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Infertility investigation through saline infusion sonohysterosalpingography

Mona ZVANCA, Resident and fellow in Obstetrics and Gynecology;
Radu VLADAREANU, MD, PhD, Professor of Obstetrics and Gynecology;
Cristian ANDREI, Specialist doctor and fellow in Obstetrics and Gynecology

Obstetrics and Gynecology Department, Elias University Hospital, Bucharest, Romania

ABSTRACT

Along with the sexual revolution there was a drasting increase in the number of cases presenting with infertility and a shift in the major causes from ovarian and uterine anomalies, to tubal infertility. Thus, it was necessary to develop better means of evaluation of tubal permeability and morphology. The technological development in the ultrasound field made it possible to introduce into clinical practice a sonographic assessment of the fallopian tubes. Started as a transabdominal examination, with poor results, it moved towards a transvaginal approach, with a good visualization, improved by Doppler and three-dimensional rendering modes.

***Material and methods**: We created a study group of 27 patients examined by sono-hysterosalpingography (sonoHSG) over a period of nine months. The procedure was performed as part of the routine assessment of the infertile couple, during the days 5 to 10 of the menstrual cycle.*

***Results**: According to the quality of the images and the diagnostic information we divided the patients into three categories. Results were checked by laparoscopy, performed in 21 out of 27 patients. The general positive diagnostic rate was 70.3% with a false positive rate of 11.1% and no false negative results.*

***Conclusions**: With improving technique, sonoHSG may become a easier method to assess fallopian tubes. It is well tolerated by the patients, may be employed as an out-patient procedure and is almost side-effects free.*

Key words: infertility, hysterosalpingography, saline infusion salpingography

INTRODUCTION

Over the past 20 years there has been a shift in the causes of infertility, passing from the ovarian and uterine anomalies, to tubal and male infertility factors. Mostly, this is due to the increasing frequency of tubal and pelvic surgery, ectopic pregnancies, use of intrauterine contraceptive devices, and, not to mention the more and more frequent pelvic inflammatory disease. Thus, there is a consequent increase in the number of couples which present with tubal infertility. Obstruction and damage of the fallopian tubes account for almost 35% of all infertility cases (1).

Address for correspondence:
Vladareanu Radu, MD, PhD, Elias Emergency Hospital, Obstetrics and Gynecology Department, 17 Marasti Blvd., District 1, Zip Code 020322, Bucharest, Romania
email address: vladareanu@gmail.com

Evaluating the tubal patency represents a key step in the assessment of the infertile couple, especially in situations with risk factors for tubal damage. There are a number of methods which may be employed, some of them considered of greater use, but with little change during the last decades. The most straight forward method, and, historically, the first one introduced in clinical practice, was the radiological hysterosalpingography (HSG), using a radioopaque contrast agent. It allows a very good visualization of the cervical canal, endometrial cavity and lumina of the fallopian tubes. A wide variety of uterine and tubal anomalies may be diagnosed, in some cases avoiding the use of more invasive procedures, such as hysteroscopy and laparoscopy. A normal HSG may, also, contraindicate further surgical examinations in most of the cases. In addition to diagnostic information, HSG also has therapeutic effects, which are associated with increased fecundability in the months following the procedure (2). This effect relies on several factors:

- mechanic desobstruction of the fallopian tubes;
- enhancement of the endometrial receptivity;
- oil media may affect peritoneal macrophages by decreasing in vitro phagocytosis of sperm and altering interleukin and prostaglandin production;
- breaking down peritoneal adhesions that restrict tubal movement;
- stimulating tubal cilia, and thus enhancing transport of gametes;
- improving cervical mucus to enhance passage of sperm;
- iodine in the contrast medium has a bacteriostatic effect on mucous membranes (3).

The diagnostic accuracy is affected by factors such as the training and experience of the physician performing the procedure and interpreting the films. The amount of radiation exposure depends upon the equipment and factors such as duration of fluoroscopy, number of films and size of the patient. Complications of HSG include uterine perforation, infection, allergic reactions, and syncope. The rate of infection of the upper genital tract is about 1 percent, but is higher in women with history of pelvic inflammatory disease. There are rare reports of hemorrhage and shock, pulmonary or retinal embolus (only with oil media) (4).

One of the main limitations of this method is the lack of visualization of the uterine fundal contour and its relation with the surrounding pelvic anatomy. For this reason the American Society for Reproductive Medicine has recognized HSG and laparoscopy as complementary diagnostic methods (5). Moreover, laparoscopy allows a good prognosis evaluation and the choice for the best surgery option. Not only a diagnosis and evaluation method, laparoscopy is considered as the gold standard. It gives a good image of the pelvic anatomy and, also, of the abdominal cavity, it may investigate tubal patency by chromopertubation without questionable results, it may diagnose and classify pelvic endometriosis and other pelvic pathology and, finally, in many cases it may be a therapeutic instrument. The main disadvantage is represented by the invasiveness of the procedure, the necessity for general anesthesia and it carries along the risk of surgical incidents and accidents (6).

An optional method, which may be employed in specific situations is hysteroscopy. It is the best method to visualize the uterine cavity and its pathology and may be used for the treatment of submucous leiomyomas, polyps and adhesions. Starting from the uterine cavity, a hysteroscopy – directed falloposcopy may be performed, which can diagnose proximal tubal obstructions, followed by balloon tuboplasty or trancervical tubal cannulation (7). It requires a very skilled practitioner, it may be associated with complications as uterine perforation, infection, hemorrhage and it may require general anesthesia.

In this context, there was a need for alternative evaluation methods, which had to be less invasive, more comfortable, cheaper and easier to use. Along with the development of the transvaginal ultrasound as the main diagnostic method for pelvic pathology, there was a logic interest in developing a possibility for sonographic tubal investigation. The idea is not a new one. It all started in 1984 when Richman et al. studied and published the first cases of sonographic transabdominal evaluation of the tubal patency using an intrauterine catheter and an

echogenic contrast medium based on dextrose (8). A positive result was suggested by the accumulation of the free contrast medium in the Douglas' pouch. The method was further modified, using saline solution injected trancervically (9). A positive test was represented by the continuous intraperitoneal accumulation of fluid, without differences of the sides. None of these methods gives informations about tubal morphology, degree and localization of possible stenosis, but offers good data regarding endometrial cavity morphology. The transvaginal technique was introduced in 1989 by Deichert et al. (10), who used an echogenic medium in order to assess tubal patency and offer structural informations. Tufekci et al. developed an easier technique, using isotonic saline solution (11). They named it transvaginal sonohysterosalpingography (sonoHSG) or saline infusion salpingography (SIS).

The first benefit of this method was represented not by the informations regarding the fallopian tubes, but the uterine cavity. This is easily visualized, the contrast is greatly enhanced, it permits the differentiation between polyps and submucous myomas. It also facilitates the differential diagnosis between endometrial hyperplasia and carcinoma, along with the Doppler analysis (12) and may visualize uterine adhesions (13). Techniquelly speaking, it is easy to perform, as a short outpatient procedure, does not require any kind of anesthesia, it is safe, avoids X-ray exposure, is well tolerated and performed at a minimal cost (14). For all these reasons, sonoHSG proved to be a very handy technique, avoiding invasive procedures in some patients, or optimizing the preoperative triage process for those women who require therapeutic intervention.

As regarding the tubal assessment, there were different opinions according to the personal clinical experience. It was clear that the actual flow and morphology of the fallopian tubes can not be directly visualized. Using the conventional two-dimensional ultrasound there were only indirect data that could be collected: easy spillage of the fluid from the uterine cavity with accumulation in the Douglas' pouch, intensity of the patient's discomfort. Doppler analysis brought some light and opened a new direction. Deichert's team used pulsed wave Doppler scanning in order to reveal tubal occlusion (15). The method required a good visualization of at least 2 cm of the tube and was prone to many false results. Color Doppler is the first attempt to create a visual map of the tubal flow. With the use of more performant ultrasound machines the results have become comparable with those of the classical HSG, without its disadvantages. The results improve with the learning curve and an experience of at least 10 cases is recommended (16).

Three-dimensional sonoHSG is the latest acquisition in the fallopian tubes investigation methods. It relies on the computer generated coronal plane. The static acquisition is made with Doppler control in the moment of saline injection. The image consists of the endometrial cavity and the two tubes and it may be further rotated and improved upon necessities. Practically, it may be very difficult to reveal the whole tubal length. In most of the cases only the ostia or the proximal segment is seen (17). ❑

MATERIAL AND METHOD

We started testing the new possibilities of sonoHSG in June 2006 and this study is based on a nine months experience. During this time 27 patients presenting with infertility undergone sonographic evaluation of tubal patency, as part of the general evaluation of the infertile couple. The age limits were 26 to 38 years. The majority of the cases (18 cases - 66.6%) were secondary infertility, 11 of them with a history of uterine curettage and 5 with previous deliveries. Only 9 cases were primary infertility. Two patients had an ectopic pregnancy, one surgically treated by laparoscopic salpingectomy, and one managed conservatively (methotrexat treatment). Eight more patients presented different types of pelvic surgery, from which 6 for uncomplicated acute appendicitis, one cesarean section and one large ovarian cyst, removed through classic, abdominal surgery (figure 1). From the whole study group, 21 patients had at least one episode of acute pelvic inflammatory disease.

Regarding their menstrual history, all patients had a regular menstrual pattern, with a cycle length varying between 24 and 40 days and an intercycle variability of less than 5 days. We excluded all patients with demonstrated ovarian and endocrine infertility, as well as those couples

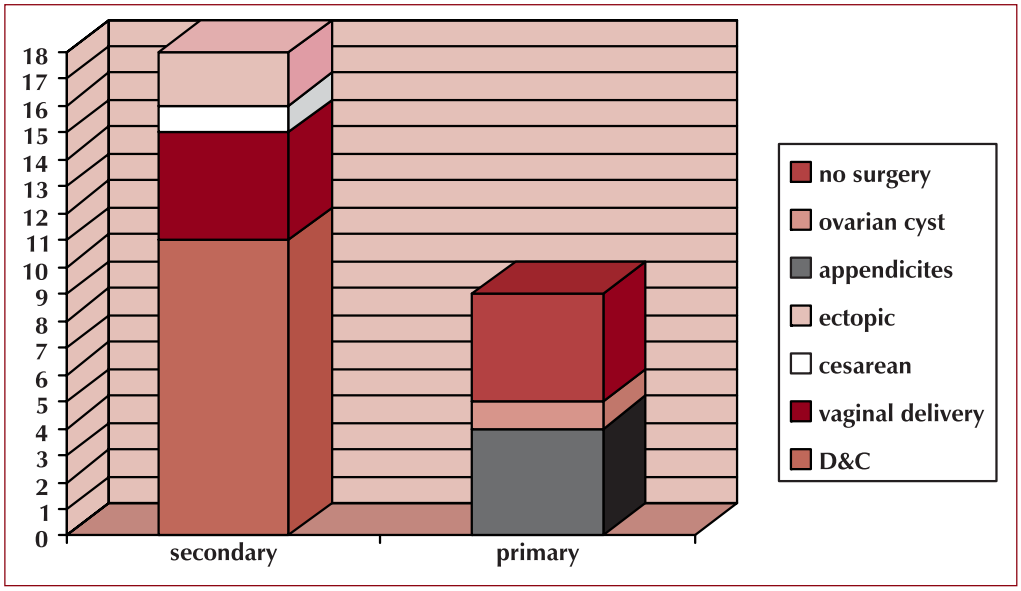

FIGURE 1. Patients distribution according to associated pathology and infertility type

with severe male infertility. A mild/moderate male factor infertility was accepted and the couple was directed for intrauterine insemination.

Three patients were diagnosed with luteal phase insufficiency and included in the study group. One patient was known and confirmed with an intramural uterine myoma and referred to us for investigation of ostium tubae obstruction. Another patient had a didelphic uterus with a longitudinal vaginal septum and a history of recurrent spontaneous first trimester abortions. We also included patients with cervical pathology, that is one case with a previous conization for cervical intraepithelial neoplasia (CIN) II with high risk HPV.

Most women (19 cases – 70%) previously used a mean of contraception. Sixteen patients preferred combined oral contraceptives, two used intrauterine devices and one patient received injectable medroxyprogesterone acetate. All contraceptives were discontinued 2 to 4 years before recruitment.

Technically speaking, we used almost the same procedure in all patients. The evaluation was scheduled during the follicular phase, days 5 to 10. Thus, we avoided artifacts due to remnant menstrual blood and diminished the interference with a possible early pregnancy. Also, later in the cycle, focal irregularities in the contour of the endometrium may be mistaken for small polyps or focal areas of endometrial hyperplasia. In all cases we preferred using premedication with 200 mg ibuprofen and drotaverine one hour before examination, in order to reduce discomfort and tubal spasm. In four patients we recommended antibiotic prophylaxis with doxicycline 100 mg twice a day for 5 days. General recommendation is to prescribe antibiotics in patients with a recent history of pelvic inflammatory disease or with a sonographic aspect consistent with such a pathology (18). Ideally, doxicycline should be started before procedure.

Anesthesia or analgesia is not required as the intrauterine insemination catheter is remarkably painless while being inserted. The procedure is well tolerated by the overwhelming majority of patients. A few experience minimal cramping.

A bimanual examination is performed initially to determine the position and mobility of the uterus. The speculum is inserted and the cervix cleansed with a 10 percent iodine-based solution. A sonohysterography catheter, such as the Goldstein Catheter (Cook ObGy), is only 1.8 mm in diameter. It is inserted to the fundus by grasping the catheter with a forceps and gently advancing it through the cervical os (figure 2). The speculum is then removed carefully to avoid dislodging the catheter. Since the catheter is 25 cm long, it will still extend beyond the

FIGURE 2. The Goldstein catheter placed in a correct position for examination.

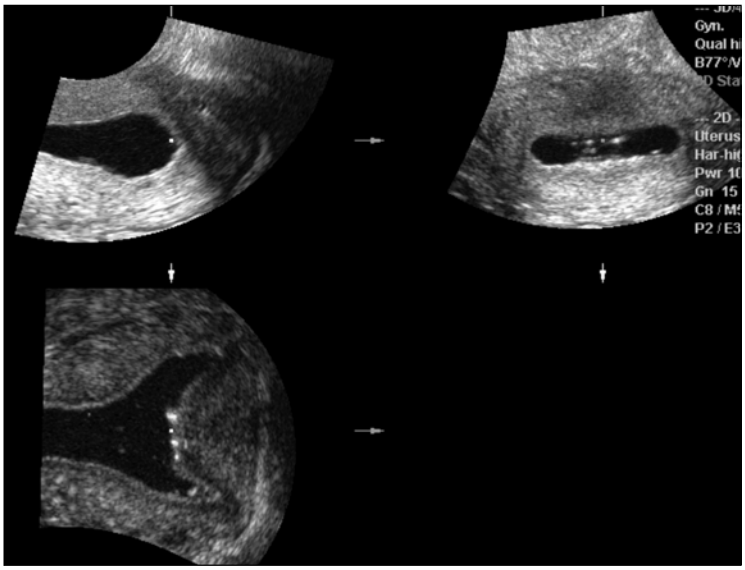

FIGURE 3. Three dimensional static acquisition. Sectional planes imaging the uterine cavity normal shape, the best view.

FIGURE 4. Direct visualization of the fluid spillage from the endometrial cavity through the ostium, distending the intramural segment of the fallopian tube.

introitus when positioned in the uterus. For the first cases we used a pediatric no.8 Foley catheter, which had the advantage of a very low cost, but was more difficult to position, as the balloon should be inflated at the internal os and not in the uterine cavity. An alternative was the use of a special silicone elliptosphere balloon catheter, which is much smaller, but expensive. Patients with a hypertrophic and/or incompetent cervix are much better examined using a balloon system. The balloon should always be inflated with saline solution and not with air, as this blocks the posterior view.

The procedure continues with a transvaginal ultrasound evaluation of the uterus, ovaries and the pelvis. Then, small amount of saline solution are being injected in a pulsed manner. The bolus depends on the quality of images and on patients' tolerability. The first step consists of a thorough examination of the uterus in a sagital plane, sliding the probe from one cornua to the other. Afterwards, the transducer is rotated 90 degrees into a coronal plane and moved down towards the endocervical canal and up towards the uterine fundus to recreate three-dimensional anatomy. Every portion of the uterine cavity should be imaged, because polyps, hyperplasia, or carcinomas may be focal. A reliable assessment requires that the endometrial echo be homogeneous, surrounded by an intact hypoechoic junctional zone. Different three dimensional rendering modes may be employed in order to create a better view of the uterine cavity (figure 3). Starting from this moment, we can gather informations regarding tubal patency. An easy and continuous spillage of the fluid from the uterus is suggestive of tubal passage. Direct data are collected by placing the sectional plane over the ostium tubae area (figure 4). The examination should use power Doppler in order to obtain a good image. A short fluid pulse is instillated. In cases of tubal passage this is visualized as a broad colored band superposed on the tubal area. The procedure is repeated for the other side and on different levels over the fallopian tube traject, with different degrees of magnification (figure 5). In most of the cases it is possible to acquire a three dimensional Doppler image, which may give more obvious informations. At the end of the examination the Douglas pouch is verified for fluid accumulation, which is the

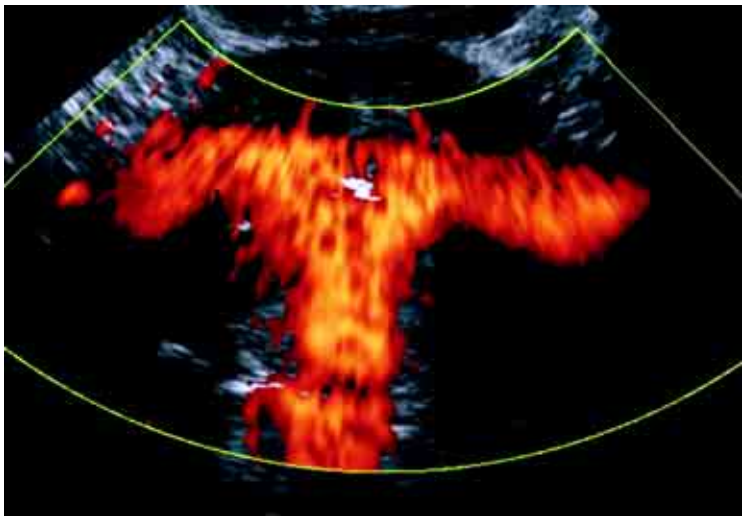

FIGURE 5. Power Doppler analysis of the flow through the fallopian tubes on a large image including the endometrial cavity and both tubes. It offers informations regarding tubal permeability, but not morphology.

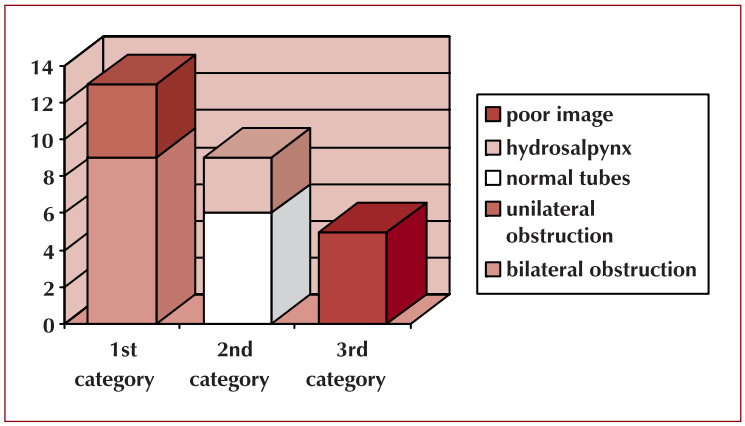

FIGURE 6. Graphic distribution of the patients according to sono HSG results.

indirect mark of tubal patency. The amount of peritoneal fluid should correspond to the injected quantity. Sometimes fimbrial ends may be seen free floating in the fluid and in these cases is recommended to reinject and visualize the fluid passage at the end of the tube. Also, the accumulated fluid may distend peritoneal adhesions, suggesting sequelae of pelvic inflammatory disease. ❑

RESULTS

Among the 27 examined patients, 21 (77.8%) had subsequently undergone laparoscopy, which we used as a comparison tool for sonoHSG results, as well as a therapeutic method in cases with tubal obstruction. For the rest of the patients there was no immediate reason for laparoscopy, as the sonoHSG found a very good tubal passage.

We can divide our cases into three categories:

1. a good visualization of the fallopian tubes, with unilateral/bilateral obstruction
2. a good visualization of the tubes with bilateral passage
3. poor tubal image with inconclusive results

Along with the informations regarding tubal function very important are the morphological data, that is informations about patent, but dilated salpingae.

Our study group was distributed mainly among the first two categories (figure 6). That is, 13 patients (48.1%) were first category patients, which were directed towards laparoscopy. Among them, 9 appeared to have bilateral obstruction and 4, unilateral.

Second category included 9 patients (33.3%). Six of them were not considered candidates for laparoscopy, as tubal function and morphology appeared normal. In three cases, even though there seemed to be a proper fluid passage, the tubal structure suggested some degree of anomaly. In two patients the salpingae could be visualized even on transvaginal ultrasound, with a dilated lumina, and a good three dimensional reconstruction of the sactosalpynx (figure 7). Therefore they were referred for therapeutic laparoscopy.

The greatest challenge was represented by the third category patients (5 cases – 18.5%). The examinations were difficult, with incomplete tubal visualization. The interpretation of Doppler image was difficult due to tubal position and artifacts. Only small amounts of fluid could be injected, so that the significance of the peritoneal fluid was difficult to interpret. It is worth mentioning that most of these cases (three) were examined within the first months of the study, so that difficulties may be related to the learning curve. Three dimensional acquisition was not possible in any situation. Laparoscopy was performed in all these patients in order to clarify the pathology and verify the sonoHSG results.

Regarding the associated pathology, 9 of the 11 patients with a history of dilatation and curettage were included in the first category, along with one patient with salpingectomy and

partial obstruction of the other tube. Second category patients with hydrosalpynx were recruited among women with a history of important pelvic inflammatory disease, all with secondary infertility after termination (two cases) or vaginal delivery (one case). The second patient with a previous ectopic pregnancy, treated with methotrexat was included in the second category, as she presented a normal tube and a completely obstructed one, but the choice was not to perform laparoscopy, as the therapeutic result was considered minimal.

Comparing sonoHSG results with the chromo per tubation during laparoscopy, there was a degree of variation related to the underlying pathology. In the first category the best concordance was in those patients with bilateral obstruction. Laparoscopy found 7 patients to have complete tubal stenosis and two only unilateral obstruction, a diagnostic rate of 77.8%. Unilateral obstruction was confirmed in 3 out of 4 (75%) patients. The last one had patent bilateral salpingae. In the whole group endometriosis typical lesions were identified in 7 patients.

All patients with suspected hydrosalpynx were confirmed by laparoscopy and in all cases an adequate surgical repair was tempted.

Third category gave the most disappointing results. Three out of five patients had normal functional and structural tubes, one had unilateral obstruction with minimal hydrosalpynx and one bilateral partial stenosis due to pelvic adhesions. Calculating the positive diagnostic rate for this category was not feasible.

The overall positive diagnostic rate for sonoHSG was 70.3% with a false positive rate of 11.1%. There was no case of false negative result. ❑

CONCLUSION

The technique and the results definitely improved with accumulating experience. The examination time was reduced and so the rate of false positive results, without completely eliminating them, as the last patient with a doubtful conclusion was examined during the last month of the study.

Important steps forward were made by changing the balloon catheter with the Goldstein type, in cases were it was convenient, and adding the three dimensional Doppler acquisition. It has to be mentioned that this type of rendering mode is not easy to use, it requires a very good positioning of the transducer and a long fluid pulse. It is more relevant in cases of tubal permeability, as tubal obstruction may be doubted for a technical flaw.

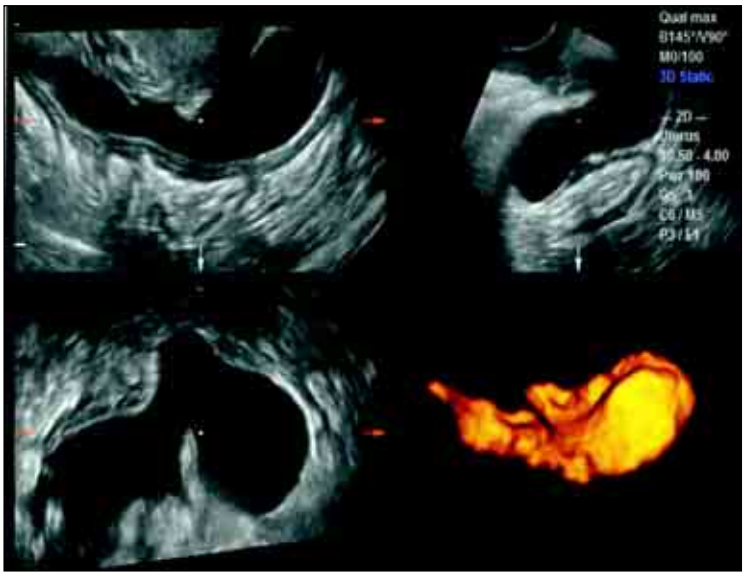

FIGURE 7. Transvaginal image of a sacctosalpynx with three-dimensional reconstruction in inversed mode.

In all cases a very good visualization of the uterine cavity is possible, with diagnosis of associated anomalies. It was the case in 3 patients, who were found for the first time to have an arcuate uterus. Also, the impact of a submucous myoma on the endometrial cavity can be easily assessed.

The first examinations may prove difficult, may offer inconclusive results, disappointing for the clinician. But, as experience accumulates, the quality of images improves, and the method becomes handier than the radiological approach, as more details regarding the pelvic anatomy are gathered. Moreover, it avoids unnecessary X-ray exposure, highly important in young women desiring a pregnancy. It is a procedure associated with less pain and discomfort. Side effects are rare, mainly consisting in an increased risk for pelvic inflammatory disease. In our study group only one patient presented two weeks later with suggestive mild symptoms.

Patients' cooperation is a very important issue and it may be achieved through a pre-procedure discussion with a detailed explan-

ation, a step-by-step communication and a good information over the results. Many of them come with fear and trepidation regarding the dreaded HSG. This image may be changed with slow, empathetic and correct technique. Not only will this make for a content patient, but will increase technical efficiency and success rate, allowing to obtain more useful diagnostic information and, thereby, better assistance for the patient.

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