及四腔心切面观察内容

内脏位置和大体观	
胎儿左右方位	
胃泡和心脏位于左侧	
心脏占据胸腔 1/3	
心脏大部分位于左侧胸腔	
心轴约 $45^{\circ} \pm 20^{\circ}$	
四个腔室	
心律规则	
无心包积液	
心房	
两个心房,大小相近	
卵圆孔瓣飘向左房	
房间隔原发隔可显示	
肺静脉回流到左房	
心室	
两个心室,大小相近	
无心肌肥厚	
右室心尖部可见节制索	
室间隔完整(从心尖至十字交叉处)	
房室连接及瓣膜	
十字交叉可显示	
两个房室瓣回声纤细,启闭正常	
三尖瓣隔瓣附着点较二尖瓣更接近心尖	

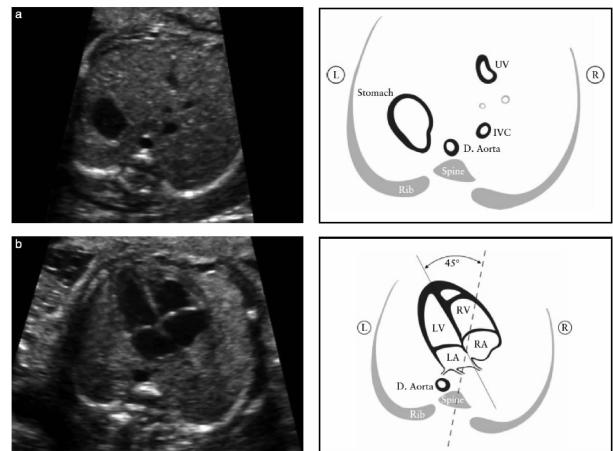


图 1 心脏切面, a. 胎儿腹部横切面确定内脏位置关系,确定胎儿左右方位后,胃泡及降主动脉应位于左侧,下腔静脉位于右侧。脐静脉可显示。 b. 心脏位置和心轴:心脏大部分位于左侧,心轴 $45^{\circ} \pm 20^{\circ}$ 。 LA:左房;LV:左室;RA:右房;RV:右室

正常心率为 120~160 次/分。正常中孕期胎儿可出现暂时性轻微心动过缓。持续性心动过缓,特别是心率低于 110 次/分,需要动态观察排除房室传导阻滞^[51]。胎儿缺氧可引起晚孕期重复出现的胎儿心率减慢。偶然出现的早搏通常与结构性先天性心脏病无关,属于良性表现并可自发缓解。然而,部分病例可发展成有临床意义的心律失常,需要进行系统胎儿超声心动图检查^[52-54]。轻度心动过速(>160 次/分)可能是由于胎动引起的。持续性心动过速(>180 次/分)则需要进一步检查排除胎儿缺氧或严重的心律失常^[55]。

左右心房大小相近,卵圆孔瓣朝左房开放。应显示房间隔下部及原发隔。心脏十字交叉结构由房间隔下部、室间隔上部、左右房室瓣构成。可见肺静脉回流到左心房,至少应显示两支肺静脉。

右室心尖部可显示节制索,是判断形态学右室的标准。左室心尖部光滑,构成心尖大部分。左右心室大小一致,无心肌肥厚。晚孕期可出现轻度心室大小不对称,如果出现重度心室大小不对称,应进行系统胎儿心脏超声检查^[56],排除左心梗阻病变如主动脉缩窄、左心发育不良综合征等^[57,58]。

从心尖部至十字交叉处详细检查室间隔,排除室间隔缺损,检查时最好使声束与室间隔垂直。当声束与室间隔平行时,有可能出现回声失落导致的

室间隔缺损假象。受仪器分辨率、胎儿大小及胎位的影响,小的室间隔缺损(1~2mm)常常很难检出。但是,这种小的室缺临床意义有限,常在宫内自行愈合^[59,60]。

左侧二尖瓣、右侧三尖瓣回声纤细,启闭正常。三尖瓣隔瓣附着点较二尖瓣附着点更靠近心尖部。房室瓣关系异常常常提示心脏异常如心内膜垫缺损。

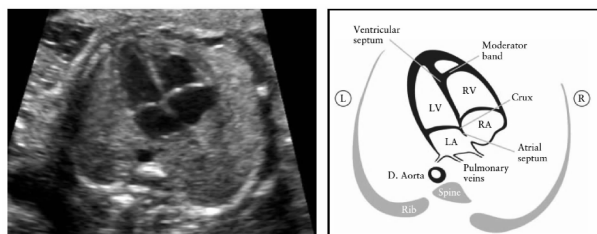


图2 四腔心切面,正常中孕期胎儿心脏不超过胸腔1/3,左右心大小及心肌厚度相近,卵圆孔瓣飘向左房,十字交叉结构可见。通过识别节制索和三尖瓣隔瓣附着点可以确定形态学右心室。D. Aorta; 降主动脉; L: 左; LA:左房; LV:左室; R:右; RA:右房

5.2 流出道切面 左右室流出道切面已被加入到胎儿心脏超声检查规范之中。大动脉与心室的连接关系、两条大动脉的大小和位置关系、半月瓣的开放都是观察重点。如果不能确定正常关系,应建议做系统胎儿心脏超声检查。

两条大动脉应该大小相近,它们与心室相连的部位呈交叉关系。一项针对 18000 名胎儿的产科研究^[61],在四腔心切面基础上增加流出道切面,纳入到 30 分钟的检查之内。多数检查(93%)满意地显示了四腔心和流出道。4.2%未显示左室流出道,1.6%未显示右室流出道,1.3%未显示左室流出道及右室流出道。

流出道切面还包括三血管切面及三血管-气管切面。一项包括 3000 位低危孕妇的研究将三血管切面和三血管-气管切面加入到常规筛查之中,平均约 2 分钟(135s;SD,20s)可获得上述切面。但是也有 1/3 的胎儿因为脊柱在前方而推迟 15-20 分钟再继续检查^[46]。

观察流出道切面可增加主要心脏畸形的检出率^[20,40,42,62,63]。四腔心切面加流出道切面后能识别圆锥动脉干异常如法洛四联症、大动脉转位、右室双

出口以及永存动脉干^[43-46,64-69]。

5.2.1 超声技术 从胎儿腹围横切面向头侧移动可依次显示左室流出道、右室流出道、三血管以及三血管气管切面^[70],多数情况下容易获得上述切面(图3)。

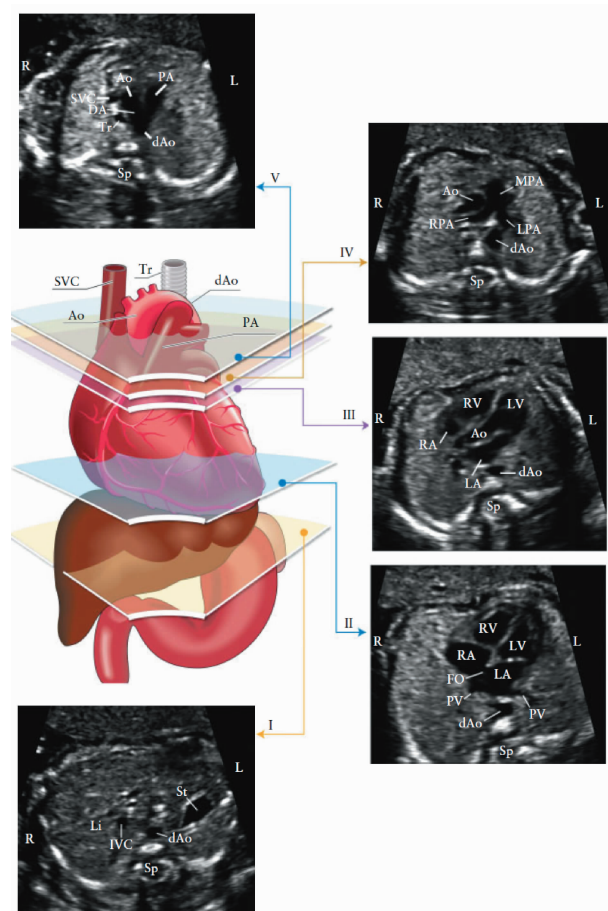


图3 胎儿心脏超声检查的五个重要切面,彩图显示气管(Tr)、心脏和大动脉、肝脏和胃泡,以及五个切面的具体方位。I. 最足侧的平面,显示胎儿胃泡(St)、降主动脉(dAo)、脊柱(Sp)和肝脏(Li);II. 四腔心切面,显示右、左心室(RV, LV)、心房(RA, LA)、卵圆孔(FO)和肺静脉(PV);III. 左室流出道切面,显示主动脉根部(Ao)、LV、RV、LA 和 RA;IV. 稍向头侧偏斜获得右室流出道切面,显示主肺动脉(MPA)及左肺动脉(LPA)、右肺动脉(RPA);V. 三血管和气管切面,显示上腔静脉(SVC)、肺动脉(PA)、动脉导管(DA)、主动脉横弓和气管(Tr)。IVC:下腔静脉

获得四腔心切面后,向头侧偏斜探头可获得左右室流出道切面(图4),显示主动脉与肺动脉的交叉关系。肺动脉分叉可显示。另外,也可采用其他方式。获得四腔心切面后,将探头旋转朝向胎儿右肩部,当声束与室间隔垂直时容易显示左室流出道

及主动脉与室间隔的连续关系,这个切面也可显示整个升主动脉。获得左室流出道切面后,探头继续向头侧倾斜可获得右室流出道切面。

继续向头侧倾斜可获得三血管和三血管气管切面,显示主动脉、肺动脉和上腔静脉,主动脉弓和动脉导管弓也可显示^[64-67]。

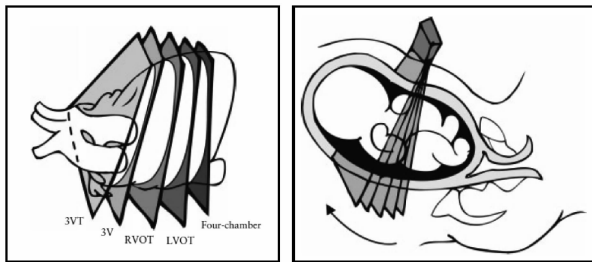


图4 四腔心切面,向头侧偏斜依次获得左室流出道(LVOT),右室流出道(RVOT),三血管(3V)和三血管气管(3VT)切面

5.2.2 左室流出道切面 左室流出道切面确定主动脉与左心室相连(图5),主动脉前壁和室间隔存在延续关系。主动脉瓣纤细。可追踪主动脉至主动脉弓及其头臂分支。主动脉弓切面并不包含在胎儿心脏检查切面之内。左室流出道切面可帮助发现流出道型室间隔缺损以及圆锥动脉干异常,通常这些异常的四腔心切面正常。

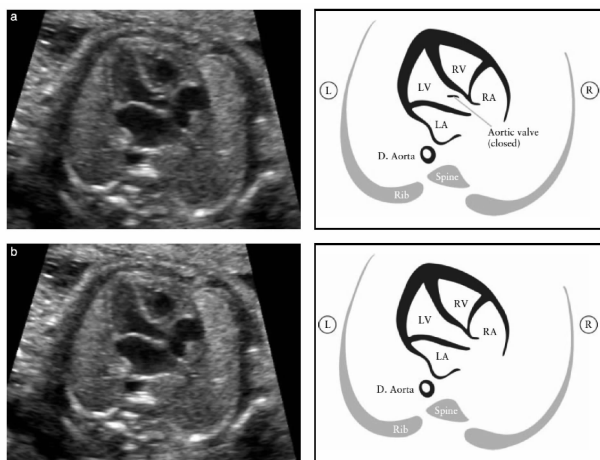


图5 左室流出道(LVOT)切面,显示左室(LV)与主动脉相连,注意观察室间隔与主动脉前壁的连续关系,主动脉瓣纤细,开放(a)及关闭(b)。D. Aorta:降主动脉;L:左;LA:左房;LV:左室;R:右;RA:右房

5.2.3 右室流出道切面 右室流出道显示右室与肺动脉相连(图6),肺动脉位于升主动脉的左后方。

胎儿期肺动脉较主动脉稍宽,与主动脉呈交叉关系。上腔静脉位于主动脉右侧。这个切面与三血管切面相似^[64]。

肺动脉瓣纤细,肺动脉发出后立即分出左右肺动脉,先发出右肺动脉然后发出左肺动脉。由于胎位影响,有时难以获得这个切面。肺动脉向左侧延续为动脉导管,与降主动脉相连。

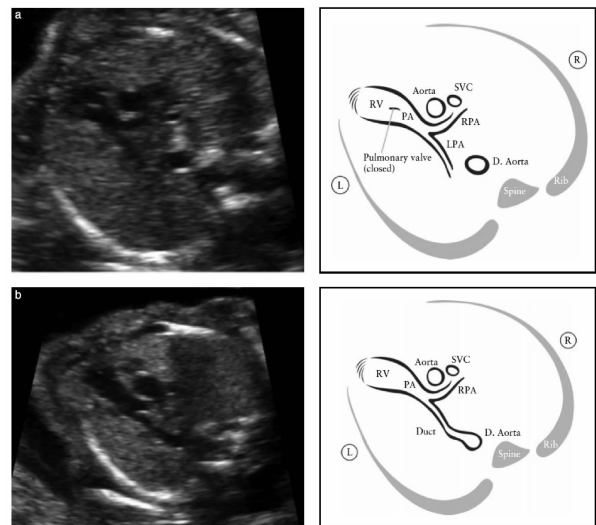


图6 右室流出道切面,显示肺动脉(PA)与右室(RV)相连。肺动脉与主动脉呈交叉关系,肺动脉瓣纤细。(a)显示肺动脉及其分叉,肺动脉瓣关闭;(b)显示右肺动脉及动脉导管。D. Aorta:降主动脉;L:左;LPA:左肺动脉;R:右;SVC:上腔静脉

5.2.4 三血管及三血管气管切面 尽管有时难以获得三血管及三血管气管切面,它们仍应被加入到常规胎儿心脏检查之中。Yoo等^[64]曾经详细描述过三血管切面(图7)。从左至右依次为肺动脉、主动脉和上腔静脉;肺动脉最靠前,下腔静脉最靠后;肺动脉、主动脉、下腔静脉内径依次变小。部分心脏畸形如完全性大动脉转位、法洛四联症、肺动脉闭锁合并完整室间隔,四腔心切面正常,但是三血管切面异常。Yagel等^[67]随后增加了三血管气管切面,较三血管切面更靠近头侧,可显示主动脉弓与气管的位置关系,气管显示为环状无回声区周边围绕强回声。动脉导管和主动脉弓位于气管左侧呈“V”型汇入降主动脉(图8)。主动脉弓较动脉导管弓更靠近头侧。三血管气管切面可帮助发现主动脉缩窄、右位主动脉弓、双主动脉弓及血管环。

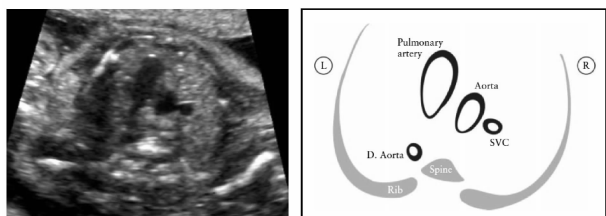


图 7

注:三血管切面,显示肺动脉、主动脉及上腔静脉(SVC)。应确定三个血管的正常位置关系及内径比例关系。肺动脉位于左侧,内径最大最靠前;上腔静脉最小最靠后。D. Aorta:降主动脉

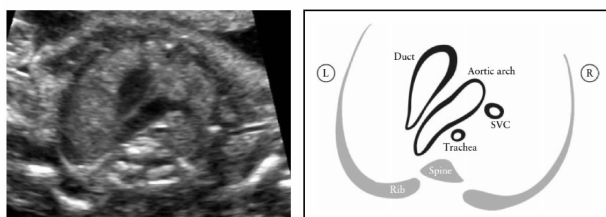


图 8

注:三血管气管切面,显示主动脉弓与气管的位置关系,主动脉弓与动脉导管弓均位于气管左侧,呈“V”形

6 彩色多普勒血流显像

尽管本指南不包含彩色多普勒,但是我们鼓励熟悉并使用彩色多普勒^[71]。彩色多普勒血流显像是胎儿超声心动图的组成部分,它的诊断作用不应被低估。如果检查者熟悉,也可在胎儿心脏超声检查中使用。彩色多普勒血流显像有助于识别心脏结构异常,显示异常血流信号。在肥胖的孕妇及低危人群中使用,可以提高诊出率^[46,73]。

调节彩色多普勒设置包括缩小感兴趣区,提高帧频,降低彩色叠加,合适的增益以显示经过瓣膜和血管的血流。

胎儿超声心动图

一旦怀疑先天性心脏病,应进行胎儿超声心动图检查。胎儿超声心动图的检查内容曾被发表过^[26],但不在本指南之内。相当一部分先天性心脏病胎儿并未合并高危因素或心外畸形^[63],因此胎儿心脏超声检查非常重要。应注意掌握胎儿心脏检查的适应征^[74],例如,孕 11~14 周颈项透明层增厚是胎儿心脏检查的适应征,即使随后颈项透明层厚度

降低到正常范围内^[75-78]。

胎儿超声心动图检查应由熟悉产前诊断先天性心脏病的专业人员进行,内容包含内脏位置关系、体静脉及肺静脉回流、卵圆孔瓣活动方向、房室连接、心室大动脉连接、大动脉位置关系和主动脉弓、动脉导管弓。

其他超声技术也可用于研究胎儿心脏。如通过血流速度识别通过瓣膜和心腔的异常血流;M 型超声分析心脏节律、心室功能和心肌厚度;组织多普勒和容积成像也可用于胎儿心脏解剖及功能的分析。4D 胎儿超声心动图在诊断复杂先天性心脏病如圆锥动脉干异常、主动脉弓异常、肺静脉回流异常中特别有帮助^[79-81]。此外,斑点追踪技术也开始应用于评价胎儿心脏功能。

指南起草人员

J. S. Carvalho, Royal Brompton Hospital, London, UK; Fetal Medicine Unit, St George's Hospital & St George's University of London, London, UK

L. D. Allan, Harris Birthright Research Centre for Fetal Medicine, King's College Hospital, London, UK

R. Chaoui, Center for Prenatal Diagnosis and Human Genetics, Friedrichstrasse 147, Berlin, Germany

J. A. Copel, Obstetrics, Gynecology and Reproductive Sciences, Yale University School of Medicine, New Haven, CT, USA

G. R. DeVore, Fetal Diagnostic Center, South Fair Oaks Ave, Pasadena, CA, USA; Department of Obstetrics and Gynecology, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

K. Hecher, Department of Obstetrics and Fetal Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

W. Lee, Texas Children's Pavilion for Women, Department of Obstetrics and Gynecology, Baylor College of Medicine, Houston, TX, USA

H. Munoz, Fetal Medicine Unit, Obstetric & Gynecology Department, University of Chile, Santiago, Chile; Clinica las Condes, Santiago, Chile

D. Paladini, Fetal Medicine and Cardiology Unit, Department of Obstetrics and Gynecology, University Federico II of Naples, Naples, Italy

B. Tutschek, Center for Fetal Medicine and Gynecological Ultrasound, Basel, Switzerland; Medical Faculty, Heinrich Heine University, Düsseldorf, Germany

S. Yagel, Division of Obstetrics and Gynecology, Hadassah-Hebrew University Medical Centers, Jerusalem, Israel

参 考 文 献

- [1] Cardiac screening examination of the fetus: guidelines for performing the 'basic' and 'extended basic' cardiac scan[J]. *Ultrasound Obstet Gynecol*, 2006, 27: 107-113.
- [2] Antenatal care: routine care for the healthy pregnant woman. <http://www.nice.org.uk/CG062> [Accessed 23 October 2011].
- [3] 18+0 to 20+6 weeks fetal anomaly scan-National standards and guidance for England 2010. <http://fetalanomaly.screening.nhs.uk/standardsandpolicies2010> [Accessed 26 November 2011].
- [4] Ultrasound Screening: Supplement to Ultrasound Screening for Fetal Abnormalities. <http://www.rcog.org.uk/print/womenshealth/clinical-guidance/ultrasound-screening> RCOG2011 [Accessed 27 November 2011].
- [5] Israel Society of Ultrasound in Obstetrics and Gynecology. <http://www.isuog.org.il/main/siteNew/?page=8&action=sidLink&stld=301> [Accessed 6 February 2012].
- [6] Ferencz C, Rubin JD, McCarter RJ, et al. Congenital heart disease: prevalence at livebirth. The Baltimore-Washington Infant Study[J]. *Am J Epidemiol*, 1985, 121: 31-36.
- [7] Meberg A, Otterstad JE, Froland G, et al. Outcome of congenital heart defects—a population-based study[J]. *Acta Paediatr*, 2000, 89: 1344-1351.
- [8] Cuneo BF, Curran LF, Davis N, et al. Trends in prenatal diagnosis of critical cardiac defects in an integrated obstetric and pediatric cardiac imaging center[J]. *J Perinatol*, 2004, 24: 674-678.
- [9] Rosano A, Botto LD, Botting B, et al. Infant mortality and congenital anomalies from 1950 to 1994: an international perspective[J]. *J Epidemiol Community Health*, 2000; 54: 660-666.
- [10] Crane JP, LeFevre ML, Winborn RC, et al. A randomized trial of prenatal ultrasonographic screening: impact on the detection, management, and outcome of anomalous fetuses. The RADIUS Study Group[J]. *Am J Obstet Gynecol*, 1994, 171: 392-399.
- [11] Abu-Harb M, Hey E, Wren C. Death in infancy from unrecognized congenital heart disease[J]. *Arch Dis Child*, 1994, 71: 3-7.
- [12] Bonnet D, Coltri A, Butera G, et al. Detection of transposition of the great arteries in fetuses reduces neonatal morbidity and mortality[J]. *Circulation*, 1999, 99: 916-918.
- [13] Tworetzky W, McElhinney DB, Reddy VM, et al. Improved surgical outcome after fetal diagnosis of hypoplastic left heart syndrome[J]. *Circulation*, 2001, 103: 1269-1273.
- [14] Andrews R, Tulloh R, Sharland G, et al. Outcome of staged reconstructive surgery for hypoplastic left heart syndrome following antenatal diagnosis[J]. *Arch Dis Child*, 2001, 85: 474-477.
- [15] Franklin O, Burch M, Manning N, Sleeman K, et al. Prenatal diagnosis of coarctation of the aorta improves survival and reduces morbidity[J]. *Heart*, 2002, 87: 67-69.
- [16] Tworetzky W, Wilkins-Haug L, Jennings RW, et al. Balloon dilation of severe aortic stenosis in the fetus: potential for prevention of hypoplastic left heart syndrome: candidate selection, technique, and results of successful intervention[J]. *Circulation*, 2004, 110: 2125-2131.
- [17] Simpson LL. Screening for congenital heart disease[J]. *Obstet Gynecol Clin North Am*, 2004, 31: 51-59.
- [18] DeVore GR, Medearis AL, Bear MB, et al. Fetal echocardiography: factors that influence imaging of the fetal heart during the second trimester of pregnancy[J]. *J Ultrasound Med*, 1993, 12: 659-663.
- [19] Sharland GK, Allan LD. Screening for congenital heart disease prenatally. Results of a 2 1/2-year study in the South East Thames Region[J]. *Br J Obstet Gynaecol*, 1992, 99: 220-225.
- [20] Carvalho JS, Mavrides E, Shinebourne EA, et al. Improving the effectiveness of routine prenatal screening for major congenital heart defects[J]. *Heart*, 2002, 88: 387-391.

- [21] Hunter S, Heads A, Wyllie J, et al. Prenatal diagnosis of congenital heart disease in the northern region of England: benefits of a training programme for obstetric ultrasonographers[J]. *Heart*, 2000, 84: 294-298.
- [22] Lee W. Performance of the basic fetal cardiac ultrasound examination[J]. *J Ultrasound Med*, 1998, 17: 601-607.
- [23] AIUM. AIUM Practice Guideline for the performance of an antepartum obstetric ultrasound examination[J]. *J Ultrasound Med*, 2003, 22: 1116-1125.
- [24] ACR Practice Guideline for the performance of antepartum obstetrical ultrasound[J]. *Am Coll Radiol*, 2003: 689-695.
- [25] ACOG Practice Bulletin No. 58. Ultrasonography in pregnancy[J]. *Obstet Gynecol*, 2004, 104: 1449-1458.
- [26] Lee W, Allan L, Carvalho JS, et al. ISUOG consensus statement: what constitutes a fetal echocardiogram? [J]. *Ultrasound Obstet Gynecol*, 2008, 32: 239-242.
- [27] Tegnander E, Eik-Nes SH, Johansen OJ, et al. Prenatal detection of heart defects at the routine fetal examination at 18 weeks in a non-selected population[J]. *Ultrasound Obstet Gynecol*, 1995, 5: 372-380.
- [28] Chaoui R. The four-chamber view: four reasons why it seems to fail in screening for cardiac abnormalities and suggestions to improve detection rate[J]. *Ultrasound Obstet Gynecol*, 2003, 22: 3-10.
- [29] Tegnander E, Eik-Nes SH, Linker DT. Incorporating the fourchamber view of the fetal heart into the second-trimester routine fetal examination[J]. *Ultrasound Obstet Gynecol*, 1994, 4: 24-28.
- [30] Achiron R, Rotstein Z, Lipitz S, et al. Firsttrimester diagnosis of fetal congenital heart disease by transvaginal ultrasonography[J]. *Obstet Gynecol*, 1994, 84: 69-72.
- [31] Yagel S, Weissman A, Rotstein Z, et al. Congenital heart defects: natural course and in utero development[J]. *Circulation*, 1997, 96: 550-555.
- [32] Rustico MA, Benettoni A, D'Ottavio G, et al. Early screening for fetal cardiac anomalies by transvaginal echocardiography in an unselected population: the role of operator experience[J]. *Ultrasound Obstet Gynecol*, 2000, 16: 614-619.
- [33] Carvalho JS. Fetal heart scanning in the first trimester. *Prenat Diagn* 2004; 24: 1060-1067.
- [34] Carvalho JS, Moscoso G, Tekay A, et al. Clinical impact of first and early second trimester fetal echocardiography on high risk pregnancies[J]. *Heart*, 2004, 90: 921-926.
- [35] Huggon IC, Ghi T, Cook AC, et al. Fetal cardiac abnormalities identified prior to 14weeks' gestation[J]. *Ultrasound Obstet Gynecol*, 2002, 20: 22-29.
- [36] Schwarzler P, Senat MV, Holden D, et al. Feasibility of the second-trimester fetal ultrasound examination in an unselected population at 18, 20 or 22 weeks of pregnancy: a randomized trial[J]. *Ultrasound Obstet Gynecol*, 1999, 14: 92-97.
- [37] Paladini D, Vassallo M, Tartaglione A, et al. The role of tissue harmonic imaging in fetal echocardiography[J]. *Ultrasound Obstet Gynecol*, 2004, 23: 159-164.
- [38] Allan LD, Crawford DC, Chita SK, et al. Prenatal screening for congenital heart disease[J]. *Br Med J (Clin Res Ed)*, 1986, 292: 1717-1719.
- [39] Copel JA, Pilu G, Green J, et al. Fetal echocardiographic screening for congenital heart disease: the importance of the four-chamber view[J]. *Am J Obstet Gynecol*, 1987, 157: 648-655.
- [40] Kirk JS, Riggs TW, Comstock CH, et al. Prenatal screening for cardiac anomalies: the value of routine addition of the aortic root to the four-chamber view[J]. *Obstet Gynecol*, 1994, 84: 427-431.
- [41] DeVore GR. The aortic and pulmonary outflow tract screening examination in the human fetus[J]. *J Ultrasound Med*, 1992, 11: 345-348.
- [42] Achiron R, Glaser J, Gelernter I, et al. Extended fetal echocardiographic examination for detecting cardiac malformations in low risk pregnancies[J]. *BMJ*, 1992, 304: 671-674.
- [43] Achiron R, Rotstein Z, Heggsh J, et al. Anomalies of the fetal aortic arch: a novel sonographic approach to in-utero diagnosis[J]. *Ultrasound Obstet Gynecol*, 2002, 20: 553-557.
- [44] Yoo SJ, Min JY, Lee YH, et al. Fetal sonographic diagnosis of aortic arch anomalies [J]. *Ultrasound Obstet Gynecol*, 2003, 22: 535-546.
- [45] Barboza JM, Dajani NK, Glenn LG, et al. Prenatal diagnosis of congenital cardiac anomalies: a practical approach using two basic views[J]. *Radiographics*, 2002, 22: 1125-1137; discussion 1137-1138.
- [46] Del Bianco A, Russo S, Lacerenza N, et al. Four chamber view plus three-vessel and trachea view for a complete evaluation of the fetal heart during the second trimester[J]. *J PerinatMed*, 2006, 34: 309-312.
- [47] Di Salvo DN, Brown DL, Doubilet PM, et al. Clinical significance of isolated fetal pericardial effusion[J]. *J Ultrasound Med*, 1994, 13: 291-293.
- [48] Yoo SJ, Min JY, Lee YH. Normal pericardial fluid in the fe-

- tus; color and spectral Doppler analysis[J]. *Ultrasound Obstet Gynecol*, 2001, 18: 248-252.
- [49] Comstock CH. Normal fetal heart axis and position[J]. *Obstet Gynecol*, 1987, 70: 255-259.
- [50] Smith RS, Comstock CH, Kirk JS, et al. Ultrasonographic left cardiac axis deviation: a marker for fetal anomalies[J]. *Obstet Gynecol*, 1995, 85: 187-191.
- [51] ACOG Practice Bulletin No. 106: Intrapartum fetal heart rate monitoring: nomenclature, interpretation, and general management principles[J]. *Obstet Gynecol*, 2009, 114: 192-202.
- [52] Copel JA, Liang RI, Demasio K, et al. The clinical significance of the irregular fetal heart rhythm[J]. *Am J Obstet Gynecol*, 2000, 182: 813-817.
- [53] Simpson JL, Yates RW, Sharland GK. Irregular heart rate in the fetus; not always benign[J]. *Cardiol Young*, 1996, 6: 28-31.
- [54] Cuneo BF, Strasburger JF, Wakai RT, et al. Conduction system disease in fetuses evaluated for irregular cardiac rhythm[J]. *Fetal Diagn Ther*, 2006, 21: 307-313.
- [55] Srinivasan S, Strasburger J. Overview of fetal arrhythmias [J]. *Curr Opin Pediatr*, 2008, 20: 522-531.
- [56] Kirk JS, Comstock CH, Lee W, et al. Fetal cardiac asymmetry: a marker for congenital heart disease[J]. *Obstet Gynecol*, 1999, 93: 189-192.
- [57] Sharland GK, Chan KY, Allan LD. Coarctation of the aorta; difficulties in prenatal diagnosis[J]. *Br Heart J*, 1994, 71: 70-75.
- [58] Hornberger LK, Sanders SP, Rein AJ, et al. Left heart obstructive lesions and left ventricular growth in the midtrimester fetus. A longitudinal study[J]. *Circulation*, 1995, 92: 1531-1538.
- [59] Paladini D, Palmieri S, Lamberti A, et al. Characterization and natural history of ventricular septal defects in the fetus [J]. *Ultrasound Obstet Gynecol*, 2000, 16: 118-122.
- [60] Axt-Flidner R, Schwarze A, Smrcek J, et al. Isolated ventricular septal defects detected by color Doppler imaging: evolution during fetal and first year of postnatal life[J]. *Ultrasound Obstet Gynecol*, 2006, 27: 266-273.
- [61] Vettraino IM, Lee W, Bronsteen RA, et al. Sonographic evaluation of the ventricular cardiac outflow tracts[J]. *J Ultrasound Med*, 2005, 24: 566.
- [62] Bromley B, Estroff JA, Sanders SP, et al. Fetal echocardiography: accuracy and limitations in a population at high and low risk for heart defects[J]. *Am J Obstet Gynecol*, 1992, 166: 1473-1481.
- [63] Stumpflen I, Stumpflen A, Wimmer M, et al. Effect of detailed fetal echocardiography as part of routine prenatal ultrasonographic screening on detection of congenital heart disease [J]. *Lancet*, 1996, 348: 854-857.
- [64] Yoo SJ, Lee YH, Kim ES, et al. Three-vessel view of the fetal uppermediastinum: an easy means of detecting abnormalities of the ventricular outflow tracts and great arteries during obstetric screening[J]. *Ultrasound Obstet Gynecol*, 1997, 9: 173-182.
- [65] Yoo SJ, Lee YH, Cho KS. Abnormal three-vessel view on sonography: a clue to the diagnosis of congenital heart disease in the fetus[J]. *AJR Am J Roentgenol*, 1999, 172: 825-830.
- [66] Vinals F, Heredia F, Giuliano A. The role of the three vessels and trachea view (3VT) in the diagnosis of congenital heart defects[J]. *Ultrasound Obstet Gynecol*, 2003, 22: 358-367.
- [67] Yagel S, Arbel R, Anteby EY, et al. The three vessels and trachea view (3VT) in fetal cardiac scanning[J]. *Ultrasound Obstet Gynecol*, 2002, 20: 340-345.
- [68] Tongsong T, Tongprasert F, Srisupundit K, et al. The complete three-vessel view in prenatal detection of congenital heart defects[J]. *Prenat Diagn*, 2010, 30: 23-29.
- [69] Berg C, Gembruch U, Geipel A. Outflow tract views in twodimensional fetal echocardiography-part i[J]. *Ultraschall Med*, 2009, 30: 230-251.
- [70] Yagel S, Cohen SM, Achiron R. Examination of the fetal heart by five short-axis views: a proposed screening method for comprehensive cardiac evaluation[J]. *Ultrasound Obstet Gynecol*, 2001, 17: 367-369.
- [71] Chaoui R, McEwing R. Three cross-sectional planes for fetal color Doppler echocardiography[J]. *Ultrasound Obstet Gynecol*, 2003, 21: 81-93.
- [72] Paladini D. Sonography in obese and overweight pregnant women: clinical, medicolegal and technical issues[J]. *Ultrasound Obstet Gynecol*, 2009, 33: 720-729.
- [73] Nadel AS. Addition of color Doppler to the routine obstetric sonographic survey aids in the detection of pulmonic stenosis [J]. *Fetal Diagn Ther*, 2010, 28: 175-179.
- [74] Small M, Copel JA. Indications for fetal echocardiography [J]. *Pediatr Cardiol*, 2004, 25: 210-222.
- [75] Hyett J, Moscoso G, Papapanagiotou G, et al. Abnormalities of the heart and great arteries in chromosomally normal

- fetuses with increased nuchal translucency thickness at 11-13 weeks of gestation[J]. Ultrasound Obstet Gynecol, 1996, 7: 245-250.
- [76] Hyett JA, Perdu M, Sharland GK, et al. Increased nuchal translucency at 10-14 weeks of gestation as a marker for major cardiac defects[J]. Ultrasound Obstet Gynecol, 1997, 10: 242-246.
- [77] Mavrides E, Cobian-Sanchez F, Tekay A, Moscoso G, et al. Limitations of using first trimester nuchal translucency measurement in routine screening for major congenital heart defects[J]. Ultrasound Obstet Gynecol, 2001, 17: 106-110.
- [78] Ghi T, Huggon IC, Zosmer N, et al. Incidence of major structural cardiac defects associated with increased nuchal translucency but normal karyotype[J]. Ultrasound Obstet Gynecol, 2001, 18: 610-614.
- [79] Paladini D, Volpe P, Sglavo G, et al. Transposition of the great arteries in the fetus: assessment of the spatial relationships of the arterial trunks by four-dimensional echocardiography[J]. Ultrasound Obstet Gynecol, 2008, 31: 271-276.
- [80] Volpe P, Campobasso G, De Robertis V, et al. Two- and four-dimensional echocardiography with B-flow imaging and spatiotemporal image correlation in prenatal diagnosis of isolated total anomalous pulmonary venous connection[J]. Ultrasound Obstet Gynecol, 2007, 30: 830-837.
- [81] Volpe P, Tuo G, De Robertis V, et al. Fetal interrupted aortic arch: 2D-4D echocardiography, associations and outcome[J]. Ultrasound Obstet Gynecol, 2010, 35: 302-309.

赵胜 翻译

陈欣林 校对

读者 · 作者 · 编者

《中国产前诊断杂志(电子版)》2014 年选题计划

1. 双胎妊娠相关疾病的临床诊治;
2. 产前诊断实验技术;
3. 选择性减胎;
4. 产前超声与磁共振。

欢迎来稿 欢迎订阅

地址:上海浦东新区高科西路 2699 号,门诊楼四楼胎儿医学部
编辑部(201204)

电话:021-20261150 网上投稿:www.chinjpd.com

ISUOG胎儿心脏超声检查指南（修订版）

作者: [ISUOG, 赵胜\(翻译\)](#)
作者单位: [湖北省妇幼保健院](#)
刊名: [中国产前诊断杂志（电子版）](#)
英文刊名: [Chinese Journal of Prenatal Diagnosis \(Electronic Version\)](#)
年, 卷(期): 2014(1)

本文链接: http://d.g.wanfangdata.com.cn/Periodical_zgcqzdzz201401014.aspx