



A Randomised Comparative Study Between Flow And Air Infusion Technique For The Assessment Of Fallopian Tube Patency In Infertile Women

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Abstract

Background: To estimate the accuracy of the assessment of tubal patency using hysteroscopic flow technique and air infusion technique which are compared with gold standard laparoscopic chromopertubation.

Methods: Tubal patency can be assessed in two way by the help of hysteroscope, one is flow technique and other is air infusion technique in 40 womens in each group and the results compared with gold standard laparoscopic chromopertubation.

Results: In hysteroscopic assessment of tubal patency was possible in a statistically significant manner in both study groups ($p < 0.05$). The air infusion technique achieved higher sensitivity and specificity than flow technique.

Conclusion: Using hysteroscope in assessment of tubal patency, air infusion technique was more accurate and comparable to laparoscopic chromopertubation than flow technique.

Keywords: Tubal patency, flow technique, air infusion technique, laparoscopic chromopertubation

Introduction

Infertility is defined as failure to achieve a successful pregnancy after 12 months regular unprotected intercourse. Prevalence of primary infertility varying from 8.9 to 14.2%. Tubal dysfunction is responsible for approximately 30% of infertility cases.¹

Test to determine whether the tubes are patent and undamaged are important part of the infertility workup². Hysteroscope is an important tool in the evaluation of infertility. Assessing tubal patency during hysteroscopy seems highly relevant, particularly when it allows for a low cost, fast, gentle and accurate way of gathering information that may guide clinical care.³

Hysteroscopy when combined with laparoscopy/ chromopertubation is considered the gold standard in the evaluation of tubal patency and uterine cavity.^{4,5}

As compared to HSG, Hysteroscopy is also less invasive, no radiation exposure, no allergic reactions and it is a diagnostic, treatment and management tool as well.^{6,7}

Introducing a hysteroscope under direct vision is the safe and accurate method to bypass the cervical factor and reduce the false negative results of tubal patency.⁸

Tubal patency can be assessed in two way by the help of hysteroscope, one is the flow technique and the other is air infusion technique. Tubal patency

assessment typically done on day 7 to day 11 of the menstrual period, with day 1 being the first day of full and heavy flow (the start of a woman's period). This timing means the uterus lining has shed, allowing one to see inside well.^{9,10}

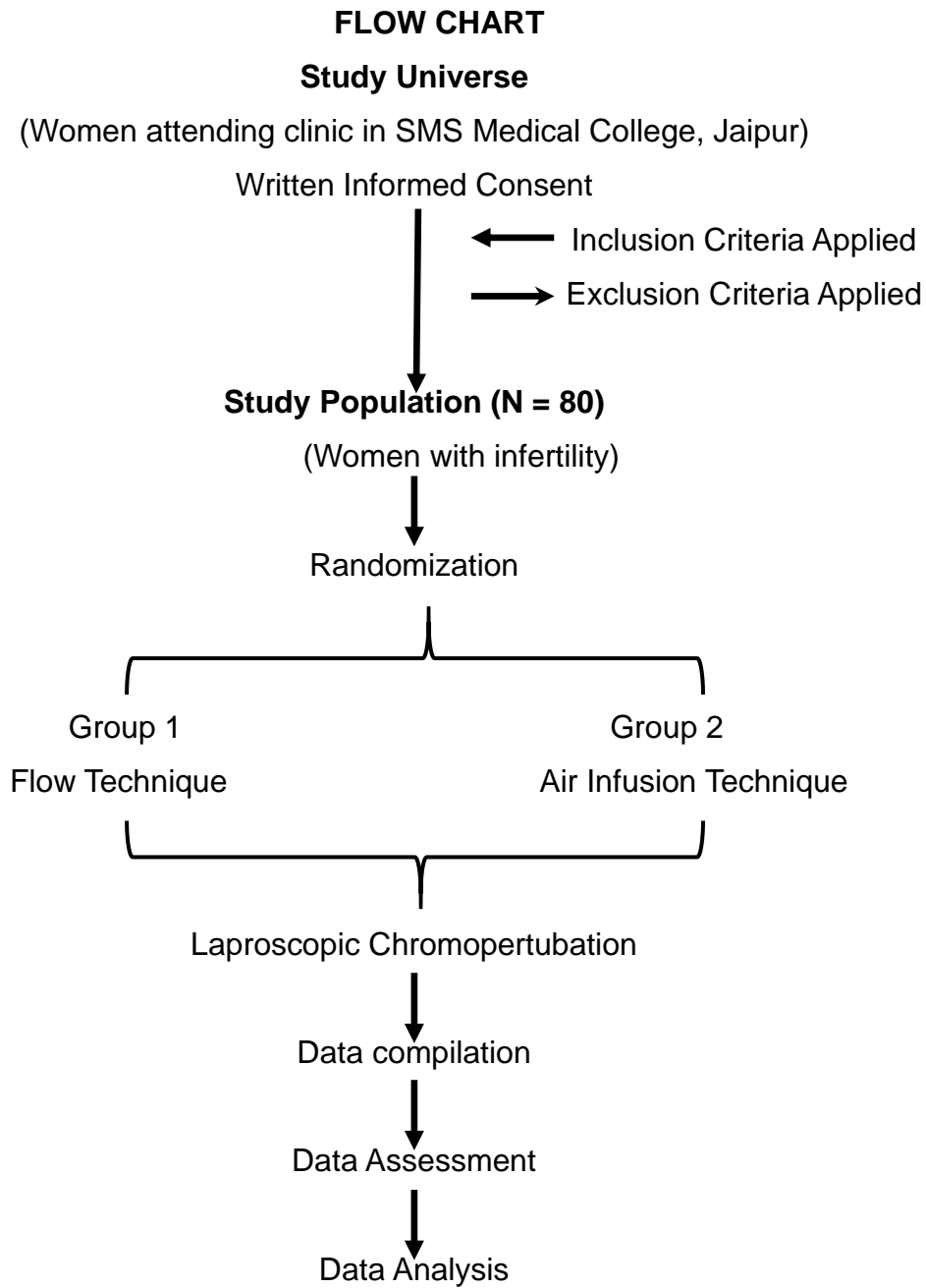
In air infusion technique, approximately 0.5 to 1 ml of air will be introduced into the intravenous tubing by inverting the drip chamber to create air bubbles. When air enters the uterine cavity, a single large air bubble or stream of air bubbles traversing the Ostia was considered indicative of tubal patency. In flow technique, a positive flow will be defined as the naturally present substance contrasting with saline that traversed the Ostia, examples of these included but not limited to blood, mucus and displaced endometrial tissue.¹¹

Intracavitary evaluation will be typically performed for at least 10 seconds before air bubble entry to allow pressure equilibration if a hydrosalpinx present not observed. Subsequent laparoscopy with chromopertubation performed using a dilute solution of indigo carmine blue dye through the uterine manipulator with a 50 ml syringe and free flow of dye noted at fimbrial end.¹²

Methodology

In a prospective, monocentral, randomized study, infertile women aged between 18 to 45 years were enrolled between march 2021 to Feb. 2022 for combined hysteroscopy and laparoscopy with chromopertubation, as part of their infertility evaluation at the SMS Medical College, Department of Obstetrics and Gynaecology, Jaipur Rajasthan.

All women provided informed consent in writing. All surgical procedures was conducted under general anesthesia. Tubal patency assessed with hysteroscopy in two ways. One flow technique and other was air infusion technique. As the patient population divided in two groups- Flow group and air infusion group. Hysteroscopic assessment of fallopian tube patency would be conducted with the 5mm Aesculap hysteroscope. Intrauterine length was measured from the uterine fundus to external os of the cervix with help of uterine sound. A continuous inflow was achieved with an intravenous solution of 0.9% sterile saline, resulting in uterine distention to see tubal Ostia. For flow group, a positive flow was defined as the naturally present substance contrasting with saline that traversed the Ostia, examples of these included, but not limited to, blood, mucus and displaced endometrial tissue. For air infusion group, approximately 0.5-1 ml of air was introduced into the intravenous tubing by inverting the drip chamber to create air bubbles. When air enters the uterine cavity, a single large air bubble or stream of air bubbles traversing the Ostia was considered indicative of tubal patency. Intracavitary evaluation was typically performed for at least 10 seconds before air bubble entry to allow pressure equilibration if a hydrosalpinx present. At least 30 seconds of observation per Ostia was performed if patency not observed. Subsequent laparoscopy with chromopertubation performed using a dilute solution of indigo carmine blue dye through the uterine manipulator with a 50 ml syringe and free flow of dye noted at fimbrial end.



Statistical Analysis

Continuous data would be summarized in form of mean and S.D. The difference in means would be analysed using student 't' test. Count data would be expressed in the form of proportions. The difference in proportion would be analysed using Chi square test. Odd's Ratio would be kept 95% for all statistical analysis.

Results.

Table 1 : Association Between 'Group' and 'Hysteroscopic tubal patency test on right side'

Hysteroscopy if tubal patency test (Right)	Group			Chi-Squared Test	
	Air Infusion	Flow	Total	χ^2	P Value

Patent	33 (82.5%)	31 (77.5%)	64 (80.0%)	0.312	0.576
Occluded	7 (17.5%)	9 (22.5%)	16 (20.0%)		
Total	40 (100.0%)	40 (100.0%)	80 (100.0%)		

82.5% of the participants in the air infusion group had patent right sided Fallopian tube. 17.5% of the participants in the air infusion group had occluded right sided Fallopian tube. 77.5% of the participants in the flow group had patent right sided Fallopian tube. 22.5% of the participants in the flow group had occluded right sided Fallopian tube.

Table 2 : Association Between 'Group' and 'Hysteroscopic tubal patency test on left side'

Hysteroscopic tubal patency test (Left)	Group			Chi-Squared Test	
	Air Infusion	Flow	Total	χ^2	P Value
Patent	30 (75.0%)	34 (85.0%)	64 (80.0%)	1.250	0.264
Occluded	10 (25.0%)	6 (15.0%)	16 (20.0%)		
Total	40 (100.0%)	40 (100.0%)	80 (100.0%)		

75.0% of the participants in the air infusion group had patent left sided Fallopian tube. 25.0% of the participants in the air infusion group had occluded left sided Fallopian tube. 85.0% of the participants in the flow group had patent right sided Fallopian tube. 15.0% of the participants in the flow group occluded left sided Fallopian tube.

Table 3 : Association Between 'Group' and 'Laparoscopic Chromopertubation (Right side)'

Laparoscopic Chromopertubation (Right)	Group			Chi-Squared Test	
	Air Infusion	Flow	Total	χ^2	P Value
Positive	30 (75.0%)	26 (65.0%)	56 (70.0%)	0.952	0.329
Negative	10 (25.0%)	14 (35.0%)	24 (30.0%)		
Total	40 (100.0%)	40 (100.0%)	80 (100.0%)		

75.0% of the participants in the air infusion group had Laparoscopic Chromopertubation on Right side found Positive. 25.0% of the participants in the air infusion group had Laparoscopic Chromopertubation on Right side found Negative. 65.0% of the participants in the flow group had Laparoscopic Chromopertubation on Right side found Positive. 35.0% of the participants in the flow group had Laparoscopic Chromopertubation on Right side found Negative.

Table 4 : Association Between 'Group' and 'Laparoscopic Chromopertubation (Left side)'

Laparoscopic Chromopertubation (Left)	Group			Chi-Squared Test	
	Air Infusion	Flow	Total	χ^2	P Value
Positive	28 (70.0%)	22 (55.0%)	50 (62.5%)	1.920	0.166

Negative	12 (30.0%)	18 (45.0%)	30 (37.5%)		
Total	40 (100.0%)	40 (100.0%)	80 (100.0%)		

70.0% of the participants in the air infusion group had Laparoscopic Chromopertubation on Left side found Positive. 30.0% of the participants in the air infusion group had Laparoscopic Chromopertubation on Left side found Negative. 55.0% of the participants in the flow group had Laparoscopic Chromopertubation on Left side found Positive. 45.0% of the participants in the flow group had Laparoscopic Chromopertubation on Left side found Negative.

Table 5 : Comparison of Flow Technique (Right) with Laparoscopic Chromopertubation (Right) (n = 40)

		Laparoscopic Chromopertubation (Right)			Cohen's Kappa	
		Positive	Negative	Total	k	P Value
Flow Technique (Right)	Positive	23 (57.5%)	8 (20.0%)	31 (77.5%)	0.341	0.024
	Negative	3 (7.5%)	6 (15.0%)	9 (22.5%)		
Total		26 (65.0%)	14 (35.0%)	40 (100.0%)		

The two methods agreed in 72.5% of the cases and disagreed in 27.5% of the cases. The diagnostic performance of Flow Technique (Right) in predicting Laparoscopic Chromopertubation (Right): Positive was as follows: Sensitivity: 88.5%, Specificity: 42.9%, PPV: 74.2%, NPV: 66.7%, Diagnostic Accuracy: 72.5%.

Table 6 : Comparison of flow Technique (Left) with Laparoscopic Chromopertubation (Left) (n = 40)

		Laparoscopic Chromopertubation (Left)			Cohen's Kappa	
		Positive	Negative	Total	k	P Value
Flow Technique (Left)	Positive	20 (50.0%)	14 (35.0%)	34 (85.0%)	0.140	0.247
	Negative	2 (5.0%)	4 (10.0%)	6 (15.0%)		
Total		22 (55.0%)	18 (45.0%)	40 (100.0%)		

The two methods agreed in 60.0% of the cases and disagreed in 40.0% of the cases.

The diagnostic performance of Flow Technique (Left) in predicting Laparoscopic Chromopertubation (Left): Positive was as follows: Sensitivity: 90.9%, Specificity: 22.2%, PPV: 58.8%, NPV: 66.7%, Diagnostic Accuracy: 60.0%.

Table 7 : Comparison of Air infusion Technique (Right) with Laparoscopic Chromopertubation (Right) (n = 40)

		Laparoscopic Chromopertubation (Right)			Cohen's Kappa	
		Positive	Negative	Total	k	P Value
Air infusion Technique (Right)	Positive	30 (75.0%)	3 (7.5%)	33 (82.5%)	0.778	<0.001

	Negative	0 (0.0%)	7 (17.5%)	7 (17.5%)		
	Total	30 (75.0%)	10 (25.0%)	40 (100.0%)		

The two methods agreed in 92.5% of the cases and disagreed in 7.5% of the cases.

The diagnostic performance of Air infusion Technique (Right) in predicting Laparoscopic Chromopertubation (Right): Positive was as follows: Sensitivity: 100.0%, Specificity: 70.0%, PPV: 90.9%, NPV: 100.0%, Diagnostic Accuracy: 92.5%.

(Right) were classified as Positive by Air infusion Technique (Right).

Table 8 : Comparison of Air infusion Technique (Left) with Laparoscopic Chromopertubation (Left) (n = 40)

		Laparoscopic Chromopertubation (Left)			Cohen's Kappa	
		Positive	Negative	Total	k	P Value
Air infusion Technique (Left)	Positive	27 (67.5%)	3 (7.5%)	30 (75.0%)	0.750	<0.001
	Negative	1 (2.5%)	9 (22.5%)	10 (25.0%)		
Total		28 (70.0%)	12 (30.0%)	40 (100.0%)		

The two methods agreed in 90.0% of the cases and disagreed in 10.0% of the cases.

The diagnostic performance of Air infusion Technique (Left) in predicting Laparoscopic Chromopertubation (Left): Positive was as follows: Sensitivity: 96.4%, Specificity: 75.0%, PPV: 90.0%, NPV: 90.0%, Diagnostic Accuracy: 90.0%.

Discussion

We found that on hysteroscopic tubal patency test on right sided fallopian tube in air infusion group 82.5% were patent and in flow group 77.5% were patent with 0.576 p value. Similarly on left sided Fallopian tubes in air infusion group 75.0% were patent and in flow group 85% were patent with 0.264 p value. Study conducted by Marlene Hager E et al (2020) had 76.6% patent in Parryscope group and 56.6 % patent in flow group while study conducted by Johannes Ott E et al (2019) had 52.08% patent Fallopian tubes on hysteroscopic flow technique.

On laparoscopic chromopertubation test on right sided Fallopian tubes in air infusion group 75.0% were patent and in flow group 65.0% were patent with 0.329 p value. Similarly on left sided Fallopian tubes in air infusion group 70.0% were patent and in flow group 55% were patent with 0.166 p value. Study conducted by Marlene Hager E et al (2020) had 75% patent tubes in Parryscope group and 68.33% patent tubes in flow group while study

conducted by Johannes Ott E et al (2019) had 61.11% patent tubes on laparoscopic chromopertubation.

When laparoscopic chromopertubation compared with hysteroscopic flow technique on right side two methods agreed in 72.5% and disagreed in 27.5% of the cases with 88.5% sensitivity and 42.9% specificity, PPV : 74.5% , NPV : 66.7% , Diagnostic accuracy: 72.5% similarly on left side two methods agreed in 60.0% of the cases and disagreed in 40.0% of the cases with 90.9% sensitivity and 22.2% specificity, PPV : 58.8% ,NPV : 66.7%, Diagnostic accuracy:60.0%. Study conducted by Marlene Hager E et al (2020) had 73.7% sensitivity and 70.7% specificity with PPV : 53.8% and NPV:85.3% while study conducted by Johannes Ott E et al (2019) had sensitivity of 85.2% and specificity of 66.1% with PPV:79.8% and NPV:74% and when laparoscopic chromopertubation compared with hysteroscopic air infusion technique on right side two methods agreed in 92.5% of the cases and disagreed in 7.5% of the cases with sensitivity of 100.0% ,specificity of 70.0%

,PPV:90.9% ,NPV:100.0% and diagnostic accuracy: 92.5% similarly on left side two methods agreed in 90.0% of the cases and disagreed in 10.0% of the cases with sensitivity of 96.4%, specificity of 75.0%, PPV:90.0% , NPV:90.0% and diagnostic accuracy:90.0% . Study conducted by Marlene Hager E et al (2020) had sensitivity of 90.6% , specificity of 100.0% , PPV : 100.0% and NPV : 96.8% while study conducted by Johannes Ott E et al (2019) had sensitivity of 98.3% and specificity of 83.7% which were statistically significant and proves air infusion technique superior to flow technique and comparable to laparoscopic chromopertubation.

Thus, the ability to perform air infusion technique under anaesthesia solve one of the core limitations to tubal patency assessment in conscious patients, where low pressure (so as to avoid pain) allows for higher sensitivity to occlusion at the expense of specificity, when higher pressure could demonstrate a tube to be patent instead of false positive occlusion, and there by improves specificity.

Conclusion

This study found that the air infusion technique was more accurate for predicting Fallopian tube patency than flow technique.

Incorporating Air infusion into standard hysteroscopy and observing whether air bubbles traverse or not traverse the tubal Ostia can provide valuable information regarding patency of tubes for patients who desire fertility.

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