Section: Miscellaneous

Original Research Article

A COMPARATIVE EVALUATION OF HYSTEROSALPINGOGRAPHY AND SALINE INFUSION SONOSALPINGOGRAPHY IN THE ASSESSMENT OF FEMALE INFERTILITY

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ABSTRACT

Background: Infertility affects an estimated 10–15% of reproductive-aged couples globally, with female factors contributing to 40–50% of cases. Tubal pathology accounts for 25–35% of female infertility, necessitating accurate diagnostic evaluation. While hysterosalpingography (HSG) has been the gold standard, saline infusion sonosalpingography (SIS) offers a radiation-free alternative with potential advantages in patient comfort and safety. **Materials and Methods:** This prospective observational study enrolled 67 women (aged 18–40 years) presenting with primary or secondary infertility. All participants underwent both HSG and SIS during the proliferative phase of their menstrual cycle. Diagnostic accuracy, procedural pain (measured by Visual Analogue Scale, VAS), patient satisfaction, and complication rates were systematically compared. **Result:** SIS demonstrated comparable diagnostic efficacy to HSG, with sensitivity and specificity of 79.69% and 100%, respectively, for tubal patency assessment. SIS detected uterine abnormalities in 38.81% of cases versus 25.37% by HSG. Patient-reported outcomes significantly favored SIS: 71.64% reported mild pain (VAS 1–3) compared to 8.96% with HSG ($p < 0.001$), and satisfaction rates were 92.54% versus 59.7% ($p < 0.001$). HSG was associated with universal radiation exposure and higher rates of infection (7.46% vs. 4.48%) and contrast reactions (2.99% vs. 1.49%). **Conclusion:** SIS emerges as a safer, better-tolerated, and diagnostically robust alternative to HSG for initial infertility evaluation. Its non-invasive nature, absence of ionizing radiation, and superior patient acceptance support its adoption as a first-line diagnostic modality, reserving HSG for cases requiring further clarification.

INTRODUCTION

Infertility, defined as the failure to conceive after 12 months of regular unprotected intercourse, represents a significant global health challenge affecting approximately 48 million couples worldwide.[1] The World Health Organization estimates that 10–15% of reproductive-aged couples experience infertility, with female factors contributing to 40–50% of cases.[2] Among female infertility etiologies, tubal pathology accounts for 25–35% of cases, often resulting from pelvic inflammatory disease, endometriosis, or prior pelvic surgery.[3]

The diagnostic evaluation of female infertility traditionally relies on assessment of tubal patency and uterine cavity integrity. Since its introduction in 1914, hysterosalpingography (HSG) has remained the cornerstone imaging modality for this purpose.[4] However, HSG carries several limitations including exposure to ionizing radiation, discomfort from cervical manipulation, and risks associated with iodinated contrast media.[5] These drawbacks have prompted investigation into alternative modalities such as saline infusion sonosalpingography (SIS), which utilizes ultrasound technology to visualize tubal patency and uterine abnormalities without radiation exposure.[6]

This study aims to comprehensively compare HSG and SIS in terms of diagnostic accuracy, procedural safety, and patient-reported outcomes to establish evidence-based recommendations for optimal infertility evaluation protocols.

Aims and Objectives

1. To compare the diagnostic performance of HSG and SIS in detecting tubal and uterine abnormalities in infertile women.
2. To assess the role of transcervical selective salpingography in resolving ambiguous HSG findings.
3. To evaluate patient comfort, pain, and satisfaction during and after both procedures.

MATERIALS AND METHODS

A prospective observational study was conducted over two years in the Departments of Radiodiagnosis and Obstetrics & Gynecology at SKIMS, Srinagar. Sixty-seven women aged 18–40 years presenting with primary or secondary infertility were enrolled. Exclusion criteria included male factor infertility, hormonal abnormalities, pelvic infections, recent uterine/tubal surgery, and contrast allergy.

Each participant underwent both HSG and SIS. HSG was performed in the proliferative phase (days 8–10) of their menstrual cycle, using iodine-based contrast under fluoroscopic guidance, and selective tubal cannulation was attempted in cases of proximal obstruction. SIS was conducted using transvaginal ultrasound following intrauterine instillation of sterile saline.

Pain was measured using the Visual Analogue Scale (VAS). Diagnostic parameters were compared against each other using HSG as the reference. Sensitivity, specificity, and patient-reported outcomes were analyzed using standard statistical tools.

1. **HSG Protocol:**

- Premedication with NSAIDs and prophylactic antibiotics
- Cervical cannulation using 8F Foley catheter
- Fluoroscopic imaging with water-soluble iodinated contrast
- Selective tubal cannulation attempted for proximal obstructions

2. **SIS Protocol:**

- Transvaginal ultrasound with 5–7MHz transducer
- Intrauterine instillation of 30–40mL sterile saline
- Real-time assessment of tubal spill and uterine cavity

****Outcome Measures****

Primary outcomes included:

1. **Diagnostic accuracy:** Sensitivity, specificity, PPV, NPV for tubal patency and uterine anomalies
2. **Patient comfort:** Pain scores (VAS 1–10), anxiety levels, satisfaction ratings
3. **Safety profile:** Radiation exposure, infection rates, allergic reactions

RESULTS

****Statistical Analysis****

Data analysis was performed using SPSS v26. Continuous variables were reported as mean ± SD; categorical variables as frequencies (%). Diagnostic test characteristics were calculated with 95% confidence intervals. Group comparisons used chi-square tests for categorical data and t-tests for continuous variables (significance at $p<0.05$).

The study population (n=67) had a mean age of 30.04 ± 4.61 years. Primary infertility accounted for 70.15% of cases, with mean infertility duration of 2.4 ± 1.1 years.

Diagnostic Findings:

- HSG: Normal in 59.7%, unilateral tubal block (19.4%), bilateral block (7.46%), hydrosalpinx (5.97%), and various uterine anomalies.
- SIS: Normal in 61.19%, bilateral tubal block (10.44%), unilateral block (7.46%), fibroids (7.46%), and endometrial polyps (2.98%).

Parameter	HSG (%)	SIS (%)	p-value
Normal findings	59.70	61.19	0.477
Tubal obstruction	26.86	17.90	0.032*
Uterine anomalies	25.37	38.81	0.008*

Diagnostic Accuracy of SIS Compared to HSG:

- Tubal Patency: Sensitivity 79.69%, Specificity 100%.
- Uterine Abnormalities: Sensitivity 100%, Specificity 90.48%.

Patient Experience:

- Mild pain: SIS (71.64%) vs HSG (8.96%).
- Severe pain: HSG (28.36%), SIS (0%).
- Satisfaction: SIS (92.54%), HSG (59.7%).

Metric	HSG (%)	SIS (%)	p-value
Mild pain (VAS 1–3)	8.96	71.64	<0.001***
Severe pain (VAS 7–10)	28.36	0.00	<0.001***
Patient satisfaction	59.70	92.54	<0.001***

Safety Profile: Radiation exposure and contrast reaction was exclusive to HSG. Infection and allergic reactions were slightly higher in HSG but not statistically significant.

DISCUSSION

The results of this study highlight key distinctions between HSG and SIS across various diagnostic and patient-centered parameters. HSG, as a time-honored technique, demonstrates robust performance in evaluating tubal patency and anatomical anomalies.

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It is especially useful in visualizing the tubal course and proximal occlusions, with the added therapeutic potential in selective salpingography. However, HSG is not without limitations. The use of ionizing radiation, iodinated contrast, and the associated procedural discomfort contribute to reduced patient compliance and increased anxiety. In contrast, SIS offers several benefits: it is devoid of radiation, employs readily available saline as contrast, and is generally better tolerated. It also allows for concurrent evaluation of adnexal structures, endometrial lesions, and real-time dynamic assessment of tubal flow.

The diagnostic accuracy data reinforce these distinctions. While both HSG and SIS demonstrate strong sensitivity and specificity, SIS surpasses HSG in detecting intrauterine pathology, likely due to its superior soft-tissue contrast and multiplanar visualization. Additionally, the absence of ionizing radiation makes SIS more suitable for younger patients and for repeated assessments. The complete absence of severe pain and significantly higher patient satisfaction further support the transition toward ultrasound-based imaging modalities for infertility evaluation.

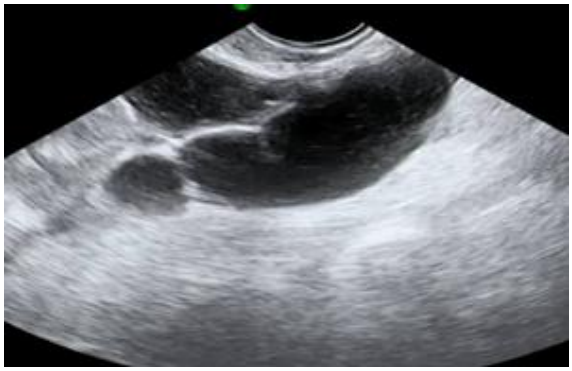
The significantly lower pain scores and higher satisfaction rates with SIS align with previous studies reporting mean VAS scores of 2.4 ± 1.6 for SIS versus 3.4 ± 1.9 for HSG.[7] The enhanced detection of uterine abnormalities by SIS (38.81% vs 25.37%) likely reflects its superior soft tissue resolution, particularly for endometrial polyps and submucosal fibroids.[8] This advantage is clinically significant as intrauterine pathologies are found in 10–15% of infertile women and may require hysteroscopic intervention.[9]

Notably, our study confirms the therapeutic potential of selective tubal cannulation during HSG, with successful recanalization achieved in 75% of proximal obstructions. This finding supports the judicious use of HSG in selected cases despite the overall advantages of SIS.[10-15]

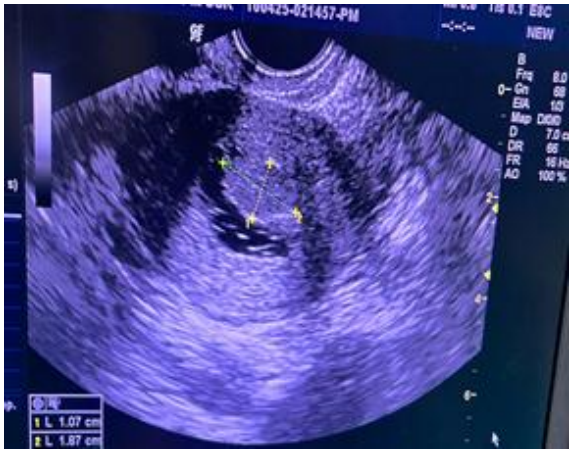
This study aligns with a growing body of literature advocating for the integration of SIS into standard infertility protocols. Moreover, as healthcare shifts toward patient-centered models, the improved comfort, safety, and efficiency of SIS highlight its value in clinical practice. Future studies should investigate cost-effectiveness at scale and assess long-term reproductive outcomes to further substantiate its widespread adoption.[16-20]

HSG reveals left tubal blockade

Selective tubal cannulaton left tube using microcatheter



SIS showing left Hydrosalpinx



SIS showing submucosal fibroid

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CONCLUSION

Based on the evidence presented, saline infusion sonosalpingography stands out as a compelling alternative to conventional hysterosalpingography for the initial assessment of female infertility. It demonstrates equivalent—if not superior—diagnostic capabilities for evaluating tubal patency and intrauterine pathology while offering significant advantages in terms of patient comfort, safety, and procedural simplicity. HSG continues to hold value, particularly in complex anatomical evaluations and therapeutic interventions such as selective salpingography. However, the future of infertility diagnostics is leaning toward minimally invasive, patient-preferred modalities like SIS.

Clinicians are encouraged to adopt a tiered approach, initiating investigations with SIS and reserving HSG or laparoscopy for inconclusive cases or where therapeutic benefits are anticipated. This strategy not only enhances diagnostic accuracy but also reduces patient anxiety, minimizes exposure to potentially harmful agents, and aligns with modern standards of patient-centered care. Broad adoption of SIS, supported by training and infrastructure, could revolutionize infertility workups and contribute to improved reproductive outcomes for women worldwide.

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