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超声评分法及肾动脉阻力指数对胎儿肾积水预后的评价价值分析*

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摘要 目的:研究超声评分法及肾动脉阻力指数(RRI)对胎儿肾积水预后的评价价值。**方法:**将从2016年1月~2019年1月经我院超声检查发现的孕晚期肾积水胎儿210例纳入研究,测定其肾实质厚度(RPT)、肾盂前后径(APD)以及肾盂肾盏形态,对上述各项超声检测指标进行评分,累计计算分值。此外,对所有胎儿的积水肾脏肾门部位的RRI值进行测定,并以受试者工作特征(ROC)曲线分析超声评分法与RRI值诊断胎儿肾积水预后类型的价值。**结果:**所有胎儿出生1年内分别行超声检查以及临床诊断,结果显示210例胎儿,共计420只肾脏,共发生285只肾积水,包括病理性肾积水84只(病理性组),非病理性肾积水201只(非病理性组)。病理性肾积水胎儿超声评分为1~3分的肾只数占比显著低于非病理性胎儿($P<0.05$),而7~9分的肾只数占比显著高于非病理性胎儿($P<0.05$)。病理性肾积水胎儿的平均RRI值为 0.74 ± 0.05 ,显著高于非病理性肾积水胎儿的 0.63 ± 0.02 ,差异有统计学意义($t=26.563, P=0.000$)。超声评分法与RRI联合诊断病理性肾积水的曲线下面积(AUC)、敏感度、特异度、准确度均显著高于超声评分法或RRI单独诊断($P<0.05$)。**结论:**超声评分法及RRI诊断对胎儿肾积水预后评价具有较重要的价值,值得临床推广应用。

关键词:胎儿肾积水;超声评分法;肾动脉阻力指数;评价价值;预后

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The Value of Ultrasonography and Renal Artery Resistance Index in Evaluating the Prognosis of Fetal Hydronephrosis*

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ABSTRACT Objective: To study the value of ultrasonography and renal artery resistance index (RRI) in evaluating the prognosis of fetal hydronephrosis. **Methods:** 210 cases of fetuses with late gestational hydronephrosis discovered by ultrasonography in our hospital from January 2016 to January 2019 were included in the study. Their renal parenchymal thickness (RPT), anteroposterior diameter (APD), and calyces morphology were measured. The above ultrasonographic indicators were scored and scores were calculated. In addition, RRI values of renal hilum in all fetuses were measured. The diagnostic value of ultrasonography and RRI in the prognosis of fetal hydronephrosis was analyzed by receiver operating characteristic (ROC) curve. **Results:** Ultrasound examination and clinical diagnosis were performed on all fetuses 1 year after birth, the results showed that 210 fetuses, a total of 420 kidneys, had 285 hydronephrosis, including 84 cases of pathological hydronephrosis (pathological group), and 201 cases of non-pathological hydronephrosis (non-pathological group). The ratio of the number of kidneys in the pathological hydronephrosis fetus with 1-3 points was significantly lower than that in the non-pathological fetus ($P<0.05$), while the ratio of the number of kidneys in the 7-9 points was significantly higher than that in the non-pathological fetus ($P<0.05$). The mean RRI of fetuses with pathological hydronephrosis was 0.74 ± 0.05 , which was significantly higher than that of fetuses without pathological hydronephrosis 0.63 ± 0.02 , the difference was statistically significant ($t=26.563, P=0.000$). The area under curve (AUC), sensitivity, specificity, and accuracy of combined ultrasonography and RRI in the diagnosis of pathological hydronephrosis were significantly higher than that of ultrasonography or RRI alone ($P<0.05$). **Conclusion:** Ultrasonic scoring and RRI diagnosis have important value in evaluating the prognosis of fetal hydronephrosis, which is worthy of clinical application.

Key words: Fetal hydronephrosis; Ultrasonic grading method; Renal artery resistance index; Evaluation value; Prognosis

Chinese Library Classification(CLC): R726.9; R722; R445.1 **Document code:** A

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前言

肾积水属于胎儿较为常见的一种先天性畸形,主要临床特

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征为肾盂或肾盏扩张积水,胎儿期肾积水的差异亦会导致预后的明显差异,病情较轻者可进行随访观察直至肾积水消失,病情较重者可能会出现生长发育异常,甚至出现肾功能的降低^[1,2]。超声检查是一种目前临床上应用较为普遍的产前诊断手段,其在优生优育中起着至关重要的作用,且随着产前超声诊断技术的日益发展、完善,越来越多的胎儿先天性畸形被检测出来,并为胎儿出生后的治疗以及预后评估提供了指导作用^[3,4]。然而,现今临床常使用的超声检查指标对胎儿肾积水的评价效果并不十分理想,因此寻找一种具有更高价值的评价方法在胎儿期对胎儿肾积水的预后情况进行有效的评价具有重要的意义,亦是目前临床医师普遍关注以及亟待解决的重要问题^[5-7]。鉴于此,本文通过研究超声评分法及肾动脉阻力指数(Renal artery resistance index, RRI)对胎儿肾积水预后的评价价值,旨在为超声评分法联合 RRI 诊断对胎儿肾积水预后评估的临床应用提供理论依据,现作以下报道:

1 对象与方法

1.1 一般资料

将从 2016 年 1 月~2019 年 1 月经我院超声检查发现的孕晚期肾积水胎儿 210 例纳入研究。纳入标准:(1)所有胎儿均于我院接受超声检查;(2)所有胎儿的孕周均在 28 周以上;(3)

所有孕妇均为单胎妊娠;(4)部分胎儿伴有输尿管膀胱等泌尿系统异常。排除标准:(1)高龄产妇;(2)合并严重妊娠期并发症者;(3)意识障碍或伴有精神疾病产妇;(4)正参与其他研究者;(5)研究过程中因各种原因退出者。孕妇年龄 22~37 岁,平均年龄(28.37±3.22)岁。所有孕妇均在知情同意书上签字,本研究获批于医院伦理委员会。

1.2 研究方法

对所有胎儿进行超声检查,检查仪器选用 Philips iU22 彩色多普勒超声诊断仪(购自深圳迈瑞生物医疗电子股份有限公司),设置频率为 3.5~5.0 MHz,凸阵探头。检查前要求胎儿膀胱处于非充盈状态,且以脊柱为中心,以胎儿双肾切面为标准切面。随后完成肾盂前后径(Anteroposterior diameter of renal pelvis, APD)、肾实质厚度(Renal parenchyma thickness, RPT)、肾盂肾盏形态的检测和记录。APD 为肾盂宽度,可反应肾盂扩张程度。RPT 为纵切时肾脏外缘和集合系统最外缘之间的距离,上述指标分别测量 3 次,以平均值为最终结果。肾盂肾盏形态分级如下^[8]:肾大盏扩张或合并肾小盏轻度扩张即为 I 级;肾大盏扩张、肾小盏中度扩张即为 II 级;肾大盏扩张,肾小盏显著扩张或严重肾积水,难以清晰显示肾盂肾盏形态即为 III 级。将上述 3 个因素根据胎儿肾积水严重程度分别赋值 0~3 分^[9],计算每只积水肾脏的总分,见表 1。

表 1 胎儿肾积水超声评分表

Table 1 Ultrasonic rating scale for fetal hydronephrosis

Ultrasonic detection index	0 score	1 score	2 score	3 score
APD (cm)	APD<1	1≤APD<1.3	1.3≤APD<1.5	APD≥1.5
RPT (cm)	>0.7	0.6~0.7	0.3~0.5	<0.3
Renal pelvis and calices	Simple dilatation of the renal pelvis	Caliectasis of class I	Caliectasis of class II	Caliectasis of class III

1.3 观察指标

分析 210 例胎儿出生 1 年内的检查、诊断结果,对比不同预后分类肾积水胎儿的超声评分,不同预后分类肾积水胎儿的 RRI 值,分析超声评分及 RRI 诊断病理性肾积水的价值。

1.4 统计学处理

应用 SPSS 22.0 软件分析数据。 $(\bar{x} \pm s)$ 表示计量资料,%表示计数资料,组间比较分别采用 t 及 χ^2 检验,受试者工作特征(Receiver operating characteristic, ROC)曲线分析超声评分与 RRI 诊断病理性肾积水的价值,以 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 210 例胎儿出生一年内的检查、诊断结果分析

所有胎儿出生 1 年内分别行超声检查以及临床诊断,结果显示 210 例胎儿,共计 420 只肾脏,共发生 285 只肾积水,包括病理性肾积水 84 只,非病理性肾积水 201 只,其中非病理性肾积水中 146 只肾复查肾积水完全消失或 APD<1 cm;55 只肾 1≤APD<1.5,肾小盏无扩张,肾实质未变薄,其中 25 只肾复查肾积水缓解、消失或 APD<1 cm,30 只肾积水无好转,但肾功能无异常。

2.2 不同预后分类肾积水胎儿的超声评分对比

病理性肾积水胎儿超声评分为 1~3 分的肾只数占比显著低于非病理性胎儿($P<0.05$),而 7~9 分肾只数占比显著高于非病理性胎儿($P<0.05$),见表 2。

表 2 不同预后分类肾积水胎儿的超声评分对比(例,%)

Table 2 Comparison of ultrasonography scores of renal water fetals with different prognostic classification(n,%)

Groups	Number of kidneys	1~3 socres	4~6 socres	7~9 socres
Non-pathological group	201	161(80.10)	34(16.92)	6(2.99)
Pathological group	84	0(0.00)	21(25.00)	63(75.00)
χ^2	-	154.644	0.085	167.441
P	-	0.000	0.770	0.000

2.3 不同预后分类肾积水胎儿的 RRI 值对比

病理性肾积水胎儿的平均 RRI 值为 0.74 ± 0.05 , 显著高于非病理性肾积水胎儿的 0.63 ± 0.02 , 差异有统计学意义 ($t=26.563, P=0.000$)。

2.4 超声评分与 RRI 诊断病理性肾积水的 ROC 曲线分析

超声评分与 RRI 联合诊断病理性肾积水的曲线下面积 (Area under curve, AUC)、敏感度、特异度、准确度均显著高于超声评分或 RRI 单独诊断, 见表 3、图 1。

表 3 超声评分与 RRI 诊断病理性肾积水的效能

Table 3 Ultrasound score and RRI in the diagnosis of pathological hydronephrosis

Diagnostic mode	AUC	Sensitivity	Specificity	Accuracy degree
Ultrasound score	0.86	0.83	0.88	0.85
RRI	0.79	0.81	0.75	0.77
Joint diagnosis	0.94	0.96	0.93	0.94

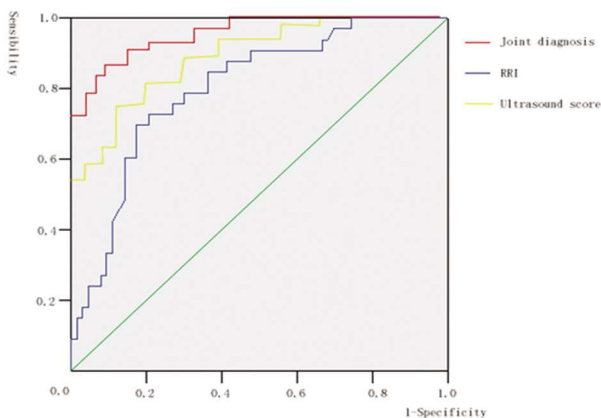


图 1 超声评分与 RRI 诊断病理性肾积水的 ROC 曲线

Fig.1 ROC curve of ultrasound score and RRI in the diagnosis of pathological hydronephrosis

3 讨论

相关数据表明, 产前常规超声检查过程中胎儿畸形发生率在 0.6% 左右, 其中约有 30%~50% 是泌尿生殖系统畸形, 且肾积水的发病率可达 2.0% 以上^[10]。随着近年来产前超声筛查水平的日益提高, 胎儿肾积水的诊断率亦 "水涨船高", 然而对胎儿肾积水的处理以及预后评估仍是迄今为止严重困扰医务人员的一大难题。胎儿肾积水主要包括生理性肾积水以及病理性肾积水两种, 前者会伴随着胎儿的不断生长发育逐步缓解, 而后者主要是由于多种梗阻因素导致, 会伴随着胎儿的生长发育促进肾功能出现进行性下降, 严重威胁胎儿的生命健康安全^[11-13]。目前, 临床上广泛用以诊断鉴别胎儿肾积水的方式包括胎儿泌尿外科学会 (Society of Fetal Urology, SFU) 分级法以及 APD 法两种, 然而学术界对于上述两种方式的界值以及临床意义尚且存在一定的争议^[14-16]。有研究学者表明, SFU 分级具有准确度较高的优势, 但在实际操作过程中其受主观因素的影响相对较大^[17-19]。APD 分级法的测量标准掌握难度较低, 但对于预后的衡量相对 SFU 分级法略显不足^[20,21]。随着近年来相关研究的日益深入, 越来越多的学者发现: 肾盂肾盏扩张最先表现特征为肾盂扩张, 肾小盏伴随着肾积水的增多逐步扩张, 且 RPT 随之变薄^[22,23]。由此可见, 对胎儿的肾小盏形态、RPT 以及 APD 等进行综合评估, 可在一定程度上减少胎儿肾积水诊断过程中发生的假阳性或 (和) 假阴性^[24,25]。

本文结果发现, 病理性肾积水胎儿超声评分为 1~3 分的肾只数占比显著低于非病理性肾积水 ($P<0.05$), 而 7~9 分的肾只数占比显著高于非病理性肾积水 ($P<0.05$)。这和钟周华等人的研究报道相符^[26]。超声评分法对于胎儿肾积水的评价具有较高的指导作用。分析原因, 我们认为超声评分法主要是通过对胎儿的 RPT、APD 以及肾盂肾盏形态等情况进行检测, 并实施赋值评分, 从而有助于为临床医师反映胎儿肾积水情况, 且随着超声评分的不断升高, 胎儿发生病理性肾积水的风险随之升高。另有学者研究发现^[27]: 对评分在 3 分以内的肾积水胎儿可诊断为非病理性肾积水, 而在 8 分及 8 分以上的肾积水胎儿基本上可诊断为病理性肾积水, 其中 4~7 分的肾积水胎儿随着分值的增加, 发生病理性肾积水的风险越高, 提示了预后不良的几率升高。此外, 王婧霖等人的研究结果显示^[28]: 超声评分为 5 分是诊断病理性肾积水胎儿的最佳截断值, 具有较高的敏感度以及特异度。另外, 病理性肾积水胎儿的平均 RRI 值显著高于非病理性肾积水胎儿, 差异有统计学意义 ($t=26.563, P=0.000$)。这提示了胎儿肾门部位 RRI 亦是评价胎儿肾积水预后的重要指标。究其原因, RRI 是有效反映血管阻力大小的一项重要超声参数, 在肾积水发生后, 由于肾盂内的压力显著升高, 从而对肾实质造成压迫, 引起了肾内局部血管因子的变化, 进一步导致肾内血管的收缩以及肾血管阻力的升高^[29]。这在祖建成等人的研究中得以证实^[30]: 经过治疗, 肾积水患儿病情及肾段动脉 RRI 均有明显改善, 提示了 RRI 可反映患儿肾脏功能损害程度。本文结果还显示了超声评分与 RRI 联合诊断病理性肾积水的曲线下面积、敏感度、特异度、准确度均显著高于超声评分或 RRI 单独诊断。这提示了在临床实际工作中, 可能通过联合超声评分与 RRI 检测, 继而达到提高胎儿病理性肾积水检出率的目的。然而, 本研究尚且存在样本量不足的缺陷, 今后可进一步地扩充研究的样本容量, 从而获得更加精准的研究结论, 亦为更加深入地科研分析提供了方向。

综上所述, 超声评分法及 RRI 对胎儿肾积水预后评价具有较重要的价值, 通过联合上述两种方式诊断, 可在一定程度上提高诊断胎儿病理性肾积水的敏感度、特异度、准确度。

参考文献 (References)

- [1] Luis H, Braga, Melissa, et al. Society for Fetal Urology Classification vs Urinary Tract Dilation Grading System for Prognostication in Prenatal Hydronephrosis: A Time to Resolution Analysis[J]. Journal of urology, 2018, 199(6): 1615-1621

- [2] Krajewski W, Wojciechowska J, Dembowski J, et al. Hydronephrosis in the course of ureteropelvic junction obstruction: An underestimated problem? Current opinions on the pathogenesis, diagnosis and treatment[J]. *Adv Clin Exp Med*, 2017, 26(5): 857-864
- [3] Shoichi, Magawa, Hiroaki, et al. In utero spontaneous bladder rupture in a fetus with posterior urethral valve: A case report of prenatal diagnosis and management [J]. *Journal of obstetrics and gynaecology research*, 2018, 44(7): 1318-1321
- [4] Amr, Hodhod, John-Paul, et al. Influence of postnatal hydroureter in determining the need for voiding cystourethrogram in children with high-grade hydronephrosis[J]. *Arab journal of urology*, 2018, 16(23): 238-244
- [5] 安园园, 王莉, 姚琴, 等. 胎儿肾盂扩张相关疾病的三维超声诊断研究[J]. *中国临床医学影像杂志*, 2019, 30(1): 39-41
- [6] Douglas A, Canning. Re: Urinary Tract Infections in Children with Prenatal Hydronephrosis: A Risk Assessment from the Society for Fetal Urology Hydronephrosis Registry[J]. *Journal of urology*, 2018, 199(5): 1101-1103
- [7] Mutaz, Orabi, Sameh, et al. Outcomes of Isolated Antenatal Hydronephrosis at First Year of Life[J]. *Oman medical journal*, 2018, 33(2): 126-132
- [8] 高伟, 王腾春, 罗娜, 等. 多参数超声评分法对评估胎儿肾积水预后的临床价值[J]. *医药卫生*, 2016, 11(2): 96-96
- [9] Sharon, Perlman, Lucia, et al. Severe fetal hydronephrosis: the added value of associated congenital anomalies of the kidneys and urinary tract (CAKUT) in the prediction of postnatal outcome[J]. *Prenatal diagnosis*, 2018, 38(3): 179-183
- [10] Jun Nyung, Lee, Jun-Koo, et al. Predictive value of cortical transit time on MAG3 for surgery in antenatally detected unilateral hydronephrosis caused by ureteropelvic junction stenosis [J]. *Journal of pediatric urology*, 2018, 14(1): e1-e6
- [11] Yogesh, Kumar, Sarin. Is it Always Necessary to Treat an Asymptomatic Hydronephrosis Due to Ureteropelvic Junction Obstruction [J]. *Indian journal of pediatrics*, 2017, 84(7): 531-539
- [12] 吴盛德, 魏春, 何大维, 等. 儿童肾积水肾盂收缩情况及与预后的相关性分析[J]. *中华实用儿科临床杂志*, 2018, 33(23): 1773-1776
- [13] 高波, 雷光, 翟春红, 等. 核医学肾动态显像和血清 Cys C 在评价肾积水患者肾功能中的临床应用[J]. *现代生物医学进展*, 2017, 17(11): 2054-2056
- [14] Anneliese, Vélez-Pérez, Pamela, et al. Placental Fetal Thrombotic Vasculopathy Occurring in Association with Megacystis-microcolon-intestinal Hypoperistalsis Syndrome: A Case Report[J]. *Annals of clinical and laboratory science*, 2017, 47(3): 357-361
- [15] Gabriela E, Jones, Anna K, et al. Renal anomalies and lymphedema distichiasis syndrome. A rare association [J]. *American journal of medical genetics*, 2017, 173(8): 2251-2256
- [16] Lin, Li, Shaobin, et al. Discordant phenotypes in monozygotic twins with 16p11.2 microdeletions including the SH2B1 gene[J]. *American journal of medical genetics*, 2017, 173(8): 2284-2288
- [17] Anne, Kosfeld, Frank, et al. Mutations in the leukemia inhibitory factor receptor (LIFR) gene and Lifr deficiency cause urinary tract malformations[J]. *Human molecular genetics*, 2017, 26(9): 1716-1731
- [18] Zhe-Ming, Xu, Min-Ju, et al. Serum and urinary thioredoxin concentrations are associated with severity of children hydronephrosis [J]. *Clinica chimica acta; international journal of clinical chemistry*, 2017, 466(1): 127-132
- [19] Rafaienne Q, Moraes-Souza, Ana Paula, et al. Safety evaluation of a vaccine: Effect in maternal reproductive outcome and fetal anomaly frequency in rats using a leishmanial vaccine as a model[J]. *PloS one*, 2017, 12(3): 172525-172526
- [20] RS, Zee, Anthony CD, et al. Time to resolution: A prospective evaluation from the Society for Fetal Urology hydronephrosis registry[J]. *Journal of pediatric urology*, 2018, 13(3): e1-e5
- [21] Roberto Iglesias, Lopes. Re: Kajbafzadeh et al. Maternal Urinary Carbohydrate Antigen 19-9 as a Novel Biomarker for Evaluating Fetal Hydronephrosis: A Pilot Study[J]. *Urology*, 2017, 101(2): 172-173
- [22] Genxia, Li, Na, et al. Perinatal and follow-up outcome study of fetal anomalies with multidisciplinary consultation [J]. *Therapeutics and clinical risk management*, 2017, 13(22): 1303-1307
- [23] Deborah L, Jacobson, Carl C, et al. The Correlation between Serial Ultrasound and Diuretic Renography in Children with Severe Unilateral Hydronephrosis[J]. *Journal of urology* 2018, 200(2): 440-447
- [24] Yasar, Kandur, Ahmet, et al. Diuretic renography in hydronephrosis: a retrospective single-center study [J]. *International urology and nephrology*, 2018, 50(7): 1199-1204
- [25] Tsukuru, Amano, Shinsuke, et al. Severe hydronephrosis secondary to uterine artery pseudoaneurysm in the early second trimester of pregnancy: A case report[J]. *BMC pregnancy and childbirth*, 2017, 17(1): 323-325
- [26] 钟周华, 廖宝兰, 刘玲, 等. 超声评分法与肾动脉阻力指数对胎儿肾积水预后综合评估的临床价值 [J]. *中国现代医生*, 2019, 57(2): 99-101
- [27] 陈霞, 吴竹君, 刘峰, 等. 多因素超声评分法在胎儿肾积水产前诊断及预后预测中的诊断价值[J]. *贵州医药*, 2018, 42(6): 753-754
- [28] 王婧霖, 刘雨涵, 吕卓, 等. 超声评分法及肾动脉阻力指数对胎儿肾积水预后的研究价值 [J]. *临床超声医学杂志*, 2014, 16(12): 824-826
- [29] Mandy, Rickard, Armando J, et al. Parenchyma-to-hydronephrosis Area Ratio Is a Promising Outcome Measure to Quantify Upper Tract Changes in Infants With High-grade Prenatal Hydronephrosis [J]. *Urology*, 2017, 194(1): 166-171
- [30] 祖建成, 何军, 宁锋, 等. 离断式肾盂成形术对小儿肾积水的治疗及疗效影响因素分析[J]. *国际外科学杂志*, 2019, 46(1): 48-52