

多模态子宫输卵管超声造影评估输卵管堵塞性病变的诊断价值

肖晓青¹, 邱思花¹, 谢芳², 王金永³, 董小丽², 陈淑金¹, 侯淑红¹

1. 龙岩市第一医院(福建医科大学附属龙岩第一医院)超声科, 福建 龙岩 364000; 2. 龙岩市第一医院(福建医科大学附属龙岩第一医院)生殖医学科, 福建 龙岩 364000; 3. 龙岩市第一医院(福建医科大学附属龙岩第一医院)妇科, 福建 龙岩 364000

【摘要】目的:分析多模态子宫输卵管超声造影(HyCoSy)对输卵管堵塞性病变的诊断价值。**方法:**选择在龙岩市第一医院超声科完成子宫输卵管造影的948例患者,其中符合纳排标准的不孕患者84例,行2D/3D/4D-HyCoSy及宫腔镜下输卵管通染液检查(LDT)。记录84例患者宫腔镜与LDT分析结果,以LDT诊断结果为金标准,分析3D/4D-HyCoSy的多模态HyCoSy检查的灵敏度、特异度、准确率。**结果:**84例患者中慢性盆腔炎最多,占比为33.33%,内膜炎伴赘生物占比为19.05%,多囊卵巢占比为14.29%,子宫内膜异位症占比为13.09%,输卵管炎占比为11.91%,其他占比为8.33%。84例患者共168条输卵管中通畅110条,堵塞58条,其中58条输卵管堵塞中以单侧堵塞(89.66%)与远端堵塞(67.25%)为主。以LDT诊断结果为金标准,多模态HyCoSy诊断输卵管堵塞性病变的临床灵敏度、特异度及准确率分别为98.27%、94.55%、95.24%,分别高于3D-HyCoSy(86.20%、80.00%、82.14%)与4D-HyCoSy(91.37%、85.45%、87.50%)($P<0.05$),与LDT诊断结果一致性良好(Kappa=0.912);而3D-HyCoSy与4D-HyCoSy检查的临床灵敏度、特异度及准确率比较无统计学差异($P>0.05$),3D-HyCoSy、4D-HyCoSy检查与LDT的诊断结果一致性尚可(Kappa=0.698、0.816)。**结论:**多模态HyCoSy诊断输卵管堵塞性病变具有较高临床灵敏度、特异度及准确率,分别高于3D-HyCoSy与4D-HyCoSy,与LDT诊断结果一致性良好。

【关键词】输卵管堵塞性病变;多模态;子宫输卵管超声造影;输卵管通染液检查

【中图分类号】R445.1

【文献标志码】A

【文章编号】1005-202X(2023)10-1246-05

Diagnostic value of multimodal hysterosalpingo-contrast sonography for obstructive lesions of fallopian tubes

XIAO Xiaoqing¹, QIU Sihua¹, XIE Fang², WANG Jinyong³, DONG Xiaoli², CHEN Shujin¹, HOU Shuhong¹

1. Department of Ultrasound, Longyan First Hospital of Fujian Medical University, Longyan 364000, China; 2. Department of Reproductive Medicine, Longyan First Hospital of Fujian Medical University, Longyan 364000, China; 3. Department of Gynecology, Longyan First Hospital of Fujian Medical University, Longyan 364000, China

Abstract: Objective To analyze the value of multimodal hysterosalpingo-contrast sonography (HyCoSy) in diagnosing the obstructive lesions of fallopian tubes. **Methods** Among the 948 patients who had received HyCoSy in the Department of Ultrasound of Longyan First Hospital, 84 infertility patients were selected according to inclusion and excluding criteria. All of the 84 patients underwent 2D/3D/4D-HyCoSy and laparoscopic examination (LDT) for tubal patency evaluation. The diagnostic sensitivity, specificity and accuracy of 3D/4D-HyCoSy and multimodal HyCoSy were analyzed using the LDT results as the golden standard. **Results** Chronic pelvic inflammatory disease was the most frequent in 84 patients, accounting for 33.33%, followed by endometritis with redundancy (19.05%), polycystic ovary (14.29%), endometriosis (13.09%), salpingitis (11.91%), and others (8.33%). Out of a total of 168 fallopian tubes in 84 patients, 110 were patent and 58 were blocked. Among the 58 blocked tubes, unilateral blockage (89.66%) and distal blockage (67.25%) were predominant. The sensitivity, specificity and accuracy of multimodal HyCoSy for diagnosing the obstructive lesions of fallopian tubes were 98.27%, 94.55% and 95.24%, respectively, which were higher than those of 3D-HyCoSy (86.20%, 80.00% and 82.14%) and 4D-HyCoSy (91.37%, 85.45% and 87.50%) ($P<0.05$), with good agreement with the LDT results (Kappa=0.912). The

【收稿日期】2023-04-21

【基金项目】龙岩市科技创新联合资金卫生面上项目(2021LYF17026)

【作者简介】肖晓青,副主任医师,研究方向:妇产超声医学,E-mail: ydetjuo@163.com

【通信作者】侯淑红,硕士,副主任医师,研究方向:妇产超声医学,E-mail: Fjhoush@163.com

differences between 3D-HyCoSy and 4D-HyCoSy in the sensitivity, specificity and accuracy were trivial ($P>0.05$), and the diagnostic results of 3D-HyCoSy or 3D-HyCoSy were also in agreement with LDT results ($Kappa=0.698, 0.816$).

Conclusion Multimodal HyCoSy has higher sensitivity, specificity and accuracy for diagnosing the obstructive lesions of fallopian tubes as compared with 3D-HyCoSy and 4D-HyCoSy, and is in good agreement with LDT results.

Keywords: obstructive lesion of fallopian tube; multimodality; hysterosalpingo-contrast sonography; laparoscopic examination for tubal patency evaluation

前言

据报道,发达国家5%~8%的育龄夫妇有不孕问题,而输卵管疾病引起的女性不孕占30%~50%^[1]。临床上不孕患者常用的检查方法有二维(2D)、三维(3D)、四维(4D)超声、X射线成像和宫腔镜^[2]。临床上将2D、3D超声、输卵管成像和子宫输卵管超声造影(HyCoSy)相结合,可以有效提高不孕症的诊断效率。虽然超声造影可以有效诊断输卵管通畅、输卵管积液和输卵管形态异常,但3D-HyCoSy检查仅可获得某时刻的静态图像,同时造影剂推注时间相对较短,压力升高,增强了对输卵管的疏通作用,在评估输卵管通畅的准确性方面有40%~60%的假阳性,影响了临床治疗方案的选择,而4D-HyCoSy检查获取的是一段动态影像,可移动探头寻找理想观察角度,诊断效能更高^[3-4]。本研究探讨3D/4D相结合的多模态HyCoSy对输卵管堵塞性病变的诊断价值。

1 资料与方法

1.1 一般资料

选取2019年1月~2021年6月在龙岩市第一医院超声科完成HyCoSy的患者948例,选择符合纳排标准的不孕患者84例。纳入标准:①行2D/3D/4D-HyCoSy及宫腔镜下输卵管通液检查(LDT)者;②适龄或有孕育计划而不孕患者;③无阴道出血,无急性传染病者;④经筛查均无明显禁忌证者。受试者均签订知情同意书。排除标准:①严重内脏器质性疾病者;②女性子宫结构异常者;③合并全身性疾病、传染性疾病者;④男方因素、内分泌因素引起的不孕症,正常性生活1年以上且未避孕者;⑤有占位性病变压迫输卵管者;⑥对造影剂过敏患者。入选患者年龄26~43岁,平均(30.34±6.89)岁;病程1~5年,平均(3.15±1.26)年;原发性不孕症46例,继发性不孕症38例(宫外孕手术史5例,流产史15例,卵巢囊肿切除史12例,足月生产后6例)。

1.2 方法

所有入选者均于月经干净后第3~7天,最好第5~7天,无急性炎症疾病、无怀孕,患者取膀胱截石位,实施经阴道HyCoSy。

Sono Vue配置:声诺维注入5 mL生理盐水,配成微泡混悬液,再抽取2 mL用生理盐水稀释成20 mL的混悬液备用。雪瑞欣:取3 mL用生理盐水稀释成20 mL。GE Voluson E8、E10彩色多普勒超声诊断仪,探头为RIC-9-D,频率为5~9 MHz,患者肌内注射0.5 mg硫酸阿托品注射液(天津金耀药业有限公司/北京京丰制药集团有限公司)。常规2D、3D超声检查,观察卵巢、子宫位置及病变情况。

在常规2D、3D超声检查结束后,会阴和阴道消毒,宫腔置管,完成后续的宫腔水造影和输卵管超声造影。注意事项:在2D、3D超声发现双子宫或完全中隔子宫、完全双角子宫时,必要向两侧宫腔分别置管进行检查。会阴和阴道消毒,宫腔置管:球囊内注入1.5 mL生理盐水,稍回拉,使水囊靠近宫颈内口。输卵管超声造影:启动4D扫描键进行4D扫查,宫腔内注入造影剂混悬液,实时观察造影剂通过子宫腔、输卵管到盆腔的全过程。超声造影图像采集及观察顺序:首先当感兴趣区置于容积框内后进入实时4D-HyCoSy状态图像采集,经导管匀速注入造影剂,观察宫腔输卵管,其次关注卵巢环绕征,并动态观察造影剂进入子宫、双侧输卵管及盆腔全过程,随即补充4D-HyCoSy,记录盆腔内造影剂弥散情况后再次补充观察输卵管2D-HyCoSy超声实时图像。全部造影数据存储于仪器硬盘以备后期分析。宫腔水造影(观察宫腔情况):①宫腔内注入生理盐水,利用水的无回声与周围组织形成对比,观察子宫、宫腔及内膜情况;②评估内膜息肉、宫腔黏连、粘膜下肌瘤等宫腔病变。由两位影像学专家分别分析和评估超声资料。

HyCoSy流程:常规2D超声(插管前或后)、宫腔置管、2D/3D输卵管超声造影、宫腔水造影。2D图像观察的内容:2D与造影模式的双幅实时对照显示卵巢周围环绕征,可以间隔注射造影剂,多角度观察输卵管的通畅情况。

2D超声对子宫、输卵管、卵巢及盆底的疾病做基础检查,如子宫肌瘤、内膜厚度、卵巢囊肿、输卵管积水。宫腔3D超声:排查子宫畸形及宫腔病变,如粘膜下肌瘤、宫腔息肉、宫腔黏连等,子宫内膜容受性(内

膜形态、体积、血流),卵巢储备功能(卵巢大小、体积、血流、窦卵泡大小和数目)。

1.3 观察指标

记录84例患者宫腔镜与LDT结果。以LDT诊断结果为金标准,评估2D/3D/4D-HyCoSy及多模态HyCoSy检查的灵敏度、特异度、准确度。(1)输卵管通畅程度标准:根据LDT结果分为通畅和堵塞,其中宫腔镜下亚甲蓝注射液经输卵管伞端流入,走形充盈自然,盆腔溢出为通畅,反之为堵塞^[5]。(2)根据HyCoSy结果分为通畅和堵塞,其中输卵管发育完全,双侧输卵管同步显影,对造影剂注射阻力小,管腔光滑,行走自然,造影剂在伞端溢出。造影剂在盆腔内均匀分散,无回流,说明通畅,反之为堵塞。示例见图1~图3。

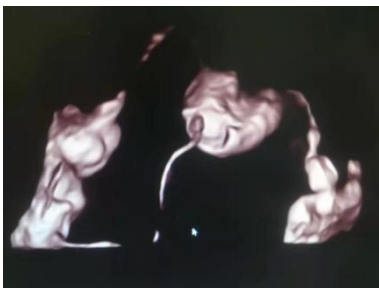


图1 双侧输卵管伞端黏连,引起输卵管积水
Figure 1 Bilateral adhesions at the umbilical ends of the fallopian tubes causing hydrosalpinx

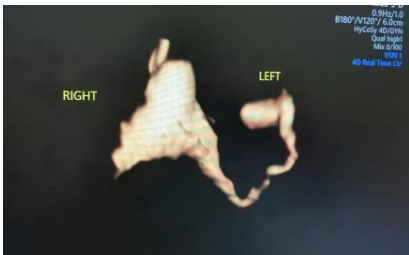


图2 右侧输卵管近端堵塞,左侧输卵管轻度积水
Figure 2 Proximal blockage of the right fallopian tube and mild effusion of the left fallopian tube



图3 左侧输卵管近端堵塞,右侧输卵管通畅
Figure 3 Proximal blockage of the left fallopian tube and patency of the right fallopian tube

1.4 统计学方法

采用SPSS19.0软件进行统计学分析,宫腔镜与LDT分析结果、灵敏度、特异度、准确度用例数(%)表示,一致性采用Kappa检验,Kappa<0.40为一致性不佳,0.40~0.74为一致性尚可,>0.74为一致性良好, $P<0.05$ 表示差异有统计学意义。

2 结果

2.1 宫腔镜检查结果

84例患者中慢性盆腔炎最多,占比为33.33%(28/84),内膜炎伴赘生物占比为19.05%(16/84),多囊卵巢占比为14.29%(12/84),子宫内膜异位症占比为13.09%(11/84),输卵管炎占比为11.91%(10/84),其他占比为8.33%(7/84)。

2.2 LDT诊断结果

84例患者共168条输卵管中通畅最多,占比为65.47%(110/168),堵塞占比为34.53%(58/168)。58条输卵管堵塞中以单侧堵塞(89.66%,52/58)与远端堵塞(67.25%,39/58)为主,双侧堵塞、输卵管近端堵塞分别占比为10.34%(6/58)、32.75%(19/58)。

2.3 3D/4D-HyCoSy检查及多模态HyCoSy检查的诊断价值

以LDT诊断结果为金标准,多模态HyCoSy诊断输卵管堵塞性病变的临床灵敏度、特异度及准确率分别为98.27%、94.55%、95.24%,高于3D-HyCoSy(86.20%、80.00%、82.14%)和4D-HyCoSy(91.37%、85.45%、87.50%)($P<0.05$),与LDT诊断结果一致性良好(Kappa=0.912);而3D-HyCoSy与4D-HyCoSy检查的临床灵敏度、特异度及准确率比较无统计学差异($P>0.05$),但是3D-HyCoSy、4D-HyCoSy检查与LDT的诊断结果一致性尚可(Kappa=0.698、0.816)。

3 讨论

女性不孕的常见因素有宫颈因素(宫颈发育异常、炎症、赘生物)、子宫畸形(子宫先天发育畸形、子宫内膜炎、子宫内膜息肉、子宫内膜粘连、子宫肌瘤、子宫腺肌症、子宫内膜耐受)、输卵管因素(发育不全、炎症、输卵管周围病变)、卵巢因素(多囊卵巢、发育不全、卵巢排卵障碍等)、内分泌、全身因素和心理应激等^[6-10]。评估卵巢位置可以提供关于分布和形状的初步信息帮助操作者选择合适的初始平面和必要的检查方法^[11]。傅芬等^[12]认为多模式经阴道造影剂增强超声在输卵管通畅性和子宫病变评价方面具有较高的准确性和一致性。李诗雨等^[13]研究表明联合灰阶超声、超声造影及剪切波弹性成像多模态超声有助于诊断良恶性非肿块乳腺病变,具有较

高的诊断敏感度、特异度、阳性预测值、阴性预测值。张珊珊等^[14]研究表明HyCoSy输卵管伞端造影剂溢出且时间越短,患者不孕治疗后妊娠成功率越高。王瑞等^[15]认为3D-HyCoSy中造影剂推注压力峰值的大小与输卵管的通畅程度存在相关性。周学刚等^[16]研究结果表明3D-HyCoSy诊断输卵管通畅性能较全面地反映输卵管的整体形态、内部结构,诊断效率明显提升。蔡泓等^[17]研究认为子宫输卵管碘油造影术可以诊断出输卵管开放的不孕女性合并较多的输卵管微小病变情况。周敏霞等^[18]研究显示宫腔镜联合HyCoSy能提高诊断输卵管性不孕症准确率。古淑芳等^[19]评估多模态3D-HyCoSy与LDT结果,一致性检验良好(Kappa=0.832),多模态3D-HyCoSy降低输卵管通畅度的假阳性率。刘真真等^[20]评估结果显示超声造影显示通畅率为57.8%、通而不畅率为20.4%、不通率为14.2%、积水率为7.6%,超声诊断的准确性为82.5%(Kappa=0.595)。以上提示3D-HyCoSy技术可以诊断不孕症患者,对其后续治疗提供帮助,评估输卵管通畅性效果良好。刘晓志等^[21]研究结果表明,与LDT诊断结果比较,“一站式”HyCoSy造影诊断准确度、敏感度、特异度、阳性预测值、阴性预测值分别为95.5%、96.5%、93.0%、87.5%、93%,两种检查方式一致性较高(Kappa=0.926, $P<0.05$),提示“一站式”HyCoSy造影诊疗技术可以提高诊断女性生殖系统不孕症的临床诊断率。朱爱萍等^[22]报道以金标准为参考,4D-HyCoSy联合宫腔水造影诊断输卵管通畅性的特异度分别高于单纯4D-HyCoSy诊断结果。本研究结果显示,以LDT诊断结果为金标准,多模态HyCoSy诊断输卵管堵塞性病变的临床灵敏度、特异度及准确率分别高于3D-HyCoSy与4D-HyCoSy,与LDT诊断结果一致性良好(Kappa=0.912)。同时3D-HyCoSy、4D-HyCoSy检查与LDT的诊断结果一致性尚可(Kappa=0.698、0.816)。与刘玉君^[23]、Li^[24]、Qu^[25]等研究的4D-HyCoSy诊断输卵管不孕与“金标准”一致性较高。最后,笔者对宫腔水造影体会:宫腔水造影诊断宫腔内病变的准确性与宫腔镜相近,宫腔镜检查应限制在宫腔水造影失败的人群中,宫腔水造影是宫腔内病变的最佳筛查方法。

综上所述,多模态HyCoSy诊断输卵管堵塞性病变具有较高的临床灵敏度、特异度及准确率,分别高于3D-HyCoSy与4D-HyCoSy,与LDT诊断结果一致性良好,值得临床推广。

【参考文献】

[1] Grigovich M, Kacharia V S, Bharwani N, et al. Evaluating fallopian tube patency: what the radiologist needs to know[J]. Radiographics, 2021, 41(6): 1876-18961.

- [2] Zhang Y, Wang Q, Gao C, et al. Evaluation of the safety and effectiveness of tubal inflammatory drugs in patients with incomplete tubal obstruction after four-dimensional hysterosalpingo-contrast-sonography examination[J]. BMC Pregnancy Childbirth, 2022, 22(1): 395.
- [3] 袁怡清, 曹蕾, 曹力, 等. 经阴道实时三维超声子宫输卵管超声造影和X线子宫输卵管碘油造影在女性不孕症中的临床应用价值[J]. 中国妇幼保健, 2021, 36(21): 4997-4999.
- Yuan YQ, Cao L, Cao L, et al. Clinical value of transvaginal real-time 3D ultrasound hysterosalpingography and X-ray hysterosalpingography with iodine oil in female infertility [J]. Maternal Child Health Care of China, 2021, 36(21): 4997-4999.
- [4] 苏果, 车会会, 武林松, 等. 经阴道子宫输卵管四维超声造影联合抗HCG抗体评估不孕症输卵管通畅程度的临床研究[J]. 中国现代医学杂志, 2021, 31(18): 5-9.
- Su G, Che HH, Wu LS, et al. Clinical study on the evaluation of tubal patency in infertility by transvaginal hysterosalpingography combined with anti HCG antibodies [J]. Chinese Journal of Modern Medicine, 2021, 31(18): 5-9
- [5] Gu P, Yang X, Zhao X, et al. The value of transvaginal 4-dimensional hysterosalpingo-contrast sonography in predicting the necessity of assisted reproductive technology for women with tubal factor infertility [J]. Quant Imaging Med Surg, 2021, 11(8): 3698-3714.
- [6] Zheng W, Chen L, Chen S, et al. Value of ovarian positional assessment on 4D hysterosalpingo-contrast sonography[J]. Med Ultrason, 2022, 24(2): 167-173.
- [7] Bisogni FA, Galanti F, Riccio S, et al. 4D-HyCoSy performed in a reproductive center: retrospective analysis of pain perception, complications and spontaneous pregnancy rate after the technique[J]. Eur Rev Med Pharmacol Sci, 2021, 25(23): 7468-7475.
- [8] Narayanarao CV. A prospective observational 2D/3D/4D hysterosalpingo contrast sonography using mixture of lignocaine gel and normal saline as contrast in patients undergoing infertility investigations [J]. WFUMB Ultrasound Open, 2023, 11(2): 100004-100012.
- [9] 王蕾, 颜晓红, 林莉, 等. 高龄不孕患者降调后激素替代内膜准备方案对冻融胚胎移植周期妊娠结局的影响[J]. 吉林大学学报(医学版), 2020, 46(4): 810-815.
- Wang L, Yan XH, Lin L, et al. Effect of preparation plan of hormone replacement after down-regulation on pregnancy outcome of frozen-thawed embryo transfer cycle in advanced age infertile patients[J]. Journal of Jilin University (Medical Edition), 2020, 46(4): 810-815.
- [10] Zhang N, Liu Y, He Y, et al. Transvaginal four-dimensional hysterosalpingo-contrast sonography: Pain perception and factors influencing pain severity[J]. J Obstet Gynaecol Res, 2021, 47(1): 302-310.
- [11] Jin Y, Huang W, Qü Q, et al. Development of a nomogram for predicting intravasation before transvaginal 4-dimensional hysterosalpingo-contrast sonography [J]. Int J Womens Health, 2022, 14: 583-591.
- [12] 傅芬, 叶琴, 梁荣喜, 等. 多模态经阴道超声造影技术对输卵管通畅性的诊断价值[J]. 中华超声影像学杂志, 2023. DOI: 10.3760/cma.j.cn131148-20200327-00236.
- Fu F, Ye Q, Liang RX, et al. Diagnostic value of multimodal transvaginal contrast-enhanced ultrasound combined with negative intrauterine contrast-enhanced ultrasound in female infertility [J]. Chinese Journal of Ultrasonography, 2023. DOI: 10.3760/cmaj.cn131148-20200327-00236.
- [13] 李诗雨, 牛瑞兰, 王博, 等. 多模态超声在非肿块乳腺病变诊断中的应用[J]. 中国医学影像学杂志, 2022, 30(3): 230-234.
- Li SY, Niu RL, Wang B, et al. Application of multimodal ultrasound in the diagnosis of non-mass breast lesions[J]. Chinese Journal of Medical Imaging, 2022, 30(3): 230-234.
- [14] 张珊珊, 朱梦姣, 何青新, 等. 子宫输卵管超声造影剂输卵管伞端溢出时间预测不孕患者治疗后自然妊娠[J]. 中国计划生育学杂志, 2022, 30(2): 399-401.
- Zhang SH, Zhu MJ, He QX, et al. Time of tubal umbilical spill of uterine tubal ultrasound contrast agent to predict spontaneous pregnancy after treatment in infertile patients[J]. Chinese Journal of Family Planning, 2022, 30(2): 399-401.
- [15] 王瑞, 王金萍, 李燕, 等. 造影剂推注装置在子宫输卵管实时三维超

- 声造影中的应用[J]. 海南医学院学报, 2021, 27(1): 30-35.
- Wang R, Wang JP, Li Y, et al. Application of contrast agent pushing device in real-time 3D ultrasonography of the uterine tube[J]. Journal of Hainan Medical College, 2021, 27(1): 30-35.
- [16] 周学刚, 谢科, 张怡, 等. 经阴道实时三维超声子宫输卵管造影诊断输卵管通畅性的临床研究[J]. 中国优生与遗传杂志, 2021, 29(3): 402-404.
- Zhou XG, Xie K, Zhang Y, et al. Clinical study on the diagnosis of tubal patency by transvaginal real-time three-dimensional ultrasound hysterosalpingography[J]. Chinese Journal of Eugenics and Genetics, 2021, 29(3): 402-404.
- [17] 蔡泓, 刘倩, 于晓明, 等. 子宫输卵管造影在输卵管及盆腔微小病变中的诊断与治疗价值[J]. 中国妇产科临床杂志, 2022, 23(1): 73-74.
- Cai H, Liu Q, Yu XM, et al. Diagnostic and therapeutic value of hysterosalpingography in microscopic lesions of the fallopian tubes and pelvis[J]. Chinese Journal of Clinical Obstetrics and Gynecology, 2022, 23(1): 73-74.
- [18] 周敏霞, 杨清, 王迎春, 等. 宫腔镜联合子宫输卵管超声造影对不孕症诊治的临床价值[J]. 现代医学, 2021, 49(5): 501-505.
- Zhou MX, Yang Q, Wang YC, et al. Clinical value of hysteroscopy combined with hysterosalpingography in the diagnosis and management of infertility[J]. Modern Medicine, 2021, 49(5): 501-505.
- [19] 古淑芳, 王莎莎, 朱贤胜, 等. 多模式子宫输卵管超声造影的临床应用价值[J]. 中国超声医学杂志, 2021, 37(10): 1162-1164.
- Gu SF, Wang SS, Zhu XS, et al. Clinical application value of multimodal uterine tubal ultrasonography[J]. Chinese Journal of Ultrasound Medicine, 2021, 37(10): 1162-1164.
- [20] 刘真真, 韦瑶, 邓珊, 等. 经阴道实时三维宫腔输卵管超声造影成像技术评估输卵管通畅性的价值[J]. 生殖医学杂志, 2021, 30(3): 362-366.
- Liu ZZ, Wei Y, Deng S, et al. The value of real-time transvaginal three-dimensional hysterosalpingography to assess tubal patency[J]. Journal of Reproductive Medicine, 2021, 30(3): 362-366.
- [21] 刘晓志, 张天杰, 宋烨, 等. “一站式”子宫输卵管超声造影在不孕症诊疗中的应用价值探讨[J]. 同济大学学报(医学版), 2023, 44(1): 110-115.
- Liu XZ, Zhang TJ, Song Y, et al. The value of "one-stop" uterine tubal ultrasonography in the diagnosis and treatment of infertility[J]. Journal of Tongji University (Medical Edition), 2023, 44(1): 110-115.
- [22] 朱爱萍, 邓学东, 陈琰. 经阴道四维宫腔输卵管超声造影联合宫腔水造影对不孕症的诊断价值[J]. 川北医学院学报, 2022, 37(2): 205-208.
- Zhu AP, Deng XD, Chen Y. Diagnostic value of transvaginal 4-dimensional hysterosalpingography combined with hysterosalpingography for infertility[J]. Journal of Sichuan North Medical College, 2022, 37(2): 205-208.
- [23] 刘玉君, 谭庆英, 李汝斐, 等. 经阴道4D-HyCoSy在输卵管不孕诊断中的应用[J]. 影像科学与光化学, 2022, 40(3): 565-569.
- Liu YJ, Tan QY, Li RF, et al. Application of transvaginal 4D-HyCoSy in the diagnosis of tubal infertility[J]. Imaging Science and Photochemistry, 2022, 40(3): 565-569.
- [24] Li R, Qiu X, Chen X F, et al. Effects of hysterosalpingo-contrast sonography examination on endometrial receptivity among women with unexplained infertility[J]. Arch Gynecol Obstet, 2022, 306(3): 893-900.
- [25] Qu E, Zhang M, Ju J, et al. Is Hysterosalpingo-contrast sonography (HyCoSy) using sulfur hexafluoride microbubbles (SonoVue) sufficient for the assessment of fallopian tube patency? a systematic review and Meta-analysis[J]. J Ultrasound Med, 2023, 42(1): 7-15.

(编辑: 黄开颜)