HYSTEROSALPINGOGRAPHY: A RE-EMERGING STUDY WITH CURRENT APPLICATION

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ABSTRACT

Hysterosalpingography (HSG) is one of the most important radiological procedure in the investigation of female infertility and has become commonly performed examination due to recent advances in reproductive medicine. HSG is quick and noninvasive examination for evaluation of abnormalities related to uterus and fallopian tubes. It remains best modality for demonstrating patency of fallopian tubes. In this article we present indication, technique, complication and diagnostic findings seen at HSG. We believe that with increasing demand of HSG, radiologists should be familiar with technique and interpretations of HSG images.

KEYWORDS
Hysterosalpingography, Fallopian Tubes, Reproductive Medicine, Uterus.

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INTRODUCTION

Hysterosalpingography (HSG) is radiographic evaluation of uterus and fallopian tubes and is used predominantly in evaluation of infertility. Other indication of HSG includes evaluation of women with history of recurrent spontaneous abortion, postoperative evaluation of tubal ligation or reversal of tubal ligation and assessment of patient prior to myomectomy. Number of HSG examination has increased over last few years. This is likely due to – (a) Advances in reproductive medicine resulting in more successful in vitro procedure, (B) The trends towards delayed pregnancy. The first HSG was performed in 1910 and was considered to be first special radiologic procedure. If properly performed, HSG show no abnormality in uterus and fallopian tube. It is unlikely that other modality would do so.

INDICATIONS OF HSG

- Infertility.
- Recurrent spontaneous abortion.
- Postoperative evaluation following tubal ligation or reversal of tubal ligation.
- Preoperative evaluation prior to myomectomy.
- Evaluation of uterine cavity after metroplasty.
- Assessment of integrity of caesarean scar.
- In staging and grading of uterine synechiae.
- Amenorrhea unresponsive to hormonal stimulation.[1]

CONTRAINDICATION OF HSG

- Menstruation and pregnancy.
- Acute pelvic infection.
- Recent dilatation and curettage.
- Severe cardiac and renal disease.
- Uterine malignancy (endometrial carcinoma).
- Sensitivity to contrast material.[2]

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HSG TECHNIQUE

Examination should be scheduled during day 7–12 of menstrual cycle (day 1 being first day of menstrual bleeding). The endometrium is thin during this proliferative phase, a fact that facilitates image interpretation and should be insured that there is no pregnancy. The patient is advised to abstain from sexual intercourse from the day one after her menstrual bleeding until the day of HSG performed to avoid a potential pregnancy. Examination in second half of menstrual cycle is avoided because of thickened secretory phase of endometrium increases risk of venous intravasation and causes false positive diagnosis of corneal blockage. If patient has irregular menstrual cycle or there is possibility of pregnancy, serum beta-hcG level is evaluated or pregnancy test should be done.

Decision concerning prophylactic use of antibiotic in patient with a history of pelvic inflammatory disease are left on referring physician. Antibiotic prophylaxis is given to patient at risk of infection, e.g.- patient with cardiac and renal disease. No specific patient preparation is required for HSG. NSAID is given to patient 1 hour prior to procedure. Patient lies supine in lithotomy position on x-ray or fluoroscopy table. Perineum is washed with savlon and then betadine (povidine–iodine) and draped with sterile towels.

Sims speculum is inserted into vagina. Anterior lip of cervix is grasped with vulsellum forceps and cleansed with betadine solution. A Leech Wilkinson cannula is inserted into cervical canal and fixed. Alternatively, 5-F HSG catheter or 8-F Paediatric Foley's catheter can be used. When catheter is used, then there is no need to grasp the cervix with vulsellum forceps. In cases when catheter is used, balloon is inflated fully. Metallic marker is placed on one side of pelvic to indicate right or left side of patient.

A scout film of pelvis is taken before contrast material is instilled. Water soluble contrast material is slowly instilled under intermittent fluoroscopic control to evaluate uterus and fallopian tubes. Care must be taken to expel air from syringe and Leech-Wilkinsion cannula, otherwise confusion may occur during interpretation. We obtain four spot radiographs after scout film of pelvis. First image is obtained

during early filling of uterus and is used to evaluate any filling defect and contour abnormality of uterus.

Small filling defects are best seen at this stage. Second image is obtained when uterus is fully distended with contrast material. Shape of uterus is best evaluated during this stage, although small fillings may be obscured when uterus is well opacified. Third image is obtained to demonstrate fallopian tubes. Fourth image show free intraperitoneal spillage of contrast material (Fig. 1a, b, c, d). If one or both tube show no contrast spillage into peritoneal cavity, the possibility of tubal spasm excluded by intravenous administration of 20mg of buscopan (scopolamine).[3]

As soon as patient's heart rate increases on monitoring, additional image is taken. Additional spot radiographs are obtained to document any abnormality – oblique radiographs of fallopian tubes may be obtained as needed to 'elongate' the tube or displace superimposed structure. A radiograph is usually obtained at the end of study after removal of cannula or balloon of catheter is deflated to evaluate lower uterine segment.[1,2,3,4]

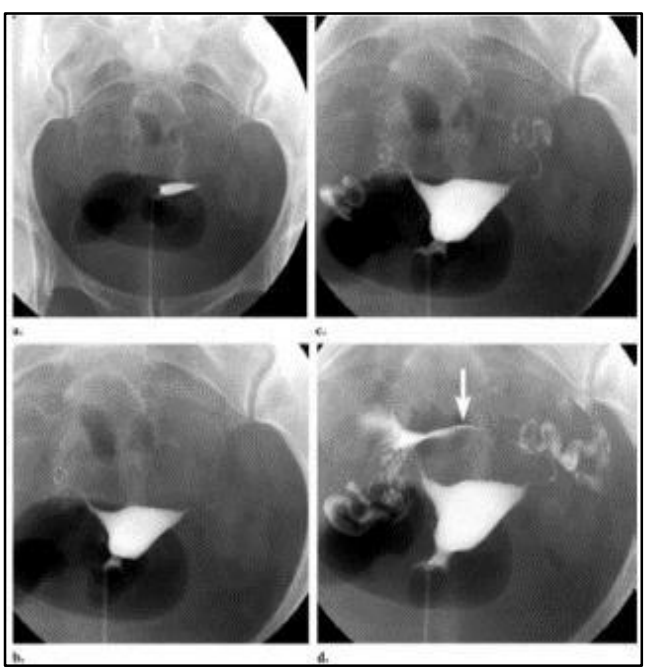

Fig.1: (a) Spot Radiograph show: (a) Early Filling Stage, Small Filling Defects are best seen at this stage. (b) Fully Distended Uterus with Both Fallopian Tubes Opacified. (c) All parts of Opacified Bilateral Tubes are shown. (d) Free Intraperitoneal Spillage of Contrast Material.

TECHNICAL ARTEFACTS

AIR BUBBLES

Air bubbles are inadvertently introduced into uterine cavity. Care should be taken to flush catheter or cannula thoroughly with contrast material to avoid injecting air bubbles. Air as bubbles manifest well defined lucencies that is mobile and collect in non-dependent part of uterus. When single air bubble is present, it can be mistaken for other uterine pathology, e.g. polyp, submucosal fibroid. Air bubble can be expelled into peritoneal cavity (fig.2). Aternatively if possible, aspirate the air bubble and re-inject the contrast material into uterine cavity.[5]

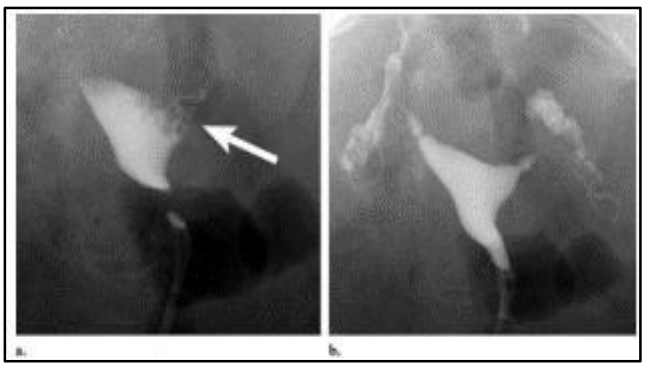

Fig. 2: Air Bubbles (a) Multiple well defined lucencies seen in Left Side of Uterine Cavity. (b) Air Bubbles not seen in Left Cornua of Uterus after they are expelled into Fallopian Tube.

CONTRAST INTRAVASATION

Contrast intravasation can occur via venous or lymphatic routes. Predisposing factors include increased uterine pressure or recent surgery, but can also be seen in normal examination. Contrast intravasation radiographically seen as multiple thin lines forming a reticular patterns (fig.3).[4]

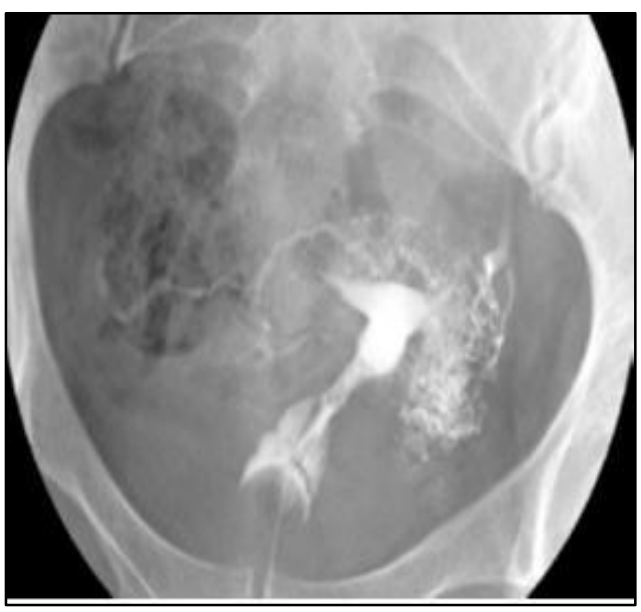

Fig. 3: HSG show Multiple Linear Densities forming a Reticular Pattern adjacent to Uterine Cavity with Opacification of Left Ovarian Vein with Venous Contrast Intravasation.

COMPLICATION OF HSG

Pevic Pain or Discomfort

Commonest complication seen after HSG and usually due to sudden uterine distention, especially in case of tubal blockage or peritoneal irritation from contrast media.

Bleeding

Second common complication. Patient should be made aware that she may experience light spotting after procedure, which usually lasts for 2-3 days, especially when balloon of catheter irritate endocervical canal or when endocervical canal is pulled to provide uterine traction.

Infection

Patients are instructed to watch for development of fever or foul smelling vaginal discharge over 2-4 days following procedure.

Reaction to Contrast Media

Such reaction are very uncommon due to current use of low osmolar water soluble contrast media.

Exposure to Radiation Abortion of Early Unsuspected Pregnancy

Appropriate timing of examination and negative pregnancy test minimise these potential risks.[4,5]

COMMON PATHOLOGICAL FINDINGS

UTERUS

HSG helps in evaluation of uterine cavity, providing indirect information about remainder of uterus. At HSG, uterus look like an inverted, triangle with well defined, smooth contour.

Uterine anomalies can be due to

a. Congenital abnormalities of shape of uterus.
b. Luminal filling defect.
c. Abnormalities of uterine contour.

CONGENITAL ABNORMALITIES OF UTERINE SHAPE (CONGENITAL UTERINE MALFORMATIONS)

Congenital abnormalities of shape of uterus caused by abnormal fusion of Mullerian duct during early gestation (6-12w). Majority of patient with Mullerian duct anomalies have little problem of conceiving. They have higher associated rate spontaneous abortion, premature delivery, abnormal position, intrauterine growth retardation and dystocia at delivery.[5]

According to American Society of Reproductive Medicine, there are seven different classes of Mullerian duct anomalies (Fig. 4).[1] They are

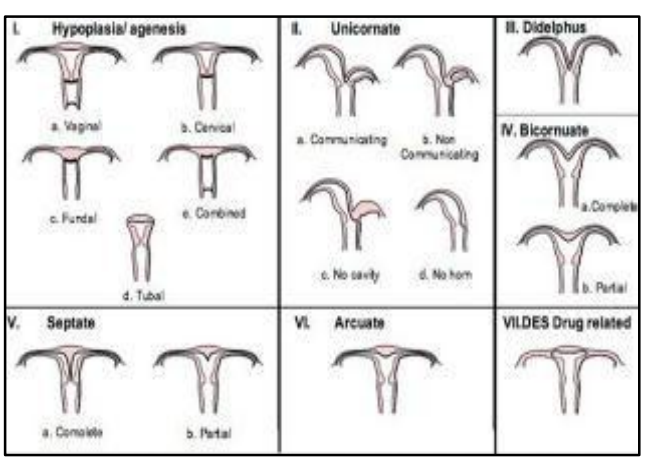

Fig. 4: Classification of Mullerian Duct Anomalies used by American Society of Reproductive Medicine

Class I

Segmental agenesis or variable degree of uterovaginal hypoplasia.

Class II

Unicornuate uterus represent partial or complete hypoplasia. In rare cases of degeneration of the mesonephric duct, the uterine cavity appears monocular when imaged, placed right or left of midline. The unicornuate uterus contact only the coordinate fallopian tube.

Class III

Didelphys uterus. This is rare abnormality that result from complete nonfusion of Mullerian duct and includes the duplication of uterine cavity, cervix and vagina. Rarely, this uterus has a single vagina.

Class IV

Bicornuate uterus. It demonstrates incomplete fusion of superior segment of uterovaginal canal. The uterine cavity is divided into two, each half has a narrow length, shape and stand apart from each other. MRI confirm the presence of bicornuate uterus by showing intercornual distance of >4cm and concavity of fundal contour or an external fundal cleft >1cm.

Class V

Septate uterus. It represents partial or incomplete resorption of the uterovaginal septum. MR imaging helps to differentiate a septate uterus from bicornuate uterus by depicting a normal convex, flat or minimally concave (<1cm deep) external fundal contour with septate uterus. MR imaging readily demonstrate composition and extent of septum.

Class VI

Arcuate uterus. Near complete resorption of septum resulting in shallow, smooth, broad based impression on uterine cavity which may be depicted in HSG, US and MRI.

Class VII

DES–related uterine anomaly. Anomaly that result comprise sequelae of in utero diethylestradiol exposure. Uterus is hypoplastic, irregular, T-shaped with hypoplastic and strictured fallopian tube (Fig. 5).

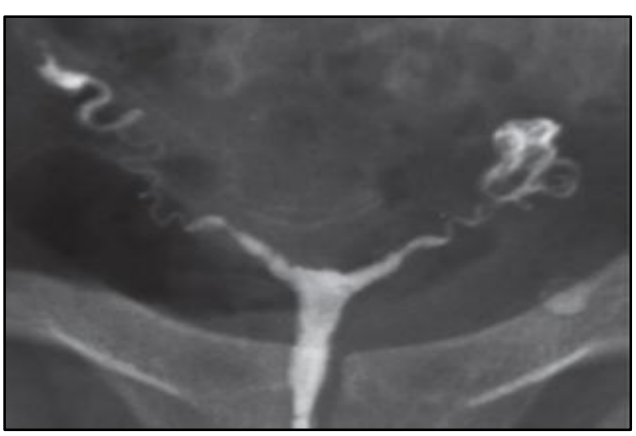

Fig. 5: DES-related Uterine Anomaly. HSG demonstrate a Hypoplastic, T-shaped Uterus

LUMINAL FILLING DEFECT

Filling defect due air bubble – already described in technical artefacts.

UTERINE FOLDS

Are normal variants that are occasionally seen at HSG. They are caused by infolding of inner aspect of the myometrium in the undistended uterus. Uterine folds are parallel to long axix of uterus and can extend into uterine horns.[2]

UTERINE SYNECHIAE

Are intrauterine adhesion that result from scarring, most commonly secondary to endometrial trauma resulting from previous pregnancy, dilatation and curettage, surgery and endometrial infection. On HSG synechiae demonstrate as irregular, linear, filling defect that arise from one of the uterine wall. Infertility secondary to synechiae is known as Asherman syndrome.[3,6]

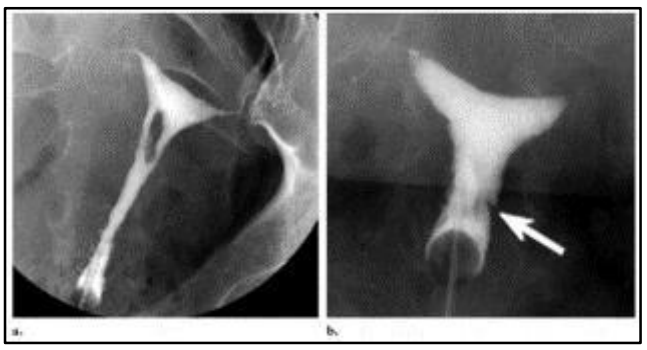

Fig. 6: Synechiae. Spot radiograph demonstrate (a) Central, Linear Filling Defect within uterus that represent Synechiae. (b) Small Linear Filling Defect in left infero-lateral wall of uterus

ENDOMETRIAL POLYPS

Are focal outgrowth of endometrium. They are usually seen as well defined filling defect in early filling stage of hysterosalpingograph. Small polyps may be obscured when uterus is distended with contrast material. Small polyps are indistinguishable from small submucosal fibroid (leiomyoma). Sonohysterosalpingography is preferred method for imaging of endometrial polyp. It allows accurate assesment of no. and location of endometrial polyps in uterine cavity and provides guidance in subsequent managment. In pedunculated polyp colour doppler used to identify central vascular stalk in polyp (Fig. 7).[2,6]

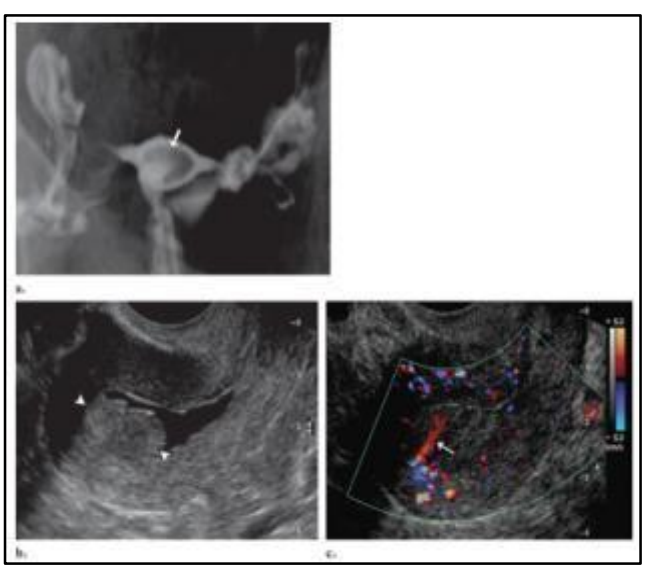

Fig. 7: Uterine Polyp (a) Spot Radiograph in early filling phase show well defined intrauterine filling defect. (b) Sonosalpingography show Posterior Endometrial Fundal Polyp. (c) TVS with Doppler show Central Feeding Vessel

ABNORMALITIES OF UTERINE CONTOUR

LEIOMYOMA

Also known as fibroid. They occur in any part of uterus – submucosal, intramural and subserosal. On HSG, fibroid demonstrate well defined filling defect. Appearance vary depending on their size and location within uterus. Like polyp, submucosal fibroids are best seen during early filling stage of uterus and may be obscured in complete filling of uterus with contrast material. Large fibroid distort size and shape of uterine cavity (Fig. 8).[2,6]

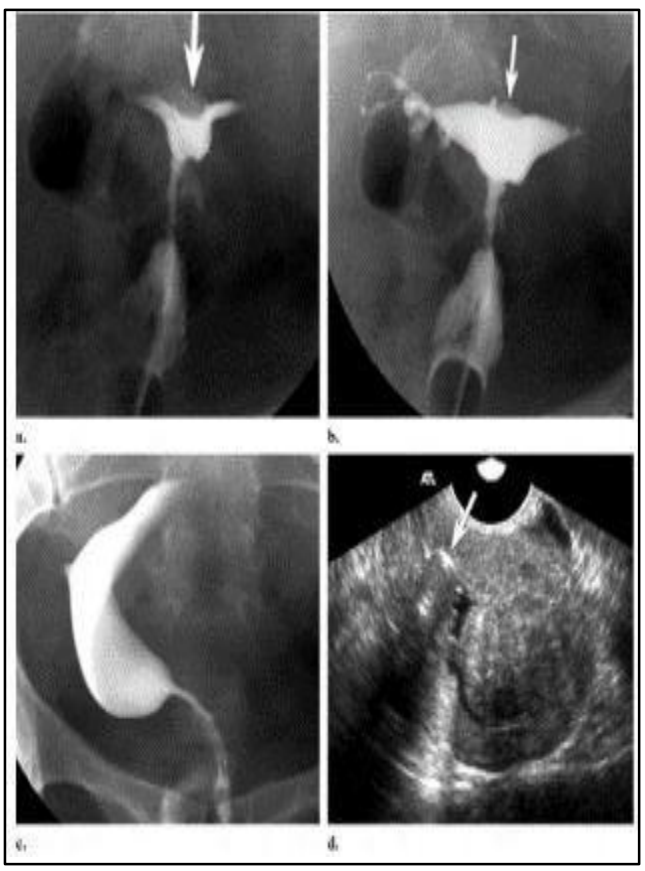

Fig. 8: Submucosal fibroid. Spot radiograph show (a) Well defined Intrauterine Filling Defect at Fundus in early filling stage of HSG. (b) Less apparent Fibroid when Uterus is more distended. (c) Large fibroid distorting uterine cavity. (d) Sonosalpingogram show saline outline of the submucosal fibroid

ADENOMYOSIS

Is characterised by presence of heterotopic endometrial gland and stroma in myometrium with adjacent smooth muscle hypertrophy. MRI is highly accurate in detection of adenomyosis. T2 weighted MR images show focal or diffuse widening of junctional zone. These area of low signal intensity corresponds to smooth muscle hyperplasia accompanying heterotopic endometrial tissue. On T2 weighted image, bright foci are seen in area of abnormal low signal intensity within myometrium. These foci corresponds to island of heterotopic endometrial gland, cystic dilatation heterotopic gland or haemorrhage (Fig. 9).[7]

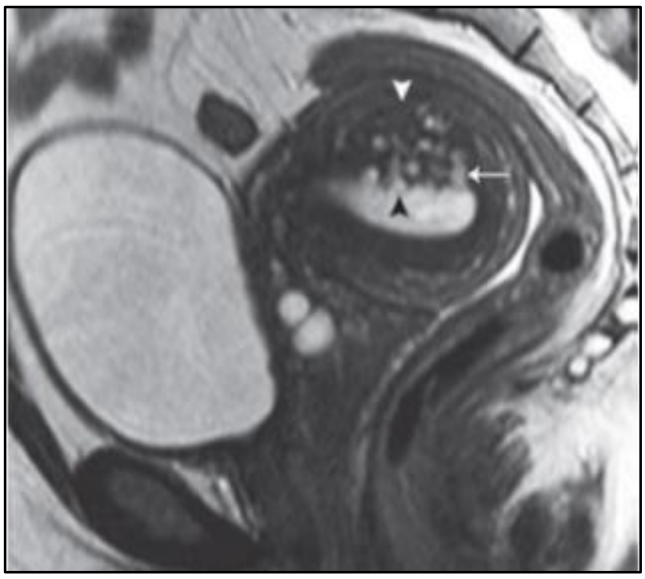

Fig. 9: Adenomyosis. Sagittal T2-weighted MR image show Foci of High Signal Intensity indicate Ectopic Endometrial Gland with Widening of Junctional Zone

Adenomyosis is only occasionally recognised on HSG, if there is connection between endometrial gland and endometrial cavity. It is seen as irregular branching outpouching that are continous with endometrial cavity. It is also seen as small diverticula filled with contrast material protruding beyond normal contour of endometrial cavity.[7,8]

Fig. 10: Adenomyosis. Spot radiograph show Irregular Branching Outpouching Radiating from Endometrial Cavity represent Extension of Endometrial Gland into Myometrium

FALLOPIAN TUBES

Fallopian tube abnormalities are most common cause of female infertility, accounting for 30%-40% of cases. HSG is best method for optimal depiction of fallopian tubes, allowing detection of tubal occlusion, tubal irregularity, peritubal disease (process diag in Fig. 11). Although sonohysterography is also used as a means of assessing tubal patency, US contrast is very costly, is not commonly used in developing country like India.

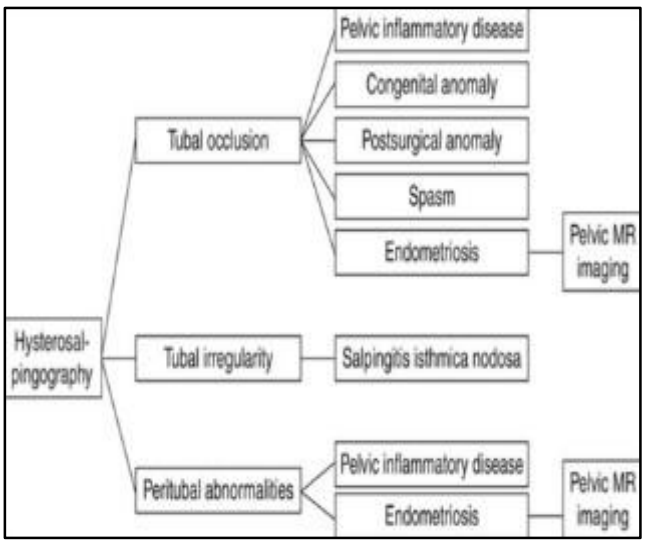

Fig. 11: A process diagram for diagnostic imaging of Fallopian Tube abnormality

These days MR hysterography with heavily T2-weighted sequence is also suggested for visualisation of fallopian tubes, but MR hysterography does not assess tubal patency. This may be the reason that why MR hysterography has not become popular.[9]

TUBAL OCCLUSION

May occur at any site along course of fallopian tubes. Differential diagnosis of tubal occlusion includes tubal spasm, infection and prior surgery. Rare cause of tubal occlusion include granulomatous salpingitis due to tuberculosis, which is common in developing country like India, intraluminal endometriosis, congenital atresia of fallopian tubes.

When tubal occlusion in proximal or interstitial portion is seen at HSG, a tubal spasm should be considered the possible cause. Delayed radiography differentiate tubal spasm from tubal occlusion. A spasmolytic agent like glucagon administered to relax uterine muscles. To relieve spasm, other method may be useful is to place the patient in prone position and re-inject contrast material into uterus.[8,10]

HYSTEROSALPINX

Result from occlusion at ampullary end of fallopian tubes, leading to dilatation of proximal segment. It is commomly caused by previous pelvic inflammatory disease. At HSG, it appears as dilated tubes (unilateral or bilateral) with abscence of intraperitoneal spillover of contrast material (Fig. 12). If hydrosalpinx seen at HSG, it is important to prescribe antibiotic prophylaxis typically doxycycline, to prevent procedure related infection due to stasis of contrast material within dilated, obstructed fallopian tubes.[11,12]

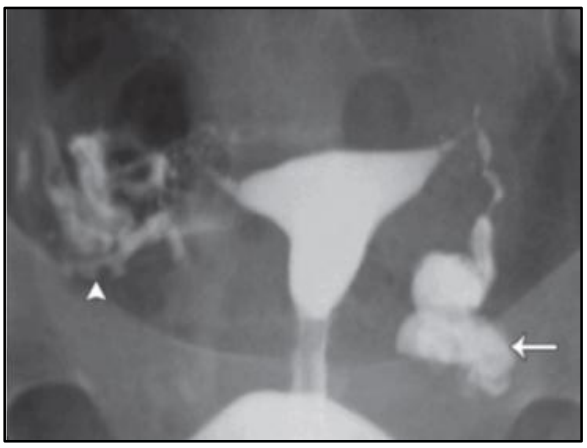

Fig. 12: Left Hydrosalpinx. HSG show dilated left Fallopian Tube with Abscence of Intraperitoneal Spillage of Contrast Material. Right Fallopian is patent with Free Spillage of Contrast Material

TUBAL IRREGULARITY: Tubal irregularity may be seen due to salpingitis isthmica nodosa, an inflammatory process within fallopian tube of unknown aetiology. It is associated with infertility, PID and occasionally ectopic pregnancy. On HSG, it appears as tubal irregularity and small (subcentimetric) outpouching or diverticula from isthmic portion of fallopian tube. It can be unilateral or bilateral.[2,6]

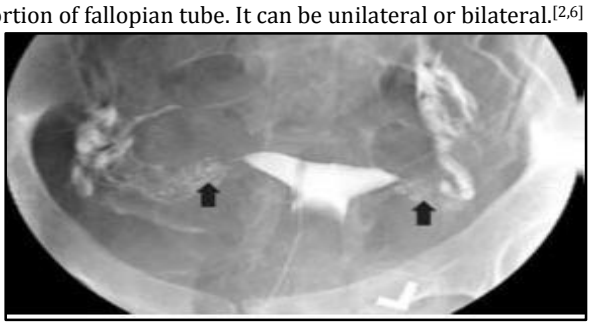

Fig. 13: Salpingitis Isthmica Nodosa. HSG show Small Outpouching or Diverticula in Isthmic Region of Bilateral Tube

PERITUBAL ABNORMALITY: Even when fallopian tubes are normal, an abnormal accumulation of contrast material seen adjacent to ampullary end of fallopian tube at HSG and is suggestive of peritubal adhesion. Both endometriosis and PID lead to peritubal adhesion, which result in infertility.

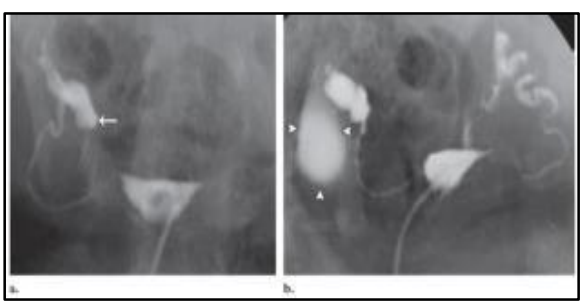

Fig. 14: Right Peritubal Adhesion due to previous Pelvic Infllamatory Infection. (a) Early, (b) Late HSG show Normal Filling of Contrast in Right Fallopian Tube and a Rounded Collection of Leaked Contrast Material adjacent to Ampullary Portion of Right Fallopian Tube. The collection is due to Peritubal Adhesion. Left Fallopian Tube is Normal and Patent

GENITAL TUBERCULOSIS

Genital tuberculosis is one of the common extrapulmonary manifestation of tuberculosis. It is frequent in developing country like India, leading to chronic pelvic inflammatory disease and infertility. Diagnosis of genital tuberculosis may be difficult because majority of cases are asymptomatic. Tuberculosis of fallopian tube presents various appearance on HSG ranging from nonspecific findings like hydrosalpinx to specific findings due to stricture of fallopian tubes like "beaded tube" is due to multiple constrictions along fallopian tubes, "golf club tube," "pipe stem tube" due to wide spectrum of occlusion and scar make rigidity of tube, "cobble stone tube," "leopard skin tube."

Caseous ulceration of tubal mucosa creates irregular, ragged or diverticular appearance on contour of tubal lumen on HSG. Presence of calcified lymph nodes in pelvis or in the course of fallopian tubes may enable the diagnosis of tuberculosis. It should be differentiated from calcified uterine myoma, urinary bladder calculi, pelvic phlebolith, calcification of pelvic dermoid. Appearance of endometrial tuberculosis on HSG is nonspecific and includes synechiae distorted uterine cavity or contrast intravasation.[13]

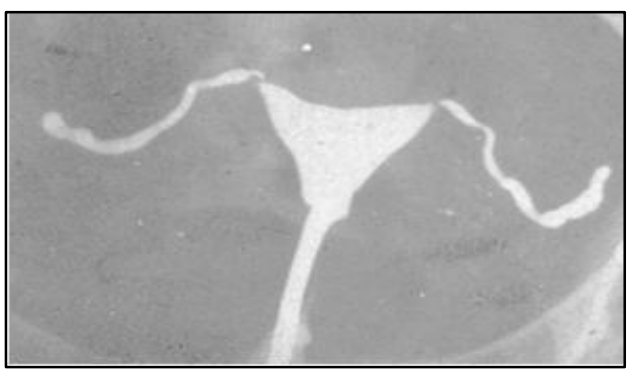

Fig. 15: Pipe Stem appearence of Fallopian Tubes in Genital Tuberculosis. HSG show entire Bilateral Fallopian Tubes are Rigid

Fig. 16: Endometrial Tuberculosis. Spot radiograph show Uterine Cavity is Severly Scarred and Oblitereted by previous Endometrial Tuberculosis. All the Contrast Injected had Refluxed into Vagina with Evidence of No Contrast in Uterine Cavity. Multiple Calcified Densities seen in Pelvis represent Calcified Lymph Nodes

CONCLUSION

HSG is the frontline imaging modality in the investigation of fertility. It is an accurate means of assessing the uterine cavity and tubal patency. It requires knowledge of anatomy of female. Radiologist should be familiar with technique and complications of HSG and interpretation of HSG images to avoid pitfalls and misinterpretations.

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