



· 综 述 ·

多普勒超声在预测妊娠期高血压疾病中的应用研究进展

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[摘要] 妊娠期高血压疾病 (hypertension in pregnancy, HIP) 是妊娠与血压升高并存的一种疾病, 可对孕产妇全身各器官产生不良影响, 如可导致胎盘早剥、弥散性血管内凝血、心肝肾衰竭、肺水肿、高血压脑病, 甚至死亡, 亦可造成胎儿生长受限、羊水过少、早产、宫内窘迫、神经系统损伤, 甚至死亡, 为产科严重并发症之一, 是孕产妇及围产儿高发病率及死亡率的主要原因。多普勒超声因具有无创、价格低廉等优点, 广泛用于产前超声诊断, 常规用于监测妊娠期并发症及评价围产儿结局。该文对多普勒超声检查在妊娠期高血压疾病中的应用研究进展进行综述。

[关键词] 超声检查; 二维超声; 能量多普勒; 妊娠期高血压疾病

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[Abstract] Hypertension in pregnancy (HIP) is a disease that pregnancy coexists with elevated blood pressure. It has adverse effects on all organs in pregnant and parturient women, resulting in complications such as placental abruption, disseminated intravascular coagulation, maternal heart, liver, renal failure, pulmonary edema, hypertensive encephalopathy and even death. Also, it may cause fetal growth restriction, oligohydramnios, premature delivery, fetal distress, nervous system injuries and even fetal death. It is one of the serious obstetric complications, and the main cause of high morbidity and mortality of pregnant women and perinatal infants. Doppler ultrasound is widely used in prenatal diagnosis because of non-invasion and low cost. It is routinely applied to monitor pregnancy complications and evaluate perinatal outcomes. The present paper reviews the application of Doppler ultrasound in hypertension in pregnancy.

[Key words] Ultrasonography; Two-dimensional ultrasound; Power Doppler; Hypertension in pregnancy

妊娠期高血压疾病 (hypertension in pregnancy, HIP) 包括妊娠期高血压、子痫前期、子痫、慢性高血压合并妊娠、慢性高血压并发子痫前期, 基本病理生理变化是全身小血管痉挛。其国内发病率约5.22%, 世界范围内发病率8%~10%^[1]。近年来, 多普勒超声检查已作为妊娠期高血压疾病的主要筛查方法而广泛用

于临床。

1 二维多普勒超声的临床应用

1.1 妊娠期高血压疾病患者子宫螺旋动脉重铸及子宫动脉血流动力学变化

受精卵着床完成后, 滋养细胞进一步分化为绒毛滋养细胞和绒毛外滋养细胞。绒毛外滋养细胞沿血管逆行迁移, 会对子宫内膜基质、肌层进

行破坏和侵入,并浸润子宫螺旋动脉,逐渐取代其血管内皮细胞,并使中层平滑肌细胞丧失,即螺旋动脉重铸。血管重铸后,子宫螺旋动脉管径从200~300 μm 增加到1 000 μm ,丧失对外源性儿茶酚胺等缩血管物质的反应性,阻力降低,胎盘绒毛间隙子宫胎盘循环血量增加,可高达600 mL/min^[2]。至此,子宫螺旋动脉由高阻力低流量血管转变为低阻力高容量血管以提高胎盘血流量,从而维持正常妊娠,满足胎儿生长发育的需要,这一变化是正常妊娠发展和胎儿生长的一个重要步骤。发生妊娠期高血压疾病时,绒毛外滋养细胞浸润子宫螺旋动脉的能力受损,导致血管重铸严重不足^[3-4],管腔径仅为正常妊娠时的1/2,管壁肌层持续存在,动脉血流阻力增加,胎盘灌注减少,从而引发妊娠期高血压疾病的一系列症状。

子宫螺旋动脉重铸发生于妊娠全程。随孕周增加,子宫动脉阻力逐渐下降。彩色多普勒超声测量孕期双侧子宫动脉的血流动力学参数,可了解是否存在血管阻力增高,从而推断是否存在血管重铸异常^[5]。常用的血流动力学参数包括收缩期峰值流速/舒张末期流速(peak systolic velocity/end diastolic velocity, S/D)、搏动指数(pulsatility index, PI)、阻力指数(resistance index, RI)、舒张早期切迹。随着研究的不断深入,有学者认为S/D、PI、RI等参数的升高提示血管重铸异常。Karaman等^[6]的研究纳入107例单胎孕妇,其中包括38例健康对照受试者、34例妊娠期高血压患者和35例子痫前期患者,应用多普勒超声测量其左、右子宫动脉血流动力学指标(PI、RI、舒张早期切迹),发现子痫前期组出现舒张早期切迹的概率为48.57%(17/35),妊娠期高血压组为5.88%(2/34),健康对照受试组未有舒张早期切迹检出;子痫前期组双侧子宫动脉PI、RI值明显高于妊娠期高血压组及健康对照受试组($P=0.001$)。国内李荆等^[7]的研究则指出,只有重度子痫前期患者子宫动脉血流动力学参数才会出现较正常妊娠孕妇差异有统计学意义。以PI平均值 >1.997 作为阈值预测重度子痫前期的灵敏度为75.1%,特异度为66.2%,以RI平均

值 >0.961 作为阈值预测重度子痫前期的灵敏度为63.7%,特异度为61.4%。另有研究指出,联合PI与双侧子宫动脉血流切迹预测子痫前期的效果更好^[8],因此建议中孕期超声筛查胎儿结构时可常规检测孕妇双侧子宫动脉血流切迹。

二维多普勒超声测量子宫动脉血流阻力参数对预测妊娠期高血压疾病有重要价值。但在孕期不同阶段,双侧子宫动脉的血流阻力是否相同、不同孕周子宫动脉各血流阻力参数的准确区间尚缺乏大量数据。

1.2 妊娠期高血压疾病患者胎儿血流动力学变化

妊娠期高血压疾病的发病机制尚未完全阐明,大部分研究集中于子痫前期-子痫的发病机制。目前普遍认为,子痫前期的发生与胎盘浅着床、子宫螺旋动脉重铸障碍、胎盘低灌注状态等有关,这些病理改变导致的胎盘缺氧、机体氧化应激、全身炎症反应、内皮细胞功能紊乱等最终引起孕妇-胎盘-胎儿血液循环系统改变,直接影响胎儿血流动力学状况^[9]。

目前,临床上常用胎儿脐动脉(umbilical artery, UA)和大脑中动脉(middle cerebral artery, MCA)监测胎儿血流动力学变化^[10-11]。脐动脉是连接母体与胎儿的重要通道。妊娠期原发性高血压导致胎盘绒毛血管狭窄,引起脐动脉外周阻力增加,造成脐动脉舒张末期血流量减少,因此检测脐动脉血流频谱变化可反映胎盘及胎儿缺血缺氧性改变。相关研究已证实,重度子痫前期患者可出现胎儿脐动脉舒张末期血流缺失或反流^[12]。MCA是颈内动脉的直接延续,是供应颅脑血液最主要的血管,可直接反映胎儿脑血液循环状态,其血流动力学参数可作为评价胎儿贫血及宫内窘迫等异常状态的参考指标^[13-14]。研究认为,MCA对缺氧敏感,在胎盘持续低灌注情况下,可通过自身调节重新分配血流量,降低MCA血流阻力,保障脑等重要脏器的血供。常用的脐动脉及MCA血流动力学参数包括PI、RI及S/D。马一瀛等^[15]通过彩色多普勒超声监测胎儿脐动脉和MCA对子痫前期患者进行病情评估,发现脐动脉血流参数PI、RI和S/D随患者妊娠期子痫严重程度的增加而增

加 (P 均 <0.05), MCA血流参数PI、RI和S/D随患者妊娠期子痫严重程度的增加而降低 (P 均 <0.05), 认为可通过彩色多普勒超声监测胎儿脐动脉和MCA的血流动力学参数以反映子痫前期严重程度。相关研究显示, 妊娠晚期胎儿脐动脉和MCA的S/D、PI预测子痫前期的灵敏度可达40%~60%, 特异度达70%~80%, 对预测子痫前期病情及胎儿宫内状态具有积极意义。

2 三维能量多普勒超声的临床应用

子痫前期的发病被认为与子宫螺旋动脉重铸障碍导致的慢性胎盘低灌注有关。直到现在, 用二维多普勒超声测量子宫动脉仍是最常见的预测子痫前期发生的方法。但这种方法有如下缺点: 不能研究垂直于超声波方向光束轴的血液流动; 对血流缓慢的血管的测量, 灵敏度很差; 此外, 被检查者的活动也可降低结果的准确性和可重复性, 尤其是小血管和低速血流^[16]。大量研究表明, 胎盘低灌注可反映在子宫动脉PI增加中, 而子宫动脉PI的测量受孕龄、体质指数、种族和是否合并糖尿病等的影响。此外, 子宫动脉作为子宫胎盘的主要血管, 仅部分反映了胎盘的真正血流动力学, 其临床价值尚不确定。因此, 有学者认为对胎盘绒毛间隙的灌注进行非侵入性和直接量化的研究可能为获取胎盘功能提供更有价值的信息。

三维能量多普勒超声通过血管化指数 (vascularization index, VI)、血流指数 (flow index, FI) 和血管血流指数 (vascular flow index, VFI) 对胎盘血管直接进行测量, 已用于胎盘血管化的评估^[17-19]。1项大样本研究显示 (4 325名孕妇), 在妊娠早期阶段, 与子宫动脉PI相比, 子宫肌层VI预测子痫前期发生和发展有更高的灵敏度和特异度。三维能量多普勒在预测妊娠高血压疾病方面具有较大的优越性^[20]。Wang等^[21]研究发现, 胎盘血管性指标在孕11~14周的正常妊娠孕妇中呈恒定分布。Chen等^[22]及Surányi等^[23]的研究均证实, VI、FI、VFI是预测妊娠高血压疾病风险的良好指标。1项前瞻性队列研究认为, 在妊娠早期阶段, 应用三维能量多普勒超声

评估妊娠期高血压疾病无明显价值; 而在孕中期阶段, 三维能量多普勒超声能在尚未出现临床症状前早期预测子痫前期, 从而为及早实施临床监测与干预提供指导^[24]。Yuan等^[25]研究发现, 高血压孕妇的胎盘血管性指标较正常妊娠妇女降低, 胎盘灌注减少与高血压疾病的严重程度一致, 且胎盘血管性指标与脐动脉阻抗之间存在相关性。也有与大多数研究结果不一致的报道。如Hannaford等^[26]对570名单胎孕妇进行超声检查, 结果提示子痫前期组及早发型子痫前期组孕妇胎盘VI、FI和VFI的平均值较低, PI平均值较高, 但差异无统计学意义。此外, 研究发现联合胎盘血管性指标与子宫动脉血流动力学指标并不能提高预测子痫前期的灵敏度。Noguchi等^[27]的研究也提示, 妊娠期高血压疾病患者胎盘VI、FI和VFI与正常孕妇胎盘相比, 差异并无统计学意义。因此, 未来需扩大样本量, 进一步评价三维能量多普勒超声预测妊娠期原发性高血压的临床价值, 并将其与其他技术联合, 以期形成预测妊娠期原发性高血压的最佳模式, 从而更准确地预测妊娠期高血压疾病的发生并评估新生儿预后。

综上所述, 多普勒超声在妊娠期高血压疾病的预测、诊疗中发挥着极其重要的作用, 其与相关技术的联合应用有望为妊娠期高血压疾病的准确预测、临床决策及预后判断提供强有力的支持。

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