



# Comparison of Hysterosalpingography and Laparoscopy in the Evaluation of Infertility: A Prospective Study

Priyanka Sharma<sup>1</sup> · S. Sunita<sup>1</sup> · Namrata Shrivastava<sup>1</sup> · Meena Bhargava<sup>1</sup>

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## Abstract

**Background** Worldwide one of the major problems of human reproduction that haunts men and women is infertility. Hysterosalpingography (HSG) and laparoscopy (LS) are the two most important modalities to evaluate infertility. Our aim is to compare the efficacy of both.

**Methodology** This is a prospective study. One hundred and five females of both primary and secondary infertility together were included. Detailed history, examination and routine investigations were carried out. Tuberculosis polymerase chain reaction (TBPCR) was made from endometrial biopsy sample for all patients. Ovulation study was done by transvaginal ultrasonography. Hysterosalpingography and diagnostic laparoscopy were done.

**Results** Out of 105 infertile patients, 51.42% were in 26–30 years group. 52.3% were from lower economic group. 55.23% presented between 1 to 5 years of infertility. Twelve patients had used contraception in the past. Sixteen patients were serologically positive. Twenty-nine patients were with positive TBPCR among 105 females. Fifty-four and fifty-six patients had patent tubes by HSG and laparoscopy, respectively. Uterine filling defects and congenital anomalies could be detected four times more by HSG than by laparoscopy. TO mass was detected only by laparoscopy. Bilateral spill was present in 66.6% by HSG and 67.6% by laparoscopy and unilateral spillage in 22.8% and 21.9%, respectively. The sensitivity, specificity and accuracy of HSG in predicting unilateral block taking laparoscopy as gold standard are 85%, 96.4% and 94.2%, respectively, and sensitivity and specificity of bilateral tubal block are 81.8% and 98%, respectively.

**Conclusions** HSG and laparoscopy are not alternative, but complimentary in diagnosing tubal pathologies. HSG remains as primary screening procedure, but laparoscopy is gold standard.

**Keywords** Hysterosalpingography · Infertility · Tubes · Laparoscopy

## Introduction

Infertility is a disease of male or female reproductive system defined by failure to achieve a pregnancy after 12 months or more of regular unprotected sexual intercourse [1]. It affects millions of people of reproductive age worldwide and has a negative social impact on couple, their families

and communities. In general, the prevalence of infertility is estimated to be 10.15% among young couple. However, experiencing infertility for at least one year is reported in 12–28% of cases [2].

The main causes of infertility include male factor, ovulatory disorders, decreased ovarian reserve, tubal injury, blockage, peritubal adhesions, uterine factors, systemic conditions, cervical immunologic factors and unexplained factors. Tuboperitoneal factors are responsible for around 30 to 40% of cases of female infertility. Hence, evaluation of tubal patency is a key step and basic investigation in the assessment of infertile women [2]. Hysterosalpingography (HSG) and laparoscopy (LS) are the two most important diagnostic procedures for the detection of causes of infertility.

The workup protocol for infertility has changed from the last four to five decades. HSG is the first-line investigation as it is non-invasive, cost-effective and safe and is a OPD

Dr Priyanka Sharma is a senior resident in UCMS & GTB hospital, Delhi. Dr. S. Sunita is a senior resident at UCMS &GTB hospital, Delhi. Dr. Namrata Shrivastava is a Associate professor in Index medical college, Madya Pradesh. Dr. Meena Bhargava is a Professor and Head of the Department in Index Medical College.

✉ S. Sunita  
sunifrn@gmail.com

<sup>1</sup> UCMS: University College of Medical Sciences, Delhi, India

procedure. While laparoscopy is the gold standard. Our purpose is to study the demographic factors, to validate and compare the efficacy of HSG and laparoscopy in the cases of primary and secondary infertility for the diagnosis of tubal occlusion and extra tubal pathologies.

## Methodology

The present study “Comparison of Hystero-salpingography and Laparoscopy in evaluation of infertility” was carried out in the department of Obstetrics and Gynaecology, Index Medical College Hospital and Research centre. It is a prospective study done from June 2017 to May 2018 for the duration 12 months. One hundred and five females of both primary and secondary infertility together of duration 1 year or more with no previous pelvic surgeries were enrolled. They were subjected to detailed history followed by clinical, systemic and gynaecological examination as per proforma. Routine workup in the form of blood investigations including serology, urine examination, X-ray chest, endometrial sampling and ovulation study was done followed by hysterosalpingography and diagnostic laparoscopy.

## HSG Procedure

All patients were subjected to HSG on outpatient basis during postmenstrual phase; Leech Wilkinson’s cannula was threaded into the cervical canal, and under the fluorescent screen, initially 3–5 cc of Urografin 60% dye was injected into cannula and initial X-ray was taken. The second film was taken after injecting 5–7 cc of dye in the filling phase.

## Diagnostic Laparoscopy Procedure

After three menstrual cycles, the patients were admitted for the laparoscopic examination. The Leech Wilkinson’s cannula was threaded through the external os. Through a

small subumbilical incision, the uterus, anterior pouch and pouch of Douglas, both tubes, ovaries and the peritoneal cavity were examined serially. Diluted methylene dye was used for chromopertubation to determine tubal patency.

## Observations and Results

Out of 105 infertile patients, 51.42% were in 26–30 years age group, out of which primary and secondary infertility patients were 37.14% and 14.28%, respectively. 34.2% were in 21–25yrs age group and 14.2% patients were above 30yrs age. 55.2% (58) patients presented between 1 to 5 years of infertility, 40.9% had 6–10yrs and 3.8% patients had 11–15yrs of infertility (Table 1).

Most patients (52.3%) were from lower class, whereas 5.7% patients were in the UMC group. 11.4% patients used contraception in the past and 88.5% did not use. Sixteen patients were serologically positive, out of which 6 (37.5%) had tubal blockage (Table 2) (Figs. 1, 2, 3).

Out of 29 patients with positive TBPCR, 15 had tubal blockage constituting to 51.6%. The most common finding was normal patent tubes, i.e. 54 and 56 patients by HSG and laparoscopy, respectively (Table 3). The extra tubal findings were peritubal adhesions in 8 cases by HSG and 11 cases by laparoscopy (Fig. 3). Uterine filling defects in 5 patients by HSG and 3 had congenital anomalies by HSG and 2 by Laparoscopy (Table 4) (Figs. 4, 5). Tubo-ovarian mass was detected only by laparoscopy (Fig. 6).

Bilateral spill was present in 66.6% by HSG and 67.6% by laparoscopy. Unilateral spillage in HSG by 22.8% and by laparoscopy 21.9%. 10.4% patients showed no spillage in both methods (Table 5).

Taking laparoscopy as gold standard, the sensitivity, specificity and accuracy of HSG in predicting unilateral block are 85%, 96.4% and 94.2%, respectively. PPV and NPV are 85% and 96%. The sensitivity and specificity of HSG in predicting bilateral tubal block are 81.8% and 98%, respectively. PPV and NPV are 81.8% and 98%.

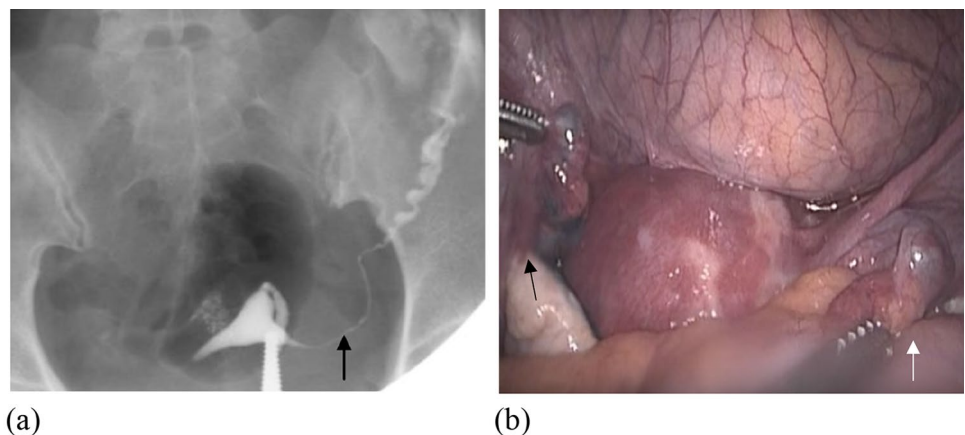
**Table 1** Distribution of type of infertility, age group and duration of infertility

Age (years)	Primary infertility	Secondary infertility	Total (%)
21–25	25	11	36 (34.2%)
26–30	39	15	54 (51.42%)
30+	9	6	15 (14.28%)
Total	73	32	105 (100%)
Duration of infertility (years)	Primary infertility	Secondary infertility	Total (%)
1–5	36	22	58 (55.2%)
6–10	34	9	43 (40.9%)
11–15	3	1	4 (3.8%)
Total	73	32	105 (100%)

**Table 2** Distribution according to socioeconomic status, contraception usage and serology

Socioeconomic group	No. of cases	Percentage (%)
Upper middle class (UMC)	6	5.7
Lower middle class (LMC)	8	7.6
Upper lower class (ULC)	36	34.2
Lower class (LC)	55	52.3
Total	105	100
Type of contraception	No. of cases	Percentage
OCP	4	3.8%
IUCD	3	2.8%
Condom	5	4.7%
No contraception	93	88.5%
Total	105	100%
Serology	Number (a)	Tubal blockage (b/a)
Positive	16	6 (37.5%)
Negative	89	25 (28%)
Total	105	31 (29.5%)

**Fig. 1** Unilateral fallopian tube block. On HSG (a), there is opacification of the left fallopian tube with free peritoneal spill (black arrow). But on right side, there is neither opacification of the fallopian tube nor free peritoneal spill noted (Right cornual block). On laparoscopy (b), there is free spill on left; however, no spill could be demonstrated on right suggestive of block



The sensitivity, specificity and accuracy of HSG in predicting peritubal adhesions are 63.6%, 98.9% and 95.2%, respectively. PPV and NPV are 87.5% and 95.8%. The sensitivity, specificity and accuracy of HSG in predicting hydrosalpinx are 66.6%, 98.0% and 97.1%, respectively. PPV and NPV are 50% and 99%. The sensitivity, specificity and accuracy of HSG in predicting congenital uterine anomalies are 100%, respectively. PPV and NPV are 66.6% and 100%.

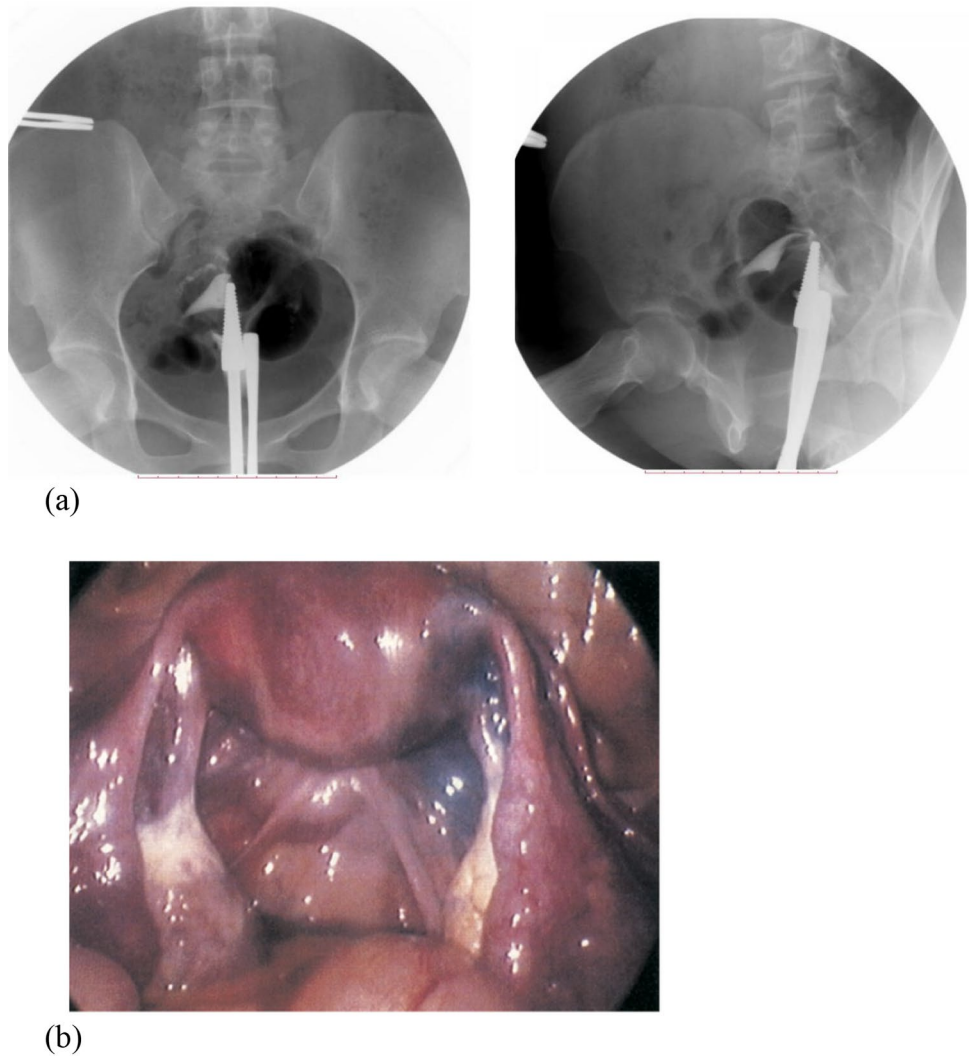
Out of 105 patients evaluated, HSG detected tubal obstruction in 32.3% patient, out of which 19% had proximal block, 4.7% had mid-block, 7.6% had distal block and 1 had combined bilateral tubal block (Table 6).

## Discussion

Hysterosalpingogram is a traditional method widely used and still remains the best clinical choice to assess the anatomy of the uterus and patency of fallopian tube in infertility evaluation. Further evaluation by laparoscopy is much needed as it is more accurate and the pathology can be treated in a same setting. Observations made in our study are compared and discussed here with other recent studies.

In our study, (51.4%) were in the age group of 26–30 years and 14.2% were in more than 30 years of age.

**Fig. 2** Bilateral fallopian tube block. On HSG (a), neither there is opacification of the bilateral fallopian tubes nor free peritoneal spill (bilateral cornual blockage). On laparoscopy (b), there is bilateral cornual obstruction to flow. Dye is seen suffusing the myometrium and vessels of the broad ligament on right



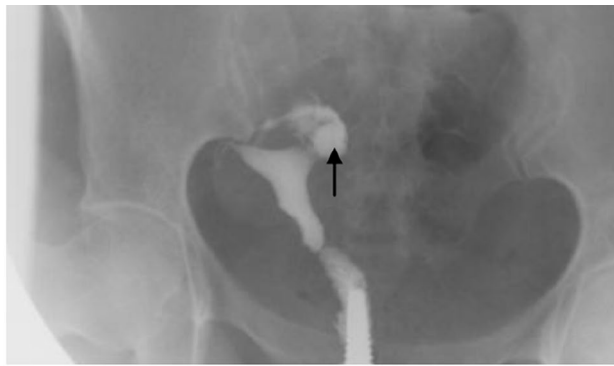
Fertility starts declining after the age of 27 making age as a most important factor in female infertility [3]. According to Kuppaswamy index, most of our patients 52.3% belonged to lower class group and 5.7% in UMC. The fact that people with higher status have easier access to health care in comparison with lower-class people with under nutrition, financial hardships and poor hygiene [4]. Majority of our patients presented within 1–5 years of infertility; only 4 patients had prolonged infertility of 11–15 yrs.

Patients with history of PID/STD were associated with a higher number of tubal blockages (43%). Also, in our study 11.4% patients gave history of contraception usage in the past. Sixteen had positive serology among which 6 had tubal blockage making it a prominent factor contributing to infertility.

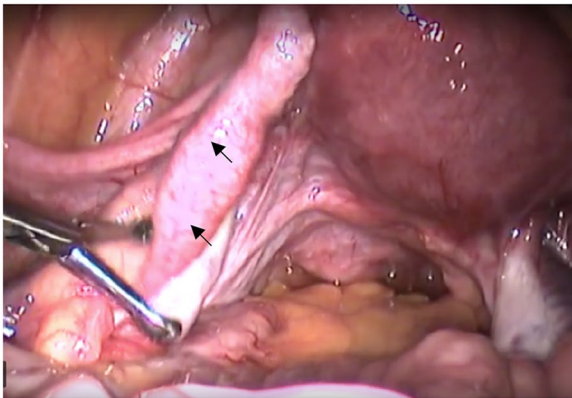
TBPCR was performed in all patients, among which 29 (27.6%) were positive, of which 51% had tubal blocks, 13.7% minimal peritubal adhesions, 6.8% tubo-ovarian mass and 3.4% hydrosalpinx (Fig. 7). These data make us

understand that genital TB is such an important cause of reproductive morbidity in women, which also seems to have high incidence in our centre. It invariably affects the fallopian tube by causing cornual block, tubal beading, tubercles, ostial fibrosis, and in 50% of the cases endometrium is involved. Extensive adhesions caused by abdominal TB also interfered in our study. Comparably, Jindal UN et al. [5] found 169 (38.15%) patients to have positive TB-PCR among 443 patients.

In total, 51.4% had patent tubes by HSG and 53.3% by laparoscopy. 29.5% had tubal block by HSG and LS. Most common extra tubal finding was peritubal adhesions. Uterine filling defects and anomalies could be detected four times more common by HSG than laparoscopy. Laparoscopy showed higher percentage of patent tubes, probably owing to opening of tubes under pressure from injection of dye giving a difference of 1% in bilateral spillage. Similarly, Khetmalas et al. [4] found bilateral spill in 70.1% patients on HSG and 71.0% on laparoscopy. On the contrary, Choudhary et al. [6]



(a)



(b)

**Fig. 3** Case 3: Hydrosalpinx. On HSG (a), left hydrosalpinx (black arrow) is noted. On laparoscopy (b), dilated fallopian tube (black arrow) is noted on left suggestive of hydrosalpinx

found that bilateral spill, unilateral spill and bilateral absent spill in 56%, 16% and 28% on hysterosalpingography and bilateral spill in 56% patients on laparoscopy.

In our study, the specificity of HSG in predicting unilateral block is 96.4% and bilateral block is 98%. HSG was unable to diagnose adhesions in 4 patients, which were seen on laparoscopy and properly evaluated. Similarly, Gharekhanloo et al. [7] got sensitivity, specificity and accuracy of HSG for the detection of unilateral tubal occlusion as 75%, 91.2% and 89.5%, respectively. The sensitivity and specificity of HSG in predicting bilateral tubal block are 91.2% and 75%, respectively. Tan et al. [8] found that the positive predictive value of HSG for detecting patency or occlusion for both tubes was 87.2%. Hence, the diagnostic accuracy of HSG for both tube patency/occlusion was explicit.

HSG detected tubal obstruction in 35 patients (32.3%), out of which most of the patients, i.e. 20 (19%) had proximal tubal block, 8 (7.6%) had distal tubal block, 5 (4.7%) had mid-tubal block, 1 had combined bilateral tubal block, which correlates with a study done by Shrikant Madhukar Khetmalas et al. [4]; they found 25% patients with proximal tubal block, 11.3% patients with distal block and 6.1% patients with mid-block.

HSG is considered a very safe procedure with <1% complications, in rare cases; infection can damage the fallopian tubes, which will necessitate their removal. The incidence of complications in laparoscopy is 3–4% with need for laparotomy in 0.73% of cases. In this study, majority of patients had no complications after HSG; only 4 patients had mild abdominal pain, which was relieved with medications and 9 had minimal

**Table 3** Pathologies in patients with positive TBPCR, HSG and LAP

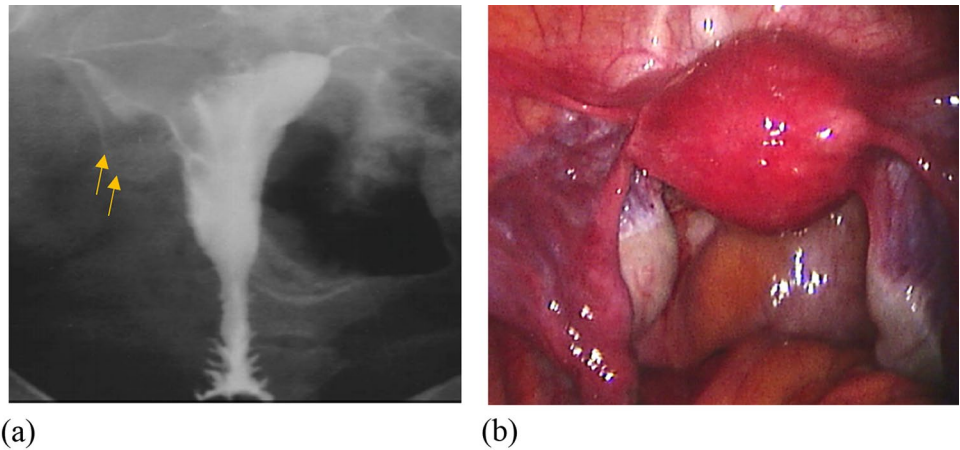
Pathology	No. of patients with positive TBPCR	Percentage (a/29)
Spill present	7	24.1
Unilateral block	9	31
Bilateral block	6	20.6
Hydrosalpinx	1	3.44
Peritubular adhesions	4	13.7
Tubo-ovarian mass (TOM)	2	6.8
Total	29	100
Tubal pathology	HSG	Laparoscopy
No pathology	54	56
Unilateral blocked tubes	20	20
Bilateral blocked tubes	11	11
Hydrosalpinx	4	3
Peritubular adhesions	8	11
Filling defect	5	–
Congenital anomaly	3	2
TOM	–	2
Total	105	105

**Table 4** Comparison of tubal factors on HSG and laparoscopy

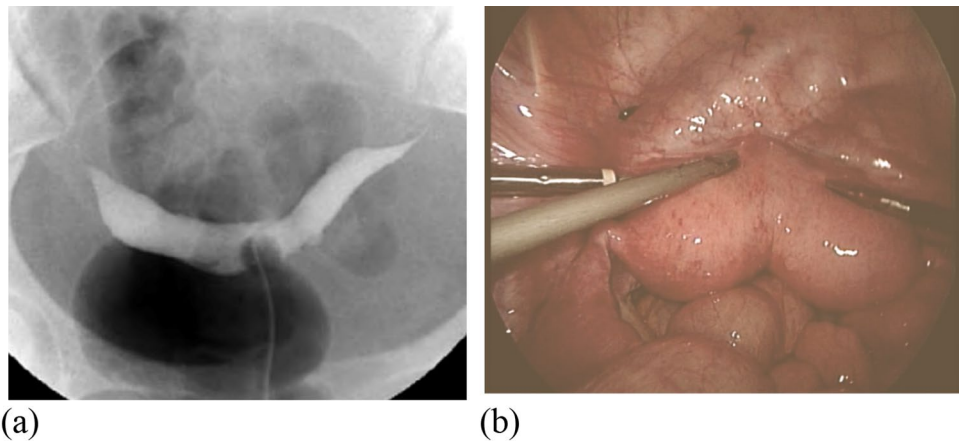
HSG		Laparoscopy		Total by HSG	Chi sq	P value
		Yes	No			
Unilateral block	Yes	17 (TP)	3 (FP)	20	69.693	<0.0001*
	No	3(FN)	82(TN)	85		
	Total	20	85	105		
Bilateral block	Yes	9(TP)	2(FP)	11	73.407	<0.0001*
	No	2(FN)	92(TN)	94		
	Total	11	94	105		
Peritubal adhesions	Yes	7(TP)	1(FP)	8	54.779	<0.0001*
	No	4(FN)	93(TN)	97		
	Total	11	94	105		
Hydrosalpinx	Yes	2(TP)	2(FP)	4	33.298	<0.0001*
	No	1(FN)	100(TN)	101		
	Total	3	102	105		
Uterine anomalies	Yes	2(TP)	1(FP)	3	69.32	<0.0001*
	No	0(FN)	102(TN)	102		
	Total	2	103	105		

TP true positive, TN true negative, FP false positive, FN false negative

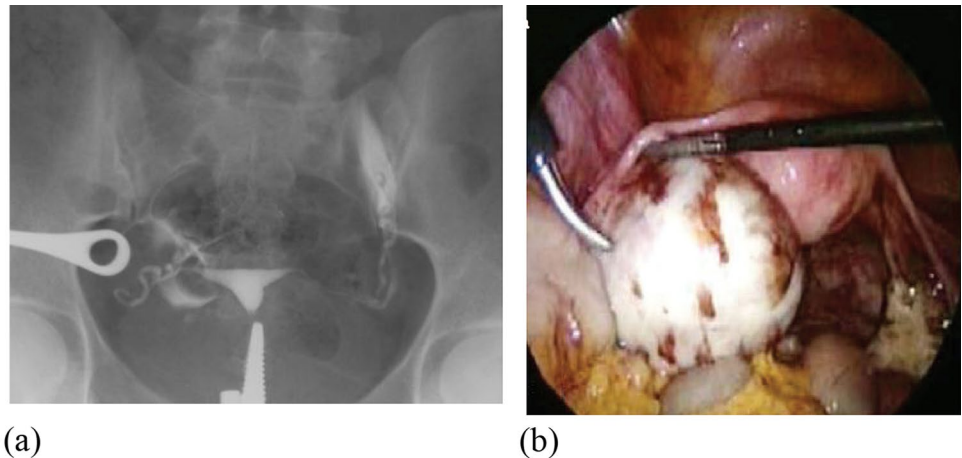
**Fig. 4** Intrauterine filling defect (Synechiae). On HSG (a), irregular and linear filling defect (yellow arrow) is noted along the superior right side near cornual suggestive of uterine synechiae. Laparoscopy (b) did not reveal any abnormality and normal configuration of uterus, fallopian tubes and both ovaries can be appreciated.



**Fig. 5** Bicornuate uterus. HSG (a) shows two markedly splayed uterine horns suggestive of bicornuate uterus. Laparoscopy (b) shows two separate uterine horns with deep fundal cleft suggestive of bicornuate uterus



**Fig. 6** Endometrioma. On HSG (a), opacification of both the tubes and bilateral spillage is noted. On laparoscopy (b), big endometrioma is noted posterior to uterus. Patient had history of infertility and painful periods



**Table 5** Tubal spillage comparison of HSG and laparoscopy

Tubal findings	HSG			Percent	Laparoscopy			Percent
	1o infertility	2o infertility	Total		1o infertility	2o infertility	Total	
Bilateral Spil+	50	20	70	66.6	52	19	71	67.6
Unilateral spil+	17	7	24	22.8	15	8	23	21.9
Spil-	6	5	11	10.4	6	5	11	10.4
Total	73	32	105	100	73	32	105	100

Chi sq = 1.304, p value = 0.5210

**Table 6** Site of obstruction

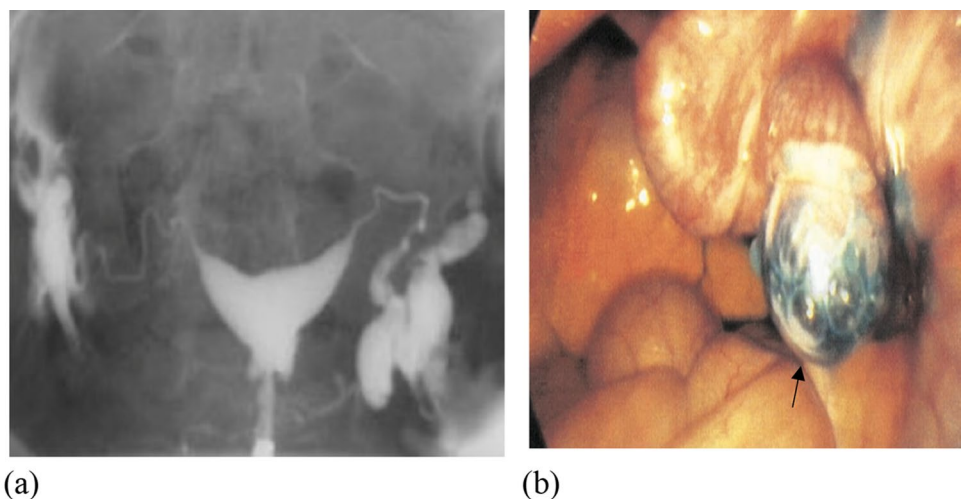
Site of block	Bilateral block (%)	Unilateral block (%)	Total no. (%)
Proximal tubal	5 (4.7%)	16 (15%)	21 (19%)
Mid-tubal	2 (1.9%)	3 (2.8%)	5 (4.7%)
Distal tubal	3 (2.8%)	5 (4.7%)	8 (7.6%)
Combined	1 (0.9%)	–	1 (0.9%)
Total	11	24	35 (32.3%)

bleeding per vagina after HSG. While in laparoscopy four patients had abdominal pain, 4 had fever, 2 had wound infection, 10 had vomiting and rest all patients were normal.

## Conclusions

Since HSG is a rapid diagnostic modality and has good sensitivity and specificity, it should be used as a screening test. It is also valuable in knowing the intraluminal environment

**Fig. 7** Peritubal adhesions. HSG image (a) revealed no abnormality with normal configuration of endometrial cavity, fallopian tubes and bilateral free spill of contrast. Laparoscopy image (b) shows peritubal adhesions leading to loculation of the injected dye, yet there is some spill into the peritoneal cavity



of the fallopian tube and endometrial cavity. However, at times in cases of long-term unexplained infertility, positive findings may be missed. Also, as seen in our study HSG can over diagnose tubal block giving false-positive values, which may be due to uterine spasm induced by pain.

Extratubal pathologies are difficult to be picked up by routine imaging procedures. Hence, it should be followed by laparoscopy. Although it is expensive and invasive and has more complications than HSG, it provides accurate picture of tubal patency and its pathologies, which gives the opportunity to treat disease at the same setting. Similar finding in study by Dubbewar et al. [9] also confirms that laparoscopy is superior and definitive for prediction of tubal blocks compared to HSG alone.

The accuracy of diagnosis is enhanced when two procedures are combined especially in those cases where the results of one are doubtful. Thus, we conclude that HSG and laparoscopy are not alternative, but complimentary in determining tubal patency and extra tubal pathologies in case of infertility.

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical Approval** Approval for conducting this study was given by institutional ethical committee.

**Informed Consent** Informed consent was obtained from study participants maintaining complete confidentiality.

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