Hysterosalpingography is the radiographic evaluation of the uterine cavity and fallopian tubes after injection of radiopaque contrast through the cervical canal. The first hysterosalpingography, performed in 1910, was considered to be the first interventional radiological procedure.

The main indication for hysterosalpingography is female infertility, either with or without repeated miscarriage. It can also be used to investigate pelvic tract pain, congenital or anatomic abnormalities, anomalies of the menstrual cycle, and abnormal menses. It is still occasionally used as a preoperative imaging study for women who are about to undergo uterine or tubal surgical procedures.

Research has indicated that hysterosalpingography has a sensitivity of 58% and a positive predictive value of 28.6% for polypoid lesions and a sensitivity of 0% for endometrial hyperplasia. The same study showed the technique to have sensitivities of 44.4% for the detection of uterine malformations and 75% for intrauterine adhesions.

The main contraindication of hysterosalpingography is probable pregnancy. Performing the examination before the ovulation phase (between days seven and 10 in the menstrual cycle) reduces the likelihood of inadvertently examining a pregnant woman. The examination should also be avoided in cases of active intrapelvic inflammation because of potential risk of diffusion and vaginal or uterine bleeding. It should not be performed in cases of severe cardiac or renal deficiency or shortly after uterine or tubal surgery.

TECHNICAL TIPS
The procedure is performed during the first half of the menstrual cycle following cessation of bleeding. Patients are asked to refrain from unprotected heterosexual intercourse from the date of their period until after the investigation to rule out a risk of pregnancy. Examination during the second half of the cycle is avoided because the thickened secretory-phase endometrium increases the risk of venous intravasation and may cause a false-positive diagnosis of corneal occlusion.

The patient's clinical history, especially regarding inflammation, may indicate a need for antibiotics, which can be given one day before examination and for a few days afterwards. Patients should also take antibiotics if the maneuvers are reasonably sanguineous or if the fallopian tubes are at risk of dilatation. A suggested regimen is 1 g of metronidazole rectally at the time of the procedure plus 100 mg of doxycycline twice daily for seven days.

The patient is placed in the fluoroscopic scanner in a gynecological examination position. External genitalia are cleaned with antiseptic solution, and the vagina is dilated by a gynecologic dilator. The uterine cervix is straightened using one pair of surgical forceps at the 12:00 position or two pair at the 9:00 and 3:00 positions. The outside uterine cervix ostium is then catheterized.

Catheterization can be operated in one of two ways. It is common practice in Greece to use a salpingographer with a bell-shaped end that is pushed through the vagina and fits in the external uterine cervix ostium. An alternative method involves a salpingographer with a plastic cup-shaped end, which is also fitted to the external uterine cervix ostium. In either case, the other end of the salpingographer is fitted with a syringe containing an iodinated hydrosoluble contrast medium. The
vagina dilator is removed after catheterization of the external uteri cervix ostium and before administration of the contrast. Oil-soluble media were most often used as contrast in the past. Today, we use iodinated hydrosoluble contrast media. The literature mentions an association between oil-soluble contrast and a decreased time to conception following salpingography.9

One plain-film x-ray (24 x 30 cm) of the pelvis should be taken before contrast is administered. This ensures that possible intrapyelic masses or calcifications will not be a problem during the study of films. We also check the reflux of the contrast fluoroscopically before the first radiograph.10 The examination is performed under fluoroscopic control so that radiographs can be taken while the cavity is filled with 2 to 3 cc of contrast. Radiographs are also acquired during the filling of fallopian tubes and, finally, after the removal of the salpingographer to check for the presence of contrast in the peritoneal cavity. The total amount of contrast injected should not exceed 10 cc.

**COMPLICATIONS**

Hysterosalpingography is associated with a number of complications and side effects.5,11,12 Patients may experience uterine contractions and discomfort due to the introduction of contrast into the uterine cavity. The most common pain is subabdominal colic caused by uterine cavity dilatation. A more diffuse pain, caused by contrast irritating the peritoneum, has also been reported. Pain can be minimized by injecting the contrast slowly and using isosmolar agents.

Uterine perforation and tubal rupture may occur, but these complications are very rare. Traumatic elevation of endometrium by the inserted cannula does not have any significant consequences. Venous or lymphatic intravasation of contrast has no adverse effect on patients if the contrast is water-based. Intravasation can make image interpretation more difficult, however. This occurs more often in the presence of fibroids or tubal obstruction.

Contrast extravasation can occur if the contrast is administered too quickly, if the endometrium is injured during catheterization, or if the examination is performed during menstruation. Because of uterine vein and ovarian veins communication, contrast medium extravasation may also occur, especially in the presence of common or special endometrium inflammation.

Additional complications include allergic reaction to contrast media and postprocedural infection. Existing intrapyelic inflammation may spread, or it may arise if examination maneuvers cause severe damage to the uterus.

Radiation exposure to the ovaries is minimal and can be reduced by good technique.

**ANATOMIC INTERPRETATION**

The uterine cavity has a triangular shape on posterior-anterior radiographs. The apex of the triangle corresponds to the isthmus and is nearly 3.7 cm wide. The apex points downward and connects with the internal ostium of the cervix uteri, which is 2.5 cm long. The two fallopian tubes are located on either side of the uterus base in the area of the lateral horns.

The fallopian tubes are described as having three segments: the isthmus attached to the uterus (not imaged in several cases), ampullary (the middle segment, longest and widest), and a bell-shaped segment at the distal end. The tubes also have an internal, or uterine, ostium and an external, or abdominal, ostium. Contrast finds its way from the abdominal ostium and diffuses into the peritoneal cavity. Remaining contrast in the furrows of the peritoneum can be observed up to three hours after administration. Contrast in the recto-uterine pouch of the peritoneum (Douglas' space) often draws the profile of the collateral ovary.4

Congenital anomalies in the uterus can be caused by an incomplete junction of the paramesonephric ducts (Muller ducts). Anomalies may also arise if the diaphragm that is located between the ducts is not absorbed during the 18th week of pregnancy.13

The true incidence and prevalence of Mullerian duct anomalies is difficult to assess.14 Different patient populations, nonstandardized classification systems, and variations in diagnostic data acquisition have resulted in widely disparate estimates. Reported prevalence ranges from 0.16% to 10%.15 A prevalence of 8% to 10% has been reported in women undergoing hysterosalpingography because of recurrent miscarriages.16 The overall data suggest that the prevalence of Mullerian duct anomalies in fertile and infertile women is approximately 1%, rising to 3% in women who repeatedly miscarry.17

Although the majority of women with Mullerian duct anomalies have little problem conceiving, they are more likely to suffer spontaneous abortion, premature delivery, and abnormal fetal positioning and dystocia at delivery. Most studies report a frequency of 25% for associated reproductive problems in this group, compared with 10% in the general population. Primary infertility in these
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women usually has an extrauterine cause and is not generally attributable to mullerian duct anomalies alone.18 Cervical incompetence has also been linked with these anomalies.19 The American Society of Reproductive Medicine has identified seven classes of mullerian duct anomaly:20

- **Class I:** Segmental agenesis or variable degrees of uterovaginal hypoplasia. Anomaly can be detected from amenorrhea long before hysterosalpingography is performed.
- **Class II:** Unicornuate uteri representing partial or complete unilateral hypoplasia. In cases of rare degeneration of the mesonephric duct, the uterine cavity is monocular on imaging, placed right or left of the middle line. The unicornuate uterus is in contact only with the collateral fallopian tube.
- **Class III:** Didelphys uterus (Figure 1). A rare abnormality that includes duplication of the uterine cavity. Cervix neck and vagina result from complete nonfusion of the mullerian ducts. This uterus more rarely has a single vagina.
- **Class IV:** Bicornuate uterus demonstrating incomplete fusion of superior segments of uterovaginal canal: Uterine cavity is divided in two. Each half is narrow lengthways and stands apart from the other.
- **Class V:** Septate uteri representing partial or complete nonresorption of the uterovaginal septum.
- **Class VI:** Arcuate uterus resulting from near-complete resorption of the septum. Together with class V, these are the most common congenital anomalies (50%) seen in infertile women.
- **Class VII:** Sequelae of in utero diethylstilbestrol (DES) exposure.

Another congenital anomaly, caused by inadequate hormone stimulation during gestation, is a small-sized uterine cavity with normal vaginal length. This is a common finding in cases of feminine infertility.

Fibromyomas are diagnosed by suprapubic ultrasound (Figure 2).4 Submucosal fibromyomas are imaged as smooth filling defects in the uterine cavity. Differential diagnosis includes submucosal polyps or possible pregnancy. Subserous fibromyomas can produce smooth filling defects or smooth repression of the fallopian tubes if they are located in the lateral walls of the uterus.

Internal endometriosis is caused by ectopic islets of active endometrium in the muscularis wall of the uterus.7 This usually appears on imaging after contrast administration as a pointed 2 to 3-mm projection perpendicular to the uterus wall. It may occasionally be visualized as a contrast-filled sack-shaped projection, ranging in length from 4 to 10 mm. Differential diagnosis should include hyperplasia of the endometrium and the presence of contrast in the myometrium or the nutrient arteriole of the submucosa fibromyomas.

Uterine cancer is rarely diagnosed by hysterosalpingography, but filling defects in the vaginal lumen are seen in cases of vaginal cancer or polyps. The vagina may have an abnormal profile in cases of cervicitis or tuberculosis. External pressure on the vagina from a fibromyoma may cause decreased lumen width or repulsion.

A number of different fallopian tube anomalies may be seen on hysterosalpingography. Hydrosalpinx, from the Greek, literally means "water tube," and is a blocked, dilated, fluid-filled fallopian tube usually caused by a previous tubal infection. A hydrosalpinx appears as a large sausage-shaped dilation of the tubes. Folds inside the tube disappear, and a flat bulbous shape is visible. Dye does not spill out of the tube.

Tuberculated salpingitis usually obliterates the distant fallopian tube ends. Extensive infections can cause areas of dilatation and stenosis. An abnormal uterine and vaginal profile is observed in cases of widespread infection. Salpingitis isthmica nodosa (Figure 3) is a disease of unknown etiology. It is probably caused by diverticulum of the fallopian tubes (Figure 4) and is related to the presence of endometriosis.

Nondrawing of the fallopian tubes is the most common imaging finding of hysterosalpingography. It can be caused by the practitioner's inability to straighten the external cervical ostium or by an inadequate amount of contrast in the uterine cavity. Spasm in the first segment can also result in nondrawing of the fallopian tubes. This could be avoided by progressive administration of contrast. Other causes include obliteration, usually caused by previous inflammation or uterine surgery, and external adhesions following salpingitis or peritonitis.

Hysterosalpingography remains the frontline imaging modality when investigating infertility. It is an accurate means of assessing the uterine cavity and tubal patency. It has a low sensitivity for the
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diagnosis of pelvic adhesions, however, so cannot replace laparoscopy. Practitioners require a good
anatomic knowledge of the female reproductive organs and a careful technique to avoid pitfalls and
misinterpretations.

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Disclosures: