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HYSTEROSALPINGOGRAPHIC FINDINGS OF THE UTERUS AND FALLOPIAN TUBES IN WOMEN WITH INFERTILITY: A CROSS-SECTIONAL STUDY

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Abstract

Background: *Infertility is a major reproductive health concern worldwide. Hysterosalpingography (HSG) is a widely used imaging modality for evaluating uterine cavity abnormalities and fallopian tube patency in infertile women.*

Objective: *To assess uterine and fallopian tube findings on hysterosalpingography among infertile women.*

Methods: *This descriptive cross-sectional study was conducted at the Department of Radiology, Mardan Medical Complex, Pakistan. A total of 115 infertile women aged 18–45 years were enrolled through convenience sampling. Women with primary and secondary infertility underwent HSG for evaluation of uterine and tubal abnormalities. Data were collected using a structured questionnaire comprising demographic and clinical characteristics, HSG findings, uterine abnormalities, tubal findings, peritoneal spill, and overall HSG diagnosis. Data were analyzed using SPSS version 26.0 and $p < 0.05$ was considered statistically significant.*

Results: *The mean age of participants was 28.86 ± 5.84 years, and 64.3% were aged 25–35 years. Primary infertility was present in 63.5% of women, while 60.9% had infertility for 1–3 years. Overall, 82 (71.3%) women had normal HSG findings, whereas 33 (28.7%) showed abnormalities. Tubal pathology (25.2%) was markedly more common than uterine pathology (3.5%). Distal tubal obstruction (13.0%) was the most frequent abnormality, followed by proximal obstruction (10.4%), while hydrosalpinx was identified in 11.3% of participants. Duration of infertility was significantly associated with abnormal HSG findings ($p = 0.011$), whereas age, marital duration, and infertility type showed no significant associations ($p > 0.05$).*

Conclusion: *Most infertile women had normal HSG findings; however, tubal abnormalities were the predominant structural abnormality. A longer duration of infertility was associated with abnormal HSG findings, supporting the role of HSG as an effective first-line investigation in the evaluation of female infertility.*

INTRODUCTION

Infertility is a major reproductive health problem affecting nearly one in six individuals of reproductive age worldwide and globally, an estimated 60–80 million couples are affected by infertility (1). Fertility problems are thought to affect about ten to fifteen percent of couples globally, with female infertility reasons responsible

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for roughly half of these occurrences (2). The World Health Organization (WHO) gives a statement that a woman with good reproductive health is part of a country with complete physical, mental, and social well-being(3). Developing nations frequently experience severe stigma associated with infertility, especially in South Asia(4).

There are two types of conditions that might cause infertility: those that impact women, including abnormalities of the uterus, blocked fallopian tubes, or inability to ovulate, and those that impact men, like poor semen parameters(5). Semen examination of the male spouse should be the first step in evaluating an infertile pair. Examination should then proceed with the female partner if the semen analysis is within the usual normal limit(6).The most frequent cause of female infertility is tubal blockage that accounts for thirty to fifty percent cases of female infertility and the causes include pelvic inflammatory disease, endometriosis, blockage or obstruction at any level of the fallopian tubes, Tuberculosis, endosalpingeal destruction, adhesions around the fallopian tubes due to inflammation, ectopic pregnancy, and any surgery of abdomen and pelvis. The uterine cavity-related causes of infertility include polyps, endometrial fibroids, congenital Müllerian abnormalities, and intrauterine adhesions or synechia (7). Age related reduction in fertility highlight the effect of female age on reproductive potential(8).

Infertility is associated with significant psychological distress, marital discord, and substantial medical, social, and financial burden (9). It affects approximately one in six couples and often necessitates specialist evaluation and management. Assessment of fallopian tube patency is a fundamental step following initial workup, which includes detailed history, physical examination, semen analysis, and ovulatory function assessment (10). Tubal and peritoneal abnormalities are evaluated using multiple imaging modalities, including fluoroscopy, laparoscopy, saline infusion sonography, and hysterosalpingography (HSG). HSG is commonly employed as the first-line diagnostic investigation due to its simplicity, diagnostic accuracy, low complication rate, and cost-effectiveness, whereas laparoscopy remains the gold standard for comprehensive assessment of tubal patency and pelvic pathology. HSG provides important diagnostic information regarding the luminal patency, morphology, and internal architecture of the fallopian tubes(11). Despite advancements in gynecological imaging in developed countries, HSG continues to be widely used as an initial diagnostic modality for evaluation of the female reproductive tract, particularly in low-resource settings, due to its accessibility and affordability (12).

This study aims to assess uterine and fallopian tube findings on hysterosalpingography among infertile women.

Materials and Methods

This cross-sectional study was conducted in the Radiology Department of Mardan Medical Complex from January to April 2026. Informed verbal consent was obtained from all participants prior to inclusion, along with institutional approval from the ethical review board of MTI Bacha Khan Medical College. Women aged 18–45 years with primary or secondary infertility referred for hysterosalpingography were included consecutively. Patients undergoing HSG for post-operative follow-up and those with iodinated contrast media allergy were excluded.

The sample size of 115 was calculated using OpenEpi (www.openepi.com) at a 95% confidence level, 5% margin of error, and an anticipated frequency of 8.1%. Data were collected using a structured questionnaire comprising demographic and clinical characteristics, HSG findings, uterine abnormalities, tubal findings, peritoneal spill, and overall HSG diagnosis.

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Data analysis was performed using SPSS version 26.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Associations between variables were assessed using the Chi-square test. A p-value < 0.05 was considered statistically significant.

Results

A total of 115 infertile women were enrolled in the study. Most participants were aged 25–35 years (64.3%), had a marital duration of 1–3 years (47.0%), and experienced primary infertility (63.5%). The duration of infertility was predominantly 1–3 years (60.9%). Nearly half of the participants (45.2%) reported no relevant medical history, while irregular menstrual cycles (16.5%) and a history of miscarriage (15.7%) were the most commonly reported clinical conditions. Detailed demographic and clinical characteristics of the study population are presented in Table 1.

Table 1: Demographic and clinical characteristics of the study participants

Variables	Categories	Value n (%)
Age in years	<25	24 (20.9)
	25-35	74 (64.3)
	35-45	17 (14.8)
Marital duration in years	1-3	54 (47.0)
	4-6	28 (24.3)
	>6	33 (28.7)
Type of infertility	Primary Infertility	73 (63.5)
	Secondary Infertility	42 (36.5)
Duration of infertility in years	1-3	70 (60.9)
	4-6	21 (18.3)
	>6	24 (20.9)
Medical history	No relevant medical history of patient	52 (45.2)
	PID or STI	4 (3.5)
	Previous abdominal or pelvic surgery	10 (8.7)
	History of ectopic pregnancy	4 (3.5)
	History of uterine fibroid or endometrial polyp	2 (1.7)
	Irregular menstrual cycles	19 (16.5)
	History of miscarriage	18 (15.7)
	PCOS	6 (5.2)

PID: Pelvic inflammatory disease, STI: Sexually transmitted infection, PCOS: Polycystic ovary syndrome

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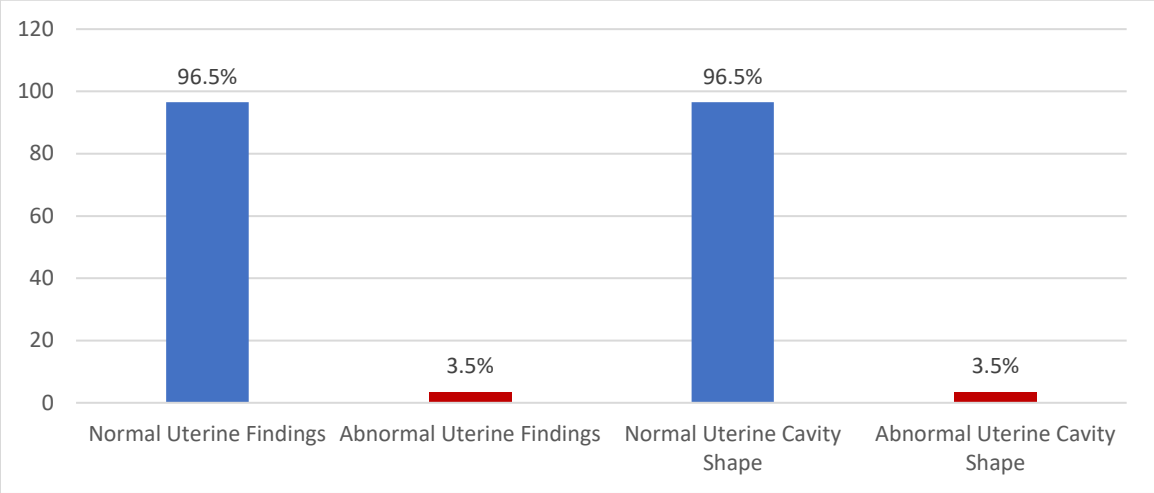

Figure 1: Uterine cavity shape and appearance findings in percentages

Most participants (96.5%) demonstrated a normal uterine cavity appearance and normal triangular uterine cavity configuration, whereas 4 women (3.5%) were diagnosed with a bicornuate uterus (Figure 1).

Tubal abnormalities were identified in 29 women (25.2%). Right-sided tubal blockage was observed in 11.3%, left-sided blockage in 6.1%, and bilateral tubal blockage in 7.8% of participants. Among obstructed tubes, distal tubal obstruction (13.0%) was the most common site, followed by proximal obstruction (10.4%), whereas mid-tubal obstruction (1.7%) was uncommon. Hydrosalpinx was identified in 11.3%, while tubal morphology could not be adequately assessed in 13.9% of examinations. Free contrast spillage was demonstrated in 80.9% of right fallopian tubes and 86.1% of left fallopian tubes (Table 2).

Table 2. Uterine and fallopian tube findings on hysterosalpingography (N = 115)

Variables	Categories	Values n (%)
Tubal blockage	Right tubal blockage	13 (11.3)
	Left tubal blockage	07 (6.1)
	Bilateral Tubal Blockage	09 (7.8)
Obstruction site of blocked fallopian tube	No obstruction	86 (74.8)
	Proximal fallopian tube	12 (10.4)
	Mid fallopian tube	02 (1.7)
	Distal fallopian tube	15 (13.0)
Tubal appearance	Not assessable fallopian tube	16 (13.9)
	Normal fallopian tube	86 (74.8)
	Hydrosalpinx	13 (11.3)
	No spillage of contrast	22 (19.1)

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Contrast spillage from right fallopian tube	Free spillage of contrast	93 (80.9)
Contrast spillage from left fallopian tube	No spillage of contrast	16 (13.9)
	Free spillage of contrast	99 (86.1)

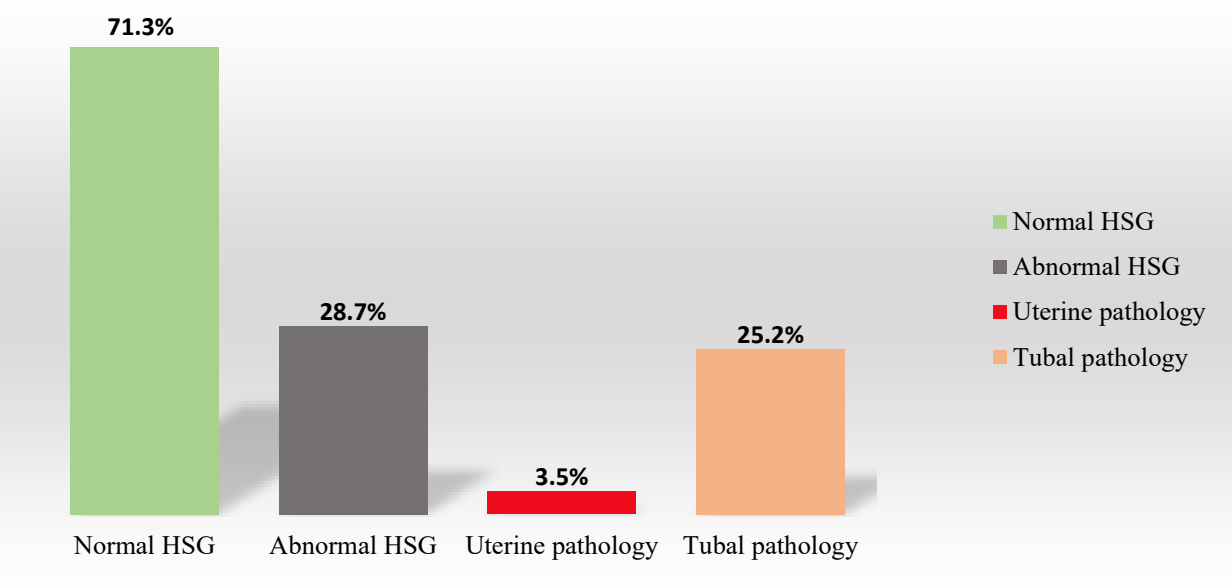

Figure 2: HSG result in percentages based on uterine and fallopian tube findings

Overall, 82 (71.3%) participants had normal HSG examinations, whereas 33 (28.7%) demonstrated abnormal findings. Tubal pathology represented the predominant abnormality (25.2%), while uterine abnormalities accounted for only 3.5% of cases (Figure 2).

There were no statistically significant associations between abnormal HSG findings and age (p = 0.101), marital duration (p = 0.115), or type of infertility (p = 0.380). In contrast, duration of infertility was significantly associated with abnormal HSG findings (p = 0.011), with women experiencing infertility for longer durations demonstrating a higher frequency of abnormal HSG abnormalities.

Similarly, infertility type was not significantly associated with uterine cavity appearance (p = 0.123), uterine cavity configuration (p = 0.123), tubal blockage (p = 0.502), site of tubal obstruction (p = 0.471), tubal appearance (p = 0.144), or the primary cause of infertility (p = 0.276). (Table 03).

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Table 3. Association of demographic characteristics and infertility type with HSG findings

Variables	Categories	HSG findings		p-value
		Normal	Abnormal	
		n (%)	n (%)	
Age in years	<25	21 (18.3)	3 (2.6)	0.101
	25-35	51 (44.3)	23 (20.0)	
	35-45	10 (8.7)	7 (6.1)	
Marital duration in years	1-3	42 (36.5)	12 (10.4)	0.115
	4-6	21 (18.3)	7 (6.1)	
	>6	19 (16.5)	14 (12.2)	
Infertility duration in years	1-3	57 (49.6)	13 (11.3)	0.011*
	4-6	12 (10.4)	9 (7.8)	
	>6	13 (11.3)	11 (9.6)	
Type of infertility	Primary infertility	50 (43.5)	23 (20.0)	0.380
	Secondary infertility	32 (27.8)	10 (8.7)	

* Statistically significant at p<0.05

No statistically significant association was observed between infertility type and uterine cavity appearance (p = 0.123), uterine cavity shape (p = 0.123), tubal blockage (p = 0.502), site of tubal obstruction (p = 0.471), or tubal appearance (p = 0.144). Likewise, the primary cause of infertility did not differ significantly between women with primary and secondary infertility (p = 0.276). Although tubal factor infertility was the most common abnormal finding among both groups, its distribution was comparable between primary and secondary infertility. Similarly, uterine abnormalities were identified only among women with primary infertility; however, the difference was not statistically significant (Table 4).

Table 4. Association between infertility type and hysterosalpingographic findings

Variable	Category	Primary infertility n (%)	Secondary infertility n (%)	p-value
Uterine cavity appearance	Normal	69 (60.0)	42 (36.5)	**0.123**
	Abnormal	4 (3.5)	0 (0.0)	
Uterine cavity shape	Normal triangular cavity	69 (60.0)	42 (36.5)	**0.123**
	Bicornuate uterus	4 (3.5)	0 (0.0)	
Tubal blockage	No tubal blockage	54 (47.0)	32 (27.8)	**0.502**
	Right tubal blockage	10 (8.7)	3 (2.6)	
	Left tubal blockage	3 (2.6)	4 (3.5)	
	Bilateral tubal blockage	6 (5.2)	3 (2.6)	

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Site of tubal obstruction	No obstruction	54 (47.0)	32 (27.8)	**0.471**
	Proximal	9 (7.8)	3 (2.6)	
	Mid tubal	2 (1.7)	0 (0.0)	
	Distal	8 (7.0)	7 (6.1)	
Tubal appearance	Normal	54 (47.0)	32 (27.8)	**0.144**
	Hydrosalpinx	6 (5.2)	7 (6.1)	
	Not assessable	13 (11.3)	3 (2.6)	
Primary cause of infertility	No abnormality	50 (43.5)	32 (27.8)	**0.276**
	Tubal factor infertility	19 (16.5)	10 (8.7)	
	Uterine factor infertility	4 (3.5)	0 (0.0)	

Discussion

The demographic profile and hysterosalpingography (HSG) results of 115 infertile women were assessed in this study. The mean age of the participants was 28.86 ± 5.84 years, and 64.3% of the women were in the 25–35 age range. This represents the predominance of women in the reproductive age group which reflects the natural peak fertility period and aligns with the study of Shermin et al. in which the mean age of the infertile women was 28.18 ± 5.69 years and the 25-29 years group consisted of the highest number of patients (30.7%)(13).

With regard to marital duration of patient, about half of the participants (47.0%) had been married for 1-3 years, this may suggest increasing awareness and early medical consultation among couples facing difficulty in conception. In terms of infertility duration, the majority of participants 70 (60.9%) had experienced infertility for 1-3 years which is comparable to previous study findings of Nishat et al. in which most patients had been infertile for 1-5 years(14). In contrast other study of Bhattarai et al. who reported longer durations of infertility, with a higher proportion (44.9%) of women experiencing infertility for 6-10 years (15). The distribution of infertility types showed that primary infertility (63.5%) was more prevalent than secondary infertility (36.5%). This finding is in agreement with previous investigations of Manandhar et el. in which primary infertility (78.57 %) was more common than secondary infertility (21.4%)(16). This pattern may reflect sociocultural influences, delayed conception, or underlying reproductive health issues affecting first-time conception. Conversely, some studies have reported higher rates of secondary infertility(17,18,19). These variations may be attributed to differences in study population characteristics (age, duration of marriage), sample size, and geographical factors.

Regarding medical history, (45.2%) cases showed no relevant medical history which is consistent with the study of Kamal et el. reporting similar findings (20). HSG findings in this study revealed that the majority of women (96.5%) had a normal uterine cavity in both appearance and shape, with only a small proportion (3.5%) showing congenital anomalies such as bicornuate uterus which shows similarity with the study findings of Bhattarai et al. in which uterine abnormalities were found in (8.8%) infertile women while congenital uterine anomalies were seen in (4.2%) infertile patients (15). Only one congenital anomaly, bicornuate uterus, was identified in this study, which is also in line with earlier reports (9). This suggests that uterine structural abnormalities are less frequent

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contributors to infertility in this population compared to other factors.

In contrast, tubal factors were more prominent. Although most participants (74.8%) had no tubal blockage, a notable proportion demonstrated right tubal blockage (11.3%), left tubal blockage (6.1%) and bilateral tubal blockage (7.8%). Distal tubal obstruction (13.0%) was more common than proximal or mid-tubal blockage, and hydrosalpinx was observed in 11.3% of cases (2-bilateral hydrosalpinx with distal block, 4-unilateral left hydrosalpinx ,7-unilateral right hydrosalpinx). These findings are consistent with the study findings of Onwuchekwa et el., where tubal pathology was recognized as a major contributor to female infertility (48%). Tubal obstruction was found to be more common on the right side (8.8%) than the left (7.6%). Distal fallopian tube obstruction was the most common form of tubal obstruction (21).

Overall hysterosalpingography results revealed that majority of participants (71.3%) showed no abnormality while (28.7%) findings were abnormal. This finding aligns with previous study of Abubakar et al. in which the commonest findings among infertile patients presenting for HSG were normal studies (62.41%), possibly indicating the involvement of non-structural factors such as hormonal or male-related causes of infertility(22). However, some studies have reported a higher proportion of abnormal findings (20). This variation may be attributed to differences in study population characteristics, timing of presentation, and inclusion criteria, with some studies involving high risk infertility cases leading to a higher proportion of abnormal findings. Among abnormal HSG findings, tubal pathology (25.2%) was significantly more common than uterine pathology (3.5%). This highlights the importance of HSG as a first-line diagnostic method, particularly in identifying tubal reasons of infertility in resource-limited settings.

In the present study, age, marital duration, and type of infertility were not significantly associated with HSG findings, whereas a longer duration of infertility was significantly associated with abnormal HSG results ($p = 0.011$). This finding suggests that prolonged infertility may reflect progressive underlying tubal or uterine pathology and supports previous studies reporting a similar association between longer infertility duration and abnormal HSG findings (2).

Our study found no significant association between the type of infertility and uterine cavity appearance, uterine cavity shape, tubal blockage, site of tubal obstruction, tubal appearance, or the primary cause of infertility. These findings suggest that structural uterine and tubal abnormalities can occur in both primary and secondary infertility, supporting the need for comprehensive HSG evaluation regardless of infertility type. In contrast, previous study of Mohammadzadehasl et al, shows significant associations of uterine pathology ($p = 0.018$) and tubal pathology ($p = 0.009$) with secondary infertility (17).

This study provides valuable local evidence on hysterosalpingographic findings in infertile women using a standardized HSG assessment. However, its single-center, cross-sectional design and relatively small sample size may limit the generalizability of the findings and preclude causal inference. Additionally, HSG findings were not routinely confirmed by laparoscopy or hysteroscopy. Despite these limitations, the study supports the role of HSG as a practical first-line investigation for evaluating uterine and tubal abnormalities in infertile women.

Conclusion

Hysterosalpingography remains a valuable first-line imaging modality for the evaluation of female infertility, particularly for detecting tubal pathology. In this study, most infertile women had normal HSG findings; however, tubal abnormalities were considerably more frequent than uterine abnormalities, with distal tubal obstruction being the predominant lesion. A longer duration of infertility was significantly associated with abnormal HSG findings, whereas age, marital duration, and infertility type showed no significant association. These findings emphasize the importance of timely HSG assessment in the infertility workup to facilitate early diagnosis and appropriate management of uterine and tubal abnormalities.

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Declarations

Ethics approval: Approved by the Ethical Review Board of MTI-BKMC, Mardan, Pakistan.

Consent to participate: Written informed consent was obtained from all participants.

Availability of data and materials: Available from the corresponding author upon reasonable request.

Funding: None.

Conflict of interests: The authors declare no competing interests.

Authors contributions: All authors contributed to the study conception, data collection, analysis, manuscript preparation, and approved the final manuscript.

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