

# The accuracy of hysterosalpingogram in the diagnosis of tubal blockage among sub-fertile women at the Kenyatta National Hospital, Nairobi

Gichunuku JG<sup>1</sup>, Wanyoike GJ<sup>2</sup>, Ong'ech J<sup>3</sup>

<sup>1</sup>Tigoni Hospital, Kiambu County, Kenya

<sup>2</sup>Department of Obstetrics and Gynaecology, University of Nairobi, Kenya

<sup>3</sup>Department of Obstetrics and Gynaecology, Kenyatta National Hospital, Nairobi, Kenya

**Correspondence to:** Dr. J. G. Wanyoike. Email: drjoewanyoike@yahoo.co.uk.

## Abstract

**Background:** Tubal factor accounts for 22% of cases of subfertility among women. The diagnosis of tubal infertility can be made using either hysterosalpingogram (HSG) or laparoscopy.

**Objective:** To determine the accuracy of using HSG in diagnosing fallopian tube blockade with laparoscopy as the gold standard.

**Design:** Prospective observational study.

**Setting:** Kenyatta National Hospital.

**Methods:** An observational study at the Kenyatta National Hospital (KNH). The main outcome measures were; proportion correctly diagnosed to have proximal and distal blockage on HSG; proportion of patients correctly diagnosed to have adhesions and proportion of patients correctly diagnosed to have hydrosalpinx. Correlation was undertaken using the chi-square test and the agreement between the two tests compared, using the laparoscopy dye test as the gold standard. Likelihood ratios and predictive values were used to test for accuracy of HSG compared to laparoscopy.

**Results:** Hysterosalpingogram could accurately detect tubal blockage with a sensitivity of 74% and a specificity of 70%. Its sensitivity in detecting tubal adhesions was 17.9% with a specificity of 85.7%; and 80% sensitivity and specificity of 76% for hydrosalpinx

**Conclusion:** HSG has a high specificity in diagnosing tubal occlusion and hydrosalpinx but of low value in detecting tubal adhesions.

**Keywords:** Hysterosalpingogram (HSG), Laparoscopy, Infertility, Fallopian tubes, Adhesions

## Introduction

Sub-fertility affects 10% to 15% of couples in the reproductive age group. The condition has significant medical, psychosocial and economic impact (1). Both male and female factors equally contribute to sub fertility. It is therefore important to consider both couples in the management of the condition. Female factors contributing to infertility include anovulation, fallopian tube blockage, and uterine anomalies or there may be no obvious identifiable cause (unexplained infertility). The World Health Organization (WHO) task force on the diagnosis and treatment of infertility found tubal factor to account for 22% of infertility (2). In Kenya, the leading causes of infertility among women are; pelvic adhesions and bilateral tubal obstruction (61%), anovulation (16%), hyperprolactinaemia (10%), ovulatory oligomenorrhoea (6%) and others (7%). Tubal occlusion could be a result of pelvic inflammatory disease due to infections such as chlamydia, gonorrhoea and post-abortal or puerperal sepsis (3-5). Indeed

pelvic inflammatory disease remains the commonest reason for gynaecological consultations in low-income countries (1). Other cases of tubal blockade include pelvic adhesions from previous infections or pelvic surgery, endometriosis or mullerian anomalies.

The tubal and uterine factors can be assessed either by HSG and/or dye laparoscopy. Dye laparoscopy remains superior to HSG and may be considered the gold standard as it allows direct visualization of the spill and could correctly identify the site of blockage. It also allows the visualization of pelvic adhesions with possibility of corrective surgery been undertaken. However, unlike HSG it does not evaluate for uterine cavity anomalies. This may require diagnostic procedure such as hysteroscopy. The visualization of the tubal lumen is also not possible with these endoscopic procedures.

The sensitivity and specificity of an HSG is approximately 65% and 85% respectively (6). Abnormalities found on HSG may therefore require confirmatory evaluation using laparoscopy and/or

hysteroscopy. However, routine use of HSG prior to laparoscopy and dye in the fertility workup does not result in a significant effect on the incidence of pregnancy, compared with routine use of laparoscopy alone (7,8). The diagnosis of tubal patency based on HSG or laparoscopic findings are not considered complete or an absolute diagnosis (9,10). Unlike laparoscopy, HSG is affordable and accessible and can be easily done in most of the hospitals. While the diagnostic usefulness of the HSG is established, its value as a therapeutic procedure in infertility is unknown.

The aim of this study was to establish the sensitivity and specificity of HSG in diagnosing the blockage of fallopian tubes, the sites of obstruction, the diagnosis of adhesions and the hydrosalpinx using laparoscopy as the gold standard.

## Materials and Methods

This was an observational study conducted at the Kenyatta National Hospital (KNH), Nairobi. The study population were all women admitted for either diagnostic or operative laparoscopy with an initial diagnosis of tubal blockage on HSG. All women underwent diagnostic laparoscopy during which the tubal patency was determined using the methylene blue dye test. The level of tubal blockage was therefore visualized and recorded. The pelvis was also assessed for adhesions and any other relevant pathology that could contribute to tubal blockage. These findings were then compared to prior HSG findings. The level of agreement between the HSG and laparoscopy was therefore determined. Data were analyzed using 4 by 4 tables to determine the accuracy of HSG with laparoscopy acting as the gold standard. The sensitivity and specificity of HSG was thus determined using the laparoscopic findings as the presumed standard.

A pre-tested structured questionnaire was used to collect relevant demographic and reproductive health data from the women. The patients were interviewed and the information entered into a structured questionnaire. The KNH ethical and research committee approved the study.

## Results

A total of 60 participants were investigated between June 2011 and February 2012. Most of the women were above 26 years with a mode 31 to 35 years. A majority of women in the dominant group were married and had at least secondary school level of education. The rest of their socio-demographic characteristics is presented in Table 1.

**Table 1:** Social demographic data (n=60)

Demographics	No.	(%)
Age (years)		
21-25	3	5
26-30	17	28
31-35	24	40
>35	16	27
Marital status		
Single	4	7
Married	52	87
Separated	4	7
Level of education		
Not educated	2	3
Primary level	17	28
Secondary level	30	50
Tertiary level	11	18
Employment		
Unemployed	8	13
Self-employed	42	70
Salaried employment	10	17

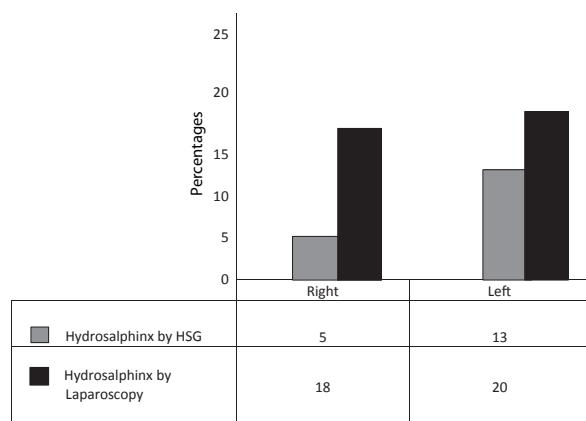
Primary and secondary infertility constituted 48% and 52% respectively of the infertile patients while 20% of the same had history of PID. Overall, the HSG showed obstruction of the right fallopian tube in 97% of cases, while laparoscopy identified 82% while on the left side HSG showed tubal blockage rate of 93% and 80% on laparoscopy. The data shows that there were more cases of tubal occlusion identified on HSG than were reported at laparoscopy. The greatest disparity was among those identified to have a distal obstruction in the left tube in which case HSG detected 53% of patients compared to a 32% by laparoscopy (Table 2).

**Table 2:** Clinical characteristics (N=60)

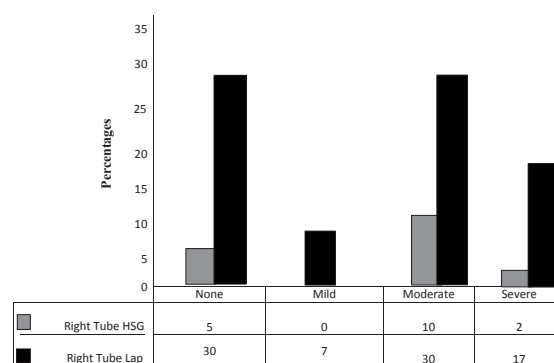
	No.		(%)	
History of PID	12		20	
Type of infertility				
Primary Infertility	29		48	
Secondary Infertility	31		52	
Location of occlusion				
	HSG		Laparoscopy	
	No.	(%)	No.	(%)
Right proximal	30	50	27	45
Right distal	28	47	22	37
Left proximal	24	40	29	48
Left distal	32	53	19	32

Thirteen per cent of patients were categorized as having hydrosalpinx on HSG compared to 20% using laparoscopy. The HSG was less effective in detecting pelvic adhesions compared to laparoscopy ( $\chi^2$ ,  $p=0.021$ ). The location of the adhesions and the side on which the fallopian tube was located did not influence the accuracy of HSG or laparoscopy (Figure 2A, 2B).

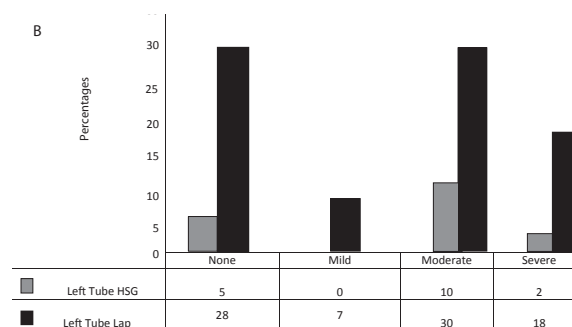
**Figure 1:** Detection of hydrosalpinx using HSG and laparoscopy



**Figure 2A:** Detection of adhesions using HSG and laparoscopy on the right tube



**Figure 2B:** Detection of adhesion using HSG and laparoscopy on the left tube



The sensitivity of HSG in detecting obstruction in the proximal section of the right fallopian tube was 74% with a specificity of 70%. These results further

show that the HSG was more likely to over-report blockage in proximal section of the right fallopian tube by a factor of 2.5 (Table 3).

**Table 3:** HSG as a diagnostic method for detection of obstruction in the proximal section of the right fallopian tube

Diagnostic techniques	Total confirmed (%)	Total not confirmed by Lap (%)	validation	value	95% confidence Intervals
HSG positive/Lap positive	20 (74%)	10 (30%)	Positive Predictive Value	67%	48.8 to 80.8
HSG positive/Lap negative	7 (26%)	23 (70%)	Negative Predictive Value	77%	59.1 to 88.2
Total (%)	27 (100)	33 (100)	Positive likelihood Ratio	2.44	1.39 to 4.29
			Negative Likelihood Ratio	0.37	0.19 to 0.73

The sensitivity of HSG in detecting obstruction in the distal section of the right fallopian tube was at 73% with a specificity of 68%. This test was therefore likely

to report negative cases as positive by a factor of 2.3 and report 30% of patients without an obstruction as having a distal right tube blockage (Table 4).

**Table 4:** HSG as a diagnostic method for detection of obstruction in the distal section of the right fallopian tube

Diagnostic techniques	Total confirmed (%)	Total not confirmed by Lap (%)	validation	value	95% confidence Intervals
HSG positive/Lap positive	16(73%)	12 (32%)	Positive Predictive Value	57%	39.1 to 73.5
HSG positive/Lap Negative	6 (27%)	26 (68%)	Negative Predictive Value	81.3%	67.7 to 91.1
Total (%)	22 (100)	38 (100)	Positive Likelihood Ratio	2.3	1.35 to 3.9
			Negative Likelihood Ratio	0.39	0.19 to 0.81

The specificity of the HSG for the detection of obstruction at the proximal section of left fallopian tube was found to be 48% and a specificity of 68%.

However, the specificity values of this method for both the right and the left side were closely compared at 70% and 68% for the right and the left tube respectively (Table 5).

**Table 5:** HSG as a diagnostic method for detection of obstruction in the proximal section of the left fallopian tube

Diagnostic Techniques	Total Confirmed (%)	Total not Confirmed by Lap (%)	Validation	Value	95% Confidence Intervals
HSG positive/Lap Positive	14(48.3%)	10 (32%)	Positive Predictive Value	58.3%	38.8 to 75.5
HSG positive/Lap Negative	15 (52%)	21(68%)	Negative Predictive Value	58.3%	42.2 to 72.9
Total (%)	29(100)	31(100)	Positive Likelihood Ratio	1.49	0.79 to 2.82
			Negative Likelihood Ratio	0.76	0.49 to 1.71

**Table 6:** HSG as a diagnostic method for detection of obstruction in the distal section of the left fallopian tube

Diagnostic techniques	Total confirmed (%)	Total not confirmed by lap (%)	validation	value	95% confidence intervals
HSG positive/Lap positive	14 (73.7%)	18 (43.9%)	Positive Predictive Value	43.8%	28.2 to 60.7
HSG positive/Lap negative	5 (26.3%)	23 (56.1%)	Negative Predictive Value	82.1%	64.4 to 92.1
Total (%)	19(100)	41(100)	Positive Likelihood Ratio	1.67	1.08 to 2.60
			Negative Likelihood Ratio	0.47	0.21 to 1.04

**Table 7:** HSG as a diagnostic method for detection of hydrosalpinx in the right fallopian tube

Diagnostic techniques	Total confirmed (%)	Total not Confirmed by Lap (%)	Validation	Value	95% Confidence Intervals
HSG positive/Lap positive	8(80%)	12(24%)	Positive Predictive Value	40%	21.9 to 61.3
HSG positive/Lap Negative	2(20.0%)	38(76%)	Negative Predictive Value	95%	83.5 to 98.6
Total (%)	10(100)	50(100%)	Positive Likelihood Ratio	3.333	1.86 to 5.96
			Negative Likelihood Ratio	0.263	0.07 to 0.91

**Table 8:** HSG as a diagnostic method for detection of hydrosalpinx in the left fallopian tube

Diagnostic techniques	Total confirmed (%)	Total not Confirmed by Lap (%)	Validation	Value	95% Confidence Intervals
HSG positive/Lap Positive	3(50.0%)	11(20.4%)	Positive Predictive Value	21.4%	7.6 to 47.6
HSG positive/Lap Negative	3(50.0%)	43 (79.6%)	Negative Predictive Value	93.5%	82.5 to 97.8
Total (%)	6(100%)	54 (100%)	Positive likelihood Ratio	2.455	0.941 to 6.4
			Negative Likelihood Ratio	0.628	0.279 to 1.414

**Table 9:** HSG as a diagnostic method for detection of adhesions against laparoscopy

Diagnostic Techniques	Total Confirmed (%)	Total not Confirmed by Lap (%)	Validation	Value	95% Confidence Intervals
HSG positive/Lap Positive	3(14.3%)	7(17.9%)	Positive Predictive Value	70%	39.7 to 89.2
HSG positive/Lap Negative	18(85.7%)	32(82%)	Negative Predictive Value	36%	24.1 to 49.9
Total (%)	21 (100)	39 (100)	Positive Likelihood Ratio	1.25	0.36 to 4.36
			Negative Likelihood Ratio	0.95	0.76 to 1.20

The sensitivity of HSG in the diagnosis of obstruction of the distal side of the left fallopian was found to be 74% with a specificity of 56% (Table 6) and 80% with a specificity of 76% in the diagnosis of hydrosalpinx of the right fallopian tube (Table 7).

The sensitivity and specificity of HSG in the diagnosis of hydrosalpinx of the left fallopian tube was 50% and a 79% respectively were found (Table 8).

The reliability of HSG for the diagnosis of adhesions was evaluated and the sensitivity was found to be 14% and a specificity of 82%. Therefore, HSG was found to perform poorly as far as detection of adhesions is concerned (Table 9).

## Discussion

Most of the women with sub-fertility in our cohort were between 31 and 40 years. Primary and secondary infertility constituted 48% and 52% respectively of the infertile patients while 20% of the same had history of pelvic inflammatory disease. Similar studies elsewhere, showed that the dominant group seeking similar treatment was in the age group of between 26 and 30 years (11-13). The difference between the findings of our study and these other studies may partially be due to differences in treatment-seeking behavior. A majority of participants (50%) had attained at least some secondary education while 70% were

self-employed. The education level among our study subjects was higher than the national average of 23% and 48% among rural and urban women respectively while the employment level was above the national average of 58% (11). While we suspect that the level of education and employment status are not linked to complications leading to infertility but some degree of education may be a factor that contributes to treatment seeking behavior in which case, informed women are more likely to seek treatment.

The study found that, 53% of women had a distal tubal blockage in the right fallopian tube but this was only confirmed in 29% of the cases on laparoscopy. Similarly, HSG showed distal blockage of the left tube at 63% with only 35% being confirmed on laparoscopy. The clinical data relating to the obstruction of the left or right tube did not differ significantly among these women ( $\chi^2$ ,  $p=0.076$ ). A huge difference was observed between the diagnostic ability of HSG compared to that of laparoscopy. Our study shows that the sensitivity of HSG in diagnosing proximal tubal blockage was 74% and specificity of 70%. This compares well with Shah's study (18), which indicated that the sensitivity and specificity of HSG are approximately 65% and 85% respectively. In this study, the detection of proximal tubal occlusion HSG had sensitivity and specificity of 74% and 70% on the right fallopian tube, 48% and 68% on the left fallopian tube. Our findings are consistent with those published elsewhere (14). Swart and colleagues (15) found that the pooled sensitivity and specificity of HSG were 53% and 87% respectively for any tubal pathology. In this study, HSG had a sensitivity of 80% and a specificity of 76% in the diagnosis of hydrosalpinx of the right fallopian tube. This finding concurs with other studies, which found that HSG had a high specificity of diagnosing proximal tubal occlusion or hydrosalpinx and low sensitivity in cases with peritubal adhesions (16,17). In this study, 30% of the participants tested negative on HSG but had moderate adhesions confirmed by laparoscopy. The sensitivity of HSG in diagnosing adhesions on the fallopian tube was estimated to be 17.9% and specificity of 85.7%. Although HSG is of limited use for detecting tubal patency because of its low sensitivity, its high specificity makes it a useful test for ruling in tubal obstruction.

Our study showed that HSG has lower predictive values compared to laparoscopy, though it has been recommended elsewhere as a primary technique for investigating tubal occlusions (18). Alternatively, HSG could serve more of a complementary role to laparoscopy in the evaluation of infertile couples or even more importantly be used as a screening tool among infertile couples (19,20). While HSG is of a relatively lower value for absolute diagnosis and treatment of sub-fertile women, the conventional use of this technique may increase the time required

to find an adequate treatment by which to achieve a successful pregnancy (16). HSG also finds extensive use because it is relatively affordable, has well-established therapeutic advantages and is associated with low frequency of complications. This method is also recommended in patent tube as an ameliorating measure awaiting laparoscopy (21).

The main limitation of this study was the unknown interval between the time the HSG was performed and the diagnostic laparoscopy. The low correlation observed could have been due to a possible therapeutic effect of HSG or the women may have received some form of treatment after the initial diagnosis. This may have yielded different results had the test been done at the same sitting and one shortly after the other. Tubal spasms have been shown to occur during HSG during the process of either cannulation or injection of contrast media. It is therefore possible for a tube to appear blocked on HSG while in real sense its patent and the blockage is a result of reflex tubal constriction.

## Conclusions

The HSG has a high specificity in diagnosing tubal blockage and hydrosalpinx but of low value in detecting tubal adhesions. HSG could therefore still be used as the first-line investigation for tubal patency, and there may be no need to perform a confirmatory laparoscopy in the event the findings are normal. The use of laparoscopy could be reserved in cases, where the findings are inconclusive or in case of suspicion of other pathology such as tubal pelvic adhesions or hydrosalpinx. The methods may therefore be used to compliment each other rather than replace one with the other.

## References

1. Honore, G.M., Holden, A.E. and Schenken, R.S. Pathophysiology and management of proximal tubal blockage. *Fertil. Steril.* 1999; **71**:785-795.
2. Gomel, V. Reanastomosis of fallopian tubes. *Fertil. Steril.* 1978; **30**:483-484.
3. Lapous, A. Subfertility: the other side of the problem. *IDRC. Rep.* 1977; **6**:17.
4. Aggarwal, V.P. Obstetric emergency referrals to Kenyatta National Hospital. *East Afr. Med. J.* 1980; **57**:144-149.
5. Chandra, A. and Stephen, E.H. Impaired fecundity in the United States 1982-1995. *Fam. Plann. Perspect.* 1998; **30**:34-42.
6. Otubu, J.A., Sagay, A.S. and Dauda, S. Hysterosalpingogram, laparoscopy and hysteroscopy in the assessment of the infertile Nigerian female. *East Afr. Med. J.* 1990; **67**: 370-372.

7. Den Hartog, J. E., Lardenoije, C.M., Severens, J.L., Land, J.A., Evers, J.L. and Kessels, G. Screening strategies for tubal factor subfertility. *Hum. Reprod.* 2008; **23**: 1840-1848.
8. Palmer, A. Ethiodol hysterosalpingography for the treatment of infertility. *Fertil. Steril.* 1960; **11**: 311-315.
9. Dabekausen, Y. A., Evers, J.L., Land, J.A., and Stals, F.S Chlamydia trachomatis antibody testing is more accurate than hysterosalpingography in predicting tubal factor infertility. *Fertil. Steril.* 1994; **61**:833-837.
10. Kitilla, T. Tubo-peritoneal infertility: comparison of pre-operative hysterosalpingography and laparotomy findings (Tikur Anbessa Hospital, 1). *Ethiop. Med. J.* 2006; **44**:167-174.
11. Kiguli-Malwadde, E. and Byanyima, R.K. Structural findings at hysterosalpingography in patients with infertility at two private clinics in Kampala, Uganda. *Afr. Health Sci.* 2004; **4**: 178-181.
12. Blacker, J., Opiyo, C., Jasseh, M., Sloggett, A. and Ssekamatte-Ssebuliba, J. Fertility in Kenya and Uganda: a comparative study of trends and determinants. *Popul. Stud.(Camb.)* 2005; **59**: 355-373
13. Jose-Miller, A. B., Boyden, J.W., and Frey, K.A. Infertility. *Am. Fam. Physician.* 2007; **75**: 849-856.
14. Bacevac, J. and Ganovic, R. Diagnostic value of hysterosalpingography in examination of fallopian tubes in infertile women. *Srp.Arh.Celok.Lek.* 2001; **129**: 243-246.
15. Swart, P., B. W. Mol, D., Redekop, W.K., and Bossuyt, P.M. The accuracy of hysterosalpingography in the diagnosis of tubal pathology: a meta-analysis. *Fertil. Steril.* 1995; **64**: 486-491.
16. Opmeer, K.A.B.C., Nan, G.N., Coppus, S.F., Collins, J.A., Hartog, J.E., et al. Are patient characteristics associated with the accuracy of hysterosalpingography in diagnosing tubal pathology? An individual patient data meta-analysis. *Hum. Reprod. Update.* 2011; **17**:293-300.
17. Streda, R., Mardesic, T., Kult, D., Lazarovska, S., Slamova, J. and Voboril, J. The diagnostic value of hysterosalpingography in the diagnosis of tubal disease. *Ceska. Gynkol.* 2009; **74**:18-21.
18. Shah, S. M., Towobola, O.A. and Masihleho, M. Diagnosis of fallopian tube patency. *East Afr. Med. J.* 2005; **82**:457-462.
19. Perquin, D. A., P. J. Dorr, De Craen, A.J. and Helmerhorst, F.M. Routine use of hysterosalpingography prior to laparoscopy in the fertility workup: a multicentre randomized controlled trial. *Hum. Reprod.* 2006; **21**:1227-1231.
20. Musana, J.W., Ojwang, S.B., Khisa, W. and Kiarie J.N. Pregnancy outcomes in mothers with advanced human immunodeficiency virus disease. *East Afr. Med. J.* 2009; **86**: 480-485.
21. Bulletti, C., I. Panzini, A. Borini, E. Coccia, P. L. Setti, and A. Palagiano. Pelvic factor infertility: diagnosis and prognosis of various procedures. *Ann.N.Y.Acad.Sci.* 2008; **1127**:73-82.