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DIAGNOSTIC ROLE OF HYSTEROSALPINGOGRAPHY IN DETECTING TUBAL AND UTERINE CAUSES OF SECONDARY INFERTILITY IN MULTIPAROUS WOMEN

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Hysterosalpingography, secondary infertility, multiparous women, tubal blockage, hydrosalpinx, uterine abnormalities, peritubal adhesions.

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Abstract

Background: *Secondary infertility is a common reproductive health problem that may result from acquired tubal and uterine abnormalities. Hysterosalpingography (HSG) provides simultaneous assessment of uterine cavity morphology and fallopian tube patency.*

Objective: *To determine the pattern of HSG findings in multiparous women with secondary infertility and assess the frequency of tubal and uterine abnormalities and their association with selected reproductive factors.*

Methods: *A cross-sectional observational study was conducted among 60 multiparous women aged 20–45 years with secondary infertility at the Radiology Departments of Services Hospital and Jinnah Hospital, Lahore. Participants were selected using non-probability consecutive sampling. Data were collected through a structured proforma, clinical interviews, and review of HSG reports. HSG was performed during the early proliferative phase using water-soluble contrast under fluoroscopic guidance. Data were analyzed using descriptive statistics and Fisher's Exact test.*

Results: *The majority of participants were aged 30–34 years (43.3%), with a mean BMI of 25.68 ± 2.45 kg/m². Tubal patency was observed in 10.0%, unilateral blockage in 48.3%, and bilateral blockage in 41.7% of participants. Proximal blockage was the most frequent site of obstruction (33.3%). Unilateral hydrosalpinx was present in 51.7%, while moderate and mild peritubal adhesions each occurred in 36.7%. Fibroids were the most common uterine abnormality (28.3%), followed by polyps and irregular uterine cavity (18.3% each). Uterine factor and combined factor infertility were each identified in 36.7%, while tubal factor infertility accounted for 26.7%. Significant associations were found between tubal patency ($p=0.016$), peritubal adhesions ($p=0.036$), and uterine abnormality type ($p=0.019$) with final diagnosis. Site of tubal blockage ($p=0.288$) and hydrosalpinx ($p=0.062$) were not significantly associated with final diagnosis.*

Conclusion: *HSG is a valuable imaging modality for evaluating secondary infertility in multiparous women. It effectively demonstrates tubal obstruction,*

hydrosalpinx, peritubal adhesions, and uterine cavity abnormalities, providing important information for classification and further management of infertility.

INTRODUCTION

Infertility is recognized as a disease of the reproductive system and remains one of the most important reproductive health problems worldwide. It is characterized by the inability to achieve a clinical pregnancy despite 12 months of regular, unprotected sexual intercourse. The condition affects both males and females and may result from abnormalities involving the reproductive organs, hormonal regulation, gamete production, fertilization, or embryo implantation. Besides limiting reproductive potential, infertility has profound psychological, social, emotional, and economic consequences for affected couples, particularly in societies where childbearing is considered an important aspect of family life (Awonuga *et al.*, 2025)

In many parts of the world and some Western countries, social attitudes towards parenthood generate tremendous psychological stress in case of reproductive difficulties. Lack of access to specialized medical care, stigma associated with infertility, misconception, and high cost of assisted reproductive techniques make the situation even more complicated in both poor and wealthy countries.(Xie *et al.*, 2022)

Infertility is broadly classified into primary infertility and secondary infertility. Primary infertility refers to the inability to conceive in couples who have never achieved a pregnancy, whereas secondary infertility refers to the inability to achieve pregnancy following one or more previous conceptions, regardless of the pregnancy outcome. Secondary infertility is commonly associated with acquired reproductive tract disorders, including pelvic inflammatory disease, postpartum or post-abortal infections, intrauterine adhesions, previous pelvic surgery, endometriosis, and tubal damage. These conditions may alter the normal anatomy and physiological function of the uterus and fallopian tubes, thereby reducing the likelihood of successful conception. (Zafarjanovna, 2025)

Infertility is a multifactorial condition in females and may arise from ovulatory dysfunction, tubal disease, uterine abnormalities, endometriosis, and diminished ovarian reserve. Accurate identification of the underlying cause is essential because appropriate management and treatment depend largely on determining the specific etiology responsible for infertility. (Kasna and Agrawal, 2022)

The female reproductive system is a complex anatomical and physiological network responsible for ovulation, fertilization, implantation, and maintenance of pregnancy. It consists of the ovaries, fallopian tubes, uterus, cervix, and vagina, all of which function in a coordinated manner under hormonal regulation. The ovaries are responsible for ovum production and hormonal secretion, while the fallopian tubes facilitate ovum capture, fertilization, and transport of the zygote toward the uterine cavity.(Carson and Kallen, 2021)

After ovulation, the oocyte is released from the ovary and captured by the fimbrial end of the fallopian tube, where fertilization usually occurs in the ampullary region. The fertilized embryo is then transported through coordinated tubal ciliary movement and smooth muscle contractions toward the uterine cavity for implantation into a receptive endometrium.(Torchia and Persaud, 2024)

Tubal factor infertility occurs when this transport mechanism is disrupted due to structural or functional damage. Inflammatory processes such as pelvic inflammatory disease lead to destruction of tubal epithelium and cilia, resulting in impaired gamete transport. Chronic infection and healing responses cause fibrosis, tubal narrowing, or complete occlusion(El-Kharoubi, 2023). Hydrosalpinx formation further affects fertility by accumulating toxic fluid that may reflux into the uterine cavity and impair embryo implantation. Peritubal adhesions mechanically restrict tubal mobility and prevent normal ovum pickup.(Capmas, Suarthana and Tulandi, 2021)

Uterine factors contribute to infertility by interfering with implantation. Intrauterine adhesions reduce the functional endometrial surface area, while fibroids and endometrial polyps distort the uterine cavity, preventing proper embryo attachment. Congenital

anomalies and post-surgical scarring, including cesarean scar defects, alter uterine architecture and impair endometrial receptivity. These structural abnormalities disrupt the hormonal and vascular environment required for successful implantation, ultimately leading to implantation failure and secondary infertility. (Sallée *et al.*, 2022)

Infertility develops as a result of structural damage, inflammatory changes, and hormonal imbalance affecting the reproductive tract. Infections such as Chlamydia trachomatis and Neisseria gonorrhoeae trigger inflammatory responses that lead to tissue damage, fibrosis, and scarring within the fallopian tubes. Surgical procedures such as cesarean section or dilatation and curettage may cause intrauterine adhesions due to trauma to the basal endometrium.(Caven and Carabeo, 2023)

The reproductive system in females can be affected by physiological problems. These problems impact the functions and structure of the reproductive system. The key areas of focus are the diseases that affect female's reproductive health. The fallopian tube, vagina cervix, ovaries and uterus are some of the organs that can be impacted. These disorders affect aspects of reproduction. They affect ovulation, fertilization and the continuation of pregnancy. Some of the causes of these conditions are linked to factors. These factors can affect reproduction in ways. Some of the causes are Hormonal imbalances, Immune system problems, Genetic issues, and Inflammatory conditions. Knowledge about the processes is essential for proper diagnosis, treatment, and better outcomes of reproduction. (Thulasiraman *et al.*, 2025)

The main reasons for secondary infertility among multiparous women are tubal and uterine causes. Tubal patency is important for fertilization and transportation of the fertilized ovum to the uterus. Any blockage or injury in the tube, usually as a result of an inflammatory condition from Chlamydia or Gonorrhea, postpartum infection or post-abortion infection, results in failure of pregnancy to occur. (Ambildhuke *et al.*, 2022) Similarly, uterine pathology like adhesions, submucous fibroids and endometrial polyps make implantation difficult. (Direk *et al.*, 2022)

The uterus is a hollow muscular organ composed of three main layers: the endometrium, myometrium, and serosa. The endometrium is the innermost functional layer that undergoes cyclical changes during the menstrual cycle and plays a key role in implantation. It consists of a functional layer that sheds during menstruation and a basal layer responsible for regeneration. The myometrium is the middle muscular layer responsible for uterine contractions, which assist in menstruation, sperm transport, and childbirth. The outer serosal layer provides structural support.(*Gray's Anatomy*, 2021)

Endometrial receptivity is a hormonally regulated process controlled mainly by estrogen and progesterone. During the proliferative phase, estrogen promotes endometrial thickening, while during the secretory phase, progesterone prepares the endometrium for implantation. Any disruption in this hormonal balance or structural integrity of the endometrium can result in implantation failure and infertility.(Lessey and Young, 2019)

Secondary infertility, in comparison to other causes of infertility, forms a significant percentage of cases worldwide. In Pakistan, secondary infertility constitutes a major proportion of infertility cases, accounting for approximately 60–65% of all infertile couples. This high prevalence is mainly attributed to a higher incidence of postpartum infections, unsafe abortion practices, inadequate maternal healthcare services, and limited access to early diagnostic and treatment facilities. As a result, preventable reproductive tract infections and complications remain a significant cause of tubal and uterine damage in the population. (Sunderam *et al.*, 2022)

Multiparous women are more affected because the reproductive tract is physiologically prepared for the process due to their experience with pregnancy and delivery. Postnatal infections, unsafe abortions, difficult childbirths, and procedures such as Cesarean delivery or dilatation and curettage expose these parts of the female body to more harm.(Vander Borght and Wyns, 2018)

Ectopic pregnancy is another important consequence of tubal pathology and an established risk factor for secondary infertility. It

occurs when a fertilized ovum implants outside the uterine cavity, with more than 90% of cases occurring within the fallopian tube. Tubal damage caused by pelvic inflammatory disease, previous ectopic pregnancy, pelvic surgery, or postoperative adhesions impairs normal embryo transport, increasing the likelihood of ectopic implantation. Women with a history of ectopic pregnancy are at greater risk of recurrent tubal damage, which may subsequently contribute to secondary infertility. Therefore, evaluation of tubal patency and morphology is essential in women with previous ectopic pregnancy undergoing infertility assessment. (Iroh and Nuraini, 2025)

Hysterosalpingography (HSG) is a frequently performed imaging modality for the diagnosis of female infertility especially when dealing with secondary infertility. (Canday, Yurtkal and Kirat, 2023) This test has been regarded as the first-line investigation since it directly shows tubal patency and the morphology of the uterine cavity, which are consider to be the two most common problems among multiparous women. Differing from the ultrasound study that fails to demonstrate whether the fallopian tube is open, the procedure of HSG involves the contrast media which enables one to see the passage of the opaque fluid through the uterus, fallopian tubes and into the peritoneal cavity, providing visualization of tubal blockage, hydrosalpinx and peritubal adhesions. (Kahramanoğlu, Güngör and Verit, 2022) Also, it aids in visualizing the conditions concerning the uterus cavity like intrauterine adhesions, submucous fibroids, endometrial polyps, and cesarean scar anomalies which prevent the embryo from implantation. As tubal and uterine conditions are reported as major causes of secondary infertility in multiparous women, the HSG provides important anatomical information. (Waheed *et al.*, 2019)

There are few local studies on the diagnostic accuracy of the procedure specifically in multiparous females suffering from secondary infertility. Most of the studies have considered mixed groups and have not differentiated them on the basis of their parity status. In most of the published studies, heterogeneous infertile groups have been studied without subgroup analysis according to parity. Depending upon the results of the study, if the HSG test turns out to be accurate, it will continue being a first line diagnostic test and if not, a lower threshold of laparoscopy or both tests together might be required.(Sharma *et al.*, 2023)

Globally, the rate of infertility is estimated to be around 8% to 12% in the couple of reproductive ages. As per the most recent World Health Organization's report which was released in 2023, one in six persons suffers from infertility problems in their lifetime. Infertility prevalence in South Asia is estimated to be around 10% to 15%. Conversely, in affluent foreign countries including the United States and EU countries, the prevalence is estimated to be 9% to 13%.(World Health Organization, 2023)

The cause of infertility varies greatly in primary versus secondary infertility, and this affects diagnosis and treatment as well. Primary infertility is associated with congenital and developmental problems such as malformation of the uterus like a septate or arcuate uterus, and other endocrine and ovulatory problems. On the other hand, secondary infertility is due to the occurrence of acquired factors following past pregnancy or surgery in the pelvis. This includes problems like damage to the fallopian tubes, pelvic adhesions, postpartum infections, complications in C-section scars, and intrauterine adhesions. There is evidence in the literature suggesting that surgical and infective causes are statistically more common in secondary infertility, and congenital problems are seen in primary infertility. Hence, it becomes necessary to differentiate between these types of infertility for appropriate investigation and counseling.(Omidiji *et al.*, 2019)

Secondary infertility demands accurate assessment of the location and type of pathology in the tubes or uterus to make a prognosis about fertility and formulate treatment. HSG is an important technique that can reveal certain anatomical and physiological characteristics of the fallopian tubes and uterine cavity that cannot be gained from medical history. HSG not only demonstrates the patency of the tubes but also identifies subtle changes like peritubal adhesions, proximal occlusion, and distorting of uterine cavity caused by pregnancy complications. The manner of spillage of the

contrast medium is associated with the ability of conceiving spontaneously; thus, this technique gives the necessary information to advise patients on the further management of infertility. (Mansour, 2023)

Hysterosalpingography is a radiological procedure that entails the instillation of a contrast agent in the cervical canal using fluoroscopy. This procedure is done when there is no chance of getting pregnant, during the follicular phase of the menses, usually between days 6 and 11 of the menstrual cycle. As the contrast moves inside the uterine cavity and reaches the fallopian tubes, X-ray images are taken in order to determine the shape of the uterus as well as the patency of the fallopian tubes. HSG has many advantages that make it the procedure of choice for initial investigations. The advantage includes evaluation of the uterine cavity and fallopian tubes in one sitting. The procedure is outpatient and does not need much anesthesia and is less costly than laparoscopy.(Yildirim and Yanik, 2023)

Hysterosalpingography is readily accessible at almost all tertiary and district hospitals in Pakistan and is also commonly used at fertility clinics in many other countries such as the UK, USA, and Australia. Moreover, Hysterosalpingography procedure may be beneficial due to its therapeutic effect in terms of removing mucus plugs and debris from the fallopian tubes. However, although there are a number of benefits associated with HSG procedure, it does have some limitations as well.(Khan *et al.*, 2023)

The non-invasive techniques such as transvaginal ultrasound and sonohysterography have no ability to visualize any pathology in the uterus but, unfortunately, cannot provide the information about the tubal patency. So, they cannot be used as a diagnostic tool to assess the tubal patency. When comparing the technique with the other two, Hysterosalpingography should be considered the most advantageous one.(Sitoula and Tamrakar, 2023)

As per the guidelines by ASRM & ESHRE, the HSG test can be considered as the initial investigation for assessing tubal patency in low-risk women who have no risk factors for tubal disease At present, no guidelines are there for investigating multiparous patients suffering from secondary infertility.(*Fertility and Sterility*, 2021)

The analysis of tubal and uterine anomalies identified by means of HSG in multiparous women suffering from secondary infertility will facilitate timely and evidence-based diagnoses. In this case, there will be fewer time losses, no repeated tests, and better planning of treatment options. The current research will offer local data on how to use HSG earlier in order to diagnose and manage secondary infertility in patients of this population group in our country. Comparing results with the existing international literature from other countries, we will make our contribution to global medical practice.(M, A and S, 2023)

OBJECTIVES

To determine the pattern of HSG findings in multiparous women with secondary infertility. To assess the frequency of tubal blockage, hydro salpinx, peritubal adhesions, and uterine abnormalities on HSG. To evaluate the association between HSG findings and factors such as parity, mode of delivery, abortion history, and history of pelvic infection.

RESEARCH METHODOLOGY

Inclusion Criteria

- Multiparous women
- Diagnosed with secondary infertility
- Age 20–45 years
- Patients undergoing Hysterosalpingography (HSG)
- History of previous pregnancy, delivery, abortion, or pelvic infection

Exclusion Criteria

- Women with primary infertility.
- Nulliparous women.
- History of hysterectomy or salpingectomy.
- Known hypersensitivity or allergy to HSG contrast media.
- Pregnant women.
- Patients with incomplete or unavailable HSG records.

Sample Size:
60 sample size was calculated by using sample size formula by keeping the reference of the parent Article for population. **Research Design:** Research Design is Cross-sectional Observational study using simple descriptive statistics.

Sampling Strategy:
Sampling strategy used in this research is Non-probability consecutive sampling. As the samples being drawn and questionnaire was filled from the part of the population that was close to hand.

Data Collection Tools:
Data were collected using a structured proforma that was designed to record the participants' demographic characteristics and relevant clinical history. Hysterosalpingography (HSG) reports were reviewed to document uterine and fallopian tube findings. Pain experienced during or immediately after the HSG procedure was assessed using a standardized pain assessment scale. In addition, relevant laboratory investigations and other clinical information were obtained from the patients' medical records, where available, to support the study findings.

Data Collection Procedure
Ethical considerations (informed consent): Consent was taken from every research subject before data collection. The data were collected through a questionnaire and face-to-face interviews. The investigation took place in the Radiology Departments of Services Hospital and Jinnah Hospital, Lahore. The HSG was done during the early proliferative phase of the menstrual cycle through the use of a water-soluble contrast media under the guidance of a fluoroscope. During the process, there was an evaluation of tubal patency, morphology of the tube, and the uterine cavity. The results from the HSG test were documented as normal or abnormal by the radiologist.

Data Analysis:
Statistical analysis.
Collected data was checked and logged into the system. Data was converted into information by using different statistical tests of mean, median, mode, standard deviation. Data was analyzed with the help of online built-in tool for response analysis. Data is displayed in the form of pie and bar charts. The entire qualitative variable will be presented in form of frequency and percentages. Pie charts and bar charts were also being used to display categorical data. SPSS. V25 for data entry.

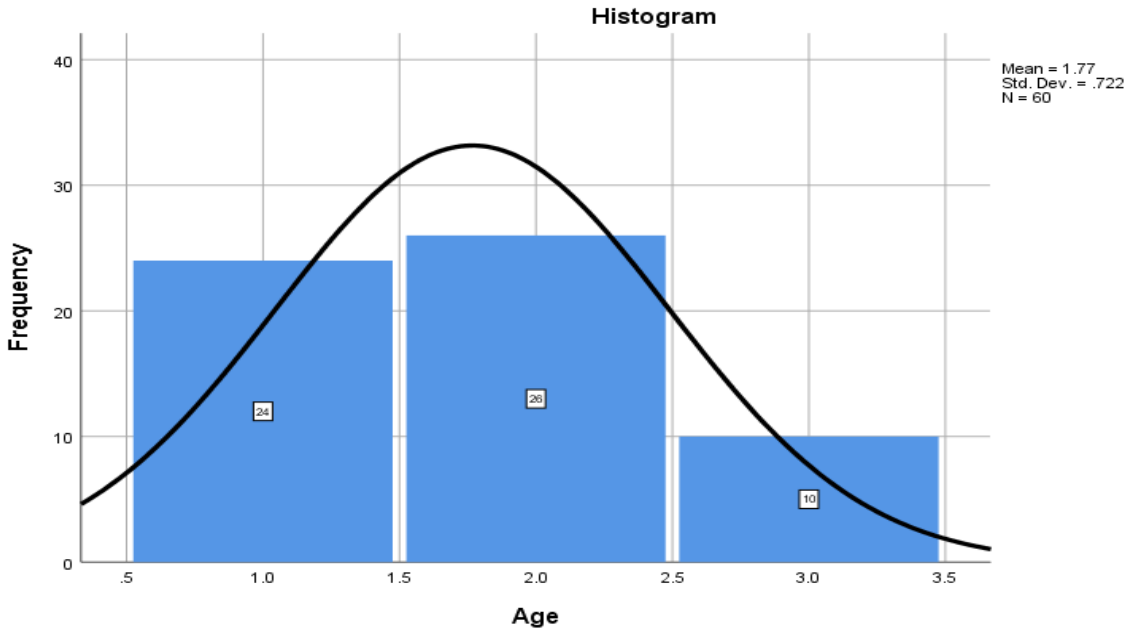
RESULTS

4.1. Age Distribution of Study Participants

Age Group	Frequency (n)	Percentage (%)
24–29 years	24	40.0
30–34 years	26	43.3
35–39 years	10	16.7
Total	**60**	**100.0**

This table 4.1 shows that an age distribution analysis of a group of 60 individuals, which suggests that the largest segment comes within the 30-34 age limit, including 26 people (43.3 %), followed by 24-29 groups with 24 individuals (40.0%). The 35-39 age group includes 10 people (16.7 %) of the study participants.

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4.2. Descriptive Characteristics for BMI of Study Participants

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Body Mass Index	60	21.7	31.2	25.675	2.4542

The mean BMI of the participants was 25.68 ± 2.45 kg/m², with values ranging from 21.7 to 31.2 kg/m².

4.3. Obstetric and Reproductive History

4.3.1 Distribution of Participants According to Gravida

Gravida	Frequency (n)	Percentage (%)
3	25	41.7
4	20	33.3
5	15	25.0
Total	60	100.0

The majority of participants were gravida 3 (41.7%), followed by gravida 4 (33.3%) and gravida 5 (25.0%).

4.3.2 Distribution of Participants According to Para

Para	Frequency (n)	Percentage (%)
1	6	10.0
2	37	61.7
3	17	28.3
Total	60	100.0

Most participants were para 2 (61.7%), while 28.3% were para 3 and 10.0% were para 1.

4.3.2 Distribution of Participants According to Duration of Secondary Infertility

Duration (years)	Frequency (n)	Percentage (%)
3	3	5.0
4	8	13.3

5	17	28.3
6	13	21.7
7	9	15.0
8	7	11.7
9	3	5.0
Total	**60**	**100.0**

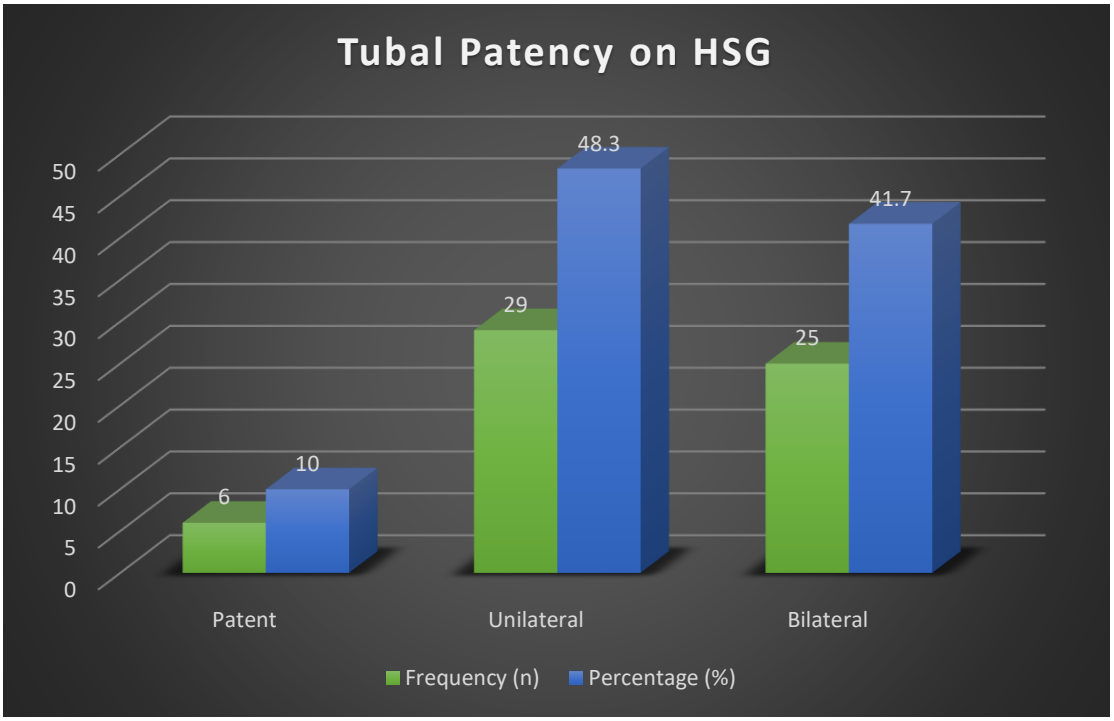
The duration of secondary infertility ranged from 3 to 9 years, with 5 years being the most common duration (28.3%), followed by 6 years (21.7%).

4.4. Hysterosalpingographic Findings

4.4.1. Tubal Patency on HSG

Tubal Patency on HSG	Frequency (n)	Percentage (%)
Patent	6	10.0
Unilateral Tubal Blockage	29	48.3
Bilateral Tubal Blockage	25	41.7
Total	**60**	**100.0**

Table 4.4.1 shows the distribution of tubal patency findings on HSG among the 60 study participants. Patent fallopian tubes were observed in 6 (10.0%) participants, while 29 (48.3%) had unilateral tubal blockage and 25 (41.7%) had bilateral tubal blockage

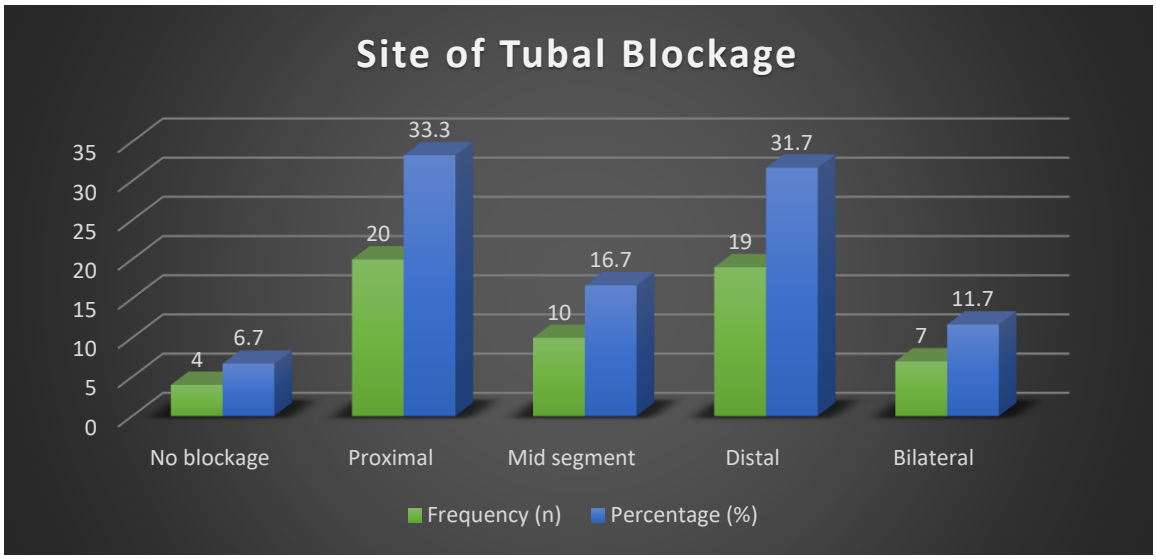


4.4.2. Site of Tubal Blockage

Site of Tubal Blockage	Frequency (n)	Percentage (%)
No blockage	4	6.7
Proximal	20	33.3
Mid segment	10	16.7

Distal	19	31.7
Bilateral	7	11.7
Total	60	100.0

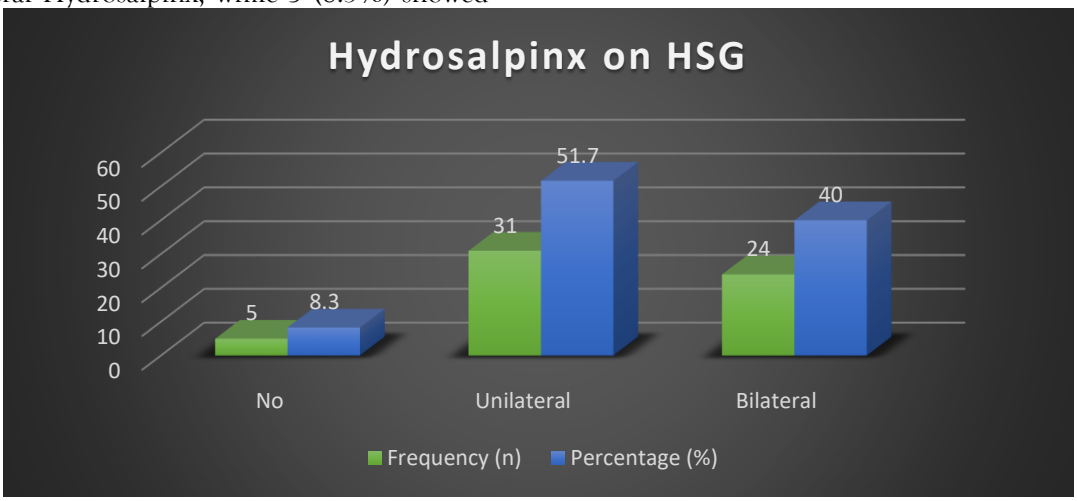
Among the 60 participants, 4(6.7%) showed no tubal blockage on HSG. Proximal blockage was observed in 20 (33.3%) participants, while distal blockage was found in 19 (31.7%). Mid-segment blockage was present in 10 (16.7%) participants, whereas bilateral blockage was least frequent, occurring in only 7 (11.7%) participant. Overall, Proximal blockage was the most frequently observed finding, while bilateral blockage was the least common.



4.4.3. Hydrosalpinx on HSG

Hydrosalpinx on HSG	Frequency (n)	Percentage (%)
No	5	8.3
Unilateral	31	51.7
Bilateral	24	40.0
Total	60	100.0

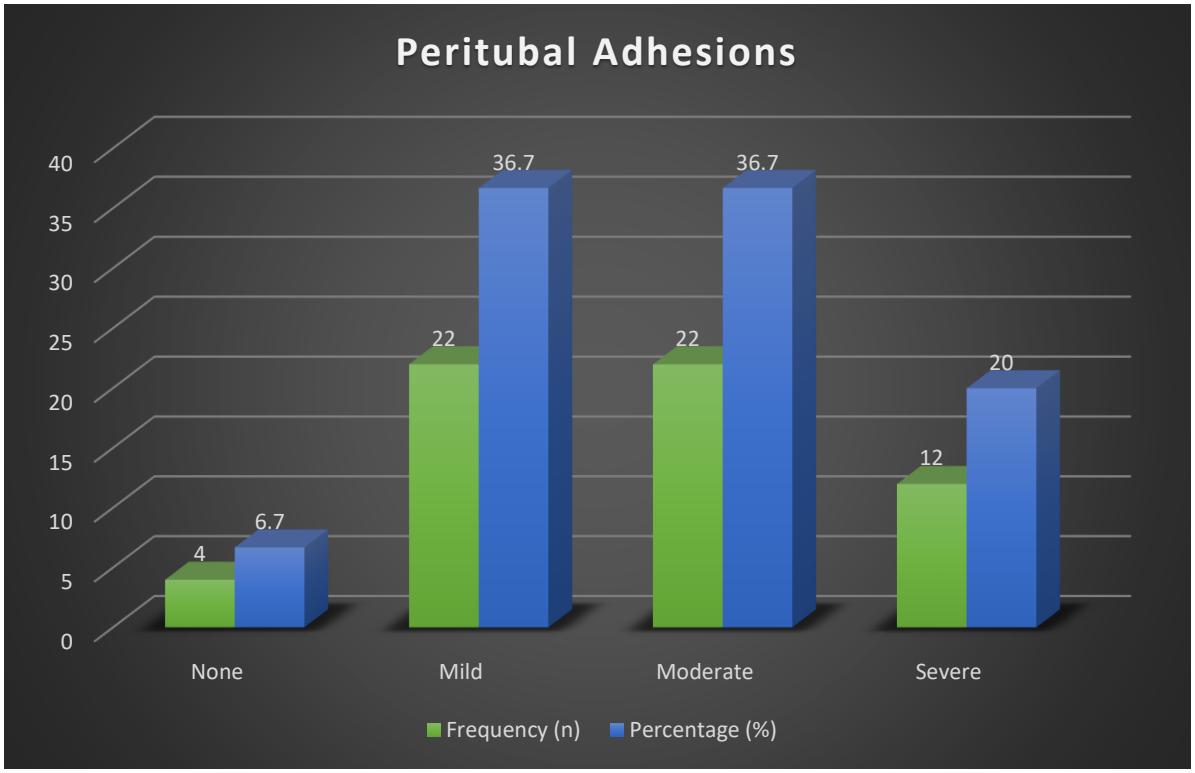
Among the 60 participants, 31 (51.7%) had unilateral Hydrosalpinx, 24 (40.0%) had bilateral Hydrosalpinx, while 5 (8.3%) showed no Hydrosalpinx. Thus, unilateral Hydrosalpinx was the most frequently observed finding.



4.4.4. Peritubal Adhesion on HSG

Peritubal Adhesions	Frequency (n)	Percentage (%)
None	4	6.7
Mild	22	36.7
Moderate	22	36.7
Severe	12	20.0
Total	60	100.0

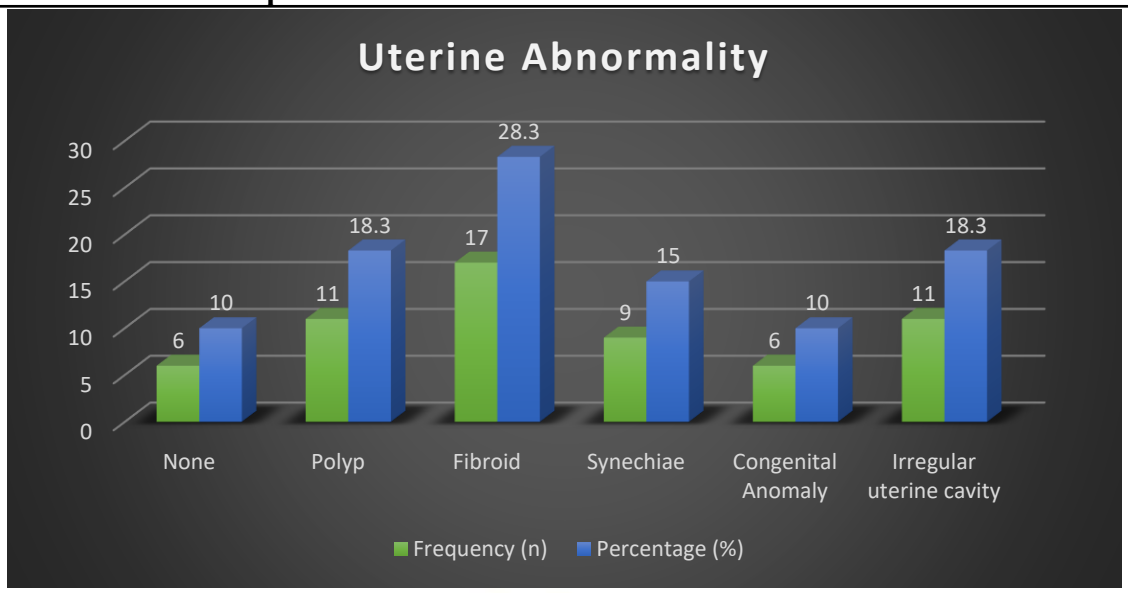
Among the 60 participants, mild and moderate peritubal adhesions were the most frequently observed findings, each present in 22 (36.7%) participants. Severe adhesions were observed in 12 (20.0%), while 4 (6.7%) participants had no peritubal adhesions.



4.4.5. Uterine Abnormalities on HSG

Uterine Abnormality	Frequency (n)	Percentage (%)
None	6	10.0
Polyp	11	18.3
Fibroid	17	28.3
Synechiae	9	15.0
Congenital Anomaly	6	10.0
Irregular uterine cavity	11	18.3
Total	60	100.0

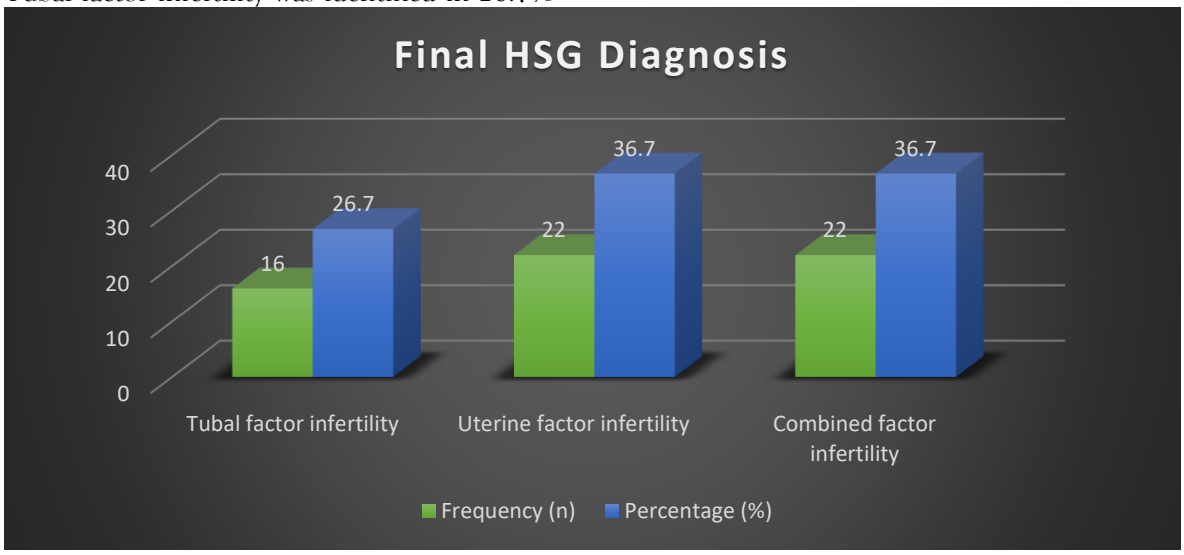
No uterine abnormality was identified in 6 (10.0%) participants. Among the abnormalities, fibroid was the most frequent finding (28.3%), followed by polyp and irregular uterine cavity, each accounting for 18.3%. Synechiae were observed in 15.0%, while congenital anomalies were least frequent (10.0%).



4.5. Distribution of Final HSG Diagnoses

Final HSG Diagnosis	Frequency (n)	Percentage (%)
Tubal factor infertility	16	26.7
Uterine factor infertility	22	36.7
Combined factor infertility	22	36.7
Total	**60**	**100.0**

Among the 60 study participants, uterine factor infertility and combined factor infertility were the most frequent final HSG diagnoses, each accounting for 36.7% (n=22) of the participants. Tubal factor infertility was identified in 26.7% (n=16) of participants. Thus, uterine and combined factors were more commonly observed than isolated tubal factor infertility in the study population.



4.6. Association of Tubal HSG Findings with Final Diagnosis

Tubal HSG Finding	Tubal factor infertility, n	Combined factor infertility, n
Tubal Patency		
Patent	0	2

Unilateral	13	10
Bilateral	3	10
Site of Tubal Blockage		
Proximal	7	7
Mid segment	2	3
Distal	4	10
Bilateral	3	2
Hydrosalpinx		
Unilateral	10	13
Bilateral	6	9
Peritubal Adhesions		
None	1	0
Mild	3	7
Moderate	6	10
Severe	6	5
Total Patients	**16**	**22**

The distribution of tubal HSG findings showed different patterns among patients with tubal factor and combined factor infertility. Unilateral tubal involvement was more frequently observed among patients with tubal factor infertility, while distal blockage and moderate Peritubal adhesions were more common among patients with combined factor infertility. The association between tubal HSG findings and final diagnosis was assessed using Fisher's Exact test. A statistically significant association was observed between tubal patency ($p = 0.016$) and Peritubal adhesions ($p = 0.036$) with final diagnosis, whereas site of tubal blockage ($p = 0.288$) and Hydrosalpinx ($p = 0.062$) were not significantly associated with final diagnosis.

4.6.1. Association of Uterine HSG Findings with Final Diagnosis

Uterine HSG Finding	Uterine factor infertility, n	Combined factor infertility, n
Uterine Abnormality Type		
None	0	1
Polyp	7	2
Fibroid	10	4
Synechiae	2	5
Congenital anomaly	1	3
Irregular uterine cavity	2	7
Total Patients	**22**	**22**

The distribution of uterine HSG findings showed that fibroid was the most frequently observed abnormality among patients with uterine factor infertility, whereas irregular uterine cavity was more frequently observed among patients with combined factor infertility. Synechiae and other uterine abnormalities were also observed in both groups. Fisher's Exact test demonstrated a statistically significant association between uterine abnormality type and final diagnosis ($p = 0.019$), indicating that the pattern of uterine abnormalities was significantly related to the classification of infertility as uterine or combined factor.

DISCUSSION

The present study evaluated Hysterosalpingographic findings among women with secondary infertility and demonstrated that both tubal and uterine abnormalities were frequently encountered. The findings support the importance of HSG as an imaging modality

for identifying structural abnormalities of the female reproductive tract and for characterizing possible factors contributing to secondary infertility. The present study identified a range of tubal abnormalities, including unilateral and bilateral tubal involvement, proximal, mid-segment and distal blockage, Hydrosalpinx, and Peritubal adhesions. Similarly, uterine abnormalities including fibroids, polyps, Synechiae, congenital anomalies, and irregular uterine cavity were observed. These findings are broadly consistent with previous studies that have emphasized the usefulness of HSG in detecting acquired and structural abnormalities associated with infertility.

In the present study, the participants were predominantly from the younger reproductive age groups, with the largest proportion belonging to the 30–34 years' age group, followed by those aged 24–29 years. Bobmanuel et al. (2023) reported that infertility was most commonly observed among women in the 32–37 years' age group, which is broadly comparable with the age distribution observed in the present study. However, differences in study populations and age distributions should be considered when comparing these findings. The relatively younger age distribution in the present study indicates that secondary infertility was observed across the reproductive age groups and was not limited to women of advanced reproductive age.

The present study also demonstrated varied obstetric and reproductive characteristics among the participants. All participants had a history of previous pregnancy, consistent with the inclusion of women with secondary infertility, and the duration of secondary infertility varied among the study participants. Toufig et al. (2020) reported that prolonged infertility was associated with a greater frequency of HSG abnormalities, particularly among women with infertility of more than four years. Their findings suggest that acquired pelvic and reproductive tract abnormalities may be important contributors to secondary infertility. In the present study, the reproductive characteristics were described as part of the participant profile, while the main analysis focused on HSG abnormalities and their relationship with the final infertility classification.grn

A major finding of the present study was the high frequency of tubal abnormalities. Unilateral tubal involvement was more common than bilateral involvement, indicating that a considerable proportion of participants had unilateral impairment of tubal function. The site of tubal blockage also varied, with proximal blockage being the most frequently observed site, followed by distal and mid-segment obstruction. These findings are consistent with Toufig et al. (2020), who reported tubal obstruction as one of the major tubal abnormalities detected on HSG and described abnormalities involving different portions of the fallopian tubes. Kiridi et al. (2022) also reported unilateral and bilateral tubal occlusion, Hydrosalpinx, and Peritubal adhesions among infertile women undergoing HSG. Thus, the present findings support previous evidence that tubal pathology represents an important component of infertility-related abnormalities detectable by HSG.

The distribution of tubal blockage in the present study showed that proximal obstruction was more frequently observed than mid-segment or distal obstruction. However, the association analysis demonstrated that the site of tubal blockage was not significantly associated with the final diagnosis. This indicates that although the anatomical site of obstruction was an important descriptive finding, its specific location did not significantly distinguish between the relevant infertility factor classifications in the present study population. Igbodike et al. (2022) reported that HSG had satisfactory diagnostic usefulness for detecting tubal obstruction, particularly unilateral and bilateral obstruction, although diagnostic performance could vary according to the specific abnormality. Therefore, the current findings reinforce the usefulness of HSG for demonstrating the location of tubal obstruction while indicating that the anatomical site alone may not determine the final infertility classification.

Hydrosalpinx was another frequently observed tubal abnormality in the present study, with unilateral hydrosalpinx being more common

than bilateral involvement. This finding is consistent with previous literature emphasizing hydrosalpinx as an important manifestation of tubal disease in infertile women. Toufig et al. (2020) identified hydrosalpinx among the important tubal abnormalities detected by HSG, while Waheed et al. (2019) reported hydrosalpinx as a common abnormality related to infectious and inflammatory processes. Pweleza (2024) similarly reported hydrosalpinx as a common tubal abnormality during laparoscopic evaluation, together with pelvic adhesions and signs of pelvic inflammation. These findings support the observation in the present study that hydrosalpinx constitutes an important tubal abnormality among women undergoing infertility evaluation.

Despite its relatively frequent occurrence, hydrosalpinx did not demonstrate a statistically significant association with the final diagnosis in the present study. This indicates that the presence of hydrosalpinx alone was not sufficient to distinguish between the relevant infertility factor classifications in this population. This finding differs to some extent from studies that focused primarily on the frequency of hydrosalpinx rather than its relationship with final diagnostic categories. Such differences may be related to variations in sample size, study population, disease distribution, and diagnostic classification. Nevertheless, the relatively frequent occurrence of hydrosalpinx in the present study highlights the importance of evaluating the fallopian tubes during HSG.

Peritubal adhesions were also frequently observed in the present study, with mild and moderate adhesions being the most common patterns, while severe adhesions were also identified. These findings are in agreement with Kiridi et al. (2022), who reported peritubal adhesions among the important tubal abnormalities observed in infertile women undergoing HSG. Pweleza (2024) also identified pelvic adhesions as common tubal and surrounding pelvic abnormalities during laparoscopic assessment. Peritubal adhesions may interfere with normal tubal function and therefore represent an important finding during infertility evaluation.

Importantly, the present study demonstrated a statistically significant association between peritubal adhesions and final diagnosis. This indicates that the distribution of peritubal adhesion severity differed across the relevant infertility factor classifications. The finding supports the clinical relevance of identifying and characterizing peritubal adhesions during HSG examination. Kiridi et al. (2022) similarly reported significant relationships between peritubal adhesions and other HSG abnormalities. Although the present study did not establish the underlying cause of the adhesions, their significant association with final diagnosis emphasizes their importance in the evaluation of secondary infertility.

Uterine abnormalities represented another important component of the findings. In the present study, fibroid was the most frequently identified uterine abnormality, followed by polyps and irregular uterine cavity, while synechiae and congenital anomalies were also observed. These findings are consistent with several previous studies. Toufig et al. (2020) reported fibroids, polyps, intrauterine adhesions, and congenital uterine abnormalities among the major uterine pathologies detected on HSG. Waheed et al. (2019) similarly reported uterine fibroids and other acquired abnormalities among infertile women. Bobmanuel et al. (2023) also identified uterine myoma as the most common uterine pathology in their study. Therefore, the predominance of fibroid in the present study is supported by previous evidence and indicates that acquired uterine abnormalities are important findings among women presenting with secondary infertility.

The presence of synechiae and irregular uterine cavity in the present study is also relevant. Okonkwo et al. (2024) reported intrauterine adhesions as an important uterine cavity pathology and found that HSG was particularly useful for detecting intrauterine adhesions, septa, and uterine cavity distortion. This is comparable with the current findings, in which synechiae and irregular uterine cavity were identified among the participants. These findings demonstrate that HSG can provide useful information regarding uterine cavity contour and structural abnormalities. However,

as highlighted by Okonkwo et al. (2024) and Igbodike et al. (2022), HSG may have limitations in detecting some smaller intrauterine lesions, and other modalities such as hysteroscopy or ultrasonography may provide additional information in selected cases.

The final HSG diagnosis in the present study demonstrated three major categories: tubal factor infertility, uterine factor infertility, and combined factor infertility. Uterine factor and combined factor infertility were the predominant diagnostic categories, while tubal factor infertility was also identified among the participants. The presence of combined factor infertility is particularly important because it indicates that tubal and uterine abnormalities may coexist in the same patient. Toufig et al. (2020) emphasized the considerable burden of both uterine and tubal abnormalities among women with secondary infertility. Waheed et al. (2019) also demonstrated the presence of both acquired uterine and tubal abnormalities in infertile women. Thus, the present findings support the importance of evaluating both the uterus and fallopian tubes rather than focusing on a single structural abnormality.

The association analysis further strengthened the findings of the present study. A statistically significant association was observed between tubal patency and final diagnosis. The distribution showed that unilateral tubal involvement was particularly prominent among patients classified with tubal factor infertility, while both unilateral and bilateral involvement were observed among patients with combined factor infertility. This significant relationship indicates that the overall pattern of tubal patency was related to the final infertility classification in the study population. The finding supports the clinical importance of determining the status of tubal patency during HSG assessment.

In contrast, the site of tubal blockage did not demonstrate a statistically significant association with final diagnosis. Although proximal, distal, mid-segment, and bilateral blockage were identified in the study population, the location of obstruction did not significantly distinguish the final diagnostic categories. Similarly, hydrosalpinx did not demonstrate a statistically significant association with final diagnosis. These findings indicate that the presence and overall pattern of tubal abnormalities may be more relevant to the final diagnostic classification than the specific anatomical site of obstruction or the presence of hydrosalpinx alone. The results also demonstrate that a frequently observed HSG abnormality does not necessarily have a statistically significant relationship with the final infertility classification.

The uterine association analysis demonstrated a statistically significant relationship between uterine abnormality type and final diagnosis. Fibroid was the most frequently observed abnormality among patients with uterine factor infertility, whereas irregular uterine cavity and synechiae were more frequently observed among patients with combined factor infertility. This finding suggests that the pattern of uterine abnormalities differed according to the final infertility classification. The result is consistent with the broader findings of Toufig et al. (2020), Waheed et al. (2019), and Okonkwo et al. (2024), who demonstrated that different uterine abnormalities can be identified in women undergoing infertility evaluation and that HSG can provide important information regarding uterine cavity abnormalities.

The findings of the present study also demonstrate the importance of considering HSG as an integrated assessment of both the fallopian tubes and uterine cavity. Previous studies have shown that HSG is particularly useful for detecting tubal obstruction and hydrosalpinx, while other imaging and endoscopic techniques may provide additional information regarding uterine lesions. Igbodike et al. (2022) reported satisfactory diagnostic accuracy of HSG for tubal abnormalities but noted limitations in the detection of some intrauterine lesions. Similarly, Okonkwo et al. (2024) demonstrated that HSG and TVS have complementary strengths depending on the type of uterine pathology. These observations support the use of HSG as an important component of infertility evaluation while recognizing that further investigation may be required in selected patients.

Overall, the findings of the present study are broadly consistent with the existing literature and demonstrate that HSG can identify a wide

range of tubal and uterine abnormalities among women with secondary infertility. The significant associations observed for tubal patency, peritubal adhesions, and uterine abnormality type indicate that these findings may have particular relevance to the classification of infertility factors in the study population. At the same time, the lack of significant association for the site of tubal blockage and hydrosalpinx demonstrates that not every HSG abnormality is necessarily related to the final infertility classification. Differences between the present study and some previous studies may be explained by variations in sample size, study setting, population characteristics, diagnostic criteria, and the frequency of individual abnormalities. Nevertheless, the current findings reinforce the role of HSG as a useful and accessible imaging investigation for identifying structural tubal and uterine abnormalities and for contributing to the evaluation and classification of secondary infertility.

CONCLUSION

The present study concluded that Hysterosalpingographic (HSG) is an important diagnostic imaging modality for the evaluation of women with secondary infertility, as it provides valuable information regarding both tubal and uterine abnormalities. Tubal abnormalities such as unilateral and bilateral tubal blockage, proximal and distal obstruction, Hydrosalpinx, and Peritubal adhesions were frequently observed, while uterine abnormalities including fibroids, polyps, irregular uterine cavity, Synechiae, and congenital anomalies were also commonly identified. The final HSG diagnoses included tubal factor, uterine factor, and combined factor infertility, with uterine and combined factors being the predominant categories. Significant associations were observed between tubal patency, Peritubal adhesions, and uterine abnormality type with the final diagnosis, whereas site of tubal blockage and Hydrosalpinx did not show significant associations. Overall, the findings highlight the important role of HSG in identifying and characterizing tubal and uterine abnormalities and in distinguishing between tubal, uterine, and combined infertility factors among women with secondary infertility.

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