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Article in *Journal of Clinical Ultrasound* · October 2016

DOI: 10.1002/jcu.22412

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# Sonohysterosalpingography: Comparison of Foam and Saline Solution

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Received 23 December 2015; accepted 29 August 2016

**ABSTRACT:** *Purpose.* To compare sonohysterosalpingography (sono-HSG) with foam instillation (HyFoSy) versus saline solution (HyCoSy) in the evaluation of tubal patency.

*Methods.* We prospectively enrolled 37 infertile women, scheduled for laparoscopy. The women were randomized into two groups: HyFoSy (group I) and HyCoSy (group II). The patients of both groups underwent laparoscopy with dye test. We assessed the diagnostic performance (sensitivity, specificity, and overall accuracy) of HyFoSy and HyCoSy, compared with laparoscopy and dye test, in the assessment of tubal patency.

*Results.* Sono-HSG findings in tubal patency assessment obtained in the HyFoSy group were concordant with laparoscopic results in 94.4% of cases, with a sensitivity of 87.5% and a specificity of 100%, whereas in the HyCoSy group, concordance occurred in only 57.8% of examinations, with a sensitivity of 50% and a specificity of 66.6%.

*Conclusions.* HyFoSy allows a more accurate diagnosis of tubal patency compared with HyCoSy. © 2016 Wiley Periodicals, Inc. *J Clin Ultrasound* 45:67–71, 2017; Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/jcu.22412

**Keywords:** gynecology; HyCoSy; HyFoSy; infertility; tubal patency; saline; foam; sonohysterosalpingography

of infertile couples.<sup>1</sup> Evaluation of tubal patency is mainly performed by hysterosalpingography (HSG) or sonohysterosalpingography (sono-HSG), even though the gold standard for diagnosis of tubal anomalies remains laparoscopy with chromopertubation, which has the added benefit of assessing pelvic organs.<sup>2</sup> However, laparoscopy is associated with risks and costs as well as a distress and discomfort for the patients.

Sono-HSG and HSG are both fast, simple, and well-tolerated outpatient procedures. However, sono-HSG has the advantage over HSG in avoiding ionizing radiation exposure and the risk of iodine allergy.<sup>3</sup> A recent meta-analysis identified nine studies totaling 582 women, comparing sono-HSG and HSG with laparoscopy. Pooled estimates for sensitivity and specificity were 0.95 and 0.93, respectively, for sono-HSG, and 0.94 and 0.92, respectively, for HSG.<sup>3</sup>

Sono-HSG is performed as an office procedure with standard endovaginal sonographic (US) equipment.<sup>4,5</sup> The contrast medium is a solution of galactose and 1% palmitic acid (Echovist) introduced in the early 1980s or a mixture of saline solution and air. Tubal patency is confirmed by demonstration of the intratubal flow of the echogenic medium in real time.<sup>6</sup>

In 2007, a nonembryo toxic gel (ExEm-gel; Gynecologic IQ BV, Delft, The Netherlands) containing hydroxyethylcellulose and glycerol was introduced as an alternative to the saline solution.<sup>7</sup> The advantage of this gelfoam compared with the saline solution is represented by its higher viscosity, which leads to a longer stability, resulting in a better visualization of the tubes with less fluid leakage and less

## INTRODUCTION

Tubal patency assessment is the most important step in the workup of infertile women, because tubal obstruction is present in 12–33%

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VOL. 45, NO. 2, FEBRUARY 2017

discomfort. Several studies have compared the use of gel versus the saline solution in the evaluation of uterine cavity. Results showed that the use of gel was less painful than the saline solution and provided a slightly better distension of the uterine cavity and a clearer image quality.<sup>8–10</sup>

The aim of this study was to compare HyFoSy with HyCoSy in order to assess tubal patency in women undergoing laparoscopy with dye test.

## MATERIALS AND METHODS

From September 2014 to October 2015, we prospectively recruited women with at least 2 years of primary infertility. Patients were scheduled for laparoscopy for suspected endometriosis, previous pelvic inflammatory disease, or unexplained infertility and were randomly allocated into two groups by a numeric computer-generated sequence. Exclusion criteria were the risk of pelvic inflammatory disease (positive swabs for chlamydia or gonorrhea), cervical dysplasia or cancer, active uterine bleeding, patient refusal, and risk factors such as heart disease, especially heart shunt hypertension and history of stroke. Exclusion criteria also included the presence of tubal pathology detected on transvaginal US (hydrosalpinx, acute salpingitis). In both groups, a baseline US study was carried out with a complete evaluation of the uterus and adnexae. Before undergoing laparoscopy, a sono-HSG was carried out in both groups, using the foam as a contrast agent in the first group (HyFoSy group) and the saline solution in the second group (HyCoSy group). All US examinations were done using an Accuvix A30 Samsung scanner (Samsung, Seoul, South Korea) equipped with a volumetric 5–9-MHz endovaginal probe. Sono-HSG and laparoscopy were performed during the follicular phase, 7–13 days after menstrual cycle and with a negative pregnancy test. The Hospital Ethical Committee approved the protocol. Written informed consent was obtained from all patients. An experienced sonographer performed all US examinations, in order to avoid interobserver bias. After inserting a speculum into the patient's vagina, the cervix was cleaned using an aqueous chlorhexidine solution. In the HyFoSy group, sono-HSG was performed using foam instillation by placing on the cervix a cervical balloon-less applicator (connected to the syringe of gel foam). The gel foam was created by mixing 10 ml of ExEmgel, containing 88.2% purified water, hydroxyethylcellulose, and glycerol, with 10 ml of purified

water, giving a mixture containing 94.1% water in a 20-ml syringe according to product instructions. The mixture develops a foam sufficiently stable to show echogenicity for at least 5 minutes and visualize the passage of the gel through the patent tubes. After removing the speculum, the vaginal probe was introduced into the vagina to carry out the sonography. At the same time, the foam was injected into the uterine cavity through the syringe connected to the applicator, with a light pressure. Once the foam is identified in the uterus, the passage of the contrast through the fallopian tubes can be visualized on transverse scan planes. Moreover, it is also possible to visualize the dispersion of the foam around the ovaries and in the peritoneal cavity.

In the HyCoSy group, sono-HSG was performed using saline solution. A 5-French balloon-catheter was placed in the cervix and connected to a syringe with 15 ml of saline solution and 5 ml of air. After removing the speculum, the endovaginal probe was inserted into the vagina and the sono-HSG performed. The mixture of air and saline solution was slowly injected, and tubal patency was established by the visualization of the echogenic flow of the solution through the patent tubes and its expansion in the adjacent ovaries and in the peritoneal cavity.<sup>11</sup> Power Doppler can also detect the flow of saline through the tubes.<sup>5</sup>

We define tubal patency as spillage of saline solution or gel foam from the fimbria end seen as fluid flow surrounding the ovary and its collection in pelvis on B-mode scanning. We used two criteria to assess tubal patency on power Doppler: detection of steady color Doppler signals in a segment of the tube and detection of spill at fimbria end.<sup>5</sup> We defined tubal blockage as absence of spillage.<sup>12</sup>

All patients subsequently underwent laparoscopy with chromopertubation. During laparoscopy, we identified all the pelvic structures and performed dye test. The dye was methylene blue, and it was instilled through an appropriate channel of the uterine introducer. About 20 ml of dye were injected slowly in order to avoid tubal spasm. In the case of tubal patency, the blue dye was visualized at the fimbria and then in the pelvic cavity.

Although this technique is regarded as the gold standard, false positives can occur due to inexperience of the operator or to temporary tubal spasm after dye injection or preferential spill due to imbalanced tubal resistance.<sup>13</sup>

The results of sono-HSG with foam and saline solution were compared with the results of the

## HYFOSY VERSUS HYCOSY

**TABLE 1**  
**Clinical Data of Patients Undergoing Sonohysterosalpingography with Foam (HyFoSy) and Saline Solution (HyCoSy)**

Clinical Data	Results	
	HyFoSy	HyCoSy
No. of patients	18	19
	Mean (min-max)	
Age (years)	34 (33–35)	34 (33–36)
BMI (kg/m <sup>2</sup> )	26.1 (23.9–28.3)	25.9 (23.9–27.9)
Months of infertility	28.8 (16–42)	26.4 (12–42)
	Patients (%)	
Causes of infertility		
Endometriosis	11 (61.1%)	11 (57.9%)
Previous PID	3 (16.7%)	4 (21%)
Unexplained infertility	4 (22.2%)	4 (21.1%)

Abbreviations: BMI, body mass index; HyCoSy, sonohysterosalpingography with saline solution instillation; HyFoSy, sonohysterosalpingography with foam instillation; PID, pelvic inflammatory disease.

dye test in terms of patency and tubal morphology. Data were statistically analyzed with SPSS statistical package using Fisher's exact test for parametric values and Student's *t* test for non-parametric values. We considered as "positive result" the finding of tubal obstruction and "negative result" the finding of tubal patency. We also evaluated the agreement of both tests with laparoscopy, considered as the gold standard.

### RESULTS

We included 37 infertile women. Eighteen patients underwent HyFoSy, whereas 19 underwent HyCoSy. The two groups of patients were well matched for age, body mass index, time of infertility, and causes of infertility. All patients had primary infertility, with a median age of 34 years. The clinical data of both groups are shown in Table 1.

The HyFoSy group showed patency in 22 tubes (Figure 1) and obstruction in 14 tubes (Figure 2). Laparoscopy confirmed these results in 20 cases with tubal patency and in all cases with tubal obstruction. The agreement with laparoscopic chromoperturbation findings was 94.4% (34/36 tubes or 17/18 patients) (95% confidence interval [CI]: 72.36–99.99).

The HyCoSy group showed patency in 22 tubes and obstruction in 16 tubes. Laparoscopy confirmed these observations in 12 cases with tubal patency and in 10 cases with tubal obstruction. Agreement with laparoscopic chromoperturbation findings was found in 57.8%



**FIGURE 1.** Sonohysterosalpingography using foam instillation (HyFoSy). Transverse transvaginal sonogram. Only the left fallopian tube is patent. There is spillage of contrast medium through the tube (arrow).



**FIGURE 2.** Sonohysterosalpingography using foam instillation (HyFoSy). Transverse transvaginal sonogram shows bilateral proximal tubal occlusion (arrows).

(22/38 tubes or 11/19 patients) (95%CI: 36.2–76.9). Sensitivity and specificity in the diagnosis of tubal patency were 87.5% and 100%, respectively, for HyFoSy and 50% and 66.6%, respectively, for HyCoSy (Table 2).

### DISCUSSION

The aim of our study was to compare the use of foam versus saline solution to assess tubal patency with sono-HSG. Our results show the superiority of the foam with a very high (>94%) agreement with laparoscopic findings. Our study has several limitations: the sample size is small and it involves a single center. Several recent studies have evaluated the use of gel versus saline solution in the assessment of the uterine cavity.<sup>7–10,13–17</sup> Lim et al<sup>17</sup> compared gel foam with saline solution as contrast agent in tubal patency assessment and found no

**TABLE 2**  
**Comparison of the Results of Sonohysterosalpingography with Foam Instillation (HyFoSy) and Sonohysterosalpingography with Saline Solution Instillation (HyCoSy) with Laparoscopic Findings**

	No. of Patient	Tubal Patency	Tubal Occlusion	Sensitivity	Specificity	Overall Accuracy
Results of dye test in HyFoSy group	18	11	7	—	—	—
HyFoSy	18	10	7	87.5%	100%	94.4%
Results of dye test in HyCoSy group	19	11	8			
HyCoSy	19	6	5	50%	66.6%	57.9%

Abbreviations: HyCoSy, sonohysterosalpingography with saline solution instillation; HyFoSy: sonohysterosalpingography with foam instillation.

significant difference in diagnostic yield between the two techniques, but the authors did not correlate their findings with the gold standard.

The excellent results of HyFoSy are probably due to the characteristics of the foam generated by the gel. In particular, the foam remains stable for at least 5 minutes, outlining the anatomic structures of the uterus, tubes, ovaries, and peritoneum. The echogenic air bubbles remain suspended much longer in the diluted gel than in water due to the difference in viscosity.<sup>18</sup> This in turn allows a better and longer visualization of the entire tubes during the US examination. The evaluation of tubal patency is a pivotal step in the workup of an infertile couple. The use of an examination that is easy to perform, in an outpatient setting, giving comprehensive information on the tubal status, is a goal of reproductive medicine. To date, despite the high cost and the surgical risks, the “gold standard” for tubal patency evaluation remains laparoscopy.<sup>19</sup> HSG has been used as a simple diagnostic examination to evaluate uterus and tubal patency in infertile women.<sup>20</sup>

However, it requires iodinated contrast medium and radiation and cannot evaluate ovarian or uterine pathologies like leiomyomas or adenomyosis. In the past years, HyCoSy has gained attention because it is simple to perform in a clinic setting. However, the visualization of the tubes and the fluid passage through them is not always accurate because it is difficult to distinguish the saline solution. Moreover, in case of severe tubal damage, the saline solution passage through the tube is not well visualized with detection of fluid around the ovaries.<sup>19,20</sup> This technical difficulty related to the saline medium has been overcome by using the foam, that, as the HSG, allow the entire tubal course evaluation and also its partial obstruction in case of tubal damage.

## CONCLUSION

In our pilot study, HyFoSy has proved superior to HyCoSy in the correct evaluation of tubal patency with a very high agreement with laparoscopic findings. These results need to be confirmed in a larger series of patients.

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## HYFOSY VERSUS HYCOSY

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