Hysterosalpingography: technique, findings and results from our experience.

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Learning objectives

1. Explain the current role of hysterosalpingography (HSG) in the study of infertile patients.

2. Review indications and technique to perform a correct study.

3. Show normal anatomy, as well as non-pathological and pathological findings that may appear on a HSG.

4. Expose the results of 400 consecutive HSGs performed in our center and compare them with the results from the literature.

Background

Infertility is defined as the failure to conceive after 1 year without contraception. Infertile couples have been estimated between 8 and 20% in developed countries. There are two main types of infertility: primary (there is no previous pregnancy) and secondary (there has been a previous pregnancy) [1]. The most frequent factors responsible for infertility include male related factors (45%), ovulation disorders (37%), tubaric pathology (18%) and a mixture of several factors (20%). Also, uterine abnormalities can contribute to the problem in more than 10% of women [2].

In the study of the female partner in an infertile couple, there are several imaging techniques that can help determine the cause of infertility: hysterosalpingography (HSG), ultrasound (US), magnetic resonance (MRI) and the invasive laparoscopy. HSG is widely used mainly to determine the patency of the fallopian tubes, but it can also show uterine abnormalities which can contribute to the infertility [3].

There are new imaging techniques for the study of the uterine cavity and the fallopian tubes. Hysterosonosalpingography and virtual CT-hysterosalpingography, are being currently used in some institutions. However, HSG the most used technique because it has a shorter learning curve than hysterosonosalpingography [2] and is less expensive than virtual hysterosalpingography [4], hence the need to be familiar with the indications, technique, normal and pathologic findings. We will also show the results of our experience with 400 consecutive patients.
Findings and procedure details

Indications and Contraindications

The main role of HSG is the study of the fallopian tubes in infertility. However, it can be used in other cases: pelvic pain, congenital or anatomic abnormalities, anomalies of the menstrual cycle, the study of abnormal menses [5], women with recurrent spontaneous abortions and the postoperative evaluation of women who have had surgical tubal ligation or reversal of the ligation [6]. Another recent indication for HSG is the need to prove tubaric occlusion after the insertion of transcervical sterilization microinserts (Essure) [7].

Contraindications for the procedure include possible pregnancy, which can be avoided performing the HSG between the 5th to 12th day of the menstrual cycle. Other main contraindications are iodine allergy and active pelvic inflammation [5-6].

Technique

The procedure must begin scheduling patients between the 5th to 12th day after the onset of menses to allow cleaning of any residual blood from the menses and to ensure a thin endometrium that helps make the interpretation of images easier [8].

The need for prophylactic antibiotics should be considered in patients with a history of previous pelvic inflammatory disease (PID), and patients who require systemic bacterial endocarditis prophylaxis. There are some institutions where routine prophylaxis is given to all infertile women (our center is one of them) [8].

A non-steroidal antiinflammatory drug (NSAID) or buscapine should be given 1 hour prior to the procedure to reduce discomfort.

In the examination room, the patient will be placed in supine decubitus and in the lithotomy position with her buttocks slightly over the edge of the table. The patient's arms should be placed over her chest. The external genitals must be cleaned with an antiseptic solution and then a vaginal speculum should be gently placed (Fig 1.). Selecting a speculum of appropriate size is very important to avoid any discomfort for the patient. If there are difficulties trying to locate the cervix, the patient can perform a Valsalva maneuver [8].

A syringe with hydrosoluble contrast media attached to a 5-F HSG catheter should be primed before the administration of contrast in order to avoid the presence of air bubbles in the study that could be mistaken for intrauterine defects (fibroids or polyps). After the
external cervical os has been catheterized the speculum will be pulled out and then the patient should move slowly from the lithotomy position to the supine decubitus position.

A first radiograph of the pelvis should be obtained before the administration of contrast so that calcifications or possible foreign bodies can be identified. One must pay attention to the anatomic structures in the radiograph, for the presence of any possible incidental lesions in the bony structures of the pelvis or vertebrae (Fig. 2 and 3).

The contrast should then be gently and slowly instilled and the first post-contrast radiograph must be obtained during the early filling of the uterus to evaluate mucous pattern, filling defects or contour abnormalities (Fig. 4). Then additional images are obtained with the uterus fully distended (Fig. 5), with the tubes filled and showing contrast spillage to the peritoneum. The last image should be obtained after removing the catheter. Oblique and additional views are obtained if necessary to elongate the tubes, displace superimposed structures or to help characterize any abnormality [6].

The most common complications after the procedure are pain, bleeding and infection. The patient must be told that there may be a light spotting after the procedure, which usually lasts less than 24 hours [6]. The pain may be secondary to discomfort due to the introduction of contrast medium into the uterine cavity or peritoneal irritation due to the contrast spillage. Other less common complications include vasovagal reaction, allergic reactions and uterine perforation [5].

**Normal Anatomy**

The uterine cavity is shown during HSG as a triangular contrast-filled structure, with its base on top and the apex caudally, reminding an inverted triangle, with the isthmus above the cervix, the uterine body in the middle and the uterine fundus on top, which can be flattened, concave or slightly convex (Fig. 5). The fallopian tubes are communicated with the uterine cavity at each side of the uterine fundus, and each tube can be divided into three different segments: the interstitial part being the short tubal segment traversing the uterine wall, the isthmic portion being the longest and thinnest part of the tubes, and finally the ampullary portion, being the wide distal part of the tubes. After the administration of contrast there should be a free spillage of the contrast to the peritoneum [6] (Fig. 6).

**Non-pathologic Findings**

During the procedure, while administering the contrast, there can be an incidental flow of air that was previously on the cannula or the contrast-filled syringe. Air bubbles appear as round, often multiple, well-defined mobile filling defects. After the administration of
additional contrast, they are usually displaced to the fallopian tubes. Therefore, it is important to remove any possible air in the instrumental before the procedure [9] (Fig. 7).

Another non-pathologic finding is the visualization of venous or lymphatic intravasation, caused by an increase intrauterine pressure due to tubal obstruction or to an excessive pressure while injecting the contrast. Intravasation is seen during HSG as a network of thin vessels filled with contrast. Nowadays, hydrosoluble contrast is the material of choice and the intravasation has no harmful effects, but if oil-soluble contrast was used, the procedure needed to be stopped (Fig. 8).

Normal miometrial folds can be seen in early stages of HSG, and are shown as longitudinal folds with a parallel orientation to the uterine cavity.

If HSG is performed after the 12th day after the onset of menses, or if it is accidentally performed on an early-pregnant patient, a double uterine contour can be seen as a thin line of contrast that surrounds the uterine cavity.

A normal structure that can be seen sometimes are prominent cervical glands, that is observed as tubular structures with their origin on both cervical walls (Fig. 9).

In patients with a previous cesarean section, a diverticulum can be seen on the place of the low transverse uterine incision at the uterine isthmus, that may lead to confusion with other entities, such as prominent cervical glands, synechiae, and focal adenomyosis. Correlation with surgical history and the typical location of the diverticulum help in the diagnosis [10]. Another entity that is shown on HSG as an uterine diverticulum is the post-myomectomy diverticulum.

Despite being classified as one of the seven types of Müllerian anomalies by the American Fertility Society, uterus arcuatus is not related to infertility and can be considered a normal variation. It is seen on the HSG as a concavity of the uterine fundus and it is the result of a mild form of septate uterus [6] (Fig 10).

If the tubes are not seen or incompletely seen after the administration of contrast, it should be applied with progressive pressure. If it fails to show the tubes, a cornual spasm should be ruled out. In some centers, buscapine is given prior to the procedure to avoid the spasm, while in some other centers they repeat the procedure after a few minutes, without any medication [1] (Fig. 11).
As a tubal non-pathologic finding, tubal polyps are foci of ectopic endometrial tissue that is located at the interstitial portion of the tubes. They show as small, round, well-defined filling defects, without tubal obstruction [9].

**Pathologic Findings**

Congenital abnormalities of the uterine shape are due to an abnormal fusion of the müllerian ducts in the 6th to the 12th weeks of gestation.

Unicornuate uterus is secondary to a lack of proper formation of one of the Müllerian ducts [6], and appears on HSG as a small, fusiform uterine cavity usually shifted to one side of the pelvis. This is recognized as a Type II anomaly [11] (Fig. 12).

The Type III anomaly, known as uterus didelphy, results from a near complete failure of müllerian duct fusion. It constitutes only 5% of all congenital uterine anomalies. There will be two separate cervices, and the image of each uterine horn will remind a unicornuate uterus, and there is no communication between the uterine cavities [11] (Fig. 13).

If the ducts do not fuse completely at the level of the fundus, there will be a bicornuate uterus, a Type IV anomaly. It will be shown in HSG as two separate uterine horns filling during the procedure, with each horn having a fusiform appearance. As a way to recognize them, all bicornuate uteri will show a cleft in the uterus' outer contour [6,11] (Fig. 14).

If the two ducts fuse properly, but there is an incomplete resorption of the septum, it will result in a septate uterus, a Type V anomaly. Septate and bicornuate uteri can have similar appearances on HSG, and in some cases it cannot be differentiated by HSG alone, needing to complete the study with ultrasound or MRI [11] (Fig. 15).

Type VI anomaly, or arcuate uterus, is the result of a almost-complete septal resorption with a mild concavity in the fundus on HSG and has no negative effects on fertility (Fig. 10).

Submucosal fibromyomas are shown in HSG as smooth filling defects in the uterine cavity [5] (Fig. 16). Small myomas can be seen in the early filling stage of HSG, but may be obscured when the uterus if completely opacified. Large myomas can distort the shape and size of the cavity [6]. Small intramural fibromyomas do not distort the endometrial cavity and are usually not visualized on HSG.
Endometrial polyps are focal overgrowths of the endometrium. They often manifest as well-defined filling defects, best seen in the early filling stage, and similar to small myomas, they may be obscured when the uterine cavity is completely filled with contrast. Polyps and small myomas are indistinguishable by HSG, and hysterosonosalpingography is the preferred method for the imaging of endometrial polyps [5]. Color Doppler ultrasound can be used to identify the central vascular stalk of the polyp [6].

Adenomyosis is a condition in which ectopic active endometrium is present within the myometrium, in a focal or diffuse pattern. At HSG, appears as small diverticula extending into the myometrium, perpendicular to the uterine wall [3,6] (Fig. 17). Rarely, it appears as a sack-shaped projection filled by contrast medium, up to 1cm in length [5].

Intrauterine adhesions, or synechiae, are most commonly caused by endometrial trauma of curettage, but they can also be seen in patients with history of previous endometrial infections such as tuberculosis. They manifest as irregular filling defects, from linear intrauterine filling defects and irregular uterine contour to an entire obliteration of the uterine cavity [3,5] (Fig. 18).

Pelvic inflammatory disease (PID) is the most common cause of tubal occlusion leading to infertility [6]. Since the performance of HSG is contraindicated in active pelvic inflammatory disease, the findings of HSG in PID usually represent late sequel or the chronic stage of PID [12]. Tubal occlusion manifests as an abrupt cutoff of contrast material with nonopacification of the distal tube and it can be uni or bilateral, with no leakage of contrast material to the peritoneum [4,6] (Fig. 19). Hydrosalpinx is a common finding that results as sequelae of PID, usually secondary to distal tubal occlusion, leading to dilation of the proximal segment [5]. The findings include fallopian dilation, with loss of the rugal folds in the severe cases [12] (Fig. 20). Peritubal adhesions are other sequelae of previous inflammation or surgery, preventing contrast material from flowing freely around the bowel loops, commonly manifesting as a loculation of the contrast around the ampullary portion of the fallopian tube [5,6] (Fig. 21).

Salpingitis Isthmica Nodosum (SIN) is an idiopathic disease associated with infertility, PID, and ectopic pregnancy [6]. It appears on HSG as small outpouchings or diverticula from the isthmic portion of the fallopian tubes, affecting one or both tubes [5,6] (Fig. 22).

**Results from our experience**

We reviewed 400 consecutive HSGs from our database and classified them as non-pathologic (including normal studies or minor findings without significance on infertility) or pathological. Only one of the studies could not be performed because of a previous
cervical conization. Of the remaining 399 patients, 294 were normal (73.5%) and 105 had pathological findings (26.3%).

The distribution of uterine and tubaric pathologies showed 61 patients with uterine anomalies, representing 58.1% of the pathological studies, and 41 HSGs with tubaric anomalies, representing 39% of the pathological studies. 3 patients (2.8%) had synchronous uterine and tubaric anomalies.

The most common finding in the group with uterine anomalies were filling defects (myomas and polyps), with 19 patients, representing 31.1% of this group's findings.

In the other group, the most common finding was tubal occlusion, with 19 patients representing 46.3% of the tubaric anomalies.

Comparing our results with Schankath et al [2], our percentage of pathological HSGs is slightly higher than theirs (26% vs 21%). There is also a difference in the distribution of the pathological studies, with uterine and tubaric anomalies representing 34.8% and 54.6%, respectively. In their series, the most common anomalies were uterine filling defects and tubal occlusions, similar to our results.

Images for this section:
**Fig. 1:** Materials used in the procedure: Speculum, tenaculum, hysterometer, cannula and contrast-filled syringes.
Fig. 2: Left pelvic chondroma (incidental finding).
Fig. 3: Left lumbosacral transitional anomaly type IIA (Castelli Classification) - Incidental finding.
Fig. 4: Early uterine filling.
Fig. 5: Fully distended uterus.
Fig. 6: Contrast material in the peritoneum after a normal HSG.

Fig. 7: Filling defects on consecutive images at the uterine fundus, that disappear progressively after the administration of contrast, compatible with air bubbles.
Fig. 8: Vascular intravasation.
Fig. 9: Prominent cervical glands.
Fig. 10: Uterus arcuatus.
Fig. 11: Left cornual spasm. After a few minutes, there was passage of contrast to the left tube.
Fig. 12: Unicornuate uterus.
Fig. 13: Uterus didelphy.
Fig. 14: Bicornuate uterus.
Fig. 15: Septate uterus.
Fig. 16: Right submucosal myoma.
Fig. 17: Left adenomyosis.
Fig. 18: Uterine post-surgical synechiae.
Fig. 19: Left tubal occlusion.
Fig. 20: Bilateral hydrosalpinx.
Fig. 21: Right peritubal adhesions containing contrast material.
Fig. 22: Left salpingitis isthmica nodosum.
Conclusion

HSG is a technique that is still being used as part of the study of infertile women. With the development of new technologies that allow a more defined imaging of the uterine cavity and the fallopian tubes, and the improvement in the acquisition of images reducing the radiation exposure, HSG remains as a very useful and inexpensive technique. The risk for radiogenic anomalies in a possible future embryo as well as the risk for radiogenic fatal cancer in the female patient undergoing HSG is low. However, patients undergoing HSG can receive a high radiation dose if the fluoroscopic study is prolonged for any reason [13], hence the significance of knowing the proper technique and indications of HSG, and also being able to recognize the normal and pathological findings without performing long studies.

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