Hysterosalpingo-Contrast Sonography Compared with Hysterosalpingography and Laparoscopic Dye Pertubation to Evaluate Tubal Patency

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Abstract

Study Objective. To evaluate the advantages and accuracy of hysterosalpingo-contrast sonography (HyCoSy) in assessing tubal patency compared with hysterosalpingogram (HSG) and laparoscopic dye perturbation.

Design. Prospective study (Canadian Task Force classification II-2).

Setting. Obstetrics and Gynecology Department, University of Rome Tor Vergata.

Patients. Twenty-three women with at least 1 year of infertility, and 15 women with a history of chronic pelvic pain, suspected endometriosis, or pelvic inflammatory disease (PID), or with sonographic markers of adhesions.

Interventions. HyCoSy, HSG, and laparoscopic dye perturbation.

Measurements and Main Results. All patients underwent HyCoSy during the proliferative phase using air with saline as contrast medium, and HSG within 1 month of HyCoSy. Laparoscopy and dye perturbation were performed only in women with chronic pelvic pain, suspected endometriosis, PID, and sonographic markers of adhesions. In women undergoing all three procedures, HSG and HyCoSy had the same high concordance as laparoscopy, 86.7% and 86.7%, respectively. Three women in the infertility group became pregnant immediately after HyCoSy and dropped out of the study. In one woman, HyCoSy could not be performed because of cervical stenosis. Considering the total number of tubes (67), concordance between HyCoSy and HSG was 89.6%.

Conclusion. Transvaginal HyCoSy using a combination of air and saline appears to be an inexpensive, fast, and well-tolerated method of determining tubal patency. One of the most important advantages of this technique is, in our opinion, the possibility of obtaining information on tubal status and the uterine cavity at the same time as conventional ultrasound scan is performed.

Some degree of tubal pathology, resulting in occlusion of one or both tubes, is found in one of three infertile women. Conventional diagnostic imaging procedures such as radiographs, hysterosalpingography (HSG), and laparoscopy with dye perturbation are associated with several risks including invasiveness and exposure to iodinated contrast media or ionizing radiation. Transvaginal ultrasound accurately diagnoses various pelvic conditions that can be responsible for infertility and that are not detectable by HSG, but it does not permit evaluation of the patency of the fallopian tubes. Hysterosalpingo-contrast sonography (HyCoSy) was introduced in the early 1980s for studying tubal patency. It is a simple, easy, outpatient technique that hardly ever requires premedication or hospitalization.

In initial studies, saline solution was passed transcervically before performing transabdominal sonography.\textsuperscript{1,2} From the finding of free fluid in the pouch of Douglas, these authors indirectly deduced patency of at least one tube. Saline solution has the advantage of being completely safe and inexpensive. However, although it is excellent for visualizing intrauterine pathology (sonohysterography), it does not seem to be particularly accurate in determining the state of fallopian tubes and their patency.\textsuperscript{3-5} Association of transvaginal ultrasonography with color Doppler sonography and/or ultrasound positive contrast media increases the accuracy of this method. Studies comparing HyCoSy and HSG in the diagnosis of tubal patency reported conflicting results, probably due to different ultrasound techniques and contrast media. Contrast media (Echovist, Levovist, Infoson)\textsuperscript{6-10} facilitate evaluation of tubal patency by HyCoSy; however, they are expensive, not available in many countries, and not always accepted by patients. Some authors\textsuperscript{11-13}

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proposed positive contrast medium of saline solution mixed with air because of its safety and low cost.

Materials and Methods

Between March 2001 and October 2002, 38 patients were divided into two groups: group 1 consisted of 23 women with a history of at least 1 year of infertility, no symptoms, and negative ultrasound scan; and group 2, 15 patients with a history of chronic pelvic pain, suspected endometriosis, pelvic inflammatory disease (PID), sonographically confirmed uterine or adnexal pathology, or sonographic markers of adhesions associated in some instances with infertility. The second group had a clinical indication for laparoscopic treatment. Women with tubal pathology detectable by ultrasound (hydrosalpinx, acute salpingitis) were excluded from the study. Informed consent was obtained from all participants.

All patients underwent HyCoSy during the proliferative phase using air and saline as contrast medium, and HSG within 1 month of HyCoSy. Laparoscopic dye pertubation was performed only in women in group 2 within 2 months of HyCoSy (Figure 1).

Conventional HSG was performed according to routine practice and was recorded on X-ray film.

HyCoSy Technique

Two gynecologists (CE and CC) with experience ranging from 10 to over 30 procedures performed HyCoSy. A preliminary scan was performed to detect ovarian position and the interstitial part of the tubes. After inserting a speculum, a 5Fr salpingographic balloon catheter (PBN Medicals, Denmark) was placed in the uterine cavity and filled with 1 to 2 ml of air. This step ensured that the cervical canal was closed, prevented leakage of saline solution and air, and kept the catheter in position. A 20-ml syringe containing 15 ml of saline solution and 5 ml of air was prepared and shaken immediately before injection.

A vaginal ultrasound probe was inserted and a transversal section of the uterus was taken to localize the interstitial part of the tube. Saline solution was injected continuously and slowly through the catheter, and resistance felt during injection was noted. At first we used power Doppler to locate the tubal area. When saline solution and air were injected, the flow of air bubbles through the tubes could be seen. The tube was followed as distally as possible by moving the probe slowly.

The process of scanning and searching for salpinges during injection should be methodical and constant. Normally we started at the uterine cornu in a plane that also visualized the interstitial part of the tube, and then scanned...
laterally during the first part of the examination. In the last part, the flow of air bubbles near the ovaries was observed. Salpinges were examined separately. The whole procedure was recorded on VCR.

If the procedure became painful the examination was interrupted for a short period to allow tubal spasm to pass. Hard pressure felt during injection of air and fluid was regarded as a sign of tubal spasm or occlusion. If pressure did not decrease and no air bubbles were seen to flow from the tube, it was considered to be obstructed. Antibiotic prophylaxis with a single dose of azithromycin 1 g was administered orally immediately after the procedure.

Our criteria for tubal patency were as follows:

1. Passage of air and saline through the interstitial part of the tube (Figure 2).
2. Detection of air bubbles moving around the ovary. Observation of flow around the ovaries is possible even without visualization of the whole passage through the tube.
3. Detection of the solution and air bubbles in the pouch of Douglas.
4. Power Doppler evidence of passage of saline solution. We generally used power Doppler in the first part of the examination to locate the tubal area.

Discomfort or pain during and after the examination was noted as follows:

1. Absent: no discomfort or pain felt by the patient.
2. Slight: patient felt pain only during the procedure and required no further attention.
3. Moderate: patient felt pain during and for some time after the procedure, occasionally asked for analgesics.
4. Severe: patient required analgesics, had some degree of vagal reaction, and required medical observation and treatment after the procedure.

**Laparoscopic Technique**

Classic diagnostic laparoscopy was performed with a 10-mm, zero-degree scope (Karl Storz, Tuttlingen, Germany). A disposable uterine manipulator was inserted through the vagina into the uterine cavity. An intraumbilical 10-mm reusable sharp trocar was inserted and one or two

**FIGURE 2.** Fallopian tube visualized after injection of saline solution mixed with air.
5-mm reusable ancillary trocars were placed laterally just above the pubic hairline. After tubes were identified, perturbation was done with 10 ml of methylene blue in 50 ml saline solution with an atraumatic 5-mm grasper.

**Statistical Analysis**

For both groups, results were evaluated calculating concordance rate between HyCoSy and HSG. Results for group 2 were calculated on the outcome of laparoscopic dye perturbation, using test performance characteristics including concordance rate, sensitivity and specificity for detecting tubal patency, and positive and negative predictive values. Cohen’s κ index was also calculated.

**Results**

Of 38 patients, 3 became pregnant immediately after HyCoSy. In one woman HyCoSy could not be performed because of severe cervical stenosis. In the remaining 34 patients (mean age 34.17 ± 4.09 yrs, range 23-42 yrs) HyCoSy showed bilateral tubal patency in 19, bilateral obstruction in 4, and unilateral obstruction in 11 (one woman had undergone unilateral adnexectomy).

During HyCoSy pain was absent in 3 women, slight in 11, moderate in 16, and severe in 4. No patient required hospital admission and none had infections after the procedure.

The HSG showed bilateral tubal patency in 18 patients, bilateral obstruction in 4, and unilateral obstruction in 12. Laparoscopic dye perturbation was performed in 15 women and showed bilateral patency in 9, bilateral obstruction in 2, and unilateral obstruction in 4.

Considering 67 tubes, comparison between HyCoSy and HSG showed agreement between 44 patent tubes and 16 obstructed tubes. The results were discordant in seven salpinges (10.4%), with a concordance rate of 89.6% (Table 1). Prevalence of tubal occlusion was 30%.

In patients treated with dye perturbation, HyCoSy agreed with the test in 20 of 30 patent tubes and in 6 obstructed tubes. Results were discordant in four salpinges (13.3%) with a concordance rate of 86.7%. The prevalence of tubal occlusion was 27% and the concordance rate between HSG and dye test was 86.7%. Table 2 shows the accuracy of HyCoSy in diagnosing tubal occlusion using HSG and dye test as references.

**Discussion**

An ideal imaging technique for evaluating infertility should be noninvasive, inexpensive, and quick and easy to perform, and provide information on both pelvic disorders and tubal patency. HyCoSy is quick, efficient, and inexpensive. It can be performed in the same setting and at the same time as transvaginal ultrasound to obtain additional information on tubal patency. The use of air and saline medium makes it even more simple and inexpensive without affecting the results. No radiation or irritant contrast medium is involved, which implies improved comfort and patient compliance. In our study three patients became pregnant after HyCoSy, suggesting that injection of saline solution may itself resolve slight tubal obstructions.

Half of the patients experienced moderate pain and four severe pain, two of them with a vagal reaction. No statistically significant correlation between degree of pain and tubal patency was observed. Nevertheless pain was more frequently referred when resistance was met during injection. Since HyCoSy is not completely painless, premedication

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**TABLE 1. Concordance among HyCoSy, HSG, and LPS**

<table>
<thead>
<tr>
<th></th>
<th>No. of Tubes</th>
<th>Patent Tubes</th>
<th>Obstructed Tubes</th>
<th>Discordance</th>
<th>Concordance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HyCoSy-HSG</td>
<td>67</td>
<td>44</td>
<td>16</td>
<td>7</td>
<td>89.6</td>
</tr>
<tr>
<td>HyCoSy-LPS</td>
<td>30</td>
<td>20</td>
<td>6</td>
<td>4</td>
<td>86.7</td>
</tr>
<tr>
<td>HSG-LPS</td>
<td>30</td>
<td>19</td>
<td>7</td>
<td>4</td>
<td>86.7</td>
</tr>
</tbody>
</table>

HyCoSy = hysterosalpingo-contrast sonography; HSG = hysterosalpingography; LPS = laparoscopic dye perturbation.

**TABLE 2. Accuracy of HyCoSy in Diagnosing Tubal Occlusion Using HSG and Dye Perturbation as Reference Tests**

<table>
<thead>
<tr>
<th></th>
<th>HyCoSy vs HSG</th>
<th>HyCoSy vs LPS</th>
<th>HSG vs LPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (%)</td>
<td>80</td>
<td>75</td>
<td>88</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>94</td>
<td>91</td>
<td>86</td>
</tr>
<tr>
<td>Positive predictive value (%)</td>
<td>84</td>
<td>75</td>
<td>70</td>
</tr>
<tr>
<td>Negative predictive value (%)</td>
<td>92</td>
<td>91</td>
<td>95</td>
</tr>
<tr>
<td>κ index (%)</td>
<td>77</td>
<td>66</td>
<td>59</td>
</tr>
</tbody>
</table>

HyCoSy = hysterosalpingo-contrast sonography; HSG = hysterosalpingography; LPS = laparoscopic dye perturbation.
with analgesics may be considered, especially in anxious women.

According to the preliminary findings of this study, correlation between HyCoSy and HSG and laparoscopic dye perturbation is good. Concordance between HSG and dye test and HyCoSy and dye test was 86.6%. Since concordance is the accuracy with which a technique agrees with the reference test, we conclude that HyCoSy and HSG are equally effective in diagnosing tubal patency. These results are comparable with those reported by others.6,13,14,16

When HSG is considered as the reference test, its sensitivity (detection rate) for tubal occlusion was 80% and specificity 94%. These data are similar to those of studies that compared HyCoSy only with HSG.6,13,14,17 However, considering dye perturbation as the reference test, HyCoSy had lower sensitivity and specificity, 75% and 91%, respectively, whereas HSG showed higher sensitivity but lower specificity, 88% and 86%, respectively. These results may indicate that HyCoSy can identify tubal patency more easily than obstruction. This could be explained by temporary tubal occlusion caused by spasm that can lead to a false diagnosis by HSG, whereas tubal patency can be recognized during HyCoSy by reinjecting the solution after some minutes when tubal spasm has passed. One of the main advantages of HyCoSy seems therefore to be that it allows continuous, repeatable, and direct real-time examination of the fallopian tubes. However, it requires a well-trained sonographer with experience in the procedure.

Ideally it is possible to follow the flow of air bubbles through the tube and to visualize air and saline solution near the ovary in the abdominal cavity, which is a sure sign of tubal patency. In some cases it is not possible to scan the entire tube, and only the distal part near the ovary is visible, or only air bubbles around the ovary can be seen. Learning to differentiate between a real occlusion and a temporary spasm requires patience and experience.

The HyCoSy technique in our study is similar to that described by others.1,12 However, we first use power Doppler sonography to identify tubal position better, and then the gray scale approach to visualize saline solution and air bubbles through the salpinx. Although color Doppler imaging is not essential in evaluating tubal patency, it might then the gray scale approach to visualize saline solution and localize the tube.

Compared with HSG, HyCoSy does not give an image of the entire tube and its course. In fact, HSG gives a more accurate location of tubal obstruction, but its costs, exposure to radiation, and false positive results due to tubal spasm confirm its disadvantages compared with HyCoSy.

HyCoSy associated with transvaginal scan can be a primary outpatient in investigation of infertility. It may replace HSG but it requires some degree of experience and must therefore be performed by specialists. If tubal occlusion is diagnosed by HyCoSy, laparoscopy should be considered a second-line procedure.

References

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