Hysterosalpingography for uterine morphologic findings.

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Authors: W. Severino Rondón, A. Carreres, R. Mirón Mombiela, J. Forner, M. Flores De La Torre; Valencia/ES
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Learning objectives

To review and evaluate the spectrum of abnormal uterine morphologic findings in hysterosalpingography (HSG) performed at our institution.
Background

Female causes of infertility affecting the uterus are both congenital and acquired. Reproductive failure may be due to any of several physiologic, anatomic or diseases of the uterus. Factors that adversely affect there anatomic and physiologic changes and cause infertility include endometriosis, inadequate endometrial response to ovarian hormones, endometriomal polyps, myomas, uterine adhesions and congenital anomalies. Correct diagnosis is essential to treat and allow the patient achieve pregnancy.¹

Imaging plays an important role, we review the characteristics of HSG as is often part of female fertility work-up. One of the procedure use to assess infertility in patients is HSG. HSG is a simple procedure that allows for visualization of the uterine cavity contour, confirming or ruling out anomalies that include intrauterine irregularities or filling defects.²

Normal gross anatomy:

The uterus is a hollow, thick-walled muscular organ. It is pear shape and slightly flattened dorsoventrally and forms nearly a right angle with the vagina. The normal nulliparous uterus is 6.5-9cm long, 3.5-6cm in its widest portion and about 2.5-4cm thick. The uterus is compose of mostly smooth muscle, the myometrium with an inner lining of glandular mucosa that corresponds to the endometrium. It is divided into a body or corpus, and a flattened portion called the cervix. The upper dome like portion of the corpus is the fundus, whereas the angle formed by the attachment of the uterine tubes at each side is called the cornu. The uterine cavity is conical, with its base in the fundus and the apex formed by the narrow internal os, leading into the cervical canal.³

In an HSG what we would usually see is the uterine cavity as an inverted triangular shape, the fundus forming the base of the triangle and the internal os the apex. (Fig. 1). In the normal anteflexed uterus the triangle is nearly symmetric. The volume of contrast needed to fill the uterine cavity is small averaging 2mL in the nulliparous uterus. Mild fundic concavity is normal and should not be confused with congenital anomalies. The depth of the concavity as measured by the perpendicular distance from a line connecting the cornua is no more than 1cm. Smooth convexity of the fundus is also normal. The lateral margins of the uterine cavity may be straight, concave or rarely convex. The uterine isthmus is the transition between the cervix and the uterine body and is seen as an area of narrowing in half HSGs. The length ranges from 0.2 to 3.5cm, being the mean 1cm.³
**Fig. 1:** HSG with normal morphology of the uterus and endocervical canal.

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Findings and procedure details

**Congenital Uterine Anomalies:**

Mullerian duct anomalies occur secondary to failure of organogenesis, failure of fusion, or failure of reabsorption, causing incomplete development of one or both of the uterine horns. These anomalies are most commonly classified by the American Fertility Society scheme\(^4\). The scheme is based on embryologic development of the mullerian ducts and divided into 7 classes (Fig. 2). It is important to be mindful that this classification system is only a framework for understanding and reporting these anomalies and that all anomalies will not completely fit into one class. In those situations it is more important to accurately describe the component parts of the anomaly\(^5\). Class I is uterine hypoplasia and/or agenesis we will not review due to the fact that HSG evaluation is not indicated for this anomaly.

**Class II: Unicornuate uterus**

- Represents 4\% of uterine congenital anomalies\(^4\) and it is due to incomplete or failed development of one of the mullerian ducts results in a functional uterine cavity with a single uterine horn. Can be associated with a rudimentary hone on the contralateral side, with or without a communication with the dominant horn.
- The condition is often asymptomatic, but can be associated with cyclic pelvic pain if there is functional endometrium in the non-communicating horn\(^5, 6\).
- Is compatible with normal pregnancy, but does carry a high risk of abortion or premature labor\(^2\).
- Imaging with HSG demonstrates a fusiform "banana-shape" endometrial cavity, which is laterally deviated with a single fallopian tube (Fig. 3) When detected MRI should be perform to evaluate for a rudimentary horn, in addition to evaluate the urinary system. Since there are urinary tract anomalies associated with unicornuate uterus.\(^6\)

**Class III: Uterus dydelphys:**

- It occurs when there is failure of fusion of mullerian ducts, resulting in a duplicated pair of uteri and cervices and represents proximally 11\% of uterine anomalies.\(^4\) A longitudinal vaginal septum is present in approximately 75\% of cases. Complete duplication of the uterus and vagina occurs in lower animal species, including species of opossum *Dydelphis virginiana*, from which uterus dydelphys derives its name.\(^3\)
• In HSG we need to demonstrated two symmetric widely spaced uterine horns each with its own cervix (Fig. 4). Sometime failure to cannulate both cervices during HSG may lead to a false diagnosis of unicornuate uterus.\textsuperscript{3, 5, 6}

• This conditions is also associate with urinary tract anomalies in 23% of the cases.\textsuperscript{5}

**Class IV: Bicornuate uterus**

• Bicornuate uterus happens when the superior portions of the mullerian ducts fail to fuse with the inferior uterine segment. There are different degrees of bicornuate uterus, the most severe being complete bicornuate uterus in which the failure of fusion extents the length of the uterine body inferiorly to the interior cervical os.\textsuperscript{3} When the central myometrium extends to the level of the internal cervical os is call bicornuate unicollis and when extends to the external cervical os is call bicornuate bicollis.

• Represents more or less 46% of the uterine anomalies.\textsuperscript{4}

• Imaging in HSG can demonstrate fusiform symmetric size and appearance of endometrial canal with possible communication between the inferior segments of the uterine horns. (Fig. 5) A widened angle superior to 105° between the uterine horns with a widened intercornual distance of greater than 4cm is very suggestive of this anomaly in HSG\textsuperscript{2}; however the imaging technique is limited in its differentiation from a septate uterus as the external contour is not evaluated and the study should be complemented with US and MRI to confirm diagnosis.\textsuperscript{6}

**Class V: Septate uterus**

• In most series represent around 55% of all cases, making it is the most common mullerian duct anomaly\textsuperscript{4}. It is cause by failure of the fibromuscular septum between the two mullerian ducts to reabsorb after the ductal fusion.\textsuperscript{6}

• Imaging shows symmetric endometrial cavities, which are narrower and smaller than normal. Although HSG has many limitations to differentiate this anomaly to bicornuate uterus a narrow angle less than 75° between the uterine horns or a distance of less than 4cm is suggestive of septate uterus (Fig.. 6). Hysteroscopy and laparoscopy are the gold standard, but US and MR are suitable for making the diagnosis also.

• From all the mullerian duct anomalies, this one has the highest rate for reproductive failure due to infertility and miscarriages. It is thought that the reason for it is because of poor blood supply of the septum providing unsuitable support for the implanted embryo\textsuperscript{4}.
Class VI: Arcuate uterus

- The reason of the anomaly is a near but incomplete resorption of the septum results in a focal bulge at the level of uterine fundus. Some author considered the arcuate uterus as a normal variant of uterine morphology, due to it little to none effect in fertility outcome.
- HSG we can see a single endometrial canal, with a smooth and broad indentation of the myometrium of less than one centimetre at the uterine fundus. (Fig. 7) The transverse diameter of the uterine cavity might be slightly increase compared to a normal uterus. HSG is limited at distinguishing arcuate from septate uterus, therefor if a patients has recurrent pregnancy losses US or MR might be indicated for further evaluation.

Class VII: Infantile Uterus Diethylestilbestrol (DES) related anomalies

- This category includes infantile or small uterus, T-shape uterus and Diethylestilbestrol (DES) related anomalies.
- The infantile uterus is believe results from early arrest of hormonal stimulation of the uterus. The radiographic appearance is that of a small but morphologically normal uterine cavity. On HSG can have marked retroversion or anteversion, and in some occasions the length and width of the cervical canal are disproportionately large in comparison to the uterine cavity. The fallopian tubes are usually normal in size and morphology (Fig. 8).
- DES is a nonsteroidal estrogen used in the 1950. It was later discovered that compared to the general population, the daugthers of this patients had both higher rate of vaginal clear-cell carcinoma and higher incidence of having hypoplastic, infantile uterus or T-shape uterus. HSG is the modality of choice for this anomalies. (Fig. 9) Cannulation may be difficult due to stenosis of the cervical canal, can also demonstrate endometrial irregularities or constrictions bands.

Acquire Uterine Anomalies:

Acquired abnormalities of the uterine body are also important causes of infertility. We will review the most prevalent causes here.

Intrauterine Adhesions or Synechiae:

- They represent scarring in the uterine cavity and result from endometrial trauma or infection, usually cause postpartum or post-abortion curettage. Uterine wall trauma induces scarring during healing, causing localized fusion
of portions of the uterine wall. The severity of scarring can be graded based on the extent of obliteration of the cavity.\textsuperscript{6}

- The prevalence is unknown, and depends largely on the population examine and the diagnostic method used.
- Patients usually present with menstrual dysfunction, infertility or complications following pregnancy. In general the pregnancy outcome of women with synechiae are poor.
- The radiographic appearance in HSG varies. They can appear as filling defect that distort the contour of the uterine cavity. Typically have an irregular, angulated shape and are immobile. They are sharply defined because the uterine walls are adhered and contrast material does not completely surround the defects.\textsuperscript{3}

\textbf{Endometrial Polyps:}

- This are benign localized overgroths of the endometrium and represent 2.5\% of the uterine pathology seen in HSG.\textsuperscript{3} Little is known about the association between endometrial polyps and infertility, but up to 26\% of patients with unexplained infertility have them and are more commonly observe in patients with recurrent pregnancy loss. Studies suggest that polyps large, numerous polyps and there location have impact on fertility those measuring less than 2cm have no impact on pregnancy outcome.\textsuperscript{5}
- HSG has a sensitivity between 50\% and 98\% for intra uterine lesions, and it is unable to reliably distinguish between submucosal myomas and endometrial polyps, which may partly be due to operator technique and expertise.\textsuperscript{5}
- They are seen in imaging as either single or multiple sessile small polyps that leave smooth filling defects within the uterine cavity and can be confused with air bubles, synechiae or myomas (Fig. 9).

\textbf{Endometrial Hyperplasia:}

- Often related to endocrine imbalanced and it is more common on older women, but can also be seen in pre and post-menopausal women. Usually presents are abnormal uterine bleeding, but infertility can also be secondary to it.\textsuperscript{7}
- The pathologic patterns of hyperplasia include cystic and polypoid, discrete polyp formation, and adenomatous and atypical hyperplasia. The HSG cannot reliably diagnose there various forms of hyperplasia\textsuperscript{3} can only suggest the alteration of the endometrium when irregular filling defect (Fig. 10-11), which can be a single one or multiple and diffuse.
**Myomas:**

- It is a very common benign disease of the uterus. The prevalence varies with age, race and diagnostic modality. They are well circumscribed tumours composed of smooth muscle and connective tissue. Degenerative changes can occur like necrosis, haemorrhage and fibrosis, and they are classified in intramural, subserosal and submucosal.
- Although frequently asymptomatic myomas are associated with menorrhagia, pelvic pain, infertility and recurrent pregnancy loss. Myomas are the sole etiological factor of 1 to 2.4% of infertile patients. The number of myomas and location correlates with symptomatology and effect on infertility.6
- They show a wide variety of radiographic appearances, depending on their number, size and location relative to the uterine cavity. Subserosal and intramural are rarely seen unless they are calcified. Larger subserosal or intramural myomas that distort and fill portions of the uterine cavity can be identified. If corneal portion of the uterus is involve, tubal occlusion may occur (Fig.12). Small, submucosal myomas appear as polypoid lesions that may be pedunculated. These are best seen in the early filling of the uterine cavity and can be obscure with complete distention.3

**Endocervical canal Anomalies:**

The importance of evaluating the endocervical canal radiographically has been less emphasized because of the wide variations in normal appearance,3 but in patients with unkwn cause for infertility should be cautionally evaluated as a posible cause. Changes que can apreciated in HSG are caliber changes (narrowing and dilatation), filling defects and countour irregularity.

Narrowing of the endocervical canal is usually normal anatomic variant or menstrual cycle variant, the result of DES in utero, related to postoperaive changes or instrumental trauma. It is important to know that severe stenesis of <2mm in diameter is a known cause of infertility, probably due to lack of sperm able to pass into the uterus and further. Dilatation is difficult to interpret, but has little importance in most women.

Filling defects in the endocervical canal may be due to air bubles, congenital remnants, synechiae, polyps of various causes and submucosal myomas in some cases. Synechiae presents is sometimes associated with stenosis of the canal.

Irregularity of the contour can be mucosal riges, but mostly of no importance. Serrated endocervical borders can represent endocervicitis, but in most cases is just a variation from normality. Dilated cervical glands often appear as outpouching resembling
diverticula (Fig. 13) and sometimes diverticular like outpouching of the lower uterine segment may represent a deformity from a low cesarean section.
Fig. 1: HSG with normal morphology of the uterus and endocervical canal.

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Fig. 2: Uterine anomalies based on the American Fertility Society Classification Scheme.

Fig. 3: Uterus unicornuate. HSG shows a opacification of a small single uterine horn that tilts to the right side of the patient. No rudimentary horn found. MRI was performed and diagnosis confirm of unicorn uterus with no rudimentary horn.

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**Fig. 4:** Uterus Didelphys. Patient with two cervix at vaginal examination and one uterine horn shown on HSG. MRI was performed to confirm the diagnosis of uterus didelphys.

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**Fig. 5:** Uterus bicornuate. A widened angle superior to 105° between the uterine horns with a widened intercornual distance of greater than 4cm is very suggestive of bicornuate uterus.

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Fig. 6: Septate uterus. HSG shows uterus with partial septum morphology with absence of contrast flow through the right fallopian tube. Left hydrosalpinx with free contrast output to peritoneal cavity.

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Fig. 7: Arcuate uterus. Arcuata uterine cavity morphology seen in the HSG. The right fallopian tube is permeable and the left has a hidrosalphinx, with delayed contrast passage into the peritoneum. The contrast that has passed to the peritoneum is not distributed freely by the presence of adhesions.

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**Fig. 8:** Infantile uterus. Uterus small and shorter than the neck, suggestive of infantile uterus with normal size fallopian tubes.

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**Fig. 9:** T-shape uterus. HSG shows a filling defect suggestive of endometrial polyp and uterine cavity with T-shape.

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Fig. 10: Endometrial Hyperplasia. Uterine cavity with irregular diffuse filling defects in the wall of uterine cavity suggestive of endometrial hyperplasia. Left hidrosalpinx.

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Fig. 11: Endometrial hyperplasia. HSG shows uterine cavity with several filling defects suggestive of endometrial hyperplasia.

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**Fig. 12:** Myomas. Right image: homogeneous filling defect of the contours of uterine cavity, suggestive of submucosal myoma, which obstructs the passage of contrast in the left fallopian. Left image: filling defect in the body of uterine cavity suggestive of myoma.

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Fig. 13: Endocervical diverticula. Outpouching formations that distorts the endocervical canal.

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Conclusion

HSG is a reliable examination as first line study in the work-up for infertility to distinguish normal uterus, from those with altered morphology that require further studies.
References