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**ORIGINAL ARTICLE**

# Correlation of Hysterosalpingography Findings with Laparoscopic Evaluation in Women with Primary Infertility

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## ABSTRACT

**Background:** Hysterosalpingography (HSG) is a commonly used first-line investigation for evaluating tubal patency in women with infertility.

**Objective:** To assess the correlation between HSG findings and laparoscopic evaluation in women with primary infertility and to determine the diagnostic accuracy of HSG in identifying tubal and pelvic abnormalities.

**Methodology:** This was a cross-sectional analytical study conducted at Lahore General Hospital from August 2021 to January 2022. A total of 110 women with primary infertility were enrolled in the study. A pre-designed proforma was used to record demographic details, HSG results, laparoscopic findings, and relevant clinical history. Eligible participants underwent a structured evaluation comprising HSG followed by diagnostic laparoscopy. HSG was performed in the follicular phase (day 7–10) using a standard technique with contrast dye.

**Results:** HSG revealed normal findings in 40.9% of participants, while 24.5% had unilateral block, 16.4% bilateral block, and 9.1% showed hydrosalpinx. Laparoscopy confirmed tubal patency in 36.4%, unilateral block in 22.7%, bilateral block in 18.2%, with additional findings including peritubal adhesions (11.8%) and endometriosis (7.3%). HSG demonstrated a sensitivity of 88.2%, specificity of 91.1%, and overall diagnostic accuracy of 89.4%, with a kappa agreement value of 0.77 indicating substantial agreement with laparoscopy. However, concordance for hydrosalpinx detection was low (40%).

**Conclusion:** HSG demonstrates good correlation with laparoscopic findings in evaluating tubal pathology among women with primary infertility. It is an effective initial screening tool due to its high sensitivity and non-invasive nature.

**Keywords:** Primary infertility, hysterosalpingography, laparoscopy, tubal block, pelvic adhesions.

## INTRODUCTION

Infertility, defined as the failure to achieve pregnancy after 12 months of regular unprotected intercourse, affects an estimated 10–15% of couples worldwide, with primary infertility constituting a significant proportion of these cases. Among women, tubal and peritoneal factors remain some of the most commonly identified causes, often secondary to pelvic inflammatory disease, endometriosis, previous pelvic surgery, or genital tuberculosis in developing countries[1]. Accurate and timely assessment of tubal patency and pelvic anatomy is therefore essential in the initial evaluation of female infertility. Infertility not only carries medical significance but also bears profound psychological, emotional, and social consequences for affected couples, particularly in patriarchal societies where childbearing is deeply intertwined with a woman's social identity[2]. In South Asian cultures, especially in countries like Pakistan and India, women with primary infertility often face stigma, social isolation, and even marital instability. Therefore, timely and accurate diagnosis is not just a clinical goal but a socio-cultural necessity[3]. Primary infertility, in contrast to secondary infertility, involves women who have never conceived despite adequate coital frequency and duration. Its etiology is frequently multifactorial, encompassing tubal, ovulatory, uterine, peritoneal, and even unexplained causes, necessitating a comprehensive yet tiered approach to evaluation[4]. In the context of tubal assessment, HSG is frequently the first-line investigation recommended by most infertility protocols, including those by the American Society for Reproductive Medicine (ASRM) and the Royal College of Obstetricians and Gynaecologists (RCOG)[5]. It utilizes contrast radiography to visualize the uterine cavity and fallopian tubes, typically performed between days 7 and 10 of the menstrual cycle. Its sensitivity and specificity for tubal obstruction have been variably reported in literature, with figures ranging from 65–85% and 70–90%, respectively. However, HSG can be misleading in cases of functional block (e.g., tubal spasm), or when hydrosalpinx or peritubal adhesions obscure accurate interpretation[6].

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Hysterosalpingography (HSG) has traditionally served as a first-line radiologic tool in the workup of infertility, offering valuable information on uterine contour, tubal patency, and gross pelvic adhesions. Its minimally invasive nature, outpatient feasibility, and lower cost make it a preferred screening modality, especially in low-resource settings[7]. However, HSG is limited by its inability to detect peritubal adhesions, subtle endometriosis, or functional tubal compromise, and it may yield false-positive or false-negative results, particularly in cases with tubal spasm or incomplete dye transit[8]. Laparoscopy with chromopertubation, on the other hand, allows real-time visualization of tubal anatomy and function, detection of peritoneal factors such as adhesions or endometriotic implants, and even identification of subclinical pathologies that are entirely missed by HSG[9]. Yet, despite its superior diagnostic yield, it is an operative procedure with associated risks, including infection, anesthesia complications, and visceral injury[10]. Furthermore, in low- and middle-income countries (LMICs), access to laparoscopic facilities, trained personnel, and affordability often limit its routine use, making HSG the more feasible, though imperfect, choice for initial assessment. Conversely, diagnostic laparoscopy with chromo-pertubation remains the gold standard for direct visualization of pelvic pathology, allowing comprehensive evaluation of the uterus, fallopian tubes, ovaries, and peritoneal cavity[11]. It not only confirms tubal patency but also provides therapeutic potential in the same sitting by enabling adhesiolysis, endometriotic lesion ablation, or correction of anatomical anomalies. However, it is invasive, requires general anesthesia, and carries procedural risks[12]. Recent studies have highlighted the discordance between HSG and laparoscopy findings, especially in cases where HSG suggests tubal blockage, but laparoscopy demonstrates patent tubes, or vice versa[13].

**Objective:** To assess the correlation between HSG findings and laparoscopic evaluation in women with primary infertility and to determine the diagnostic accuracy of HSG in identifying tubal and pelvic abnormalities.

## METHODOLOGY

This was a cross-sectional analytical study conducted at Lahore General Hospital from August 2021 to January 2022. A total of 110 women with primary infertility were enrolled in the study. Non-probability consecutive sampling was used to recruit eligible participants.

**Inclusion Criteria:**

- Women aged 20–40 years with a clinical diagnosis of primary infertility (no prior conception despite ≥12 months of unprotected regular intercourse).
- Patients who had undergone both Hysterosalpingography (HSG) and diagnostic laparoscopy as part of infertility workup.
- Normal baseline hormonal profile (FSH, LH, TSH, prolactin).

**Exclusion Criteria:**

- Women with known male factor infertility in their partners.
- Patients with secondary infertility (previous conception regardless of outcome).
- Previous pelvic surgery involving the uterus or adnexa.
- Incomplete or poor-quality imaging results from HSG or laparoscopy.

**Data Collection Procedure:** A pre-designed proforma was used to record demographic details, HSG results, laparoscopic findings, and relevant clinical history. Eligible participants underwent a structured evaluation comprising HSG followed by diagnostic laparoscopy. HSG was performed in the follicular phase (day 7–10) using a standard technique with contrast dye. Findings were categorized into normal, unilateral block, bilateral block, hydrosalpinx, or uterine anomalies. Laparoscopy was scheduled within 3 months of the HSG and performed under general anesthesia. Chromopertubation with methylene blue dye was conducted to assess tubal patency, and pelvic structures were thoroughly evaluated for adhesions, endometriosis, or anatomical abnormalities.

**Data Analysis:** Data were analyzed using SPSS version 17. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were computed for continuous variables. The agreement between HSG and laparoscopy in detecting tubal pathology was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy. A p-value <0.05 was considered statistically significant.

## RESULTS

Data were collected from 110 patients, the mean age was 29.6 ± 4.8 years, and the average duration of infertility was 3.5 ± 1.9 years. The mean BMI was 24.8 ± 3.2 kg/m². A regular menstrual cycle was reported by 86.4% (n = 95) of participants. History of pelvic inflammatory disease (PID) was seen in 16.4% (n = 18), while 10.9% (n = 12) had a past history of tuberculosis. Dysmenorrhea was present in 32.7% (n = 36), and dyspareunia in 19.1% (n = 21). HSG findings revealed normal uterine cavity with bilateral patency in 40.9% (n = 45), unilateral tubal block in 24.5% (n = 27), bilateral tubal block in 16.4% (n = 18), hydrosalpinx in 9.1% (n = 10), and uterine cavity abnormalities in another 9.1% (n = 10). Laparoscopy confirmed bilateral patency in 36.4% (n = 40), unilateral block in 22.7% (n = 25), bilateral block in 18.2% (n = 20), peritubal adhesions in 11.8% (n = 13), endometriosis in 7.3% (n = 8), and hydrosalpinx in 3.6% (n = 4), reflecting a broader detection of pelvic pathologies.

Unilateral block was detected by HSG in 27 patients and confirmed in 25 via laparoscopy (92.6% concordance), while bilateral block was detected in 18 and confirmed in 20 (83.3% concordance). However, hydrosalpinx showed poor agreement HSG detected 10 cases while laparoscopy confirmed only 4, giving a low concordance rate of 40.0%.

Sensitivity was 88.2%, specificity 91.1%, and the overall accuracy stood at 89.4%. The positive predictive value (PPV) was 84.3%, while the negative predictive value (NPV) was high at 93.3%, suggesting it was particularly reliable for ruling out disease. The kappa coefficient (κ = 0.77) indicated substantial agreement between HSG and laparoscopy, affirming HSG's utility as a non-invasive screening tool for tubal patency.

Table 1: Demographic and Clinical Characteristics of Participants (n = 110)

| Characteristic | Mean ± SD / n (%) |
|---|---|
| Age (years) | 29.6 ± 4.8 |
| Duration of Infertility (years) | 3.5 ± 1.9 |
| BMI (kg/m²) | 24.8 ± 3.2 |
| Menstrual Cycle (Regular) | 95 (86.4%) |
| History of Pelvic Inflammatory Disease (PID) | 18 (16.4%) |
| Previous Tuberculosis | 12 (10.9%) |
| Dysmenorrhea | 36 (32.7%) |
| Dyspareunia | 21 (19.1%) |
| HSG Finding | |
| Normal uterine cavity & bilateral patency | 45 (40.9%) |
| Unilateral tubal block | 27 (24.5%) |
| Bilateral tubal block | 18 (16.4%) |
| Hydrosalpinx | 10 (9.1%) |
| Uterine cavity abnormality | 10 (9.1%) |
| Laparoscopic Finding | |
| Bilateral patent tubes (normal) | 40 (36.4%) |
| Unilateral tubal block | 25 (22.7%) |
| Bilateral tubal block | 20 (18.2%) |
| Peritubal adhesions | 13 (11.8%) |
| Endometriosis (any stage) | 8 (7.3%) |
| Hydrosalpinx | 4 (3.6%) |

Figure 1: Comparison of tubal findings in HSG vs Laparoscopy

Table 2: Diagnostic Correlation Between HSG and Laparoscopy (n = 110)

| Finding Type | Detected by HSG | Confirmed by Laparoscopy | Concordance (%) |
|---|---|---|---|
| Bilateral patency | 45 | 40 | 88.9% |
| Unilateral block | 27 | 25 | 92.6% |
| Bilateral block | 18 | 20 | 83.3% |
| Hydrosalpinx | 10 | 4 | 40.0% |
| Uterine abnormality | 10 | Not evaluated by lap | – |

Table 3: Diagnostic Accuracy of HSG Compared to Laparoscopy

| Parameter | Value (%) |
|---|---|
| Sensitivity | 88.2% |
| Specificity | 91.1% |
| Positive Predictive Value (PPV) | 84.3% |
| Negative Predictive Value (NPV) | 93.3% |
| Overall Accuracy | 89.4% |
| Kappa Agreement (κ) | 0.77 (Substantial agreement) |

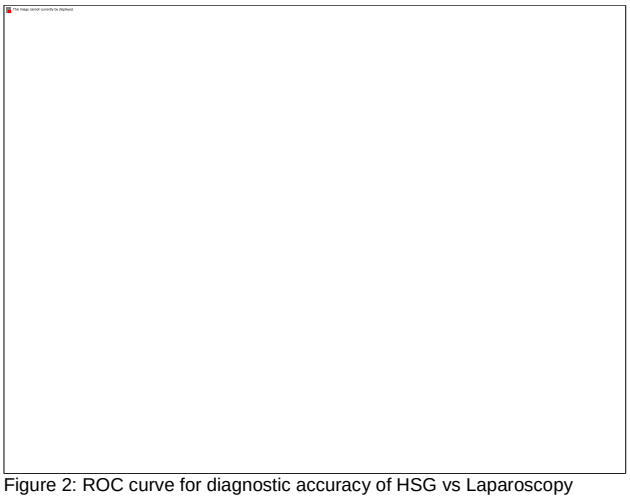

Figure 2: ROC curve for diagnostic accuracy of HSG vs Laparoscopy

## DISCUSSION

This study was conducted to assess the diagnostic correlation between Hysterosalpingography (HSG) and laparoscopy in evaluating tubal and pelvic pathology in women with primary infertility. Our results demonstrated that HSG has a high diagnostic accuracy when compared to laparoscopy, with a sensitivity of 88.2%, specificity of 91.1%, and an overall agreement of 89.4%. These findings support the utility of HSG as a first-line investigation in infertility workup, particularly in settings where access to laparoscopy is limited. The most common finding on HSG was normal tubal patency (40.9%), followed by unilateral (24.5%) and bilateral tubal block (16.4%). These findings were largely consistent with laparoscopic observations, which reported normal tubes in 36.4%, unilateral block in 22.7%, and bilateral block in 18.2% of cases. The high concordance for tubal obstruction suggests that HSG is a reliable non-invasive modality for assessing tubal patency. The kappa statistic of 0.77 in our study further indicates a substantial agreement between the two modalities. However, discrepancies were noted, particularly in the detection of hydrosalpinx [14]. HSG reported hydrosalpinx in 10 patients, whereas laparoscopy confirmed it in only 4 cases, reflecting a low concordance of 40%. This likely stems from the limitations of HSG in differentiating between tubal dilatation and actual functional obstruction [15]. False positives may occur due to mucosal folds or contrast pooling, while peritubal adhesions may lead to false negatives. These findings align with previous research, which also reported poor sensitivity of HSG in detecting peritubal adhesions and endometriosis [16]. Notably, laparoscopy identified additional pathologies that HSG could not, including peritubal adhesions (11.8%) and endometriosis (7.3%). These conditions are often missed on HSG due to its inability to assess peritoneal surfaces. This underlines the value of laparoscopy as a comprehensive diagnostic tool, especially in patients with unexplained infertility, pelvic pain, or previous pelvic inflammatory disease [17]. These observations are consistent with previous research, which has shown that nearly 20–30% of women with normal HSG may still have significant pelvic pathology on laparoscopy [18]. In this study, 10 patients also had uterine cavity abnormalities on HSG, such as irregular contours or suspected septa [19]. However, these findings could not be correlated as laparoscopy does not directly visualize the uterine cavity unless combined with hysteroscopy [20-21]. This indicates the need for adjunctive imaging or hysteroscopic evaluation in select cases with suspected intrauterine pathology. Despite the strengths of HSG in screening for tubal patency, the findings of our study reiterate that HSG cannot fully replace laparoscopy, especially for diagnosing subtle or extra-tubal pelvic conditions. Hence, laparoscopy should be considered in patients with abnormal HSG, longstanding infertility, or failed assisted reproductive interventions such as intrauterine insemination (IUI).

## CONCLUSION

It is concluded that Hysterosalpingography (HSG) demonstrates good correlation with laparoscopic findings in evaluating tubal pathology among women with primary infertility. With high sensitivity and specificity, HSG proves to be a valuable, non-invasive, and cost-effective first-line tool in the infertility workup, particularly effective in detecting tubal patency and occlusion. However, HSG has limited ability to identify peritubal adhesions, endometriosis, and other subtle pelvic abnormalities. Laparoscopy remains essential for confirming subtle pelvic pathologies missed on HSG, supporting its role as the definitive diagnostic modality in infertility assessment. Therefore, while HSG may be effectively used for initial screening, especially in low-resource settings, diagnostic laparoscopy should be considered in cases with abnormal HSG results, high-risk clinical history, or unexplained infertility.

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