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Diagnostic Comparison of Agitated Saline Sonohysterosalpingography and Hysterosalpingography for Assessing Tubal Patency in Women with Infertility

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ABSTRACT

Background: Tubal disease is the leading cause of female infertility, especially in the developing world. Though HSG is still widely employed as a first-line imaging modality for tubal evaluation, it carries with it the risks of radiation and contrast. Sonohysterosalpingography (Sono-HSG) with agitated saline is less invasive.

Methods: A prospective observational study was carried out between October 2015 and June 2017 in the Obstetrics & Gynaecology and Radiodiagnosis departments of Anil Neerukonda Institute of Technology and Sciences, Puducherry. Fifty-four women with primary or secondary infertility aged 20–40 years were evaluated on the same day using both HSG and Sono HSG, followed by laparoscopy if blockage of the tubes was suspected by either test. The performance of both tests was compared in terms of sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

Results: The age of participants was 27 years in the mean and that of infertility was 4.1 years in the mean. Sono HSG was able to detect more uterine and ovarian abnormalities than HSG. Tubal patency was detected in 92.6% of tubes by Sono HSG and 90.7% by HSG. Compared to laparoscopy, Sono HSG had 100% sensitivity, 85.7% specificity, 87.5% PPV, and 100% NPV, beating HSG in specificity and PPV. False positives were lower with Sono HSG.

Conclusion: Sono HSG is a cost-effective, safe, and reliable modality for the primary assessment of infertility and could be used as a first-line diagnostic technique in suitably equipped centers.

Key-words: Infertility, Sonohysterosalpingography, Hysterosalpingography, Tubal patency, Agitated saline, Laparoscopy

INTRODUCTION

Infertility, the failure to conceive after one year of normal unprotected intercourse, is a worldwide health concern that impacts 10–15% of couples. Although most healthy young couples should become pregnant in one year, about 50 to 80 million individuals worldwide have been affected by infertility in their reproductive lifespan.

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Access this article online https://iijls.com/ In pronatalist cultures of countries like India and most of South Asia, infertility has severe social and psychological implications, particularly for women. Even with its impact, infertile couples in most of these countries, who are commonly bound by illiteracy and poor socioeconomic standards, fail to utilize medical care, underscoring the critical necessity for extensive and affordable education and health interventions that address infertility ^[1,2].

During the last few decades, though the general prevalence of infertility has not changed significantly, the diagnostic and therapeutic strategies have transformed dramatically. The introduction of assisted reproductive technologies (ARTs), such as in vitro fertilization (IVF), has greatly enhanced results, especially in couples with

severe tubal disease or male factor subfertility. At the same time, shifting social patterns like delayed childbearing and heightened public awareness have fueled an increase in couples seeking medical evaluation and treatment for infertility ^[3,4].

Tubal factor infertility is still one of the most common causes of infertility in women, representing about 30% of all female infertility. Determination of the patency of the fallopian tubes is therefore an essential part of the evaluation of infertility. Conventional diagnostic methods involve hysterosalpingography (HSG) and laparoscopy, the latter being the gold standard. Laparoscopy, however, is invasive with attendant risks of surgery and anesthesia, whereas HSG subject's patients to the hazards of ionizing radiation and complications associated with contrast material. These drawbacks have stimulated the search for alternative, safer, and less expensive diagnostic methods ^[5,6].

Advances in ultrasound technology have made Sono-HSG a promising non-invasive test for assessing tubal patency. Even though routine transvaginal sonography is not useful in evaluating tubal function, contrast agents like agitated saline have enhanced its use as a diagnostic tool ^[7]. Agitated saline consists of air and saline that creates microbubbles and produces increased echogenicity, which allows easier imaging of tubal spillage and patency of the lumen on sonography. Although newer commercial contrast media such as ECHOVIST and SONOVUE are available for better imaging, their prohibitive cost and limited availability limit their use for routine purposes, including in resource-constrained environments.

Agitated saline in this setting represents an encouraging, inexpensive option for tubal evaluation. While numerous studies have compared Sono-HSG with agitated saline in several environments, scarce data regarding the Indian population are available ^[8]. This study intends to assess the diagnostic ability of Sono-HSG with agitated saline in evaluating tubal patency and comparing its effectiveness with routine hysterosalpingography in infertile Indian women.

MATERIALS AND METHODS

Study Design and Setting- The study was a prospective observational study that was carried out in the Departments of Radiodiagnosis and Obstetrics & Gynaecology of the Anil Neerukonda Institute of

Technology and Sciences, Visakhapatnam. The study was performed over a period between October 2015 and June 2017. The women visiting the infertility clinic of the Obstetrics & Gynaecology department constituted the study population.

Sample Size and Ethical Considerations- 54 women were enrolled on the study. The sample size was determined on the basis of a presumed difference in sensitivity between HSG and Sono-HSG with laparoscopy as the gold standard of reference. The hypothesized difference in sensitivity was assumed as 14% (99% for Sono-HSG and 85% for HSG), with 5% significance level and 80% statistical power. The research protocol was approved by the Institutional Research Council and Ethics Committee. Informed written consent was taken from all subjects before study enrollment.

Participant Selection- Females between 20 to 40 years of age who were presenting with primary or secondary infertility were taken to be eligible for recruitment. Participants were excluded based on suspected pregnancy, known malignancies of the reproductive tract, endocrine diseases like thyroid or pituitary dysfunction, and relative contraindications against the use of contrast studies. These contraindications included hypersensitivity to iodine-containing contrast media, asthma, severe renal impairment, dehydration, and active pelvic inflammatory disease.

Procedure for Sonohysterosalpingography- Sono-HSG was then carried out, with hysterosalpingography done on the same day to maintain consistency in testing conditions. The studies were conducted on the early proliferative phase of the menstrual cycle, usually between days 5 to 10. All the subjects were premedicated with 200 mg ibuprofen and an injection of Buscopan one hour before the procedure to reduce procedural discomfort as well as the possibility of spasms of the tubes.

Following the performance of a bimanual pelvic examination, an initial routine transabdominal ultrasound scan was done. It was followed by a transvaginal scan using an ACCUSON ultrasound machine that came with a 5 to 7.5 MHz curvilinear array transducer. The adnexa, ovaries, endometrial cavity, and uterus were assessed for baseline abnormalities. Under

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asepsis, a size 8 Foley catheter was placed in the endocervical canal, and the balloon was inflated with 2 ml of sterile water to hold the catheter in position.

The contrast medium used in the procedure was 10 ml of sterile saline strongly agitated with 10 ml of room air using a 20 ml syringe to produce microbubbles. This agitated saline was slowly instilled into the uterine cavity under observation for echogenic flow via the fallopian tubes and into the peritoneal cavity. The tubal patency was determined by tubal passage visualization and peritoneal spillage of the microbubble contrast. The uterine cavity was also searched for any structure or intracavitary pathology.

Procedure for Hysterosalpingography- After the Sono-HSG, HSG was also performed with 20 ml of an iodinated contrast medium, lohexol (300 mg iodine/ml), in fluoroscopic guidance. The evaluation comprised a review of the uterine contour, tubal shape, and confirmation of patency of the tubes based on a free spill of contrast into the peritoneal space.

Laparoscopic **Confirmation-**When either hysterosalpingography or Sono-HSG suggested blockage of the tubes. diagnostic laparoscopy with chromopertubation was undertaken for final assessment. The test used 10 ml of methylene blue dye diluted in 50 ml of saline to determine tubal patency. Fimbrial ends were checked for spillage of dye and the pelvic cavity for any other pathology. Each fallopian tube was examined individually and then compared among all three methods—Sono-HSG, HSG, and laparoscopy—to ascertain the accuracy of the non-invasive tests, with laparoscopy being the gold standard.

Statistical Analysis- Data collected from the research were entered and analyzed through GraphPad version 3.6 and SPSS software. Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy for Sono-HSG as well as hysterosalpingography in comparison to laparoscopy were computed.

RESULTS

The research took place at Anil Neerukonda Institute of Technology and Sciences, a tertiary care center, between October 2015 and June 2017, involving 54 women struggling with infertility who were referred from Visakhapatnam and Vizianagaram. The goal was to compare Sono-HSG using agitated saline against traditional HSG to evaluate tubal patency. All participants met specific inclusion and exclusion criteria. The statistical analysis concentrated on individual tubes, given the limited confirmation through laparoscopy.

Table 1: Patient Demographics (n=54)

| Characteristics | Categories | Number (%) | |
|-------------------------|-------------|------------|--|
| | 20–24 | 14 (25.9%) | |
| Age (years) | 25–29 | 26 (48.1%) | |
| | 30–34 | 10 (18.5%) | |
| | >35 | 4 (7.4%) | |
| Mean age | 27 years | - | |
| Infertility Duration | 1–4 years | 35 (64.8%) | |
| | 5–9 years | 15 (27.7%) | |
| | 10–14 years | 3 (5.5%) | |
| | >15 years | 1 (1.8%) | |
| Mean duration | 4.1 years | - | |
| | Primary | 50 (92.6%) | |
| Infertility Type | Secondary | 4 (7.4%) | |



Fig. 1: Age Distribution of Participants

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Fig. 2: Duration and Type of Infertility

Sono HSG found more uterine abnormalities (5 cases) compared to HSG (1 case), which included issues like fibroids, adenomyosis, and polyps. It also detected ovarian abnormalities (3 cases) that were only identified

by Sono HSG, such as PCOD and cysts. Additionally, HSG showed peritubal adhesions in one instance, which was later confirmed through laparoscopy.

| Modality | Uterine Abnormalities | Ovarian Abnormalities | Other Abnormalities |
|----------|--------------------------|--------------------------|-------------------------|
| Sono HSG | 5 | 3 | None |
| HSG | 1 | *Not assessed | 1 (Peritubal adhesions) |

Table 2: Uterine/Ovarian Abnormalities Detected (n=54)

We assessed tubal patency in 108 tubes from 54 patients. The Sono HSG method indicated a patency rate of 92.6% (100 out of 108 tubes), while the traditional HSG showed a slightly lower rate of 90.7% (98 out of 108). When we compared these results with laparoscopy, we found that it confirmed blockages in 8

tubes identified by Sono HSG and 10 tubes identified by HSG. Notably, Sono HSG had a better agreement with laparoscopy, showing 87.5% compared to 80% for HSG. The discrepancies we observed were mainly due to tubal spasms.

Table 3: Diagnostic Performance vs. Laparoscopy (Individual Tubes)

| Modality | Sensitivity | Specificity | PPV | NPV |
|----------|-------------|-------------|-------|------|
| Sono HSG | 100% | 85.7% | 87.5% | 100% |
| HSG | 100% | 75% | 80% | 100% |



a: HSG tubal patency results (n=108)



b: Laparoscopy results for Sono HSG blocked tubes (n=8)
 Fig. 3: Tubal Patency Results: Sono HSG vs. HSG







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This comparative study involving 54 women struggling with infertility (average age 27 years; 92.6% experiencing primary infertility) at a specialized care center found that Sono-HSG using agitated saline was able to identify significantly more uterine abnormalities (5 cases) and ovarian issues (3 cases) compared to traditional HSG (which found 1 uterine abnormality and couldn't assess the ovaries). Both methods showed impressive rates of tubal patency (Sono HSG: 92.6%, HSG: 90.7%), but when it came to laparoscopic correlation, Sono HSG had a better agreement rate (87.5% versus HSG's 80%) for detecting tubal blockages. Both techniques demonstrated 100% sensitivity and negative predictive value for tubal assessments, yet Sono HSG outperformed in specificity (85.7% compared to 75%) and positive predictive value (87.5% versus 80%). The discrepancies were linked to tubal spasms, reinforcing the idea that Sono HSG is a more accurate and comprehensive firstline diagnostic tool for infertility evaluations.

DISCUSSION

This study was done to assess the diagnostic accuracy of Sono-HSG with agitated saline versus conventional HSG in the assessment of tubal patency in infertile women. Tubal disease is still one of the most common causes of infertility, particularly in the developing world, where recurrent pelvic inflammatory disease significantly accelerates the risk. In Southeast and South Asia, HSG remains the first-line investigation for tubal evaluation in spite of its drawbacks such as radiation exposure, contrast reaction, and paucity in evaluating other pelvic structures. Laparoscopy, though thought to be the gold standard for establishing tubal patency, is invasive and necessitates anesthesia with no elaborate assessment of the uterine cavity or intrinsic tubal anatomy.

This research proved that Sono HSG identified more uterine and ovarian abnormalities than HSG, positing that it provides a better overall image of the female reproductive tract. Indeed, fibroids, adenomyosis, and polyps were detected by Sono HSG in five patients, whereas an abnormality was detected in only one patient using HSG. Also, ovarian pathologies such as polycystic ovarian disease and suspected endometrioma were identified solely by Sono HSG. These results concur with past studies such as Jeanty *et al.* ^[9] and Volpi *et al.* ^[10], who highlighted the increased diagnostic potential of

b: Laparoscopy results for HSG blocked tubes (n=10) **Fig. 4:** Laparoscopic Confirmation of Blocked Tubes

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Sono HSG in detecting the pertinent uterine and adnexal pathology.

It has been observed that, in the assessment of tubal patency, the current study demonstrated Sono HSG and HSG to be highly sensitive (100%) and have a negative predictive value of 100% compared to laparoscopic chromopertubation. Nonetheless, Sono HSG showed higher specificity (85.7% vs. 75%) and positive predictive value (87.5% vs. 80%) than HSG. Sono HSG and laparoscopy concordance (87.5%) in the current study were similar to those studies done by Volpi *et al.* ^[10]. and Chenia *et al.* ^[11], which found concordance rates of 89.3% and 85% respectively. The marginally improved diagnostic concordance of Sono HSG in our current study could be due to the employment of agitated saline, which has been noted to improve the visualization of tubal flow dynamics.

One observation of particular interest was the contribution of tubal spasm as a potential source of false-positive findings in both Sono HSG and HSG, which may account for variations in findings of tubal patency. In these situations, a repeat Sono HSG would be useful to separate true occlusion from transient spasm because the procedure is safe and does not damage reproductive capability. Laparoscopy was not done in all patients but only in those with suspicion of tubal block, which presents a probable selection bias when considering diagnostic accuracy parameters ^[12].

The results also show that the median length of infertility among the participants was 4.1 years, more than in similar research done by Volpi and Jeanty, yet with a lower mean age of 27 years. This is a demographic profile showing a younger population presenting with longer subfertility, which may have an impact on the clinical perspective toward diagnostic workup and management. Notably, Sono HSG was tolerable, with few complications being only mild cramping, compared to other research where occasional vasovagal responses were noted ^[13,14].

Another considerable benefit of Sono HSG is that it is non-invasive, free from ionizing radiation, and devoid of the requirement for contrast media capable of inducing allergic responses. The only limitation, however, is its operator dependency, which compromises diagnostic uniformity. With proper training and experience recommended at a minimum of 20 supervised studies clinicians can obtain reproducible and reliable results. A major logistical disadvantage of Sono HSG is the dynamic nature of the exam, making it challenging to interpret based on static images alone. Adding video recordings would overcome this challenge and enhance communication of results with referring clinicians ^[15].

SUMMARY

In summary, the current study supports the usefulness of Sono HSG as a safe, accurate, and informative first-line investigation in infertile women. Its better specificity, detection of other uterine and ovarian abnormalities, and high concordance with laparoscopy make it a viable competitor to HSG, particularly in institutions where complete and non-invasive investigation modalities are desirable.

CONCLUSIONS

In this conclusion, the prospective observational study of 54 infertile women showed that agitated saline Sono-HSG is a cost-effective, safe, and reliable modality for the evaluation of uterine anatomy and tubal patency. Equally accurate diagnostically, or superior in some parameters, compared with conventional HSG, Sono HSG was more sensitive for the detection of uterine anomalies and had greater specificity in measuring tubal occlusion. Notably, both modalities had no false negatives, although Sono HSG had fewer false positives, presumably because of transient tubal spasms. With its non-invasive nature, lack of radiation, and capacity to assess both the uterus and adnexa in a complete manner, Sono HSG is also recommended as the first-line diagnostic test in infertility workup, especially in institutions with trained transvaginal ultrasonography, while also recognizing that it will require large studies to confirm these results.

CONTRIBUTION OF AUTHORS

Researchconcept-TejaswiChalumuri,RadhaNimmakayalaResearch design- Tejaswi ChalumuriSupervision- Radha NimmakayalaMaterials- Tejaswi Chalumuri, Radha NimmakayalaData collection- Tejaswi Chalumuri, Radha NimmakayalaData analysis and interpretation- Radha NimmakayalaLiterature search- Tejaswi ChalumuriWriting article- Tejaswi Chalumuri, Radha NimmakayalaCritical review- Radha NimmakayalaArticle editing- Tejaswi Chalumuri, Radha Nimmakayala

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Final approval- Radha Nimmakayala

REFERENCES

- Speroff L, Fritz MA. Female infertility. In: Clinical Gynaecologic Endocrinology and Infertility. 7th ed. Philadelphia: Lippincott Williams and Wilkins; 2005: 1014–54.
- [2] Tripathi N. Infertility among Indian women: emerging evidence and need for policy measures. International Institute for Population Sciences (IIPS). District Level Household and Facility Survey (DLHS-3), 2007–08: India. Mumbai: IIPS; 2010.
- [3] Jejeebhoy SJ. Infertility in India levels, patterns and consequences: priorities for social sciences. J Fam Welf. 1998; 44(2): 15–24.
- [4] Larsen U. Childlessness, subfertility, and infertility in Tanzania. Stud Fam Plann., 1996; 27(1): 18–28.
- [5] Inki P, Paolo P, Anttila L. Vaginal sonosalpingography in the evaluation of tubal patency. Acta Obstet Gynecol Scand., 1998; 77: 978–82.
- [6] Zvanca M, Vladereanu R, Andreani C. Infertility investigation through saline infusion sonohysterography. J Clin Med., 2007; 2: 01–04.
- [7] Agur AMR, Dalley AF. Pelvis and perineum. In: Grant's Atlas of Anatomy. 12th ed. Philadelphia: Lippincott Williams and Wilkins; 2009: 236–38.
- [8] Lindheim RS, Thomas CS, Winter K. Hysterosalpingography and sonohysterography: lessons in technique. AJR, 2006; 186: 24–29.
- [9] Jeanty P, Besnard S, Arnold A, Turner C, Crum P. Aircontrast sonohysterography as a first step assessment of tubal patency. J Ultrasound Med. 2000; 19: 519–27.

- [10]Volpi E, Zuccaro, Patriarca P. Transvaginal sonographic tubal patency testing using air and saline solution as contrast media in a routine infertility clinic setting. Ultrasound Obstet Gynecol., 1998; 7: 43–48.
- [11]Chenia F, Hofmeyer GJ, Moolla S, Oratis P. Sonographic hydrotubation using agitated saline: a new technique for improving fallopian tube visualisation. Br J Radiol., 1997; 70: 833–36. doi: 10.1259/bjr.70.836.9486049.
- [12]Marcos MR, Soares SR, Cancado ML, Camargos A. Hysterosalpingo contrast sonography (HyCoSy) with SH U 454 (Echovist) for assessment of tubal patency. Hum Reprod., 1998; 13: 3049–52.
- [13]Almeida C, Souza C, Reginatto F, Facin A. Hysterosonosalpingography and hysterosalpingography in the diagnosis of tubal patency in infertility patients. Rev Assoc Med Bras., 2000; 46(2): 342–45.
- [14]Kiyokawa K, Masuda H, Fuyuki T, Uchina N, Fukuda T.
 Three-dimensional hysterosalpingo-contrast sonography (3D-HyCoSy): an outpatient procedure to assess infertile women a pilot study. Ultrasound Obstet Gynecol., 2000; 16: 648–54. doi: 10.1046/j.1469-0705.2000.00327.x.
- [15]Ayida G, Chamberlain P, Barlow D, Golding S, Kennedy S. Is routine diagnostic laparoscopy for infertility still justified? A pilot study assessing the use of hysterosalpingo-contrast sonography and magnetic resonance imaging. Hum Reprod., 1997; 12: 1436–39. doi: 10.1093/humrep/12.7.1436.

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