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Fallopian Tubal Patency Assessed by Ultrasound Following Fluid Injection

Work in Progress¹

The ability of ultrasound to detect patency of at least one fallopian tube by demonstrating free fluid in the cul-de-sac was evaluated in 35 infertile women. The results were compared with conventional hysterosalpingograms, which had been obtained simultaneously. Ultrasound demonstrated bilateral occlusion with a sensitivity of 100%, and showed tubal patency with a specificity of 96%. The ability to diagnose tubal occlusion or patency using this ultrasound technique, which the authors have designated "sonosalpingography," eliminates unnecessary exposure of the female pelvis to ionizing radiation and avoids the use of iodinated contrast material.

Index terms: Fallopian tubes, ultrasound studies, 853.1298 • Sterility

Radiology 1984; 152: 507-510

DETERMINING whether the fallopian tubes are patent is part of the initial evaluation procedure in seeking the cause of infertility. Currently available methods, each with its own drawbacks, include the Rubin test, which is highly subjective; laparoscopy, which is invasive; and hysterosalpingography, which exposes the patient to ionizing radiation and contrast medium. Of the three techniques, hysterosalpingography has become the method of choice (1). However, although it provides anatomic information about the uterus and tubes, masses in the pelvis are only indirectly inferred, or completely missed. The patient may eventually undergo laparoscopy to assess tubal function and directly visualize the pelvis.

Since ultrasound is an effective means of examining the female pelvis (2, 3), we attempted to determine if this modality could be used to assess tubal patency. A technique was developed, which we term "sonosalpingography," in which sterile fluid injected transcervically can be identified in the cul-de-sac, indicating patency of at least one fallopian tube. In addition, masses in the pelvis were visualized using ultrasound.

MATERIALS AND METHODS

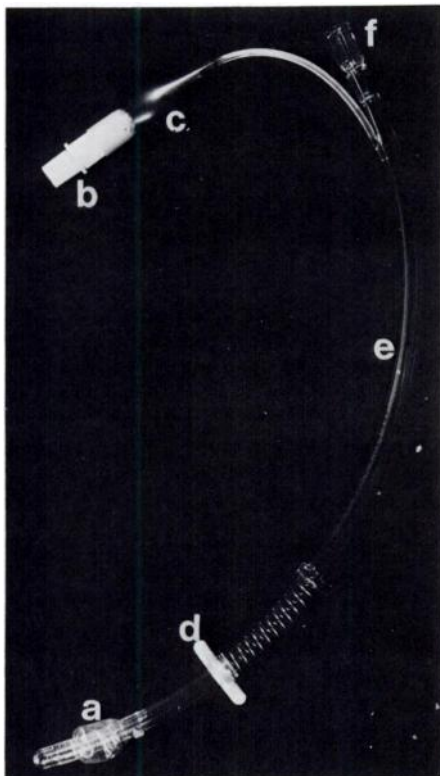
Thirty-five patients underwent sonosalpingography simultaneously with hysterosalpingography for correlation. The materials necessary for the ultrasound examination can be found in a conventional hysterosalpingogram tray. These include a speculum, Betadine (povidone-iodine, Purdue Frederick Co.) to cleanse the cervix, a tenaculum, and 5- and 20-ml syringes. Since the metallic acorn tip instrument used for injection of fluid causes shadowing of the cul-de-sac, a Harris Uterine Injector (HUI) (UNIMAR, Canoga Park, CA) was substituted (Fig. 1). This is a plastic device with an inflatable balloon tip that is placed directly into the uterine cavity. Care must be taken to prevent air bubbles from entering the balloon tip or the HUI, which is filled with fluid prior to insertion. Renografin 60 (diatrizoate meglumine-diatrizoate sodium, Squibb) served as the radiopaque contrast medium and Hyskon (dextran in dextrose, Pharmacia Laboratories, Piscataway, NJ) was used as the ultrasound contrast material. Hyskon is a highly viscous, sterile fluid developed for use during hysteroscopy. Saline may be used instead of Hyskon for the ultrasound examination.

Like oil-soluble contrast material, which is also highly viscous, Hyskon causes mechanical lavage of the tubes, which may dislodge mucus plugs or lyse peritubal adhesions. We chose Hyskon for its potential therapeutic value (4). The ultrasound examinations were performed using a Dasonics real-time sector scanner (Dasonics RA1 wide view) with a 3½ MHz transducer and a GE Datason B-scanner and linear array machine (3½ MHz).

A baseline ultrasound examination of the female pelvis was performed using the full bladder technique with the HUI in position. The distended bladder must cover the uterine fundus. This was immediately followed by conventional hysterosalpingography using Renografin 60. Hyskon was then introduced during the real-time ultrasound examination. A minimum injection of 20 ml of fluid was required for visualization in the cul-de-sac. The presence of fluid in the cul-de-sac was accepted as an indication of tubal patency. If free fluid was not readily seen, the table was tilted to a 30° reverse Trendelenberg position and the patient reevaluated. The two techniques

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Figure 1



The Harris Uterine Injector includes a sterile disposable double lumen inflatable cuff (a) with inflation valve (b) and pilot balloon assembly (c), which retain the device within the lumen of the uterus. A cervical disk (d) efficiently seals the cervix while injecting fluid. Also note injection lumen (e) with luer lock adaptor (f).

TABLE I: Results*

	No. of Patent Tubes	No. of Occluded Tubes	Total
Spill	24	0	24
No spill	1	9	10
Total	25	9	34

* TP (sensitivity) = 100%; TN (specificity) = 96%; accuracy = 97%. One case was excluded because the internal os could not be cannulated.

were performed by two different radiologists and evaluated independently without the benefit of history. Figure 2 is a typical example of tubal patency. Figure 3 demonstrates tubal occlusion.

RESULTS

TABLE I compares results of the sonosalpingogram with the hysterosalpingogram used as the "gold standard." Nine patients showed no spill of contrast material by hysterosalpingography with 100% correlation by ultrasound, a sensitivity of 100%. Twenty-five patients showed free spill of contrast material by hysterosalpingography. Ultrasound detected free fluid in the cul-de-sac in 24 of these patients, a specificity of 96%. The only false-positive result was encountered early in the series in a patient who had free spill high in the true pelvis, but not in the cul-de-sac. On three subsequent examinations fluid was not initially appreciated. After tilting the table to a 30° reverse Trendelenberg position, fluid spilled into the cul-

de-sac and became readily apparent. We now perform all of our studies with the table tilted from the beginning allowing a more rapid evaluation.

The overall accuracy of ultrasound was 97%. One patient was excluded from the study because the cervical os could not be cannulated.

DISCUSSION

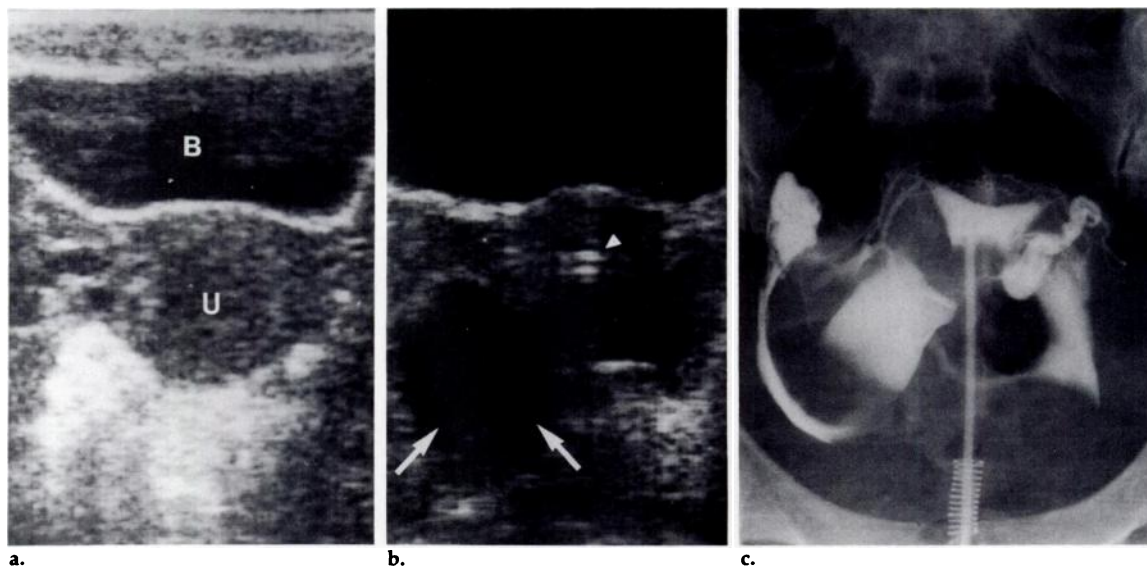
Identification of free fluid in the cul-de-sac indicates at least unilateral tubal patency. This information is sufficient in the early evaluation of infertility since these patients will either be placed on fertility drugs or be allowed a six- to eight-month trial period to become pregnant before more invasive procedures are initiated.

Sonosalpingography may also be used to assess tubal status following microsurgery for reanastomosis and is clearly indicated in patients with a history of reactions to iodinated contrast material.

Much ancillary information was obtained during the course of the study.

1. The preliminary ultrasound examination may show previously unsuspected disease in the infertile patient, information not readily available by hysterosalpingography alone. Figure 4 shows a small fibroid not clinically suspected or visible on the radiograph. This is important information since fibroids may cause repeated early trimester abortion. Figure 5 shows a 5-cm endometrioma, discovered at sonosalpingography, which

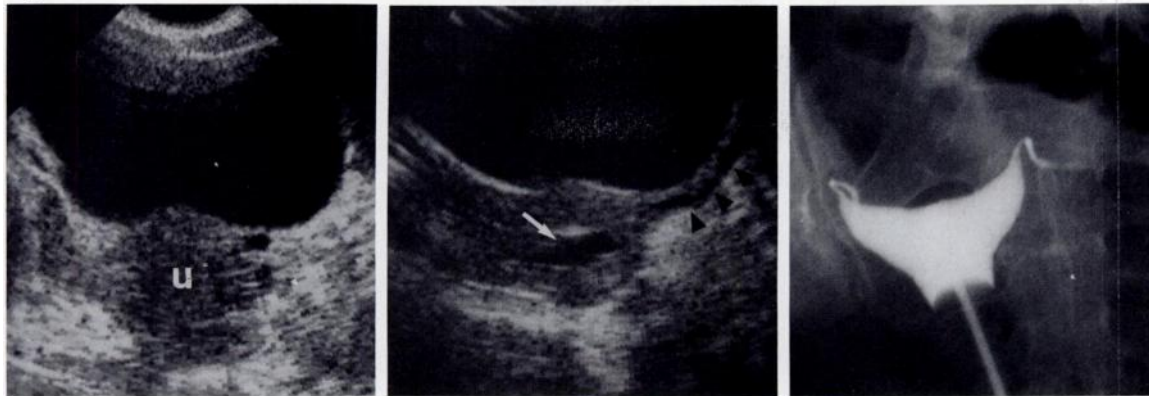
Figure 2



Tubal patency.

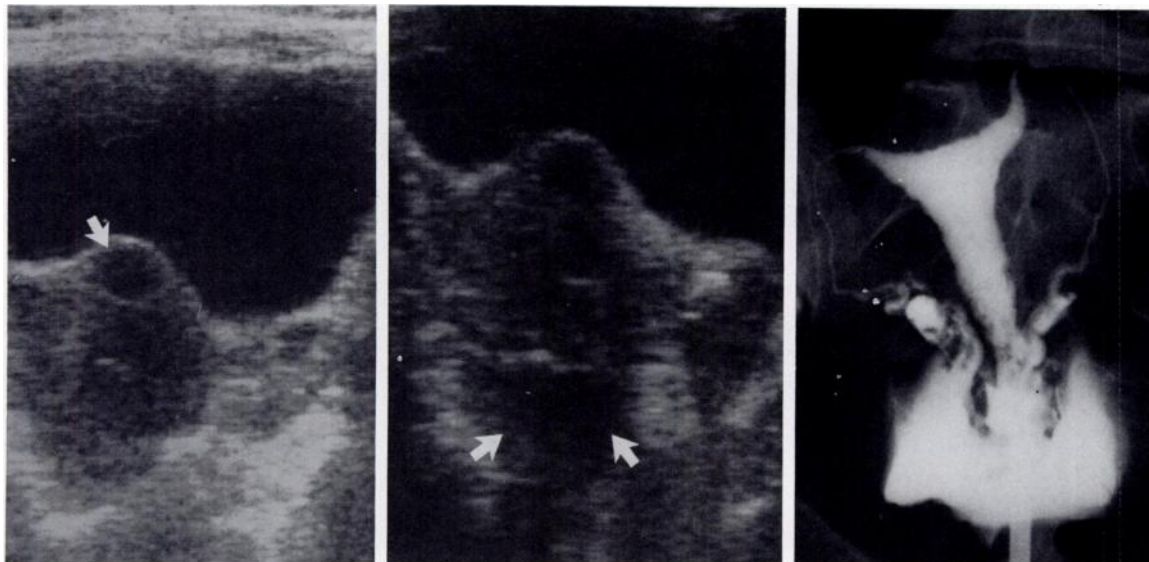
- Baseline transverse scan through the uterus (U) and urinary bladder (B).
- Following injection of fluid, free fluid (large arrows) is detected in the cul-de-sac. The double echogenic line (small arrowhead) within the lumen of the uterus represents the tip of the HUI.
- Hysterosalpingogram confirms tubal patency.

Figure 3



- a. Bilateral tubal occlusion.
a. Baseline transverse scan through the uterus (*u*).
b. After injection, the uterine cavity distends with fluid (arrow) and some fluid is seen in the left fallopian tube (arrowheads). No fluid is seen in the cul-de-sac.
c. Hysterosalpingogram confirms bilateral tubal occlusion.

Figure 4



- a. Unsuspected fibroid in uterus.
a. Baseline transverse scan showing uterus with a small fibroid (arrow) anteriorly in the fundus.
b. Free fluid (arrows) is present in the cul-de-sac after injection. It should be noted that free fluid in the cul-de-sac normally is completely anechoic. However, microbubbles of air within the injected fluid are imaged as punctate echoes, altering this appearance slightly.
c. The hysterosalpingogram shows bilateral tubal patency, but no evidence for the fibroid.

was also unsuspected clinically. This mass was indirectly imaged by radiographic technique, but ultrasound permitted further characterization.

2. A diseased tube may distend with fluid. In two cases an abnormal tube was correctly identified. Figure 6 (left side) shows the hydrosalpinx, which became filled and distended during the injection of saline.

3. A correctly timed study will show a follicle on the ovary on days 11 to 14, which is good evidence for ovulation.

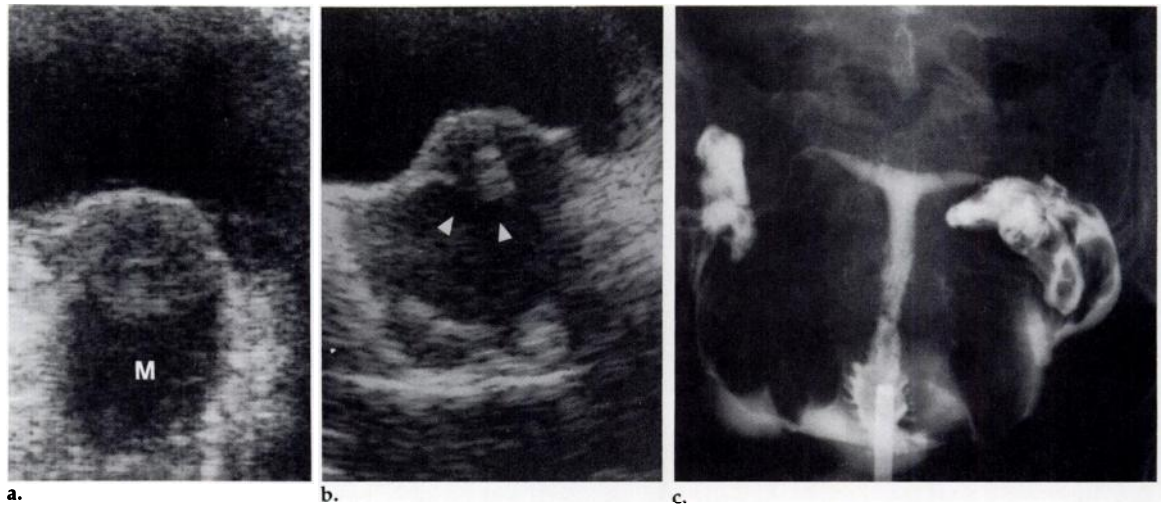
4. A distended uterine cavity (*i.e.*,

one that appears larger than at the baseline prior to injection) following introduction of contrast material suggests bilateral tubal occlusion or spasm. If this is seen, the patient should be reexamined after a few minutes. In one patient the initial hysterosalpingogram indicated occluded tubes. During real-time ultrasound examination the distended cavity emptied and free spill was demonstrated suggesting initial spasm or lysis of adhesions by Hyskon. A second hysterosalpingogram confirmed free spill.

In summary, we believe that this technique offers several advantages over the conventional hysterosalpingogram. These include visualization of uterine and extrauterine pathology; identification of a follicle, which is good evidence for ovulation; avoidance of exposure to ionizing radiation; and the therapeutic effect of Hyskon, with its high viscosity. Our technique cannot be used to define tubal anatomic structure. Hysterosalpingography should be performed for this purpose.

Excluding an early case of tubal

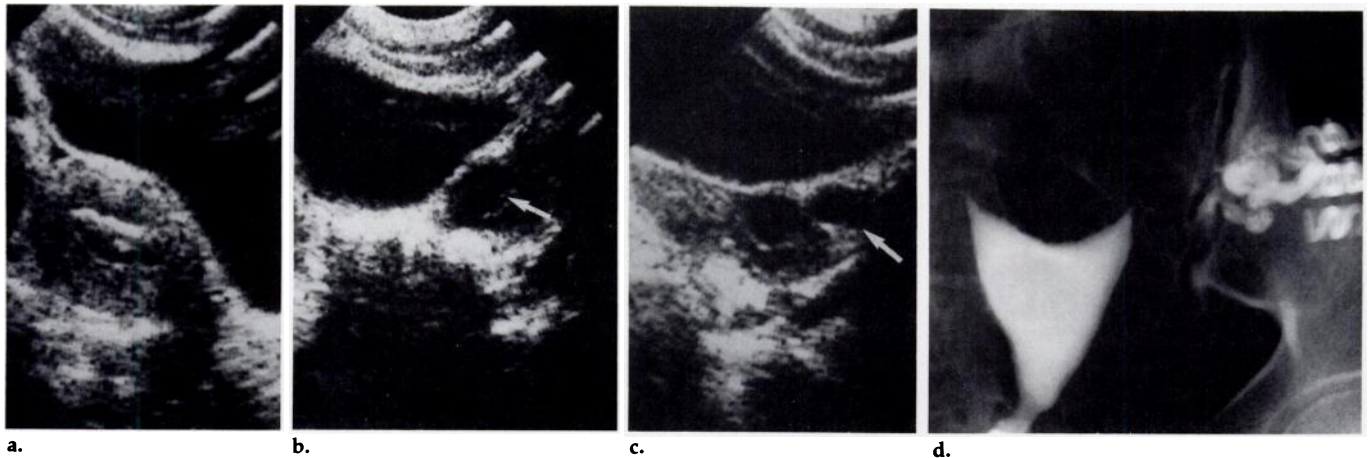
Figure 5



Unsuspected endometrioma.

- a. Baseline transverse scan through the uterus. A 5-cm hypoechoic mass (*M*) is seen behind the uterus.
- b. Free fluid (arrowheads) is seen after injection, indicating tubal patency.
- c. The hysterosalpingogram confirms patent tubes and shows indirect evidence for a mass. This was a surgically proven endometrioma.

Figure 6



Diseased fallopian tube.

- a. Baseline transverse scan of uterus.
- b. Baseline scan shows a small follicle on the left ovary (arrow).
- c. The hydrosalpinx was observed to fill and distend during the injection of the saline.
- d. The hysterosalpingogram correlated well.

patency not appreciated by ultrasound because the table had not been tilted, there was 100% correlation between the results of both studies.

We now perform sonosalpingography in the ultrasound suite and routinely inject approximately 20 ml of sterile saline, since saline flows more easily through the tubes and is more comfortable for the patient than the highly viscous Hyskon. Once tubal patency is established, a flushing dose of 5 ml of Hyskon may be injected for potential therapeutic purposes.

We feel that these highly accurate

results coupled with the safety associated with ultrasound make sonosalpingography a promising screening technique in the evaluation of the infertile patient.

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