Original Research Article

Conventional and magnetic resonance hysterosalpingography in assessing tubal patency

Mohit Agarwal*

Associate Professor, Department of Radiodiagnosis, Rohilkhand Medical College & Hospital, Bareilly, Uttar Pradesh, India

Received: 04-11-2021 / Revised: 26-12-2021 / Accepted: 15-01-2022

Abstract

Aim: Conventional and magnetic resonance hysterosalpingography in assessing tubal patency. **Material and methods:** 50 patients, age 20–40 years, for evaluation of tubal patency were included in the study. It includes patients referred for postoperative evaluation, following reversal of tubal ligation and recurrent spontaneous abortions. The examination was done on Day 7–Day 12 of the menstrual cycle.Under strict aseptic precautions, MRI-compatible plastic HSG 5 - F microcatheter with inflatable bulb was inserted into the lower uterine cavity. The bulb was inflated with 3 cc of distilled water and shifted to MRI scan 1.5 Tesla [GE] machine. T2 W (TR: 7120 ms, TE: 90 ms, flip angle 900, slice thickness 5 mm, matrix 256 × 256) axial, sagittal, and coronal sequences were done. **Results:** The comparative sensitivity, specificity, positive predictive value [PPV], negative predictive value [NPV], and diagnostic accuracy of MR HSG and cHSG were 100%, 99.08%, 100%, 97.5%, and 99.75%, respectively, and those of MR HSG and DL were 100%, 93.73%, 87.21%, 100%, and 96%, respectively. The Kappa agreement between MR HSG and cHSG was excellent [0.97] and a McNemar test value of 1 showed no statistical difference between the two procedures. **Conclusion:** MR HSG is a novel upcoming investigation method with very few pioneering studies at both national and international levels. This study is distinctive in the sense that it explores the utility and feasibility of HSG being done using MRI.

Keywords: Magnetic resonance, Hysterosalpingography, Tubal patency.

Introduction

Women presenting with infertility undergo many laboratory tests and imaging studies to exclude endocrine disturbances, con genital anomalies of the genital tract, uterine abnormality, and occlusion of the fallopian tubes. Current imaging techniques used to evaluate tubal patency include hysterosalpin- gography (HSG) under fluoroscopy and contrastenhanced hysterosalpingosonography. However, these imaging examinations pro- vide limited evaluation of congenital uterine malformation and extrauterine disease. MRI, by contradistinction, can offer a comprehensive anatomic survey and, potentially, can assess for tubal patency[1-4]. Because women with infertility may be referred to MR for diagnosis of uterine or extrauterine abnormality, the ability to simultaneously assess tubal patency would be beneficial.

Material and methods

50 patients, age 20–40 years, for evaluation of tubal patency were included in the study. It includes patients referred for postoperative evaluation, following reversal of tubal ligation and recurrent spontaneous abortions. The examination was done on Day 7–Day 12 of the menstrual cycle[5]. Patients who were dissent, uncooperative, and have active pelvic inflammatory disease and contraindications to MRI [pacemaker and cochlear implants] were excluded from the study. Proper informed consent was obtained from all the patients. The prospective controlled study was approved by the Institutional Ethics Committee.

All the patients were advised to abstain from sexual intercourse during the days after menstruation till the day of procedure so as to avoid any chance of pregnancy during the procedure. The patient was given oral mefanamic acid three times a day and a course of antibiotics [combination of ofloxacin and metronidazole] as premedication starting on the day before and continued two days post procedure.Under strict aseptic precautions, MRI-compatible plastic HSG 5 - F microcatheter with inflatable bulb was inserted into the lower uterine cavity. The bulb was inflated with 3 cc of distilled water and shifted to MRI scan 1.5 Tesla [GE] machine.

T2 W (TR: 7120 ms, TE: 90 ms, flip angle 900, slice thickness 5 mm, matrix 256 × 256) axial, sagittal, and coronal sequences were done.

Dynamic T1 Cube Coronal 5 phases were taken. (TR: 3.8 ms, TE: 1.8 ms, TI: 7 ms, flip angle 120, slice thickness 3.4 mm matrix 256 × 256). The first phase was imaged prior to saline infusion. Then, 10 ml of gadodiamide [1:100 dilution with 0.9% saline; Omniscan, GE Healthcare; 0.5 mmol/ml] was instilled and four successive phases were obtained. It demonstrates the endometrial cavity, tubal patency/block, and peritoneal spill, if any. Corresponding subtracted images were generated automatically.The patients were immediately mobilized to the fluoroscopy room and 10 ml of iodinated contrast iohexol [Omnipaque, GE Healthcare; 350 mg/ml] was instilled through the same catheter. The spot film was taken after which the balloon was deflated and the catheter was removed.Patients with unilateral or bilateral tubal blocks were subjected to DL in their next menstrual cycle as a part of routine subsequent evaluation and the findings were confirmed simultaneously. Patients with bilateral tubal patency were followed up in regular monthly intervals. If they failed to conceive after 3 months, they were subjected to DL as a part of further evaluation at the department of Obstetrics and Gynecology. The findings were confirmed during the procedure. Only one patient conceived in 2 months and was not included in this study as diagnostic laparoscopy was not performed for the patient.

Statistical analysis

Sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy were calculated for both MR HSG and cHSG. The results were compared using McNemar test and Kappa analysis using DL as the gold standard.

Results

A total of 50 patients were evaluated by MR HSG and by cHSG in the same sitting, followed by DL at intervals of 1–3 months. There were 28 cases of primary infertility (56%) and 22 cases of secondary infertility (44%). Among the patients with secondary infertility, 6

*Correspondence
Dr. Mohit Agarwal
Associate Professor, Department of Radiodiagnosis, Rohilkhand Medical College & Hospital, Bareilly, Uttar Pradesh, India.
E-mail: radiologistbly@gmail.com

patients [12%] had previous history of recurrent abortions, 10 patients [20%] had history of tubectomy or tubal ligation reversal, and 6 patients [12%] had infertility due to unidentified causes.

MR HSG

The results of MR HSG are tabulated in Table 1. Of the 50 patients, 20 patients had tubal blocks and 30 patients had bilateral patencies. Of the 20 patients, 16 patients had bilateral blocks and 4 patients had unilateral blocks, 2 in the right and 2 patients in the left tube. Considering

Table 1: Results of MR HSG

Infertility	Unilateral	Bilateral	Patent	Total
Primary	0	6	22	28
Secondary	4	10	8	22
Total	4	16	30	50

MR HSG: Magnetic resonance hysterosalpingography

The total number of tubes as 100 studied in 50 patients, 40 tubes were found to be blocked and 60 tubes were patent. Representative cases of bilateral tubal blocks and bilateral patencies are provided in, respectively. Determination of the sides was corresponding between the cHSG and MR-HSG in case of unilateral blocks. In one case, cHSG could identify spills from the right tube which was the only discordant case. The overall results of MR HSG, cHSG, and DL are tabulated in Table 2. The comparative results of MR HSG and cHSG and that of MR HSG and DL are shown in Tables 3 and 4, respectively.The comparative sensitivity, specificity, positive predictive value [PPV], negative predictive value [NPV], and diagnostic accuracy of MR HSG and cHSG were 100%, 99.08%, 100%, 97.5%, and 99.75%, respectively, and those of MR HSG and DL were 100%, 93.73%, 87.21%, 100%, and 96%, respectively.

The Kappa agreement between MR HSG and cHSG was excellent [0.97] and a McNemar test value of 1 showed no statistical difference between the two procedures.

Table 2: Results of MR HSG, conventional HSG, and D L

Type of HSG	U/L block	B/L block	Patent tubes	Total
MR HSG	4 (R1, L3)	16	30	50
X-ray HSG	5 (R2, L3)	15	30	50
DL	8 (R4, L4)	12	30	50

MR HSG: Magnetic resonance hysterosalpingography, X-ray HSG: X-ray hysterosalpingography, DL: Diagnostic laparoscopy, U/L: Unilateral, B/L: Bilateral, R: Right tubal block, L: Left tubal block

Table 3: Bilateral tubes: MR HSG vs X-ray HSG

MR HSG	X ray HSG		
	Positive	Negative	Total
Positive	39	1	40
Negative	0	60	60
Total	39	61	100

Table 4: Bilateral tubes: MR HSG vs DL

MR HSG	DL		
	Positive	Negative	Total
Positive	35	5	40
Negative	0	60	60
Total	35	65	80

MR HSG: Magnetic resonance hysterosalpingography, DL: Diagnostic laparoscopy

Discussion

The mean age of the patients was 25.8 years. The study was completed in all 50 patients with good patient compliance as against the previous studies conducted by Sadowski *et al*. and Winter *et al*. in which it was abandoned in 1/17 and 4/37 patients, respectively[6-8]. In our study, 60% of the patients had bilateral patencies and 40% had bilateral blocks which is similar to the study by Cipolla *et al*[9]. in which 65% patients had patent tubes and 35% patients had either unilateral or bilateral blocks.The first MR HSG trial dates back to 1996 when Fred *et al*[10]. evaluated its efficacy in 18 rabbit uterine horns. 4 of the fallopian tubes were ligated and 16 were left unaltered. cHSG correctly identified the presence and absence of spills in all 16and 4 cases, respectively. Sensitivity and specificity of MRHSG were 96.5% and 71%, respectively, for tubal blocks. There was no statistical difference between the cHSG and MR HSG results.

Frye *et al*[11]. in 2000 did a feasiblity study with a phantom simulating uterus, fallopian tubes, and surronding pelvic cavity using half Fourier RARE sequence. Weisner *et al*[12]. in 2001 published a preliminary report on MR HSG with a small sample size of 5 and concluded that MR HSG is a feasible technique that requires further studies.Among the cHSG group patients of our study, 20 patients had tubal blocks and 30 patients had tubal patencies. But a case of primary infertility which showed bilateral block in MR HSG was found to have a unilateral block in the cHSG and DL. This was the only case with discordance between MR and the cHSG. In all the other cases, the results were concordant between MR and cHSG.Sadowski *et al*[6]. in their study identified six patent tubes using MR HSG which appeared to be blocked as per the conventional methods, owing to the better resolution of MRI in MR HSG. However, James *et al*[12]. disagreed with the fact stating that the increased patency was only due to the plastic catheter and not because of the metallic cannula. It was not a confounding factor in our study as the same catheter was used in both MR HSG and cHSG except in one case where the balloon catheter was dislodged after MR HSG and thus proceeded with cHSG using a metallic cannula.Our results are also supported by the study conducted by Unterwerger *et al*[7]. in which 8 out of the 10 cases showed concordant results in both MR HSG and cHSG. Cipolla *et al*[9]. in 2016 did a study with 116 patients on 3T using time-resolved 3D sequence. The results showed patencies in 65%, unilateral blocks in 25%, and bilateral blocks in 9.8% patients and suggested MR with HSG as a one-stop investigation tool for infertility imaging.In DL, all patients with bilateral patency in MR HSG and cHSG were found to be patent. Among the patients with tubal blocks, 4had unilateral blocks and 16 had bilateral blocks. 8 patients with bilateral blocks in MR HSG were found to have unilateral blocks in DL. 8 patients with bilateral blocks in cHSG were found to have unilateral blocks in DL.We attribute the increased patency in DL to the fact that the tubes were opened during the previous two procedures as stated by Sadowski *et al*[6].He also identified associated findings of three cases of myomas, two cases of uterine anomalies [1 arcuate, 1 partial

septate], one hydrosalphinx, one endometrioma, and one atrophic ovary similar to our study.Our results are comparable with the study done by Winter *et al*[8]. in which 27 out of 33 patients had bilateral tubal patencies and 1 out of 6 patients had bilateral block which were confirmed using laparoscopy. In the same study, tubal catheterization was done in two patients and in three of the remaining six patients with bilateral tubal blocks, neither cHSG nor laparoscopy could be done. Fatemeh *et al*[14]. in their study stated that the sensitivity and specificity of HSG in detecting bilateral tubal patencies or tubal blocks were 92.1% and 85.7%, respectively. The PPV, NPV, and diagnostic accuracy were 98.2%, 67.7%, and 92.1%, respectively. Our results were comparable with the statistical values obtained in our study.

Conclusion

MR HSG is a novel upcoming investigation method with very few pioneering studies at both national and international levels. This study is distinctive in the sense that it explores the utility and feasibility of HSG being done using MRI.

Reference

1. Watrelot A, Hamilton J, Grudzinskas JG. Advanc- es in the assessment of the uterus and fallopian tube function. Best Pract Res Clin Obstet Gy- naecol 2003; 17:187–209
2. Levine D. Solving the problem: pelvic ultrasound with magnetic resonance imaging. Ultrasound Q 2006; 22:159–168
3. Woodward PJ, Wagner BJ, Farley TE. MR imag- ing in the evaluation of female infertility. Radio- Graphics 1993; 13:293–310
4. Imaoka I, Wada A, Matsuo M, Yoshida M, Kita- gaki H, Sugimura K. MR imaging of disorders associated with female infertility: use in diagno- sis, treatment, and management. RadioGraphics 2003; 23:1401–1421
5. Simpson Jr WL, Beitia LG, Mester J. Hysterosalpingography: A reemerging study. Radiographics 2006;26:419-31.
6. Sadowski EA, Ochsner JE, Riherd JM, Korosec FR, Agrawal G, Pritts EA, et al.MR hysterosalpingography with an angiographic time-resolved 3D pulse sequence: Assessment of tubal patency. AJR Am J Roentgenol 2008;191:1381-5.
7. Unterweger M, De Geyter C, Fröhlich JM, Bongartz G, Wiesner W. Three-dimensional dynamic MR-hysterosalpingography; a new, low invasive, radiation-free and less painful radiological approach to female infertility. Hum Reprod 2002;17:3138-41.
8. Winter L, Fröhlich JM,De Geyter C, et al. Feasibility of dynamic MR-hysterosalpingography for the diagnostic work-up of infertile women. Acta Radiol 2010;51:693-701.
9. Cipolla V, Pietrangeli D, Santucci D, Argirò R, de Felice C. Role of 3.0 tesla magnetic resonance hysterosalpingography in the diagnostic work-up of female infertility. Acta Radiol 2016;57:1132-9.
10. Lee FT,Chosy SG, Rappe AH, Shapiro SS, et al. MR hysterosalpingography in a rabbit model. J Magn Reson Imaging 1996;6:300-4.
11. Frye RE,Thomasson D. MR hysterosalpingography: Protocol development and refinement for simulating normal and abnormal fallopian tube patency—feasibility study with a phantom. Radiology 2000;214:107-12.
12. Wiesner W,Kaim A, Reese E, De Geyter C. Three-dimensional dynamic MR hysterosalpingography: A preliminary report. Eur Radiol 2001;11:1439-44.
13. Silberzweig JE. MR hysterosalpingography compared with conventional hysterosalpingography. AJR Am J Roentgenol 2009;192:W350.
14. Foroozanfard F,Sadat Z.Diagnostic value of hysterosalpin-gography and laparoscopy for tubal patency in infertile women. Nurs Midwifery Stud 2013;2:188-92

Conflict of Interest: Nil
Source of support: Nil