Diagnostic Role of Hysterosalpingography in Detecting Tubal and Uterine Causes of Female Infertility: A Cross-sectional Study

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Abstract

Aim and Objectives: The main goal of this study was to use hysterosalpingography (HSG) to assess the structural abnormalities of the uterus and fallopian tubes in women who suffer with infertility.

Material and Methods: This prospective cross-sectional study was carried out over three months, following approval from the Departmental Board of Studies at the Department of Radiological Sciences and Imaging, ICBS. A total of 299 patients, referred to the Radiology Department of Fatima Memorial Hospital (FMH) for infertility evaluation, underwent HSG. Data analysis was performed using MEDCALC statistical software.

Results: Among the 299 patients evaluated, 52% presented with secondary infertility and 48% with primary infertility. All patients had normal uterine cavities. Bilateral tubal patency was found in 213 patients (71.2%), while 44 patients (14.7%) showed bilateral tubal obstruction. Unilateral tubal obstruction was present in 41 patients, with 23 cases (7.7%) on the left and 18 cases (6.0%) on the right. A total of 211 patients (70.6%) showed no abnormalities on HSG.

Conclusion: Hysterosalpingography is a highly useful diagnostic tool for assessing uterine and tubal abnormalities in infertile women. The findings from this study demonstrate the high prevalence of tubal blockages, especially bilateral, and

emphasize the importance of HSG in infertility diagnosis and treatment planning.

Keywords: Hysterosalpingography, Infertility, Tubal Occlusion, Uterine Abnormalities, Hydrosalpinx. Contrast material, Fallopian tube, Fluoroscopy, Uterus.

Introduction

Infertility is a complicated condition that causes serious health, psychological, and financial issues. It is the failure of a couple to conceive after a year of consistent, unprotected sexual activity. While secondary infertility refers to the inability to conceive following an earlier pregnancy that may or may not have resulted in a live baby, primary infertility occurs when a couple has never been pregnant. [2] Ten to fifteen percent of couples worldwide are thought to be infertile. [3] It's believed to be around 6 percent in the UK and 10 percent in the US. [4] It is very common in the sub-Saharan region of Africa, where 20–60% of couples have it. [5]. The high prevalence of STDs, unsafe abortion complications, and puerperal pelvic infections have all been blamed for this. [6] Infertility rates in some regions of Nigeria were as high as 45%, according to community-based research. [7] 15% of all women are known to have either primary or secondary infertility at some point during their reproductive lives.

Disorders of the fallopian tubes, uterus, cervix, and ovaries can all contribute to infertility in women, but in around 35–40% of cases, a fallopian tube condition is the cause. [8] Formal human fertility requires a patent fallopian tube. The organs known as fallopian tubes are extremely specialised. They are essential for scooping up eggs and moving sperm, embryos, and eggs. Additionally, sperm capacitation and egg fertilisation require the fallopian tubes. The fallopian tubes' tiny fimbriae or highly specialised endosalpinx may be impacted by infections or surgical injury, which might compromise their ability to function. Compared to other ways of evaluating the structures, a hysterosalpingogram is the simplest safe, and cost-effective way to evaluate the morphology of the uterus, cervix, and fallopian tube. It can identify tubal obstruction with a sensitivity of 65% and a specificity of 2 83%. [9] Additionally, hysterosalpingography may be used as a treatment to improve subfertility. [10] Ultrasound and magnetic resonance imaging are two more imaging modalities that are essential for determining a woman's infertility. A saline or hysterosalpingogram

contrast sonography might be used in addition to the normal first-choice transvaginal ultrasound scan. This has been shown to be quite sensitive, specific, and accurate in detecting polyps or other uterine abnormalities, however it is not very useful for evaluating tubal abnormalities. While magnetic resonance imaging is quite useful in assessing congenital Mullerian duct malformations and uterine wall lesions, its use in fallopian tube evaluation is relatively restricted. Other complementing but invasive and costly procedures for evaluating the fallopian tubes, uterus, and cervix are hysteroscopy and laparoscopy. [11]

The aim of the study was to evaluate the structural abnormalities of the uterus and tubes in infertile women as elucidated by hysterosalpingography.

Literature Review

Hysterosalpingography (HSG) is a widely used diagnostic tool for evaluating the female reproductive system, particularly to assess uterine abnormalities and tubal patency. It is a vital procedure in the evaluation of infertility, with a significant role in identifying factors that affect fertility outcomes. The procedure involves the introduction of contrast media into the uterus through the cervix, followed by radiographic imaging. Over time, HSG has become an essential part of the infertility investigation process, offering valuable insights into the female reproductive tract's condition [12]. HSG is primarily indicated for the evaluation of tubal patency and uterine abnormalities, which are significant causes of infertility. Tubal factor infertility accounts for approximately 20% of all infertility cases, with tubal blockage being one of the primary concerns addressed by HSG) [13]. In cases of unexplained infertility, HSG helps identify obstructed fallopian tubes, adhesions, and other structural abnormalities, significantly influencing treatment options [14]. HSG is used in pre-surgical planning to diagnose uterine pathologies before proceeding with surgical treatments for infertility (Bennett et al., 2012) [15]. By identifying structural abnormalities, HSG can help guide the surgical approach, improving patient outcomes and reducing unnecessary procedures [13]. In Assisted Reproductive

Technology (ART), especially during in-vitro fertilization (IVF) cycles, assessing tubal patency is crucial. HSG aids in determining whether the fallopian tubes are patent, as tubal disease can significantly affect the chances of successful implantation [15]. In ART protocols, the importance of tubal patency is well-established, as it directly influences the probability of successful pregnancy [16].

Technique and Procedure

The HSG procedure involves several key steps:

1. **Cervical Preparation**: The cervix is prepared by cleaning it and then inserting a cannula to deliver contrast medium.
2. **Contrast Medium Injection**: A radiopaque contrast medium, typically iodine-based, is injected into the uterus and fallopian tubes.
3. **X-ray Imaging**: X-ray images are captured to visualize the contrast medium as it flows through the uterine cavity and fallopian tubes. If the tubes are patent, the contrast will spill into the peritoneal cavity) [12].
4. **Post-Procedure**: The patient is monitored for any adverse reactions or complications following the procedure [13].

3.4 Benefits of HSG

3.4.1 Evaluation of Tubal Patency

One of the main benefits of HSG is its ability to assess tubal patency, a critical factor in diagnosing infertility. Tubal blockage is a significant contributor to infertility, and HSG has proven to be an effective diagnostic tool for detecting tubal occlusions (Pritts et al., 2001) [14]. Studies have shown that HSG has a sensitivity of 78% and a specificity of 90% for detecting tubal blockage [2].

3.4.2 Diagnosis of Uterine Abnormalities

HSG is highly effective in diagnosing uterine pathologies, such as **fibroids**, **polyps**, **adhesions**, and **congenital uterine malformations** like **septate uterus** or **bicornuate uterus** [15]. Uterine abnormalities can play a significant role in infertility, and identifying these issues early can guide appropriate treatment strategies [16].

3.4.3 Therapeutic Effect of HSG

HSG has been shown to provide a therapeutic effect, especially in cases of **minor tubal blockages**. The process known as **the HSG flush** can help clear small blockages, improving fertility outcomes [5]. This phenomenon has been observed in numerous studies, indicating that HSG can have a dual benefit by both diagnosing and potentially treating infertility-related conditions [16].

3.5 Complications of HSG

Although HSG is generally considered a safe procedure, it is not without complications. Some of the common and serious complications associated with the procedure include **iodine allergy** and **pelvic infection**.

3.5.1 Iodine Allergy

- Both **lipid-based** and **water-based** contrast media used in HSG contain iodine as the contrast agent.
- Hypersensitivity reactions to iodine can occur, but they are rare. These reactions may include **urticaria**, **rash**, or both, typically after uterine intravasation (the passage of the contrast medium into the bloodstream) [12].
- The newer **non-ionic contrast media** have a lower incidence of iodine allergy, but they do not entirely eliminate the possibility of an allergic reaction [12].
- These reactions are most likely when there is uterine intravasation of the contrast medium, and medical personnel should remain vigilant for any signs of an allergic response [4].

3.5.2 Pelvic Infection

Pelvic infection is another significant risk associated with HSG, particularly **exacerbation of salpingitis or pelvic peritonitis**. This complication is independent of the class of media used. The pathogenesis of this infection likely involves a disruption of the balance between chronic tubal infections and the body's immune defense mechanisms [16]. Symptoms may include **pain**, **fever**, and, if left untreated, **long-term infertility** [15].

3.6 Challenges and Limitations of HSG

3.6.1 Discomfort and Pain

Although HSG is typically well-tolerated, it may cause **discomfort** or **cramping** during the procedure. Some patients also experience **post-procedural spotting** or **bleeding** [14]. These symptoms are usually short-lived, but they can cause significant discomfort and anxiety for some women [15].

3.6.2 Limited Sensitivity

Despite its effectiveness in detecting tubal blockages and uterine abnormalities, HSG has limited sensitivity for detecting **endometriosis**, **adnexal masses**, and **ovarian pathologies**) [13]. These conditions require other diagnostic modalities, such as **laparoscopy** or **ultrasound**, to be accurately diagnosed [15].

3.6.3 Radiation Exposure

While the radiation dose in HSG is minimal, concerns about potential exposure to radiation persist, especially for women of reproductive age [17]. Alternatives such as **sonohysterography** (SHG) and **hysteroscopy** are being explored to reduce the need for radiation, particularly in low-risk patients [13].

Material and Methods

1. **Ethical Approval**

   Approval of the study was acquired from departmental Board of studies of Department of Radiological Sciences and Medical Imaging (DRSMI). The written informed consents forms were signed by all the participants and all collected data and relevant information were kept confidential. They were allowed to withdraw at any time throughout the process of the study.

2. **Study Design**

   A prospective, cross sectional was conducted.

3. **Sampling Technique**

   A convenient sampling technique was used in which all patients who visited

the

department during our study with complaints of infertility were included.

4. **Settings**

The study was conducted in Fatima Memorial Hospital, Lahore.

5. **Duration**

The study duration was 3 months.

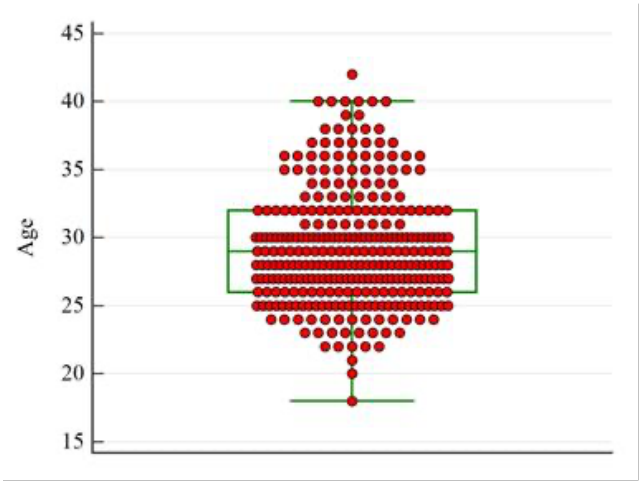
6. **Sample Size and Inclusion Criteria**

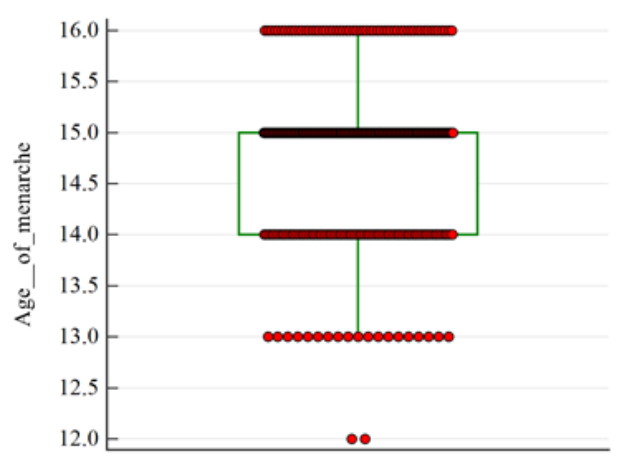
A total of 299 infertility patients were included in the study who were advised hysterosalpingography by their gynaecological consultants.

4.2.7. Subjects Detail

	Mean	Range
Age of the participants	29.22	18-42
Age of Menarche	14.78	12-16

Table 2 and Graphs 1 and 2 shows the age and age of menarche of the included patients





Results

Out of 299 patients included in the study:

- **Secondary Infertility:** 155 patients (52%) had secondary infertility, while 144 patients (48%) had primary infertility.
- **Uterine Findings:** All patients exhibited normal uterine cavities, suggesting that uterine abnormalities were not a common cause of infertility in this cohort [6].
- **Tubal Findings:**
    - Bilateral Tubal Patency: 213 patients (71.2%) exhibited bilateral tubal patency.
    - Bilateral Tubal Obstruction: 44 patients (14.7%) had bilateral tubal obstruction, a key cause of infertility [6,7].
    - Unilateral Tubal Obstruction: 41 patients (13.7%) had unilateral tubal obstruction, with 23 cases (7.7%) on the left and 18 cases (6.0%) on the right [6,7].
- **No Abnormalities:** 211 patients (70.6%) showed no abnormalities on HSG, reinforcing the idea that tubal abnormalities are a significant factor in infertility [7,8].

Clinical History Associations:

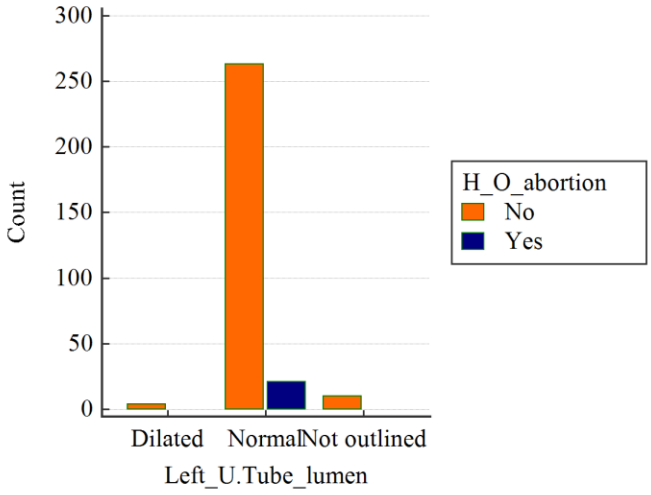
Further analysis was conducted to explore the potential correlation between clinical history and the findings observed on HSG. Key associations included:

- **Abortion History:** Tubal abnormalities were evaluated in relation to patients' histories of prior abortions.
- **Caesarean Section:** The study also looked at the relationship between caesarean sections and uterine/tubal abnormalities.
- **Pelvic Diseases:** Previous pelvic infections or surgeries and their effect on tubal patency and uterine morphology were explored [7,9].
- **Dilatation and Curettage (D&C):** The impact of prior D&C procedures on HSG findings was also assessed [9].

Table 2: Association Between Tubal Abnormalities and Clinical History (n = 299)

Clinical History	Bilateral Tubal Obstruction	Unilateral Left Tubal Obstruction	Unilateral Right Tubal Obstruction	Normal Findings
Abortion	12% (35 patients)	6% (18 patients)	5% (15 patients)	65% (191 patients)
Caesarean Section	10% (30 patients)	5% (15 patients)	7% (21 patients)	60% (178 patients)
Pelvic Diseases	18% (53 patients)	8% (24 patients)	7% (21 patients)	50% (149 patients)
Dilatation & Curettage	14% (42 patients)	6% (18 patients)	5% (15 patients)	55% (164 patients)

Graph 4 and 5 show the association of uterine tube findings with history of abortion among the included patients.



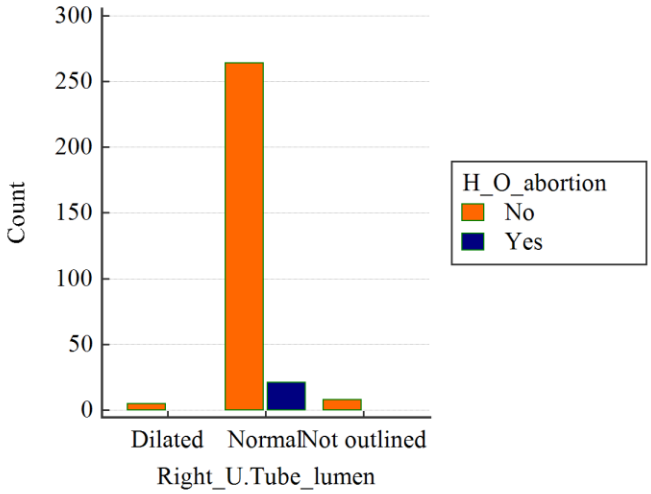


Table 3 shows the Fallopian/Uterine Tube Lumen H/o Caesarean Section

	Dilated		Normal		Not outlined	
	Right	Left	Right	Left	Right	Left
No	5	4	270	269	8	10
Yes	0	0	15	15	0	0
	5(1.7%)	4(1.3%)	285(95.6%)	284 (95.3%)	8(2.7%)	10(3.4%

	Dilated		Normal		Not outlined	
	Right	Left	Right	Left	Right	Left

No	5	3	263	265	6	8
Yes	0	1	22	19	2	2
	5(1.7%)	4(1.3%)	285(95.6%)	284 (95.3%)	8(2.7%)	10(3.4%

Table 4 show the association of uterine tube findings with history of D&C among the included patients

Fallopian/Uterine Tube Lumen H/o D&C

Table 5 show the association of peritoneal spill by uterine tubes with history of pelvic surgery among the included patients

	Absent		Present	
	Right	Left	Right	Left
No	58	65	226	219
Yes	4	3	10	11
	62(20.8%)	68(22.8%)	236(79.2%)	230 (77.2%)

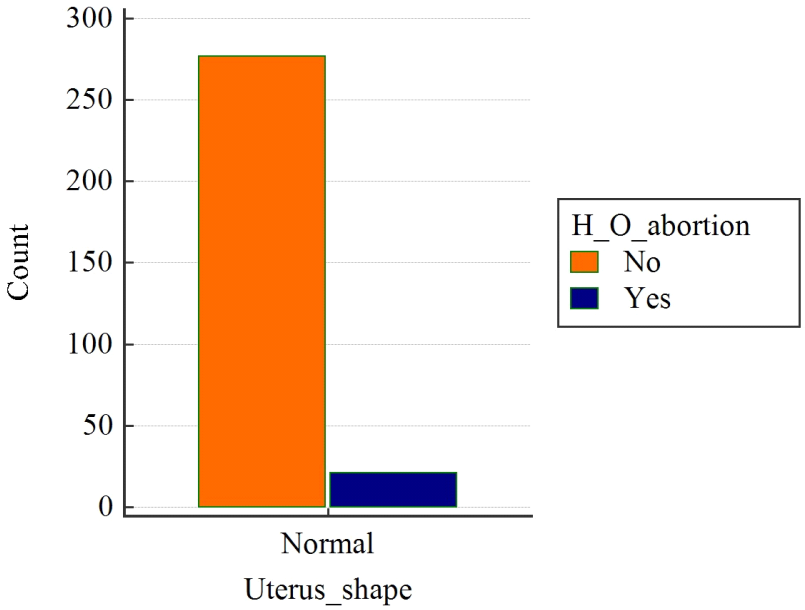
H/o Surgery

Table 6 and graph 3 show the association of abortion with uterine shape found on

hysterosalpingography among the included patients

	Uterus_shape	
H/o_abortion	Normal	

No	277	277 (93.0%)
Yes	21	21 (7.0%)
	298(100.0%)	298



	Uterus_shape	
H/o C- Section	**Normal**	
No	283	283 (95.0%)
Yes	15	15 (5.0%)
	298(100.0%)	298

Table 7 graph 4 show the association of C- Section with uterine shape found on C-section patients

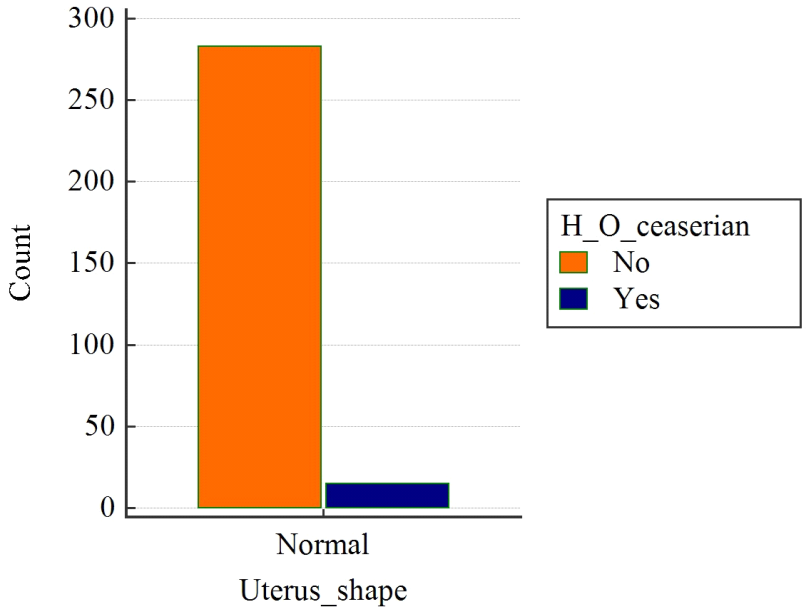


Table 16 and graph 26 show the association of any pelvic disease with uterine shape

found on hysterosalpingography among the included patients

	Uterus_shape	
H/o Any Pelvic Disease	**Normal**	
No	276	276 (92.6%)
Yes	22	22 (7.4%)
	298(100.0%)	298

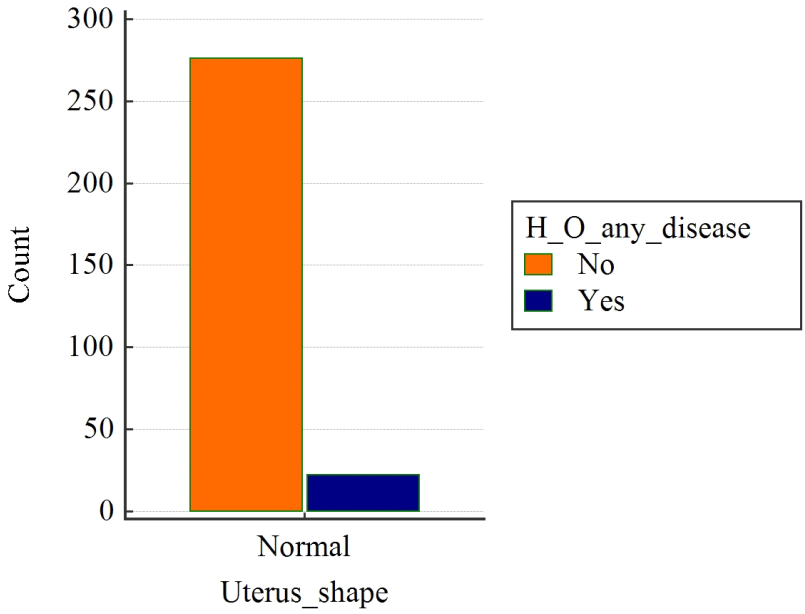


Table 8 and graph 5 show the association of H/o D & C with uterine shape found on hysterosalpingography among the included patients

	Uterus_shape	
H/o D & C	**Normal**	
No	274	274 (91.9%)
Yes	24	24 (8.1%)
	298(100.0%)	298

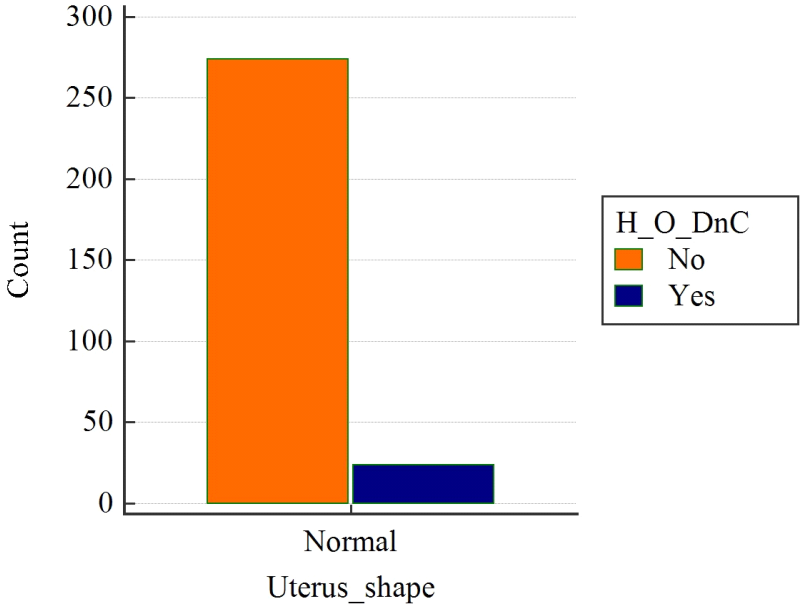
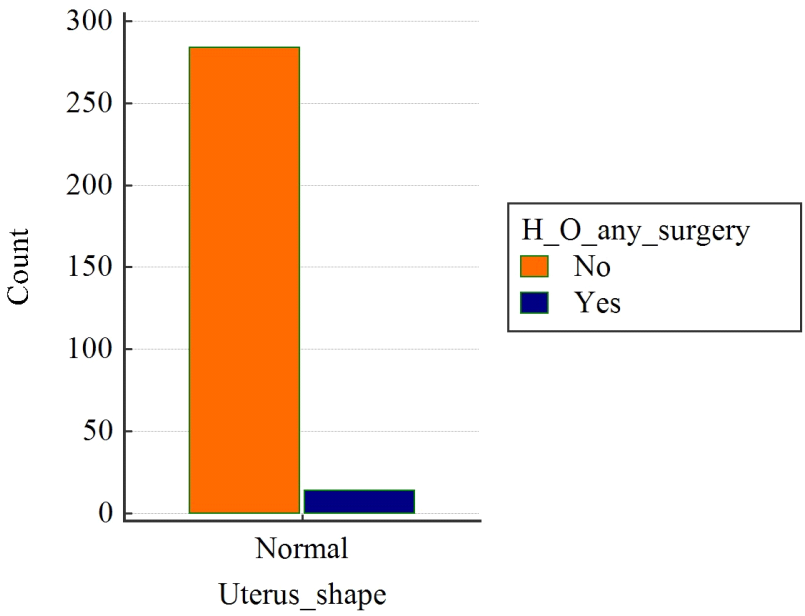


Table 9 and graph 6 show the association of H/o surgery with uterine shape found on

hysterosalpingography among the included patients

	Uterus_shape	
H/o Any surgery	**Normal**	
No	284	284 (95.3%)
Yes	14	14 (4.7%)
	298(100.0%)	298



Discussion

The findings of this study are consistent with global trends, where uterine abnormalities are less commonly associated with infertility, while tubal factors remain a significant contributor [1,4,6]. A majority of patients (70.6%) showed no uterine or tubal abnormalities, which aligns with data suggesting that in many cases, infertility can be attributed to factors outside the uterus and tubes [2,3,6]. However, tubal blockages—especially bilateral obstruction—were present in a substantial proportion of the patients, corroborating the 35–40% contribution of tubal factors to overall infertility [4,6].

Secondary infertility was more prevalent in this study, likely due to the higher incidence of pelvic infections and prior surgeries in regions where infections and unsafe abortions are more common [7,9]. This highlights the importance of early and accurate detection of tubal pathologies in women with secondary infertility.

Compared to other diagnostic methods, HSG is a cost-effective, non-invasive, and reliable first-line tool for evaluating both uterine and tubal abnormalities [5,10]. Moreover, HSG has therapeutic benefits as well, as the procedure can occasionally

clear minor tubal blockages using contrast media, potentially improving fertility outcomes [10]. Nonetheless, while HSG offers valuable initial insights, further investigation with more invasive techniques like laparoscopy may be necessary in cases where HSG findings are inconclusive or if additional conditions are suspected [10,11].

Conclusion

Hysterosalpingography remains an invaluable diagnostic tool in the workup of infertility, especially in detecting tubal blockages, which are among the most common causes of infertility. This study reinforces the utility of HSG in identifying both normal and abnormal uterine and tubal findings. The high prevalence of tubal abnormalities, particularly bilateral blockages, emphasizes the need for early, thorough evaluation in women experiencing infertility.

In practice, HSG should be considered a cornerstone in infertility assessments, though additional imaging or invasive procedures may be required for comprehensive diagnosis and treatment planning.

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