

The Use of a New Gel Foam for the Evaluation of Tubal Patency

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Key Words

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Abstract

Aims: To evaluate the feasibility and the reliability of hysterosalpingo-foam sonography (HyFoSy) using gel foam in the assessment of tubal patency. **Methods:** Nonrandomized, observational, academic and single-center study of 20 women being investigated because of subfertility and scheduled for a laparoscopy with chromopertubation. A detailed description of HyFoSy with a newly developed gel foam is given in the way it proved to be most efficient in our hands. The results of HyFoSy are compared to the data regarding tubal patency testing during laparoscopy by chromopertubation. **Results:** All 20 HyFoSy were technically successful. Four of the 40 tubes, 1 right tube and 3 left tubes, were not patent at HyFoSy (3 tubes with proximal block and 1 tube with distal block). There was a 100% agreement between tubal patency data according to HyFoSy testing and laparoscopic chromopertubation testing. **Conclusion:** HyFoSy is both feasible and accurate in the diagnosis of tubal patency.

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Introduction

Contrast agents to assess tubal patency are being used in three different settings. X-ray oil- or water-based contrast agents in X-ray hysterosalpingography (HSG), methylene blue for chromopertubation during laparoscopy and air- or water-based contrast agents in hysterosalpingo-contrast sonography (HyCoSy) [1–5]. X-ray HSG has the disadvantages of radiation exposure (on average 1–5 mSv but depending on the fluoroscopy time) and of potential allergy to the contrast agent. Laparoscopic evaluation with methylene blue is associated with the risk of laparoscopy under general anesthesia. The movement of a suspension of air bubbles through the fallopian tubes can be visualized during HyCoSy after intratubal instillation of products like Echovist or Levovist (Schering AG, Berlin, Germany) and SonoVue (Bracco International BV, Amsterdam, The Netherlands). The use of these products, which consist of a suspension of micron-sized air bubbles in an aqueous galactose solution [6–10], is limited by restricted commercial availability and high cost. A cheap but highly operator-dependent reported alternative for these products during HyCoSy is to use an alternated injection of water and air in the uterine cavity and to sonographically detect air bubbles around the ovary and free fluid in the cul-de-sac [11–13]. More recently,

Exacoustos et al. [13, 14] introduced coded contrast imaging enabling the visualization of the fallopian tubes over their total length. However, coded contrast imaging requires special software and a second-generation contrast medium.

Gel instillation sonography has been used as an alternative to saline infusion sonography in the assessment of intracavitary uterine lesions [15, 16]. This gel, diluted with sterile water and mechanically mixed with air, results in 'gel foam' with low viscosity [17]. The echogenic air bubbles remain suspended much longer in diluted gel than they would do in water due to the difference in viscosity. Their passage from the uterine cavity through the tubes to the abdominal cavity can be seen during ultrasound examination. The aim of this study was to evaluate the feasibility and reliability of hysterosalpingo-foam sonography (HyFoSy) using gel foam in the assessment of tubal patency, comparing it with laparoscopy and chromopertubation as gold standard.

Methods

In this nonrandomized, observational, academic and single-center study, 20 women being investigated because of subfertility and scheduled for a laparoscopy with chromopertubation were included. Laparoscopy was scheduled during the proliferative phase of the cycle in women with a natural cycle ($n = 17$) and at random (excluding menstruation) in women using oral contraception ($n = 3$). Exclusion criteria were: patient's refusal, pelvic infection or active uterine bleeding (including menstruation). The study was approved by the hospital's Ethics Committee and written informed consent was obtained from all patients.

Under general anesthesia the women were examined in lithotomy position and HyFoSy with gel foam was performed as follows. The gel foam mixture was prepared according to the instructions of the manufacturer of ExEm gel foam kits (ExEm; GynaecologyIQ, Delft, The Netherlands).

Firstly, a 10-ml syringe containing ExEm gel was connected to an empty 20-ml syringe by a small plastic coupling device. The gel was injected in the 20-ml syringe and subsequently the empty gel syringe was disconnected.

Secondly, a 10-ml syringe with sterile water was connected to the 20-ml syringe and the sterile water was added to the gel. Subsequently, the empty 10-ml water syringe was disconnected.

Thirdly, an empty 10-ml Luer lock syringe was connected to the 20-ml syringe containing 10 ml of gel, 10 ml of sterile water and a small amount of air. By moving the content to and fro between both syringes through the coupling device an homogeneous whitish mixture of micro air bubbles diluted in gel was obtained. The viscosity of the mixture was low enough to enable easy passage through the lumen of the narrow tubes, and was high enough to obtain a stable homogeneous suspension of the micro air bubbles within the fluid for the duration of the examination.

Fourthly, using an open-sided speculum (e.g. Collin-type), the cervix was visualized and cleaned with an aqueous chlorhexidine solution. Using a swab forceps, a 2-mm pediatric Foley balloon catheter with stylet (Pediatric Folsyl[®] Catheter; Coloplast A/S, Humlebaek, Denmark) was inserted through the cervical canal into the uterine cavity and the balloon was inflated with 0.5–1 ml water. The balloon was placed in the lower uterine cavity to prevent a backflow of gel foam through the cervix.

Fifthly, the speculum was removed, the stylet was withdrawn and the 10-ml Luer lock syringe filled with gel foam was connected to the catheter. A second operator inserted the endovaginal ultrasound probe and confirmed the correct position of the balloon. A transverse ultrasound section was made at the level of both cornua and a small amount of gel foam (2–5 ml) was slowly injected under direct ultrasound vision. The gel foam was easily visualized due to its strong hyperechogenicity. Additional small aliquots of gel foam were subsequently injected if necessary until its passage or nonpassage through both tubes had been assessed. All ultrasound examinations were performed using a GE Voluson[®] E8 ultrasound system (GE Healthcare, Milwaukee, Wisc., USA) equipped with a 6–12 MHz 3D endovaginal probe. Images were stored as 2D still images, 2D clips and 3D volumes. Tubal patency was diagnosed if a continuous forward flow (lasting for at least 15 s) was visualized in the proximal (paracornual) part of the tube, the contrast was seen over the whole length of the tube, the tubal lumen did not distend, and spilling of foam into the abdominal cavity was visible (fig. 1–3). The presence of air bubbles next to the ovaries or in the pouch of Douglas was recorded. Pulsed Doppler was used to confirm the direction of the flow as well as the acceleration during injection.

After the HyFoSy, the fertility surgeon proceeded with the laparoscopy with chromopertubation using methylene blue. The fertility surgeon was not blinded for the HyFoSy results. Tubal patency data according to HyFoSy instillation were compared to those according to laparoscopy with chromopertubation.

Results

The median (range) patient age was 30 (23–40) years with a median (range) parity of 0 (0–2) and median (range) gravidity of 0 (0–3). Patients had either primary ($n = 14$) or secondary ($n = 6$) infertility. At the time of surgery, they either had a natural cycle ($n = 17$) or were using oral contraception ($n = 3$).

All 20 HyFoSy were technically successful with respect to: (1) insertion of the catheter through the cervical canal into the uterine cavity, (2) inflation of its balloon and (3) instillation of gel foam into the uterine cavity. Four of the 40 tubes, 1 right and 3 left tubes, were not patent at HyFoSy (3 proximally blocked tubes and 1 distally blocked tube). The agreement of the HyFoSy tubal patency data and the chromopertubation tubal patency data was 100%. Endometriosis was diagnosed at laparoscopy in 12 patients (9 with minimal endometriosis, 2 with mild endometriosis, and 1 with severe endometriosis, classified ac-

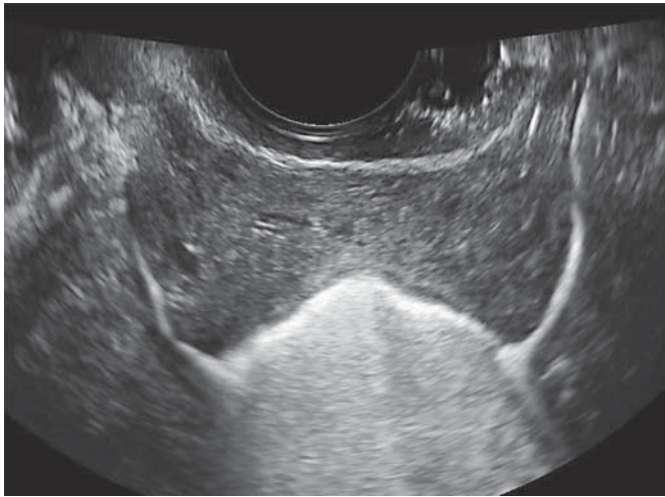


Fig. 1. Transversal section at the level of the proximal portion of both fallopian tubes. The gel foam is highly echogenic.

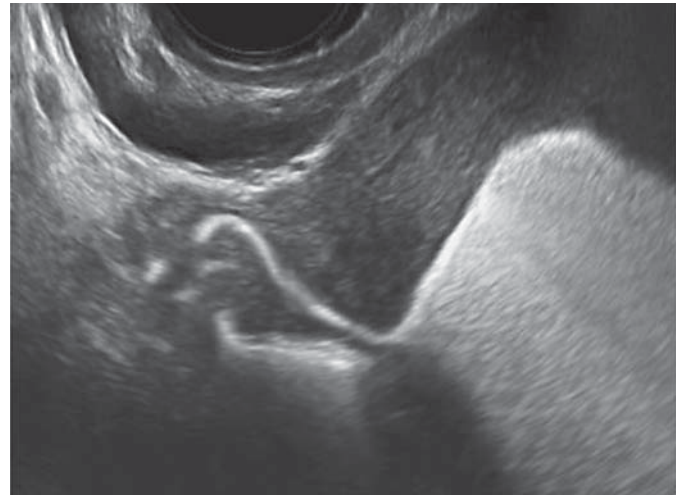


Fig. 2. Transversal section at the level of the fundus of the uterus with tortuous patent right fallopian tube.

Table 1. Overview of the 4 patients who underwent X-ray HSG, HyFoSy and laparoscopic chromopertubation

Case	Fallopian tube	HSG	HyFoSy	Lps chromo
1	left	patent	patent	patent
	right	patent	patent	patent
2	left	failed ¹	patent	patent
	right	failed ¹	patent	patent
3	left	blocked	blocked	blocked
	right	blocked	patent	patent
4	left	patent	patent	patent
	right	blocked	patent	patent

Lps chromo = Laparoscopic chromopertubation.

¹Technical failure.

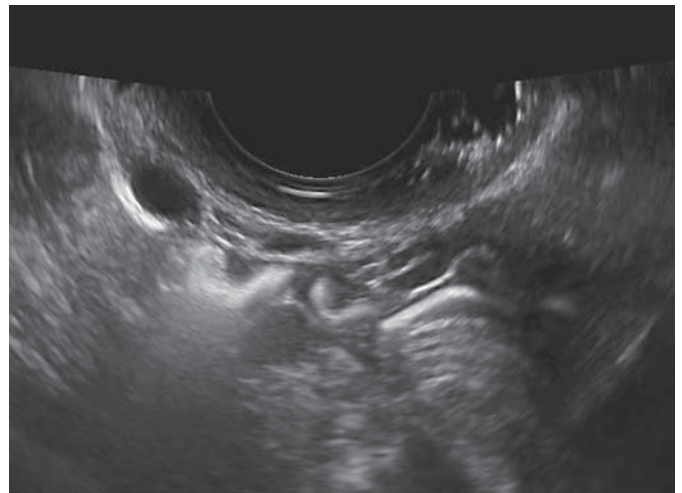


Fig. 3. Patent right fallopian tube (note the tortuous course).

according to the staging system of the American Society of Reproductive Medicine) [18]. Peritubal adhesions were seen in 2 cases: the fallopian tube was patent in 1 case but not in the other case. Four patients had previously undergone an HSG (table 1). In the first patient, both HSG and HyFoSy showed bilateral tubal patency. In the second patient, the HSG had been impossible due to cervical stenosis, whereas the HyFoSy was technically easy and demonstrated bilateral tubal patency. In the third patient, HSG reported bilateral blocked tubes, whereas HyFoSy showed a patent right tube and confirmed the left tubal block. In

the fourth patient, a unilateral block was observed on HSG, but not confirmed by HyFoSy showing bilateral tubal patency.

Discussion

This study illustrates both the feasibility and the accuracy of HyFoSy in the diagnosis of tubal patency when compared to the gold standard of chromopertubation during laparoscopy. Furthermore, we provided a detailed

description of HyFoSy, in the way it proved to be most efficient in our hands, to allow other investigators to confirm our data.

In our experience, the use of Foley's catheter is important during HyFoSy for the diagnosis of tubal patency. Firstly, this catheter can be introduced easily through the endocervical canal. Secondly, its small balloon, positioned in the lower uterine cavity, prevents backflow irrespective of the configuration of the cervical canal and the external os and allows for controlled building up of intrauterine pressure. Thirdly, the catheter is flexible and therefore does not disturb the patient or the operator manipulating the vaginal probe. Furthermore, we prefer a smaller (10-ml) syringe to instill the gel foam because this allows a better control of gel foam amount and intrauterine pressure applied. The Luer lock is necessary to connect the syringe leak-proof to the Foley catheter. These practical aspects are of major benefit in the performance of HyFoSy in an outpatient setting.

Using dynamic ultrasound imaging, the flow of the gel foam through a patent tube can be followed on ultrasonography from the interstitial portion, over the tube's entire length until the fimbrial end, where spilling is evidenced as a foggy rain. Some tubes are straight, others are very tortuous, and the course of the gel foam can be followed by real-time 2D ultrasound.

Myometrial spasm, well known to those performing HSG, can explain why forward flow over the interstitial portion of the tube started only several minutes after instillation of gel foam through the catheter in 2 cases presented. Therefore, we recommend to wait several minutes and to allow the building up of intrauterine pressure while injecting the gel foam, as tubal patency can still be demonstrated in some cases of suspected proximal block uni- or bilaterally. In the outpatient setting we routinely warm the gel to 37°C using a warming blanket to avoid thermal stimulation of the myometrial cells and to minimize uterine cramps [19].

It has to be stressed that only a positive HyFoSy result (tubal patency) is conclusive. If tubal patency cannot be demonstrated, this may be caused by a truly blocked tube or by a transient blocked tubal status due to (1) spasm of the myometrium around the interstitial portion of the tube (tubal kinking), (2) the presence of a mucus plug or clot at the proximal end of the tube, or (3) a transiently swollen endotubal mucosa (e.g. secondary to infection). It is also important to note that a normal HyFoSy result does not rule out significant mechanical transport problems such as ciliar dysfunction or adhesions in or around a tube.

We conclude that HyFoSy is both feasible and accurate in the diagnosis of tubal patency.

References

- 1 Baramki TA: Hysterosalpingography. *Fertil Steril* 2005;83:1595–1606.
- 2 Chan CC, Ng EH, Tang OS, Chan KK, Ho PC: Comparison of three-dimensional hysterosalpingo-contrast-sonography and diagnostic laparoscopy with chromopertubation in the assessment of tubal patency for the investigation of subfertility. *Acta Obstet Gynecol Scand* 2005;84:909–913.
- 3 Matorras R, Rodriguez F, Pérez C, Pijoan JI, Echanojauregui A, Rodriguez-Escudero FJ: Agreement between hysterosalpingography and laparoscopic chromopertubation in assessment of tubal patency. *Clin Exp Obstet Gynecol* 1998;25:29–31.
- 4 Exacoustos C, Zupi E, Carusotti C, Lanzi G, Marconi D, Arduini D: Hysterosalpingo-contrast sonography compared with hysterosalpingography and laparoscopic dye perturbation to evaluate tubal patency. *J Am Assoc Gynecol Laparosc* 2003;10:367–372.
- 5 Saunders RD, Shwayder JM, Nakajima ST: Current methods of tubal patency assessment. *Fertil Steril* 2011;95:2171–2179.
- 6 Tamási F, Weidner A, Domokos N, Bedros RJ, Bagdány S: Echovist-200 enhanced hystero-sonography: a new technique in the assessment of infertility. *Eur J Obstet Gynecol Reprod Biol* 2005;121:186–190.
- 7 Exacoustos C, Zupi E, Szabolcs B, Amoroso C, Di Giovanni A, Romanini ME, Arduini D: Contrast-tuned imaging and second-generation contrast agent SonoVue: a new ultrasound approach to evaluation of tubal patency. *J Min Inv Gynecol* 2009;16:437–444.
- 8 Lanzani C, Savasi V, Leone FP, Ratti M, Ferrazzi E: Two-dimensional HyCoSy with contrast tuned imaging technology and a second-generation contrast media for the assessment of tubal patency in an infertility program. *Fertil Steril* 2009;92:1158–1161.
- 9 Luciano DE, Exacoustos C, Johns DA, Luciano AA: Can hysterosalpingo-contrast sonography replace hysterosalpingography in confirming tubal blockage after hysteroscopic sterilization and in the evaluation of the uterus and tubes in infertile patients? *Am J Obstet Gynecol* 2011;204:79.e1–e5.
- 10 Lim CP, Hasafa Z, Bhattacharya S, Maheshwari A: Should a hysterosalpingogram be a first-line investigation to diagnose female tubal subfertility in the modern subfertility workup? *Hum Reprod* 2011;26:967–971.
- 11 Ahinko-Hakamaa K, Huhtala H, Tinkanen H: The validity of air and saline hysterosalpingo-contrast sonography in tubal patency investigation before insemination treatment. *Eur J Obstet gynecol Reprod Med* 2007;132:83–87.
- 12 Savelli L, Pollastri P, Guerrini M, Villa G, Manuzzi L, Mabrouk M, Rossi S, Seracchioli R: Tolerability, side effects, and complications of hysterosalpingo-contrast sonography (HyCoSy). *Fertil Steril* 2009;92:1481–1486.
- 13 Exacoustos C, Di Giovanni A, Szabolcs B, Binder-Reisinger H, Gabardi C, Arduini D: Automated sonographic tubal patency evaluation with three-dimensional coded contrast imaging (CCI) during hysterosalpingo-contrast sonography (HyCoSy). *Ultrasound Obstet Gynecol* 2009;34:609–612.

- 14 Exacoustos C, Di Giovanni A, Szabolcs B, Romeo V, Romanini ME, Luciano D, Zupi E, Arduini D: Automated three-dimensional coded contrast hysterosalpingo-contrast-sonography: feasibility in office tubal patency testing. *Ultrasound Obstet Gynecol* 2012, Doi: 10.1002/uog.11200.
- 15 Van den Bosch T, Betsas G, Van Schoubroeck D, Daemen A, Vandenbroucke V, Cornelis A, De Moor B, Deprest J, Timmerman D: Gel infusion sonography (GIS) in the evaluation of the uterine cavity. *Ultrasound Obstet Gynecol* 2009;34:711-714.
- 16 Werbrouck E, Veldman J, Luts J, Van Huffel S, Van Schoubroeck D, Timmerman D, Van den Bosch T: Detection of endometrial pathology using saline infusion sonography (SIS) versus gel instillation sonography (GIS): a prospective cohort study. *Fertil Steril* 2011;95:285-288.
- 17 Emanuel MH, van Vliet M, Weber M, Exalto N: First experiences with hysterosalpingo-foam sonography (HyFoSy) for office tubal patency testing. *Hum Reprod* 2012;27:114-117.
- 18 Revised American Society for Reproductive Medicine classification of endometriosis: 1996. *Fertil Steril* 1997;67:817-821.
- 19 Nirmal D, Griffiths AN, Jose G, Evans J: Warming Echovist contrast medium for hysterocontrastsonography and the effect on the incidence of pelvic pain. A randomized controlled study. *Hum Reprod* 2006;21:1052-1054.