

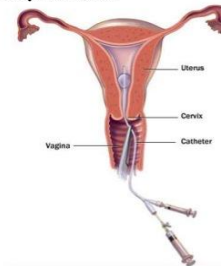


HSG TECHNIQUE & FINDING FOR RESIDENT RADIOLOGISTS

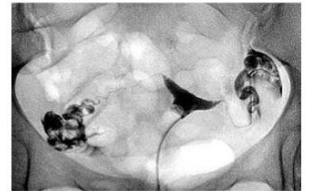
*By
Ahmad Mokhtar Abodahab
Assistant Lecturer of Radiology
Faculty of Medicine - Sohag University*

Hysterosalpingogram (HSG)

HSG procedure



Normal HSG



<http://students-of-prof-mamdouh-mahfouz.blogspot.com>

<http://Radiology-sohag.blogspot.com>

Introduction

- Hysterosalpingography (HSG) :

is

the radiographic evaluation of the uterine cavity
and fallopian tubes


after

the administration of a radio-opaque medium
through the cervical canal.

- 
- Hysterosalpingography (HSG)

remains an important radiologic procedure in the investigation of infertility .

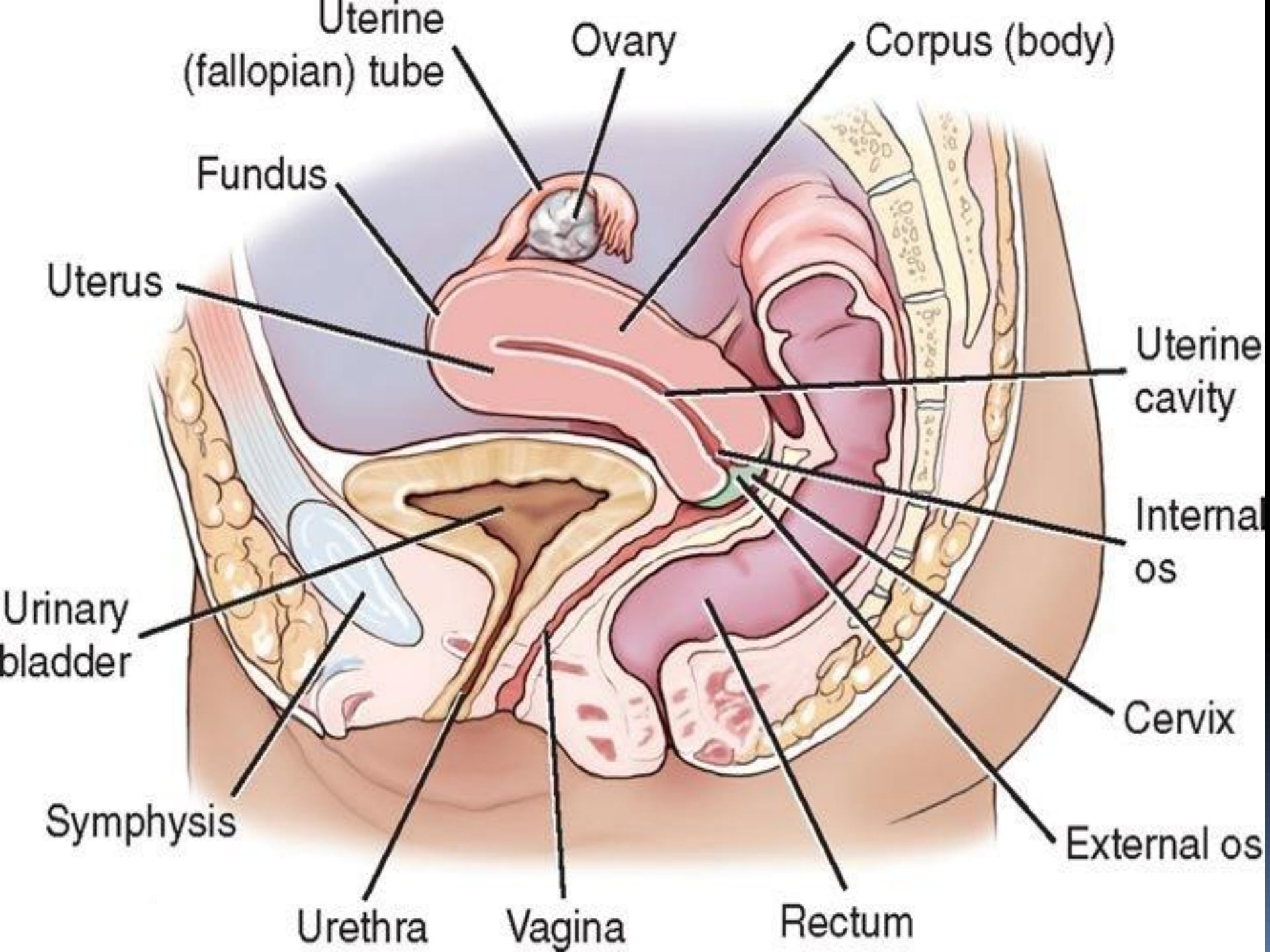
- HSG

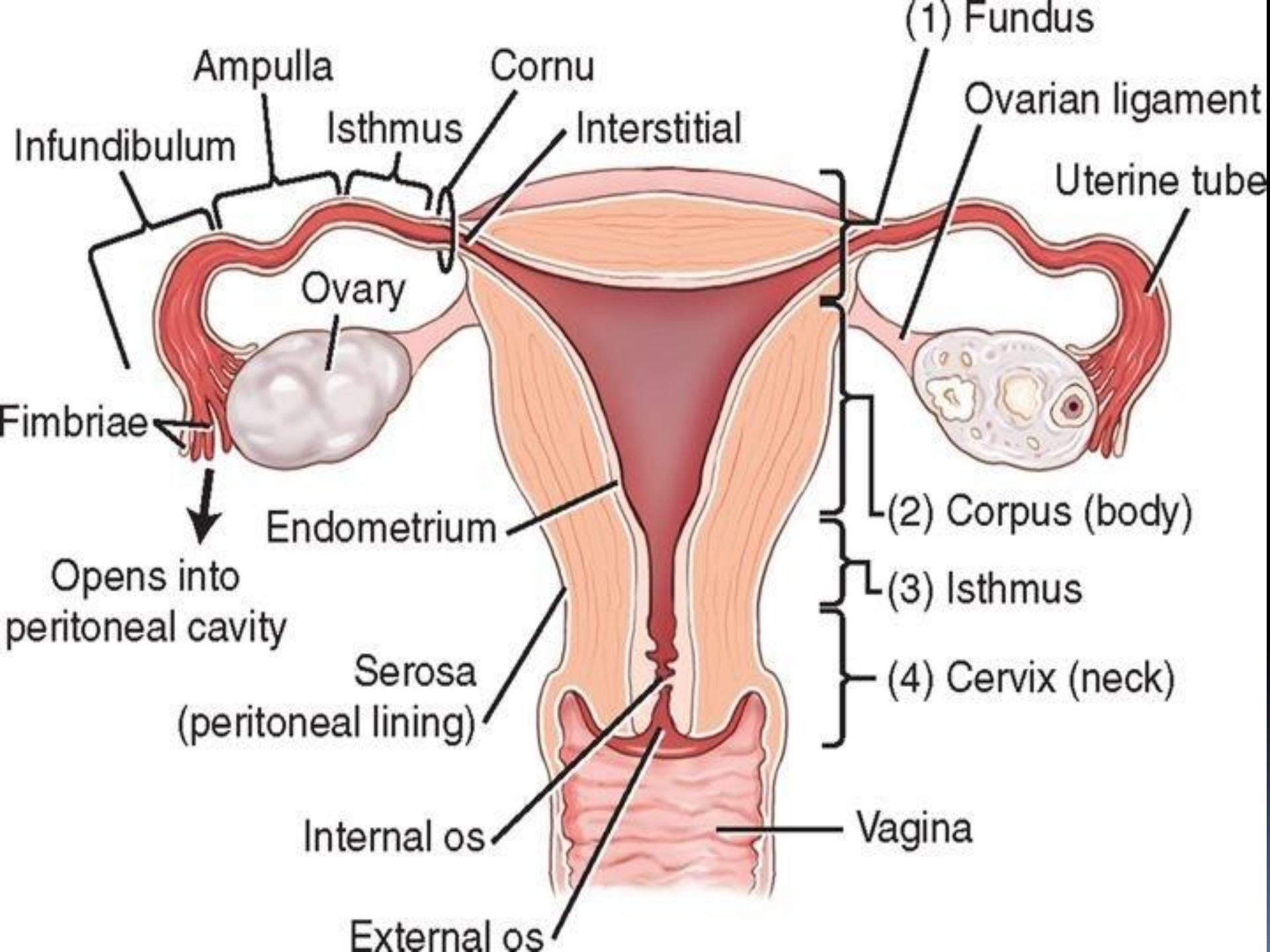


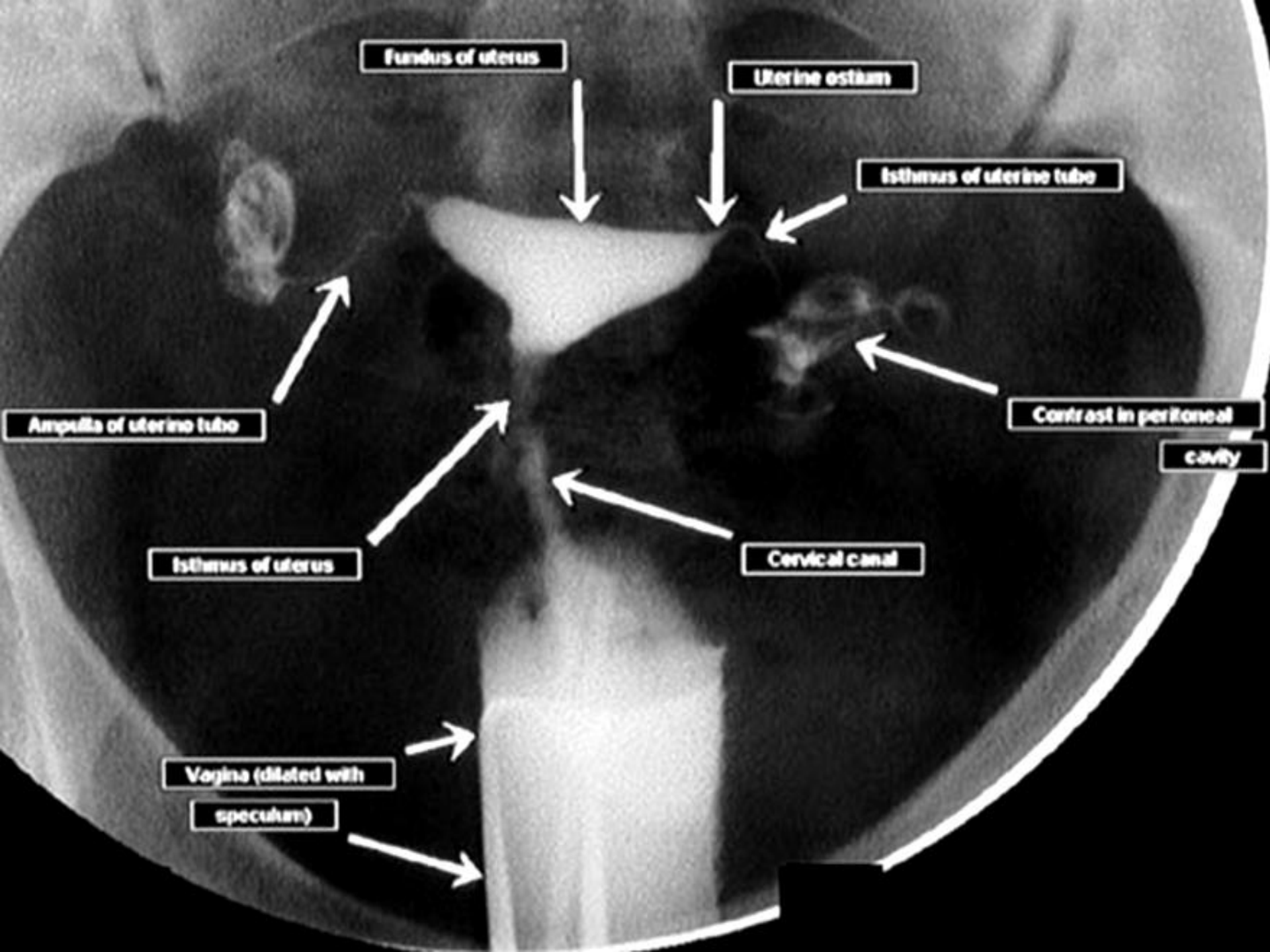
demonstrates the morphology of the uterine cavity, the lumina, and the patency of the fallopian tubes.



ANATOMY










Items To be discussed

- Technical parameters of the examination,
 - indications,
 - contraindications,
 - Possible complications .
 - Variety of abnormalities of the uterus and fallopian tubes , that can be detected accurately with HSG.
- 

History



- The first HSG was performed in 1910 and was considered to be the first special radiologic procedure.





Indications

1- *Infertility assessment.*



- One of the *most common* indications for HSG
- Diagnose **functional** or **structural defects**.
- A blockage of one or both tubes may inhibit fertilization.
- In some cases, HSG can be a *therapeutic tool*.
- Injection of contrast media → dilate or straighten a narrowed, tortuous, or occluded uterine tube

- 
- 
- 2- Evaluate patients with frequent miscarriages
 - 3- Evaluate uterine abnormalities
 - Congenital uterine anomalies
 - Fibroids or tumor masses
 - Adhesions
 - 4- Evaluate tubal patency
 - Following tubal ligation reversal procedure
 - Following pelvic inflammatory disease

- 
- 5-Evaluation of Abnormal menses
 - 6- sometimes used as a preoperative control for women who are about to have uterine or tubal surgery.
- 

Risks Vs Benefits

- Minimally invasive procedure
- Rare complications
- Can provide valuable information
- Minimal exposure to radiation
 - *Effective radiation dose ~ 1 mSv (comparable to average amount of background radiation over 4 mo)*
- **Must not** be performed if patient is *pregnant* at the time of the procedure

- 
- Despite the arrival of newer imaging modalities, HSG still remains the best procedure to image the fallopian tubes.
- 

Sensitivity

- Some studies says that HSG had a sensitivity of :
- 58% → for polypoid lesions,
- 0% → for endometrial hyperplasia.
- 44.4% → for uterine malformations,
- 75% → for the detection of intrauterine adhesions.

Contraindications:

1- *Possible Pregnancy* :

- main contraindication .
- Avoided by : performing HSG before the ovulation phase, “between the 7th to 10th day of the menstrual cycle”

2- Active intrapelvic inflammation .

3- vaginal or uterine bleeding

4- Recent uterine or tubal surgery

➔ General contraindications :

- severe cardiac or renal deficiency,

Patient Preparation

- **Timing:** the first half of the menstrual cycle following cessation of bleeding. Due to
 - Endometrium is thin during this proliferative phase, → facilitates better image interpretation
 - Ensure that there is no pregnancy.
- 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 cornual occlusion.
 - Possibility of pregnancy.




Bowel preparation :

To reproductive tract obscuring by bowel gas and/or feces.

→ Preparation may include a mild laxative, suppositories, and/or a cleansing enema be

Bladder Voiding : emptying bladder immediately before the examination → To prevent displacement of the uterus and uterine tubes,.






- **Antibiotics** :

- might be required 1 day before and for a few days after the examination if previous inflammations are present in the patient's clinical history.
- Required after the examination when :
 - the maneuvers are fairly sanguineous
 - if the fallopian tubes present a certain degree of dilation.

- *The suggested antibiotic regimen is:*

- metronidazole 1 g rectally at the time of the procedure, + doxycycline 100 mg twice daily for 7 days.
- 

Pain Killer:

- the patient may be instructed to take a mild pain reliever before the examination to alleviate some of the discomfort associated with cramping.

■ **Steroid (prednisolone)**

- *is prescribed in asthmatics* when intravenous contrast is used;
- therefore, it is used for HSG because intravasation is also possible .

■ **Antispasmodics :**

- Can be used before examination to avoid tubal spasm.

TECHNIQUE



Procedure

.....In a simple words

- A speculum is inserted into the vagina
- A catheter is then inserted into the cervix
- Contrast material is injected into the uterine cavity through the catheter
- Fluoroscopic images are then taken



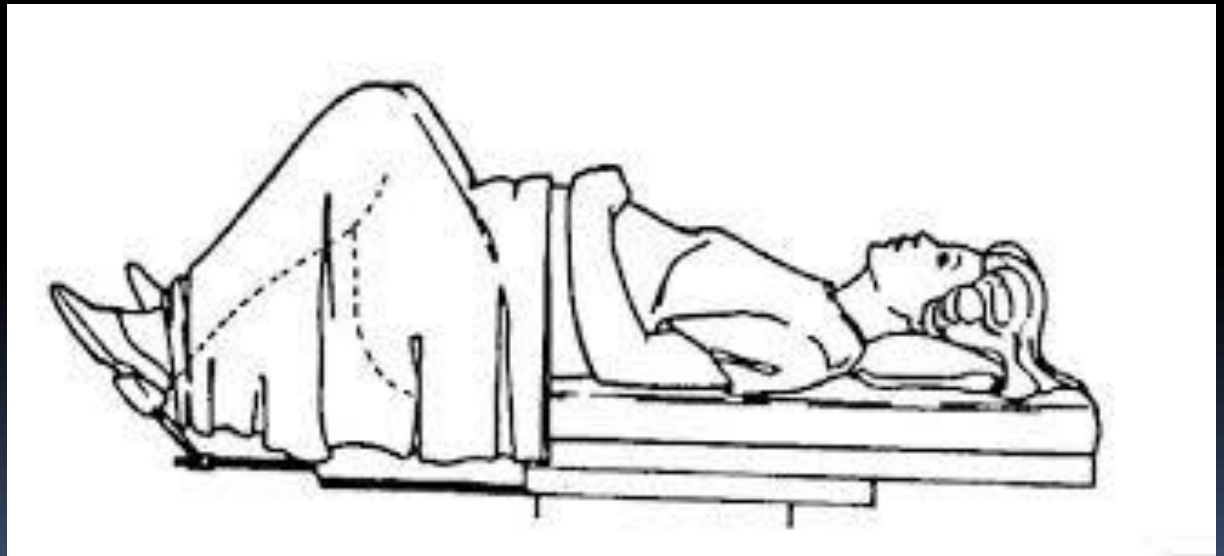
.....But let us see in details



Technique

- The patient is placed on the *fluoroscopic machine*.

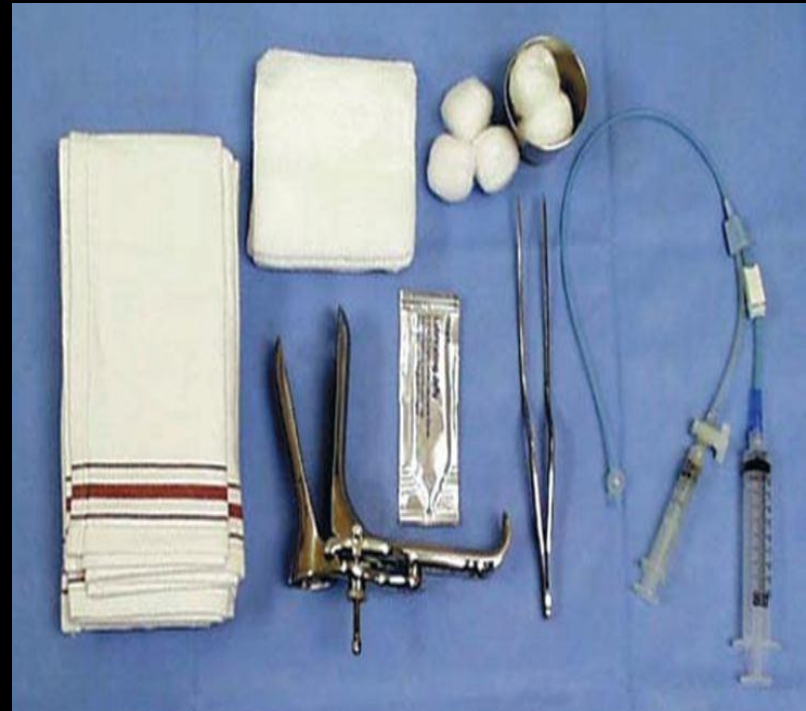




- **Position:** Gynecologic examination
the patient bends her knees and places her feet at the end of the table.



- 
- 
- Cleaning the external genital area with antiseptic solution,
 - Casco speculum : The vagina is dilated by a gynecologic dilator.
 - The cervix is localized and cleansed with iodine solution.

Equipments



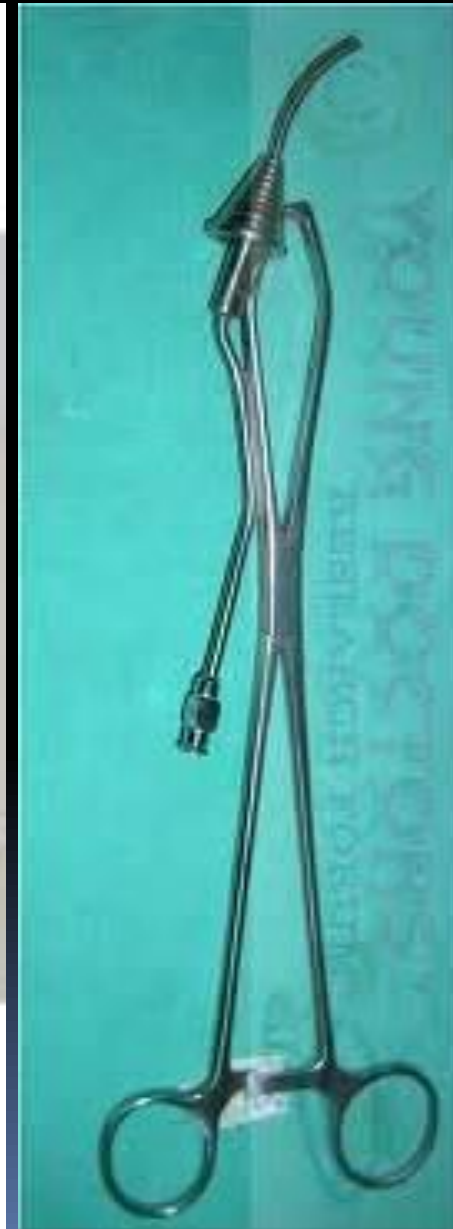
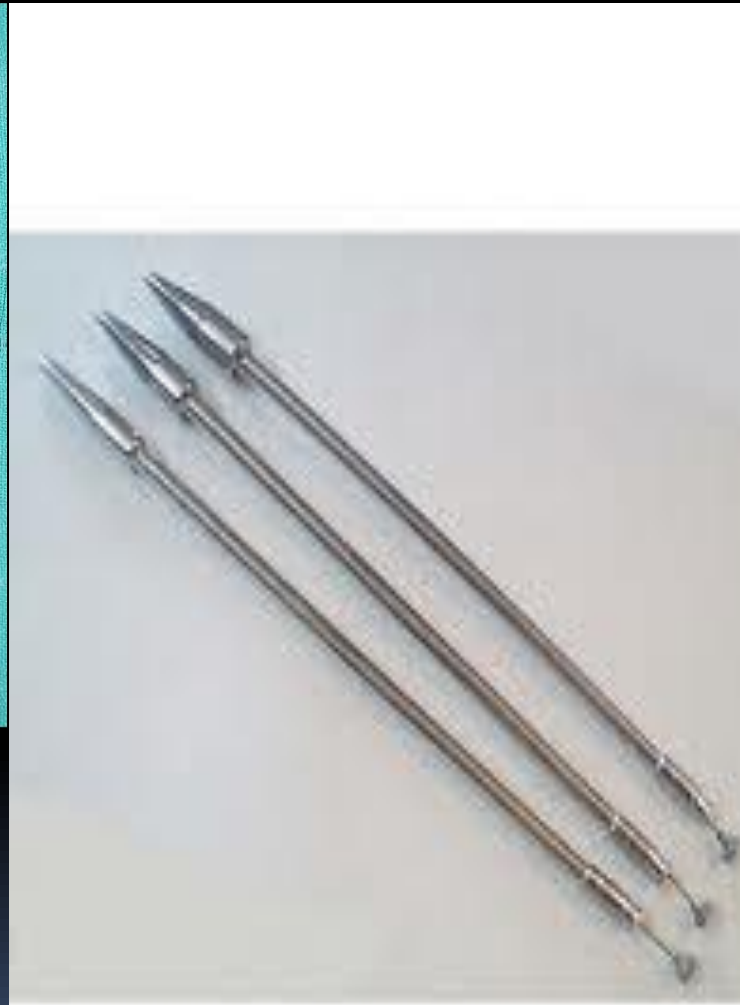
- 
- 
- *Cervix is straightened* by
 - one (at the 12 o'clock position)
 - or two (at the 9 and 3 o'clock positions)surgical forceps exercising a degree of pulling.

- **Catheterization** : the outside uterine cervix ostium is catheterized.
- The catheterization can be performed in two

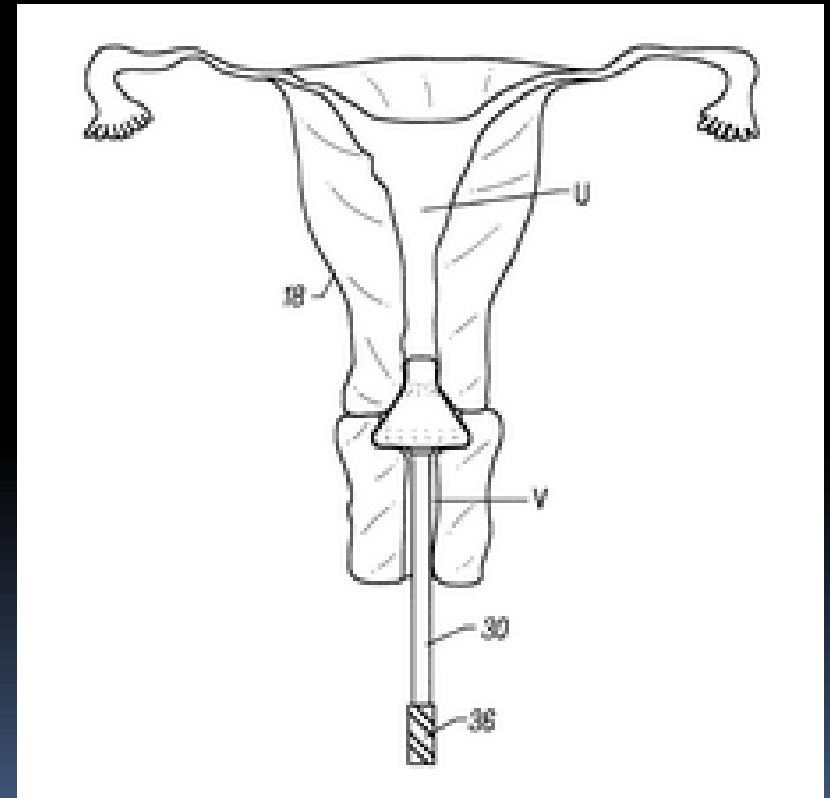
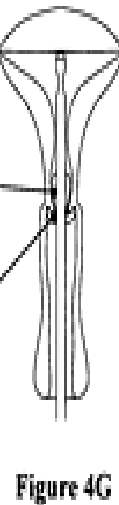
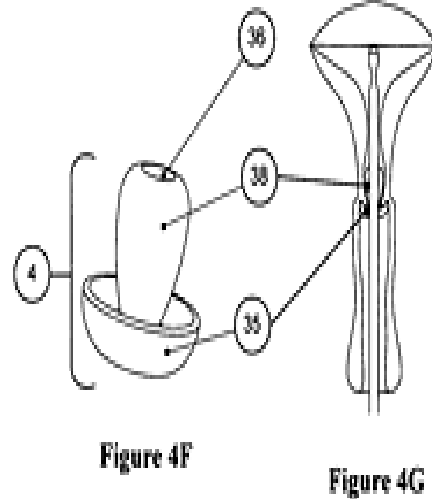
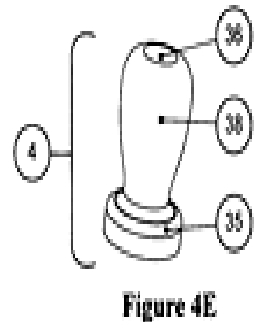
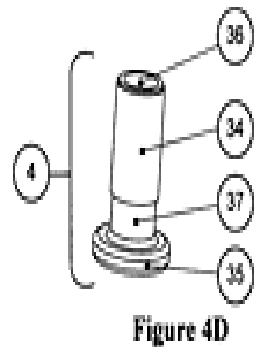
Ways:

- a salpingographer with a bell-shaped end (diameter depends on the case) is pushed through the vagina and fits in the external uterine cervix ostium.
- In the second technique, the salpingographer has a plastic cup-shaped end that is fitted to the external uterine cervix ostium, creating a void phenomenon.

Some Forms of Catheters



In both techniques, there is a syringe with iodinated hydrosoluble contrast medium at the other end of the salpingographer.



Contrast Media

→ ***Two categories*** of iodinated contrast media have been used in HSG.

→ I - ***Water-soluble iodinated*** contrast media, such as Omnipaque 300, is preferred.

- It is absorbed easily by the patient,
- Does not leave a residue within the reproductive tract, and provides adequate visualization.
- This medium does, however, cause pain when injected within the uterine cavity, and the pain may persist for several hours after the procedure.

→ II- ***oil-based contrast media***

- Allow maximal visualization of uterine structures.
- However, it has a ***very slow absorption*** rate and persists in the body cavities for an extended time.
- Risk of oil embolus that could reach the lungs.

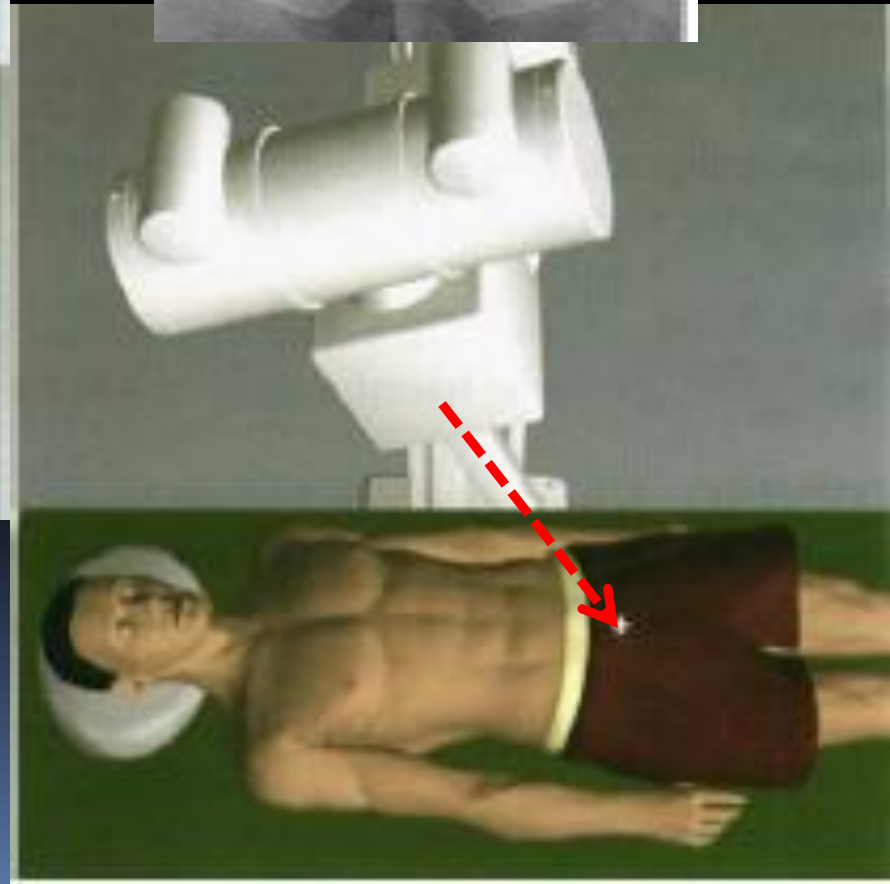
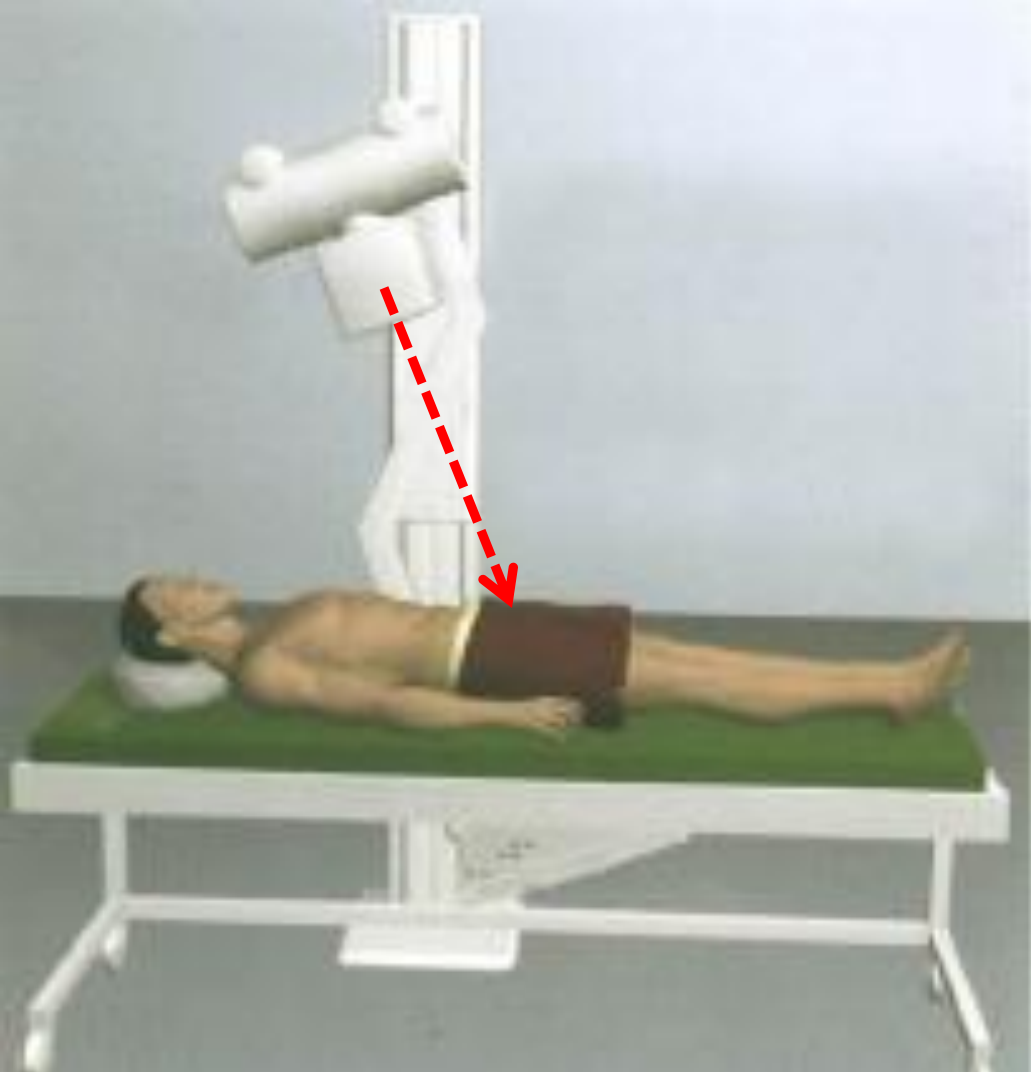
- ➔ The amount of contrast : is variable, depending on radiologist preference. “About 5 : 15 ml”
- ➔ On average, *approximately 5 ml* is necessary to fill the uterine cavity,
 - An additional 5 ml is needed to demonstrate uterine tube patency.



Radiological Views

- **Preparation Film** : “Plain Film ”
 - Of pelvis (on a 24 X 30 cm radiologic film)
 - Necessary before injecting contrast .
 - masses or calcifications
- **Fluoroscopic control** → radiographs can be taken during the filling of the uterine cavity.
 - (usually 2-3 cm³ of contrast medium is sufficient)
 - The total amount of injected contrast medium should not exceed 10 mL.
- **Additional spot radiographs** : are obtained to document any abnormality that is seen.

- The central ray: to a point 2 inches (5 cm) superior to the symphysis pubis.
- If fluoroscopy is unavailable,:
 - fractional injection of contrast medium is implemented,
 - A radiograph performed after each fraction to document filling of the uterine cavity, the uterine tubes, and contrast medium within the peritoneum.
- Additional images as determined by the radiologist may include LPO or RPO positions. + Delayed Films.



Exposure values	mAs (average)	
kV	"blue" system 200	"green" system 400/450
70	200	100
80 with contrast	100	50

Complications

- The two most common complications of HSG are pain and infection.
- SimplyComplications are related to
→ technique → Contrast & → Radiation
- Complications may be : General or Local

1-Uterine contractions and discomfort:

- due to the introduction of contrast medium into the uterine cavity → Dilating it.
- more diffuse pain, caused by irritation of the peritoneum due to the contrast.
- *Pain can be minimized* by :
 - slowly injecting the contrast medium
 - using isosmolar contrast agents.

2- Postprocedural infection:

Spreading and generalization of inflammation may happen in cases of chronic inflammation.

3- Vasovagal reaction:

A possible reaction to manipulation of the cervix or inflation of a conclusion balloon in the cervical canal.

4- Traumatic elevation of endometrium by the inserted cannula:

A complication which does not cause significant consequences.

5- Uterine perforation and tubal rupture: are very rare.

- 6- Intra-vasation of contrast media:
 - Venous or lymphatic
 - With a water-based contrast medium there is no adverse effect on the patient,
 - But it can make interpretation of the image difficult. It occurs more commonly in the presence of fibroids or tubal obstruction.
- It could occur if :
 - Rapid injection,
 - If the endometrium is injured during the catheterization, or
 - if the examination is performed during menstruation.

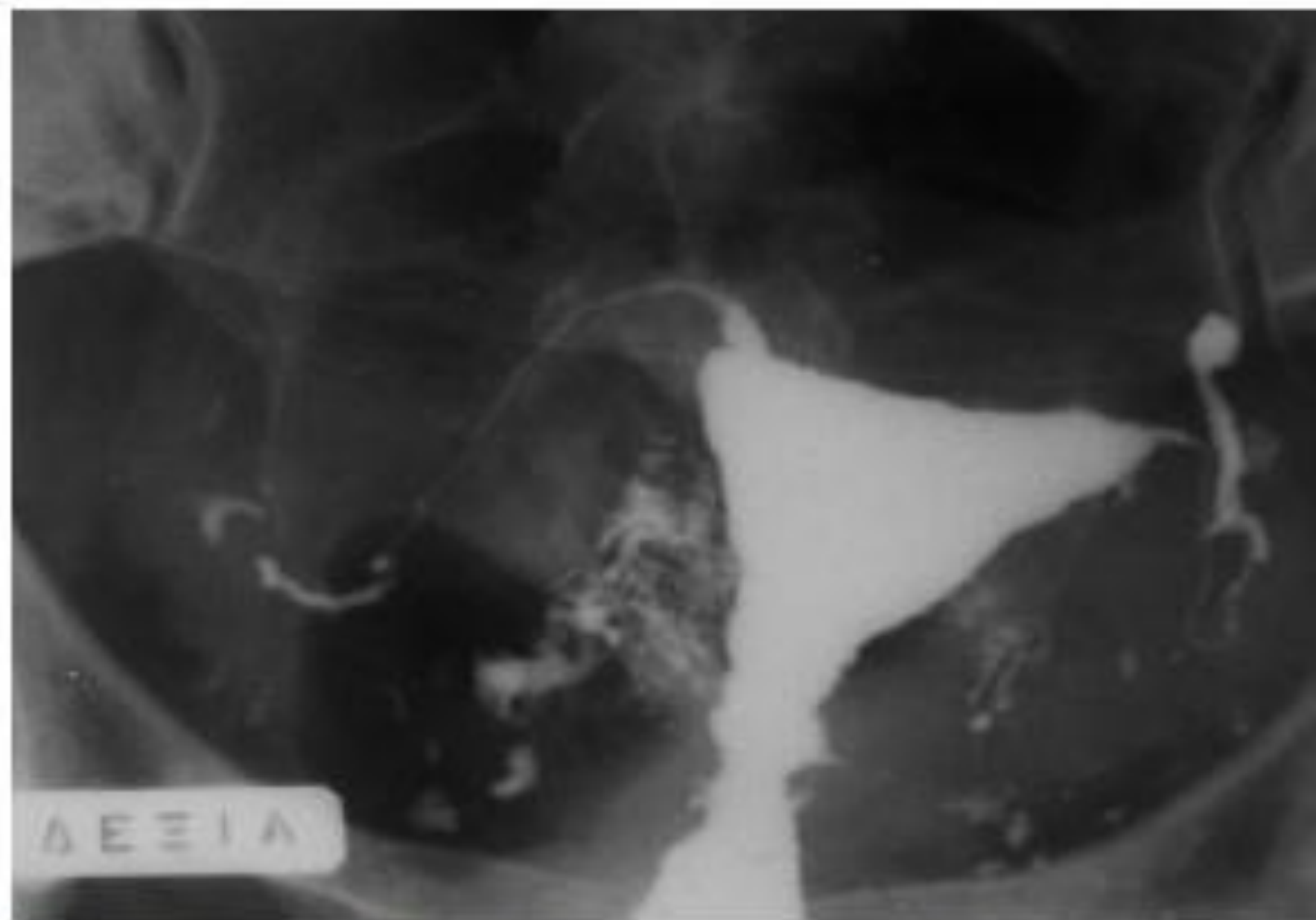


FIG 1. Extravasations of the contrast medium. Presence of contrast medium in the peritoneum.




7- Allergic reaction to contrast media:

- very uncommon with low-osmolar nonionic contrast agents currently available.

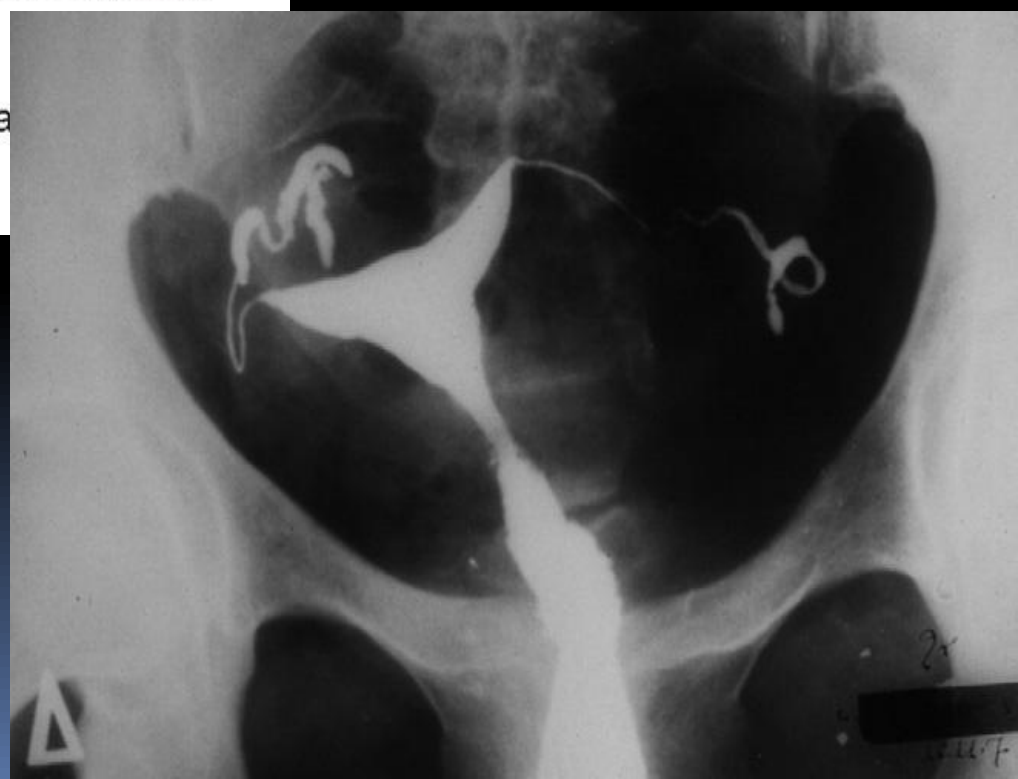
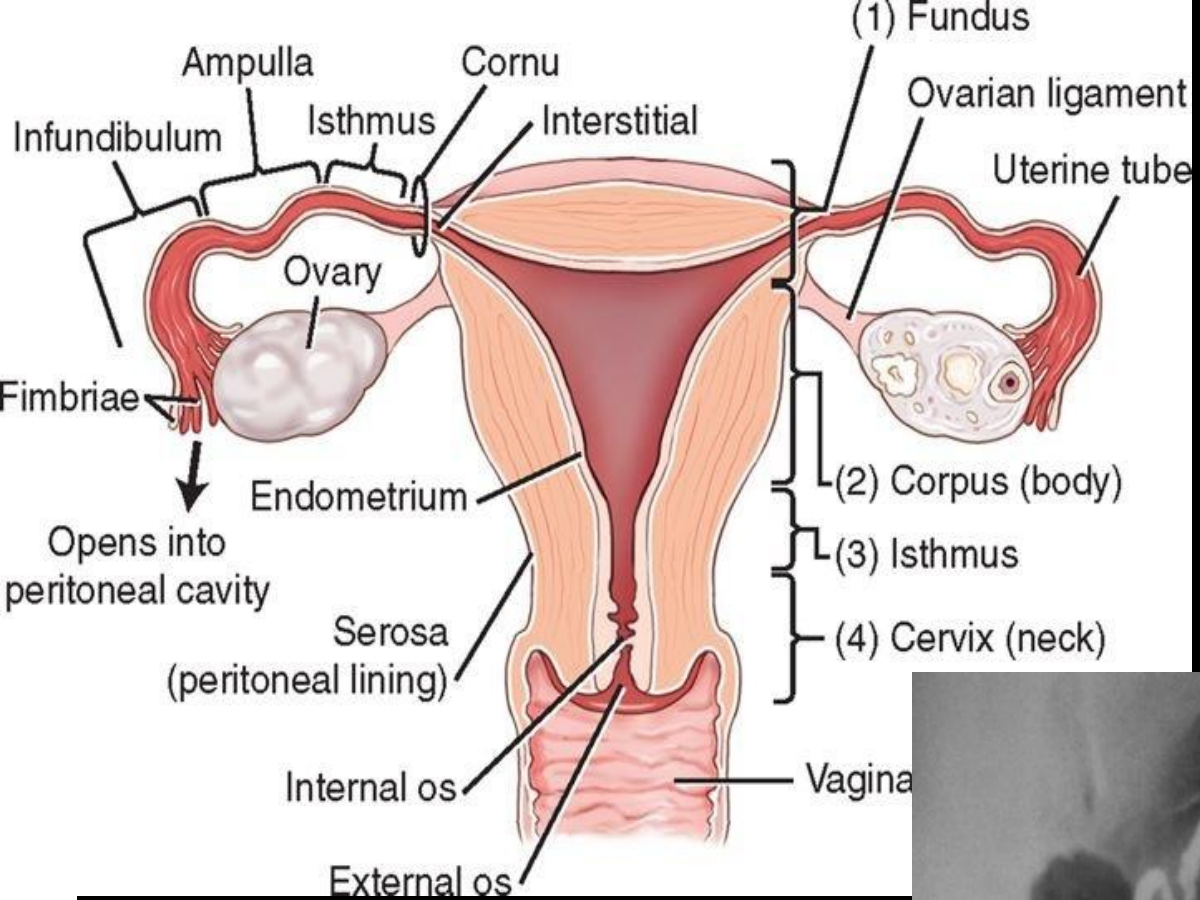
8- Radiation exposure to the ovaries:

Exposure is minimal and can be reduced if the proper technique is utilized.





Normal Findings



■ *Uterine cavity :*

- has a normal trigonal shape .
- The apex of the triangle is the isthmus, → nearly 3.7 cm wide.
- Is pointed downwards
- connected to the internal ostium of the cervix uteri,
- The base of triangle is the fundus, which can be concave, flattened, or slightly convex.
- On both sides of its base, in the area of the lateral horns,

■ *Cervix:*

- is 2.5 cm in total length.



- *The fallopian tubes :*

- separated into three segments:

- 1- Isthmus (attached to the uterus, not imaged in several cases),

- 2- Ampullary :

- in the middle,


- the longest and widest segment,

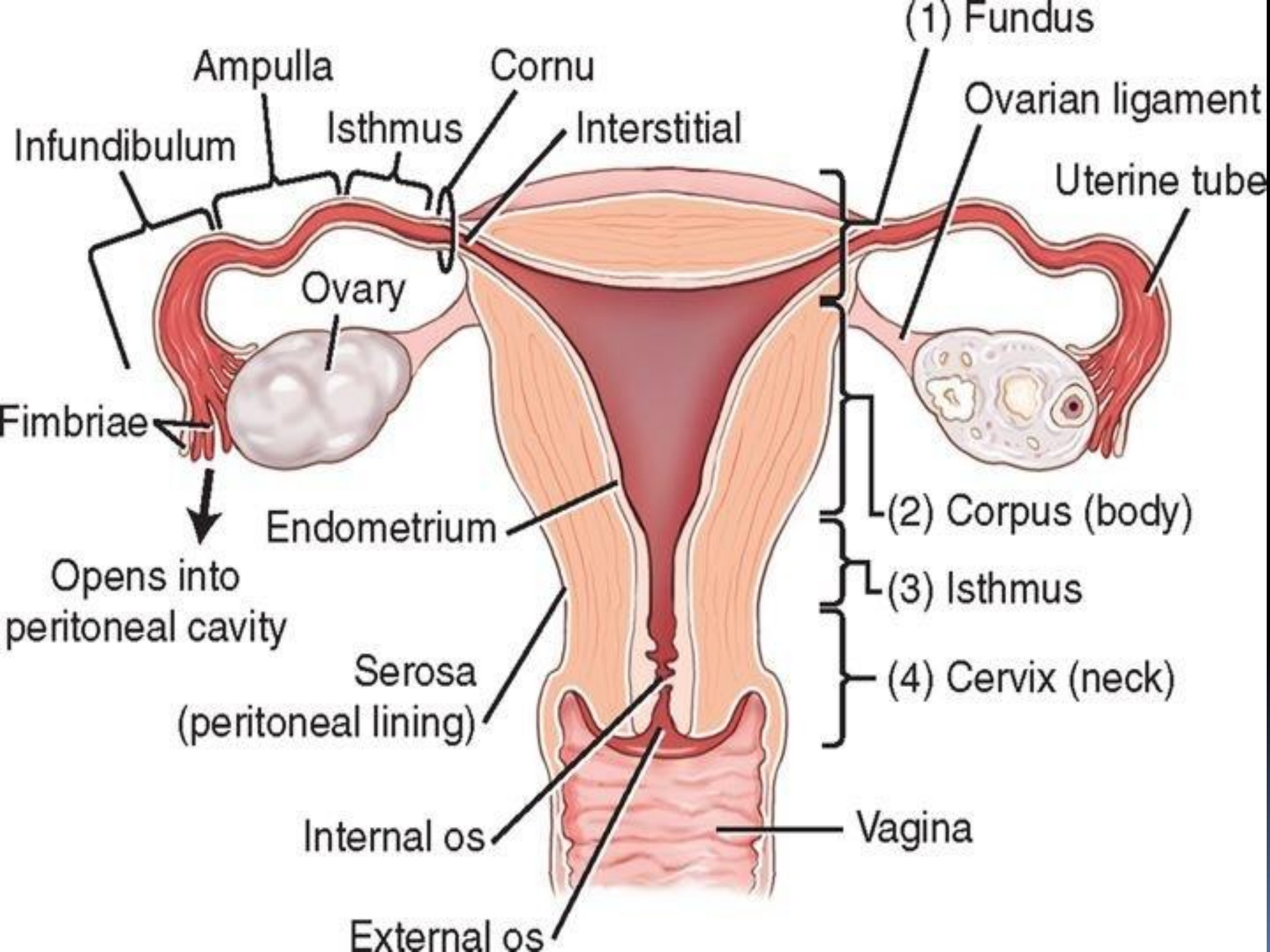
- 3- Infundibulum : bell-shaped (to the distal end).

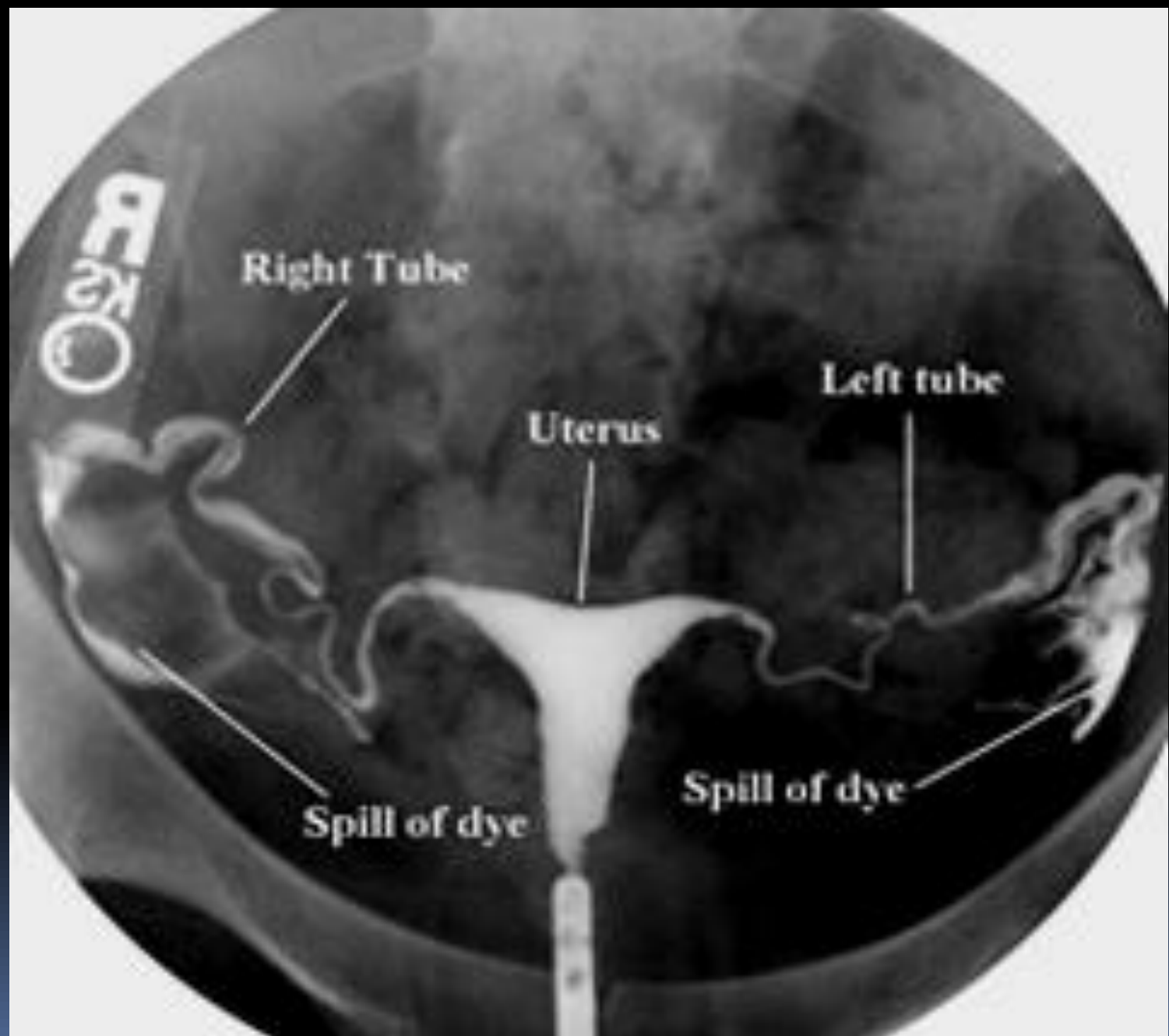
- There are two ostiums:

- Internal or uterine, and

- External or abdominal → through it contrast diffuses into the peritoneal cavity

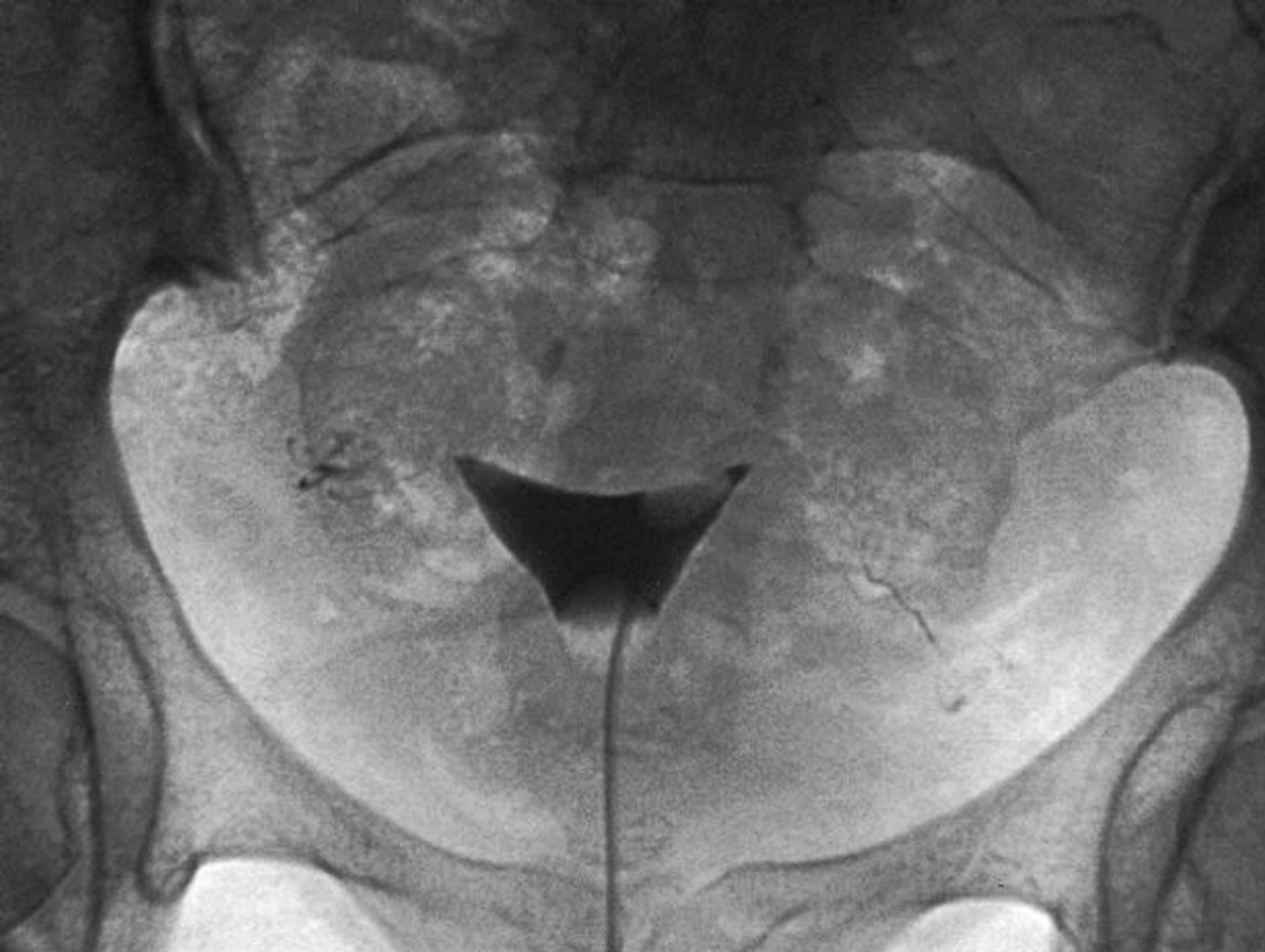
- 
- Remaining contrast medium in the furrows of the peritoneum can be observed up to **3 hours** after administration.

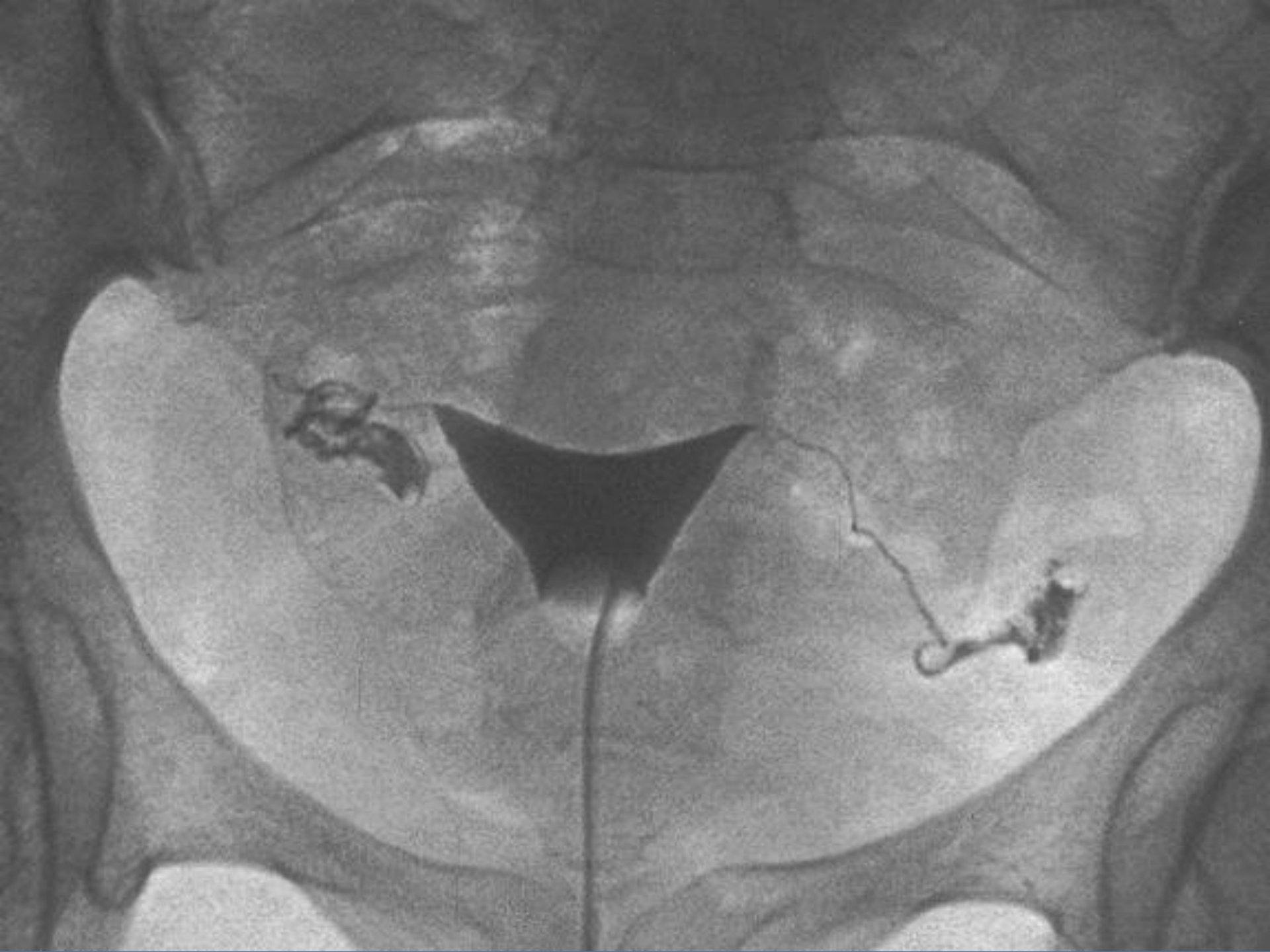




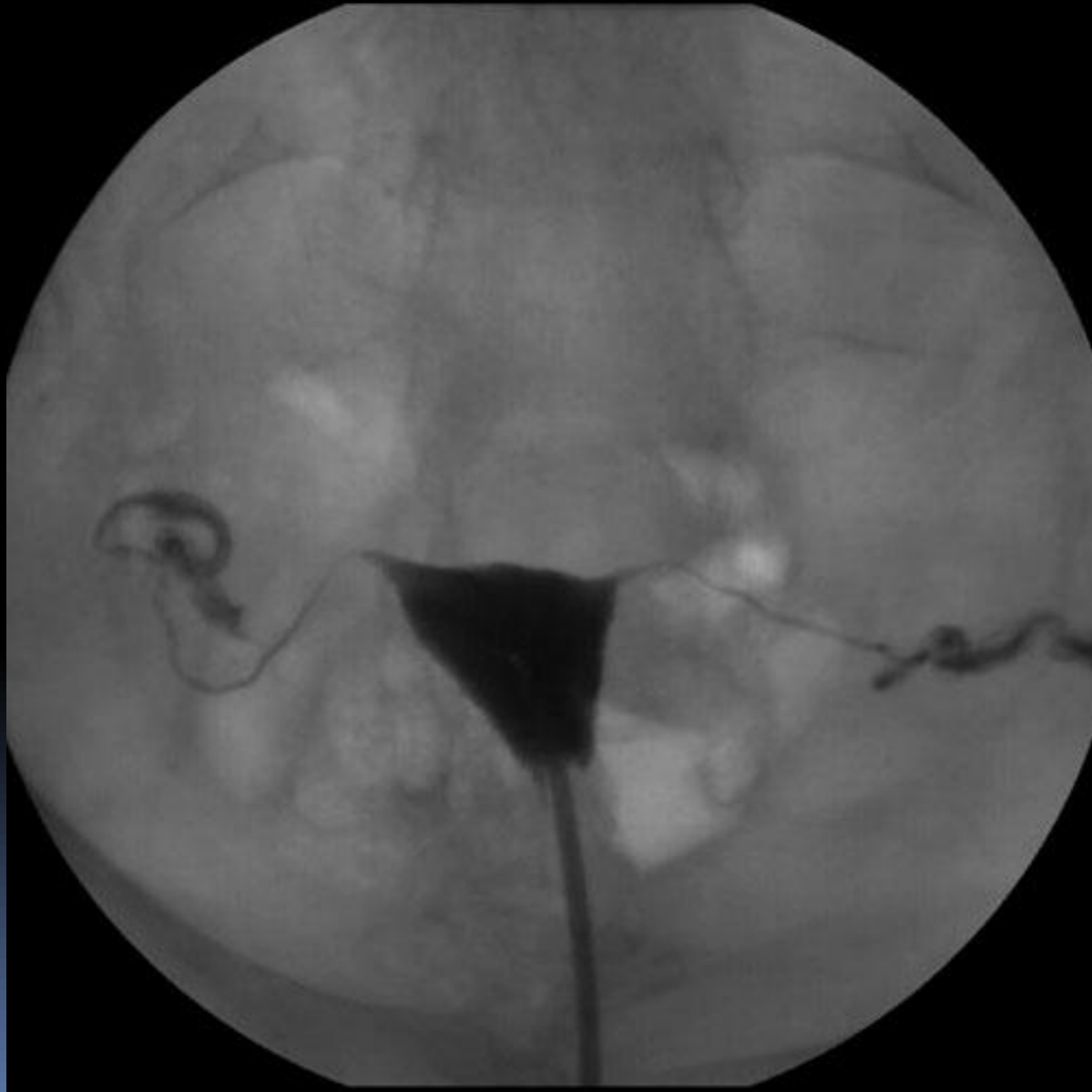
Scout

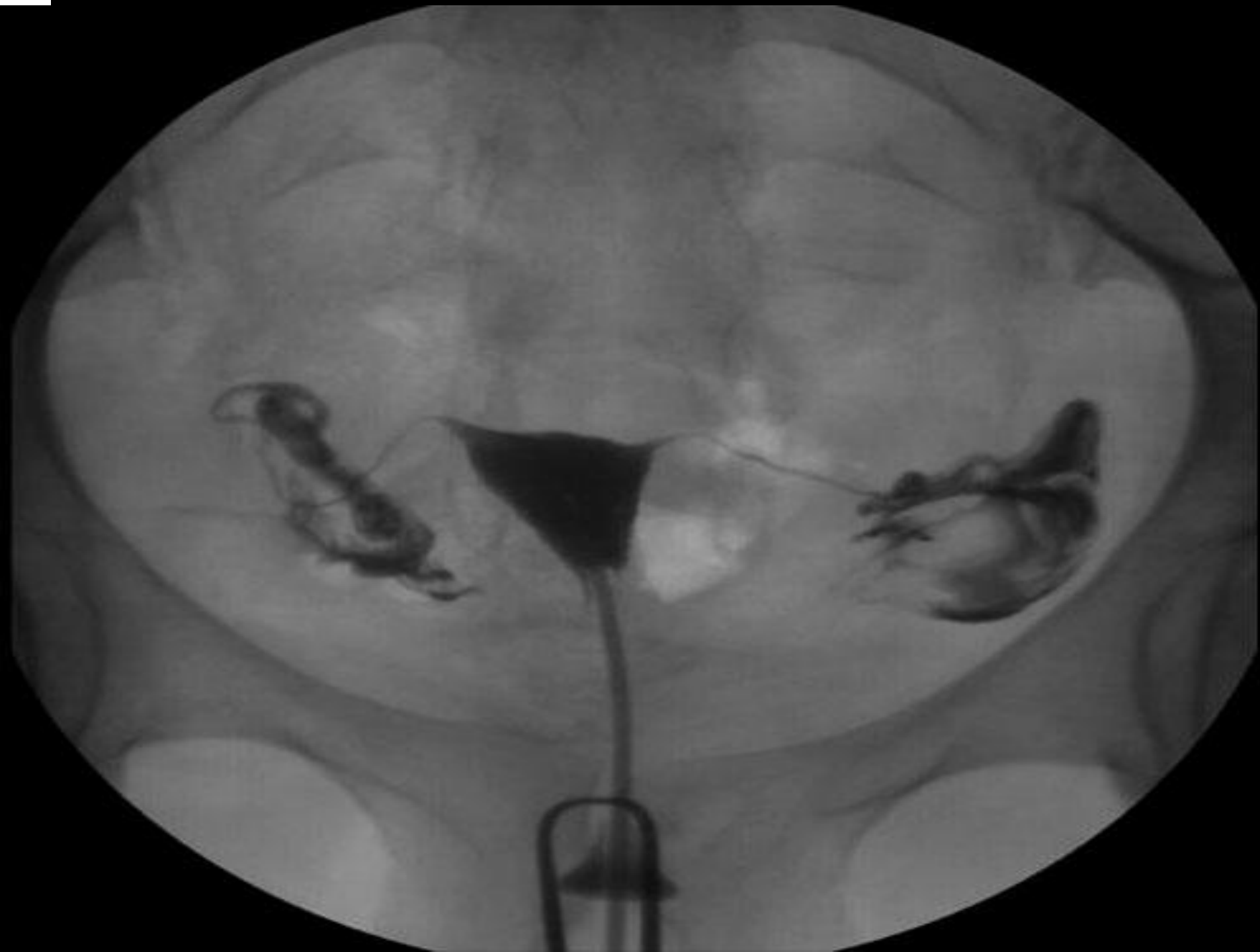






Normal Hysterosalpingograms







NORMAL

Comment on:

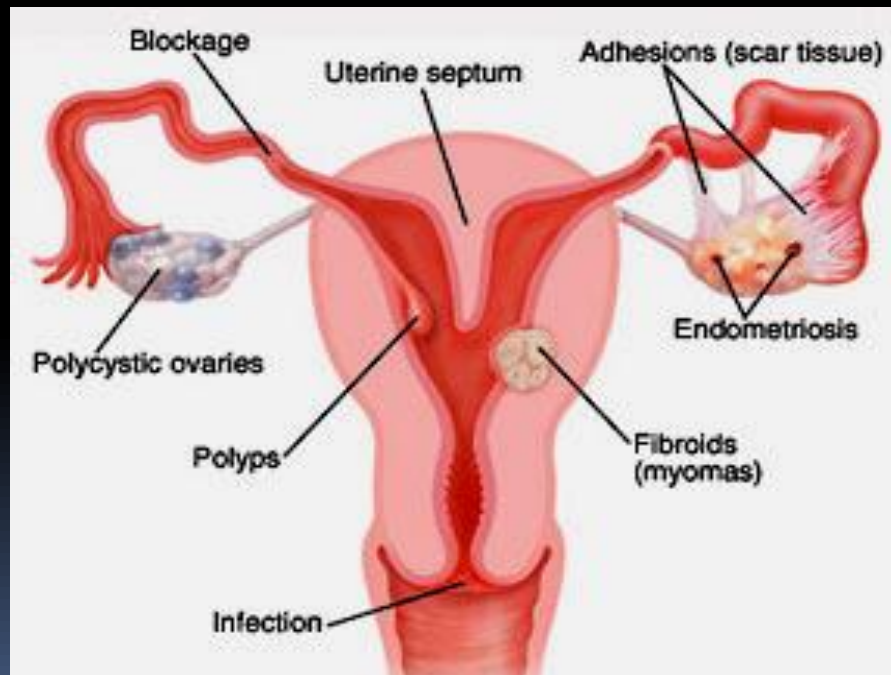
Uterine cavity: size & shape

Fallopian tubes: calibre, mucosa, patency

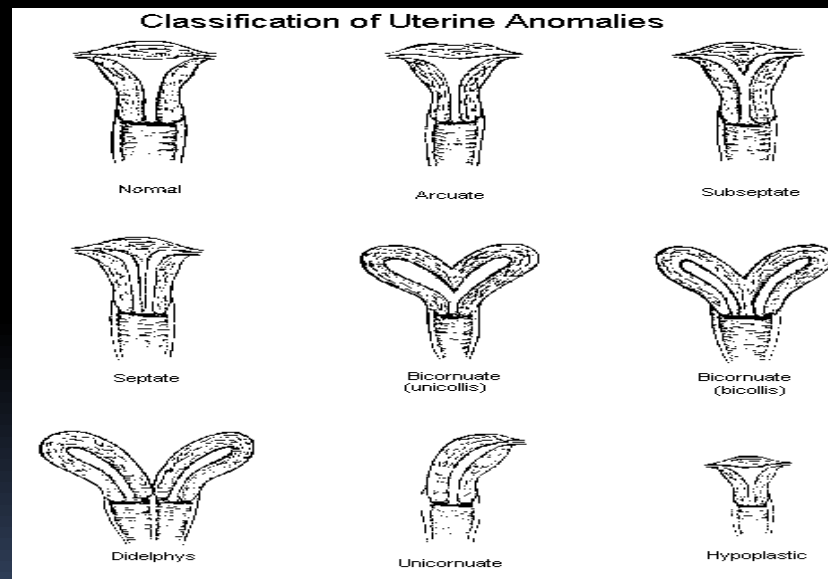
Free spill



Homogenous smearing

Abnormal Hysterosalpingogram



Congenital Uterus Anomalies



- 
- 
- Caused by incomplete junction of the paramesonephric ducts (Muller ducts),
 - Majority of women with mullerian duct anomalies have reproductive problems :
 - little chance of conceiving,
 - higher rates of spontaneous abortion,
 - higher rates of premature delivery
 - Abnormal fetal position



- *Primary infertility*

In such cases has an extra uterine cause and is not generally attributable to mullerian duct anomalies alone.

- *Cervical incompetence :*

Has been reported to be associated with these anomalies.

- 
- According to
the American Society of Reproductive Medicine,
there are seven classes of mullerian duct
anomalies:
- 



- *Class I:*

- Segmental agenesis or
 - Variable degrees of uterovaginal hypoplasia.
- The anomaly can be detected, because of the *amenorrhea*, before HSG is performed.

■ Class II:

- Unicornuate uteri .
- partial or complete unilateral hypoplasia.
- The unicornuate uterus contacts only the coordinate fallopian tube.

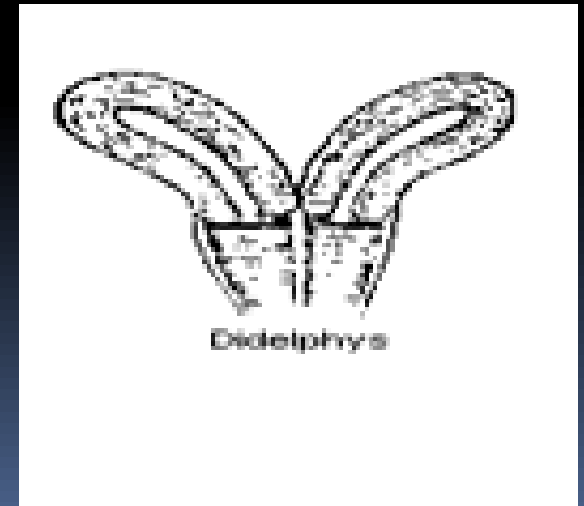




- ***Unicornous uterus.***
 - Hysterosalpingography shows opacification of a single right uterine horn.
 - A single fallopian tube is also visualized.

■ Class III:

- Didelphys uterus.
- This is a rare abnormality .
- Results from complete nonfusion of the mullerian ducts → duplication of the uterine cavity, cervix neck, and vagina.
- Rarely, this uterus has a single vagina.

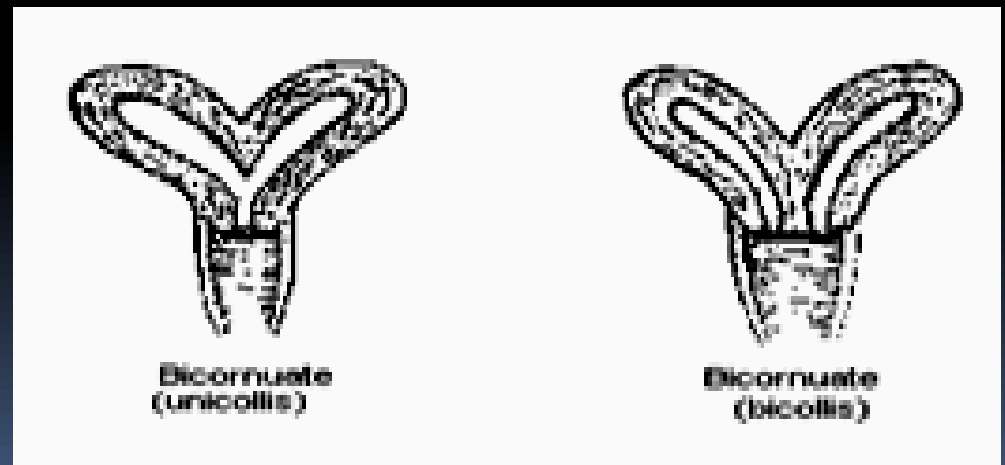




- Didelphys uterus.
 - Hysterosalpingography shows two uterine cavities, two cervices, and one single vagina.

■ Class IV:

- Bicornuate uterus .
- incomplete fusion of the superior segments of the uterovaginal canal.
- The uterine cavity is divided in two; each half has a narrow-length shape and stands apart from the other.

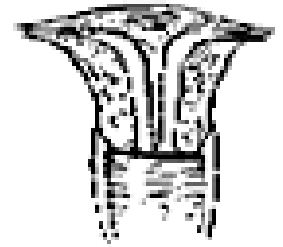




- Bicornate uterus.
 - Spot radiograph shows two uterine horns.
 - The fallopian tubes are also visualized at this imaging stage.

■ Class V:

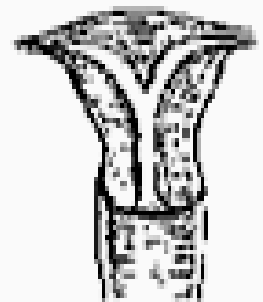
- Septate uteri.
- Partial or complete nonresorption of the uterovaginal septum.



Septate

Class VI:

- Arcuate uterus.
- resulting from nearly complete resorption of the septum. → depression of the uterine fundus
- *the most common congenital anomalies (50%) in cases detecting female infertility.*



Subseptate



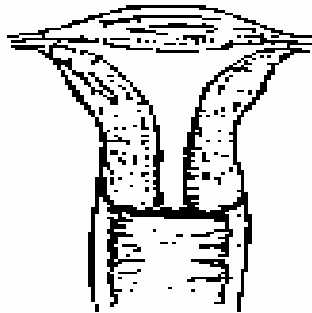
- Arcuate uterus. Hysterosalpingography demonstrates
 - a depression of the uterine fundus, compatible with an arcuate uterus.



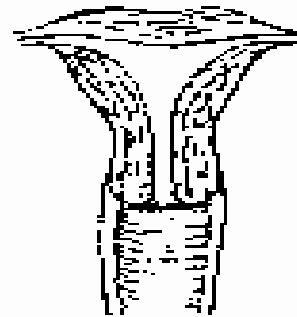
- *Class VII:*

- Anomalies that comprise sequelae of in utero diethyloestradiol exposure.
- 

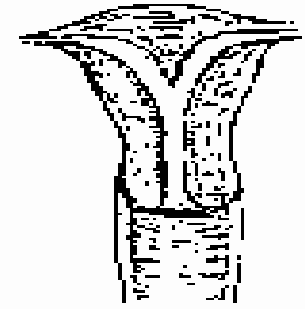
Classification of Uterine Anomalies



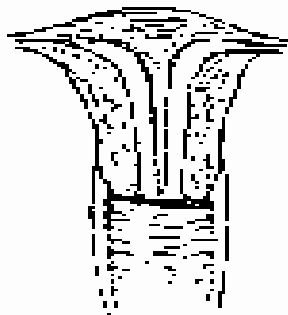
Normal



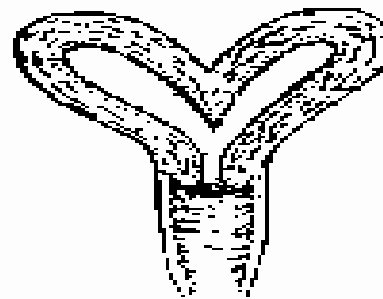
Arcuate



Subseptate



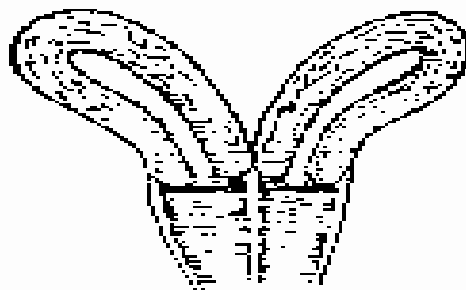
Septate



Bicornuate
(unicollis)



Bicornuate
(bicollis)





Didelphys



Unicornuate



Hypoplastic

- 
- 
- ➔ ***Small sized Uterus "Hypoplastic" :***
 - *Another congenital anomaly,*
 - caused by *inadequate hormonal stimulation* as a fetus,
 - Small uterine cavity size with normal vaginal length
 - A common finding in cases of female infertility.



- *Small size* of the uterus cavity with normal length of the vagina



Non congenital Abnormal Findings



Fibromyomas

- **Submucosa fibromyomas** → are imaged as smooth filling defects in the uterine cavity.
- DD:
 - endometrial polyps
 - possible pregnancy.
- **Small intramural fibromyomas :**
 - Do not distort the endometrial cavity
 - Not visualized on HSG.
- **Subserous fibromyomas :**
 - only if they are located in the lateral walls of the uterus. → smooth filling defects or smooth repression of the fallopian tubes




- *Submucosa fibromyoma.*

Contrast deficiency “filling defect” with smooth border at the fundus of the uterus.



Endometrial Polyps

- are focal overgrowths of the endometrium.
 - usually manifest as well-defined filling defects and
 - Best seen during the early filling stage.
 - Small polyps may be obscured by contrast filling.
- 

Internal Endometriosis (Adenomyosis)

- caused by the presence of ectopic islets of active endometrium in the muscularis wall of the uterus.
- It is usually imaged as a pointed projection of 2 to 3 mm length, perpendicular to the uterine wall
- Rarely, this is imaged as a sack-shaped projection filled by contrast medium, 4 mm to 1 cm in length.

→ Differential diagnosis :

- hyperplasia of the endometrium and the entrance of the contrast medium in the myometrium or
- in the nutrient arteriole of submucosa fibromyomas.



- Endometriosis.
Sack-shaped projection full of contrast medium

Uterine Cancer

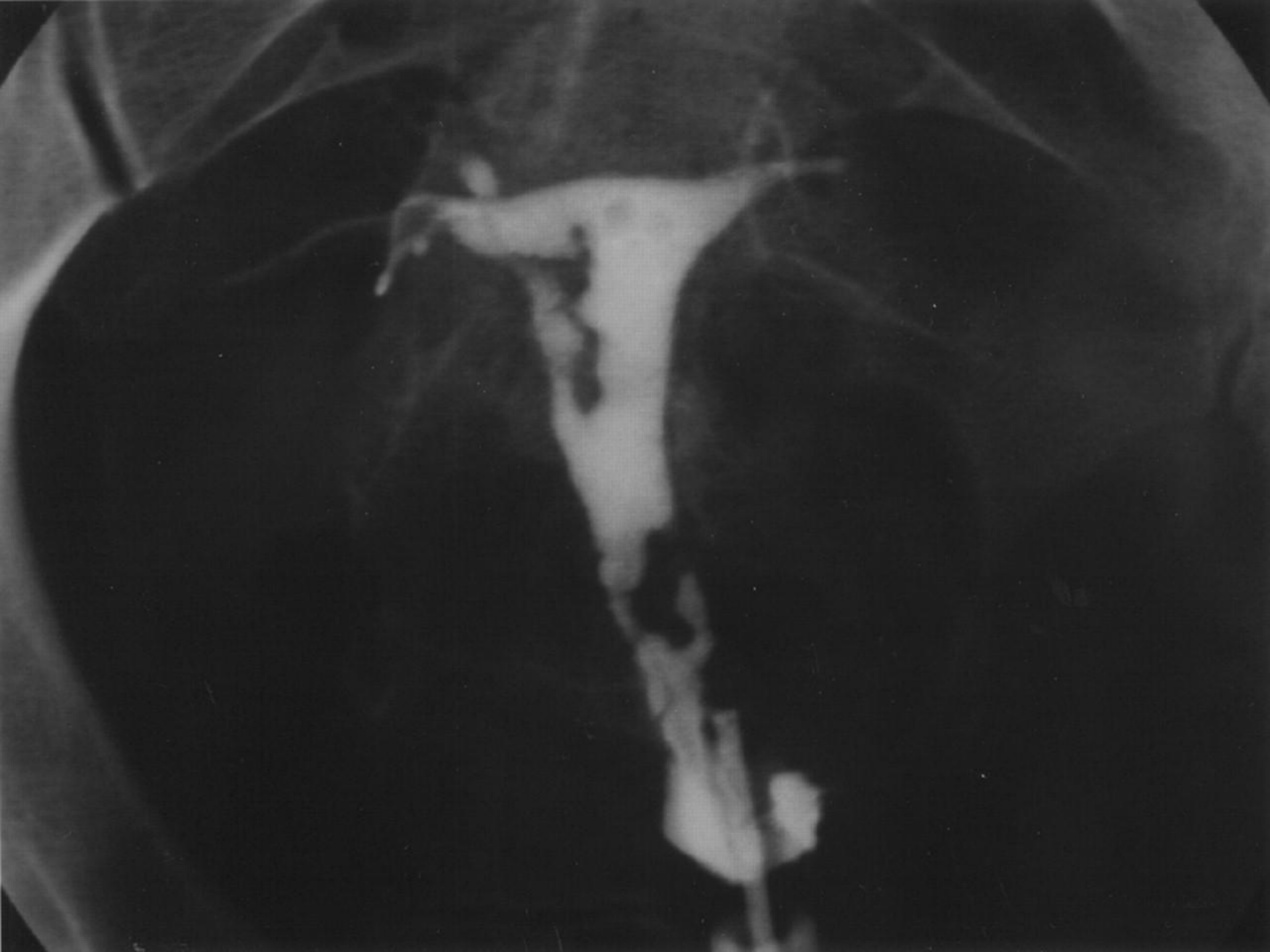
- manifests as an *irregular filling defect*,
- rarely diagnosed by the HSG method.



Uterine cancer.
Large contrast deficiency “Filling defect” with abnormal border at the left lateral uterus wall, which is indicated.

Intrauterine Adhesions

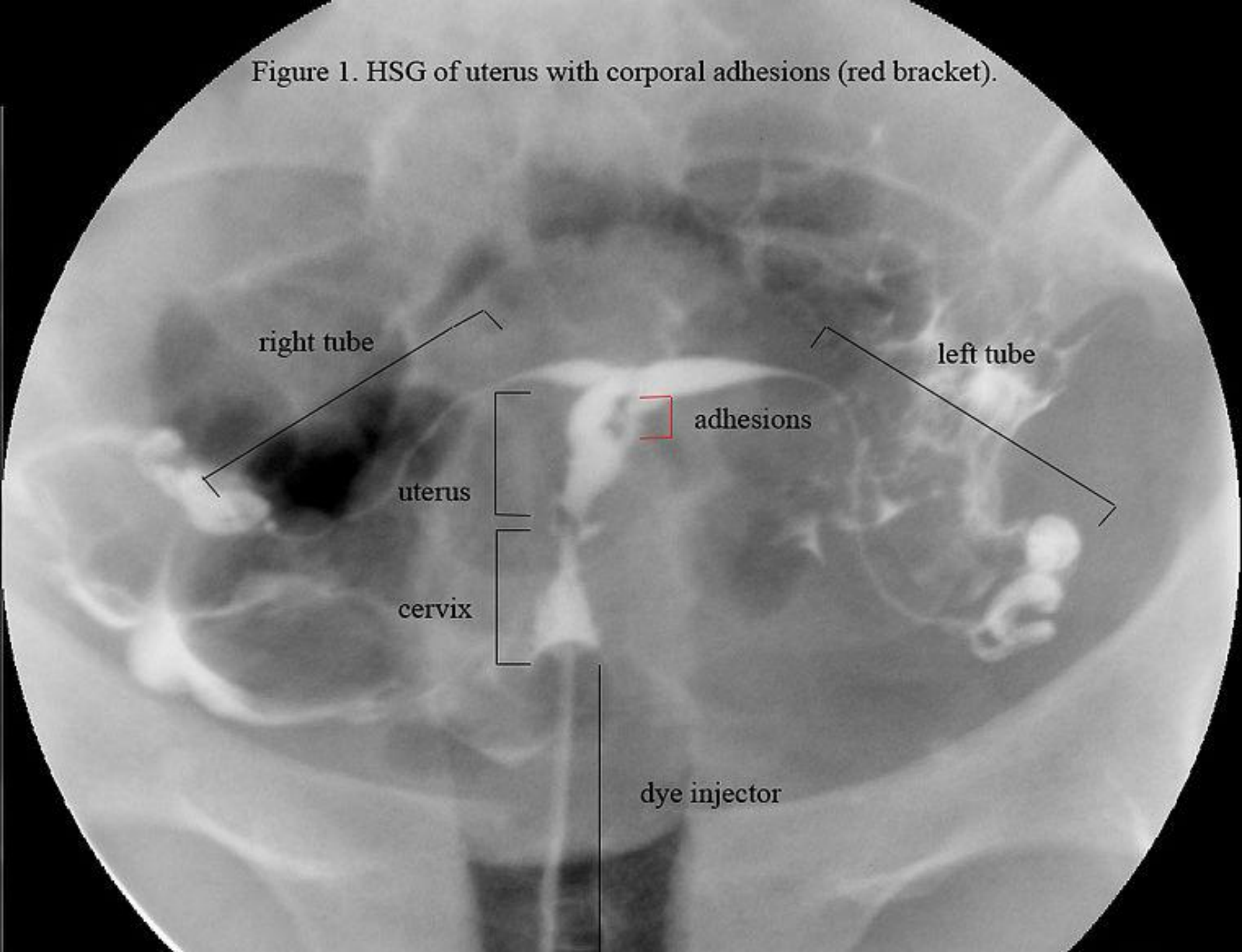
- most commonly caused by endometrial trauma of curettage.
- They are also seen in patients with chronic endometriosis due to tuberculosis.
- Intrauterine adhesions manifest as irregular filling defects, → most commonly as linear filling defects arising from one of the uterine walls.



Asherman's syndrome

- is a condition characterized by adhesions and/or fibrosis of the endometrium most often associated with dilation and curettage of the intrauterine cavity.
- was first described in 1894 by Heinrich Fritsch (Fritsch, 1894) & further characterized by Israeli gynecologist Joseph Asherman in 1948.

Figure 1. HSG of uterus with corporal adhesions (red bracket).



ALFALAH



08-09-22
23-Apr-2009
75 kV, 320 mA, 30 ms

S-7
SBAN KHALFALAH



08-09-22
23-Apr-2009
75 kV, 320 mA, 30 ms

ALFALAH



08-07-48
23-Apr-2009
75 kV, 320 mA, 30 ms

S-1
SBAN KHALFALAH



08-07-48
23-Apr-2009
75 kV, 320 mA, 30 ms

ALFALAH



08-07-48
23-Apr-2009
75 kV, 320 mA, 30 ms

S-1
SBAN KHALFALAH



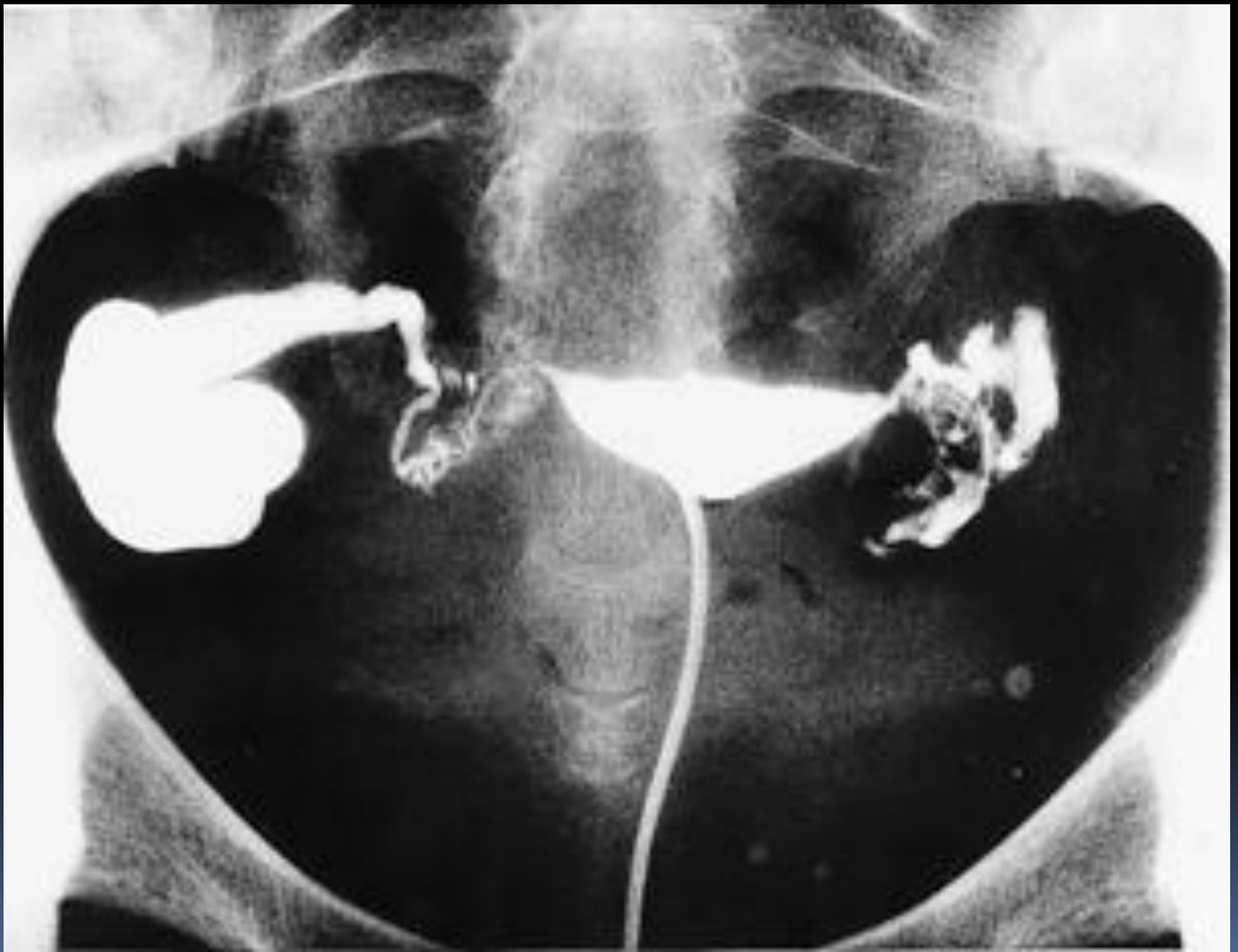
08-07-48
23-Apr-2009
75 kV, 320 mA, 30 ms

Hydrosalpinx

→ *HSG is the best method for visualizing and evaluating the fallopian tubes.*

- Commonly results from a previous inflammation of the fallopian tubes (salpingitis).
- Distal tubal occlusion, → dilation of the proximal segment.
- The radiologic image shows a dilated lumen in one or more spots, → contrast will not pass to the peritoneal cavity

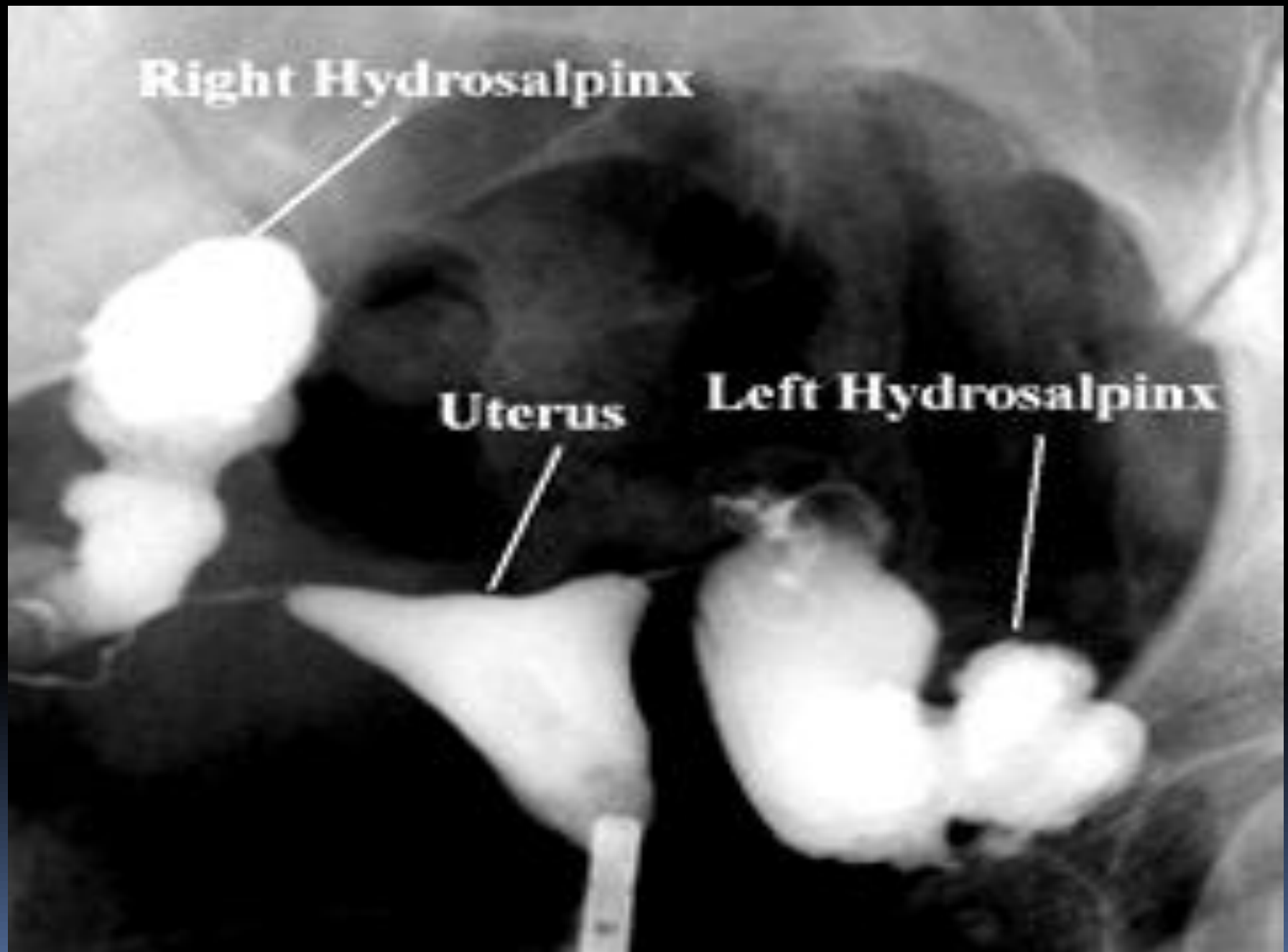




Right Hydrosalpinx

Uterus

Left Hydrosalpinx



Tuberculated Salpingitis

- This lead to distant fallopian tube end obliteration.
- In extensive infections, multiple constrictions along the course of fallopian tube can form, → areas of dilation and stenosis.
- Abnormal uterine and vaginal profiles are observed in cases of widespread infection.



Salpingitis Isthmica Nodosa

- a disease of unknown etiology,
- characterized by :
 - multiple small outpouchings or diverticula
 - Affecting one or both fallopian tubes.
- It is presumably caused by pelvic inflammatory disease or endometriosis .
- Is associated with ectopic pregnancy and infertility.9



- ***Nodosa isthmica salpingitis.*** Presence of small projected spots full of contrast medium, parallel to the fallopian tube.



©Behrang Amini, MD/PhD

Non Filling of the Fallopian Tubes

- *This is the most common finding during the examination .*
- Usually caused by:
 - poor technique,
 - spasm, or
 - obliteration of the fallopian tube.

→ *Poor technique includes:*


- imperfect straightening of the external cervical ostium
- Inadequate amount of contrast medium in the uterine cavity.

→ *Spasm Vs Obliteration :*


- The cornual portion of the fallopian tube is encased by the smooth muscle of the uterus
- If there is a spasm of the muscle during HSG, one or both tubes may not fill.
- Tubal spasm cannot be distinguished from tubal occlusion.

→ This could be avoided by:

- progressive administration of the contrast medium
- Administration of a spasmolytic agent to relieve spasm, → helping differentiate cornual spasm from true occlusion.⁴

- 
- Obliteration is usually caused by previous inflammation or uterine surgery and manifests as :

nonopacification or abrupt cutoff of the fallopian tube with no free intraperitoneal spillage.



Fallopian tube

Uterine cavity

Ovary

Vagina

Cervix

*Spillage indicates
tube is open*

*No spillage indicates
tube is blocked*

Cannula through which dye is injected

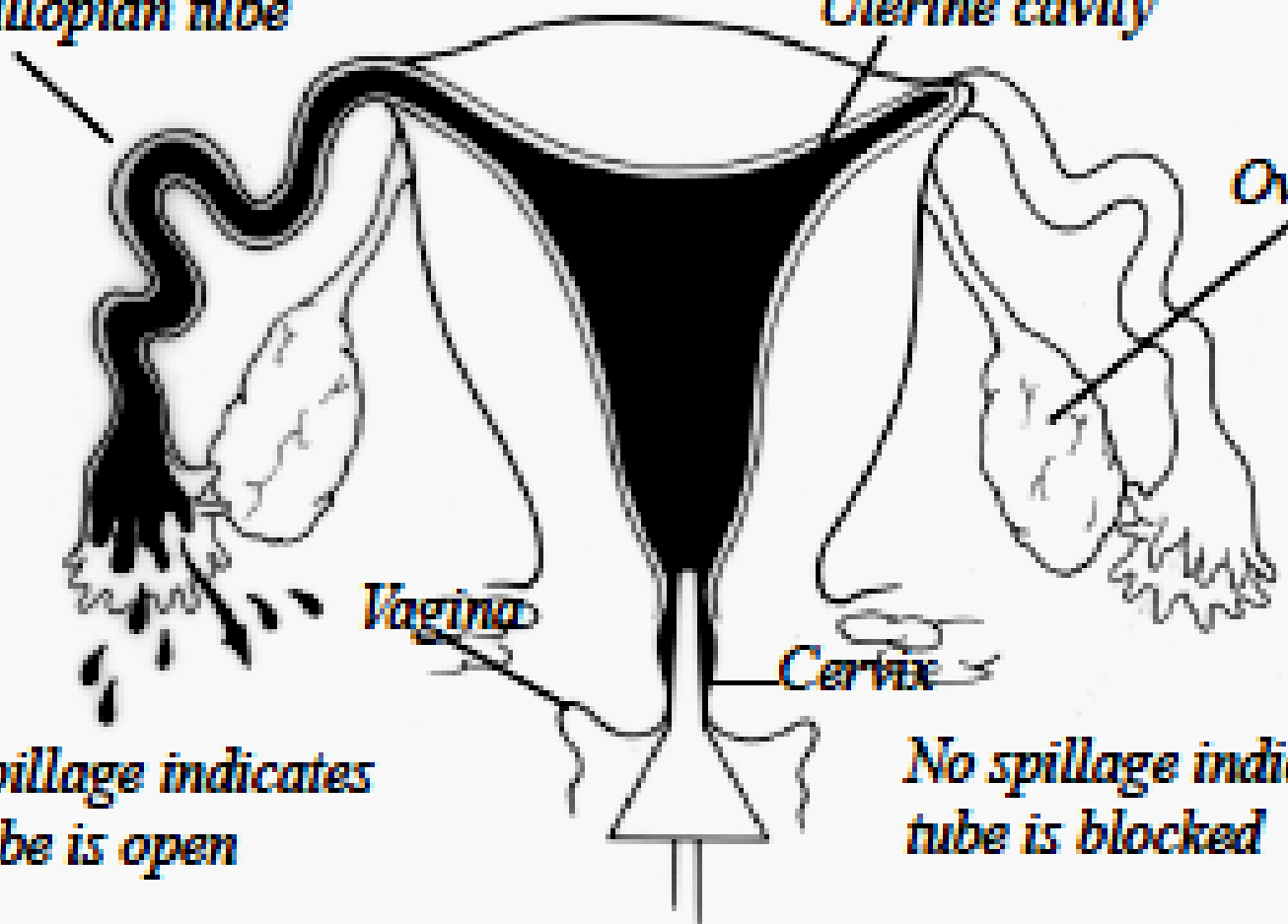




Figure 1

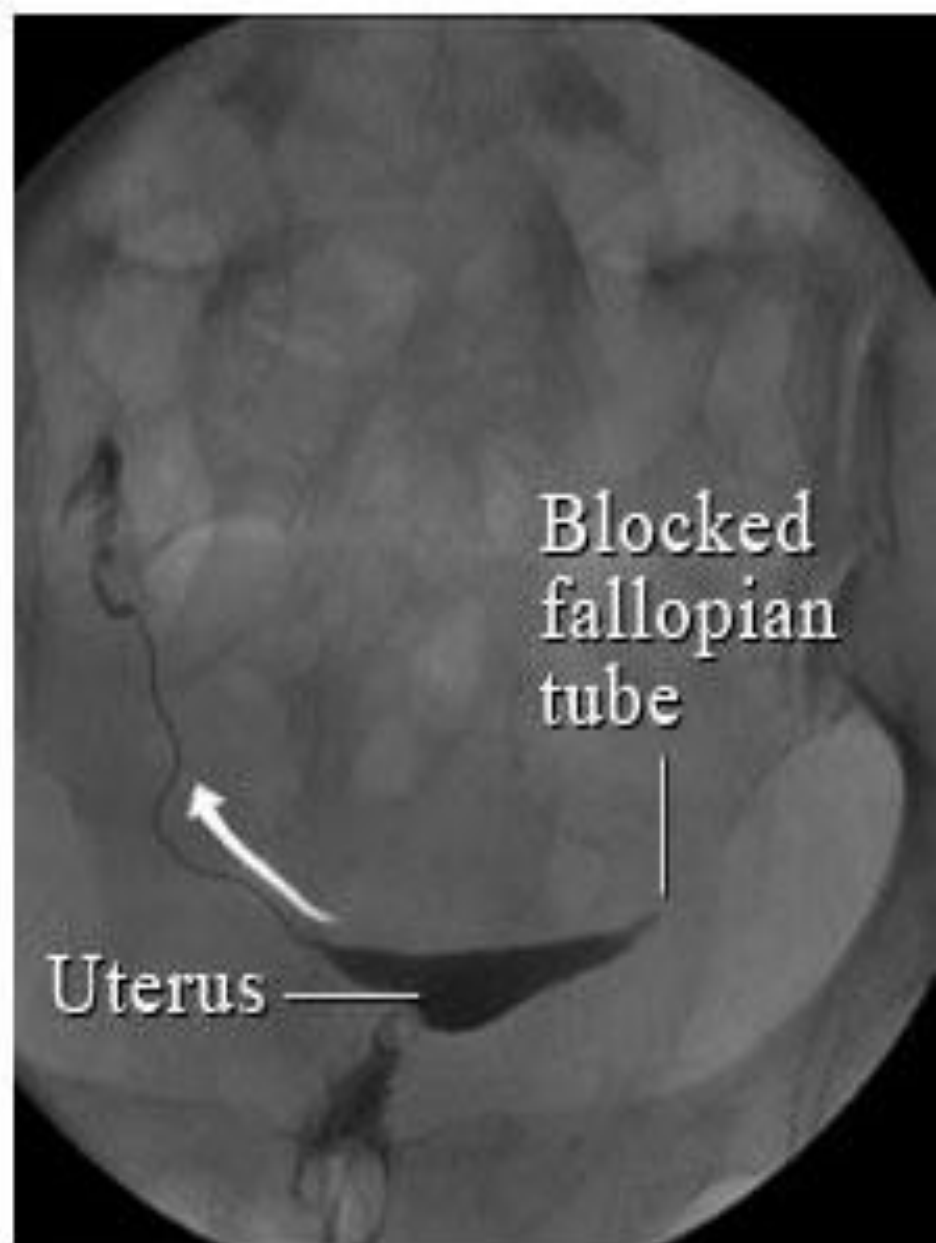


Figure 2

External Adhesions

- occur secondary to :
 - previous inflammation or
 - surgery,
similar to the causes of tubal occlusion.
- Peritubal adhesions → prevent contrast material from flowing freely around the bowel loops *“as seen in normal cases”*,
- Most commonly manifest as :
 - loculation of the contrast material around the ampullary portion of the tube.




Enlarged Ovary ← ovarian
Cyst
Confirmed BY US
+ Adhesions.






Technical Points from work & experiences

- Good Traction of cervix → Avoid enface imaging of the uterus & misdiagnosis.
 - Air bubbles in syringe → it may give misdiagnosis as filling defects confirmed by serial images → change in size & position.
 - Large , wide cervix → leak of contrast, so Use ballooned catheter , or corkscrew metal catheter of suitable size.
 - Delayed films: of water soluble → after 15 min
of Lipidol → after 24 h.
- Proper timing is a must for good tech.



Let us see miscellaneous
cases according to these
hints



Double uterine
contour
← Improper
imaging time

“Secretory
Phase”



NORMAL HSG

Injected air bubbles

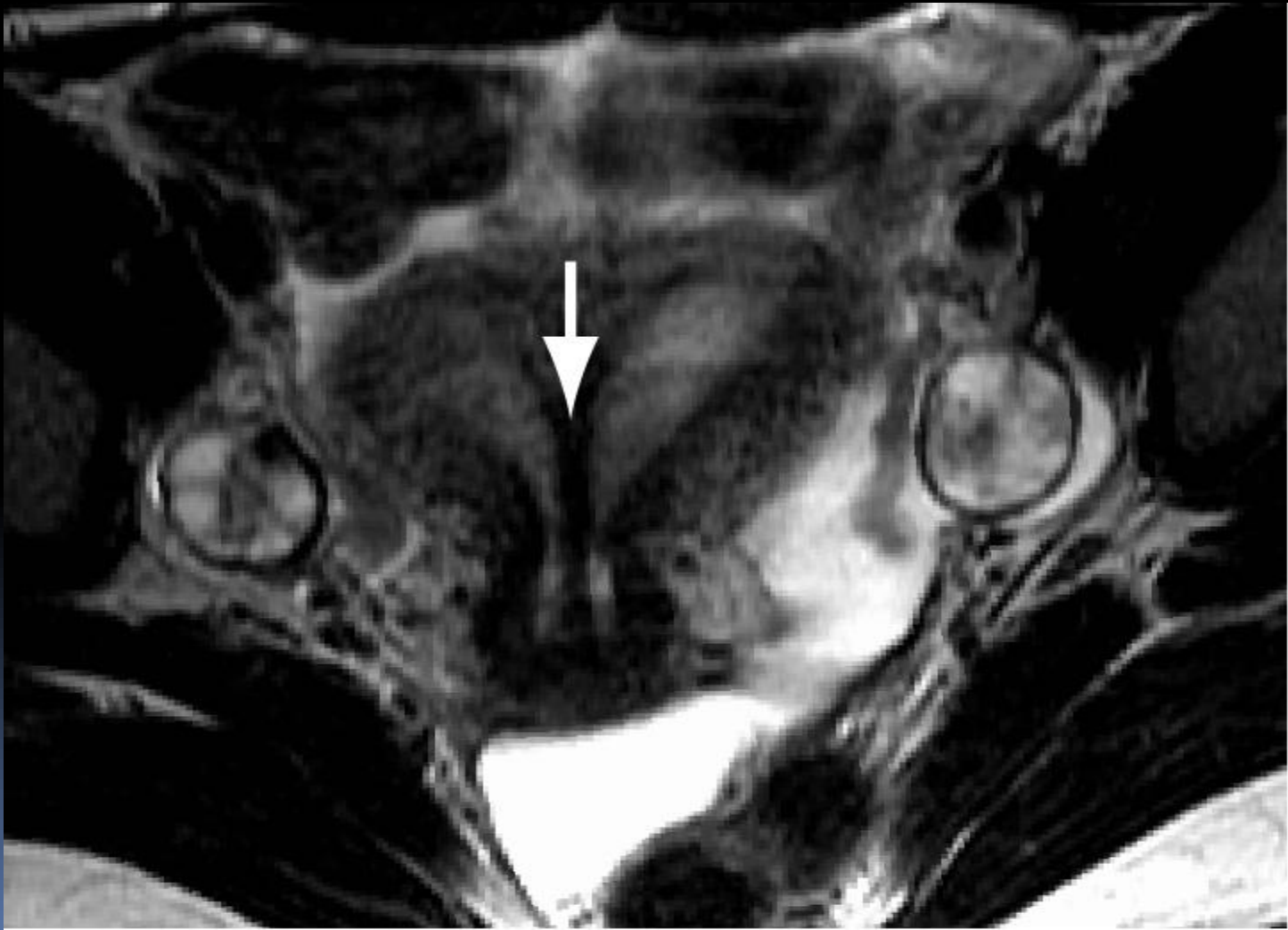


IMPROPER IMAGING

Inadequate cervical pulling
Uterus is markedly anti - flexed



N.B. MRI is important for further assessment of many cases especially “Double cavity” categories.

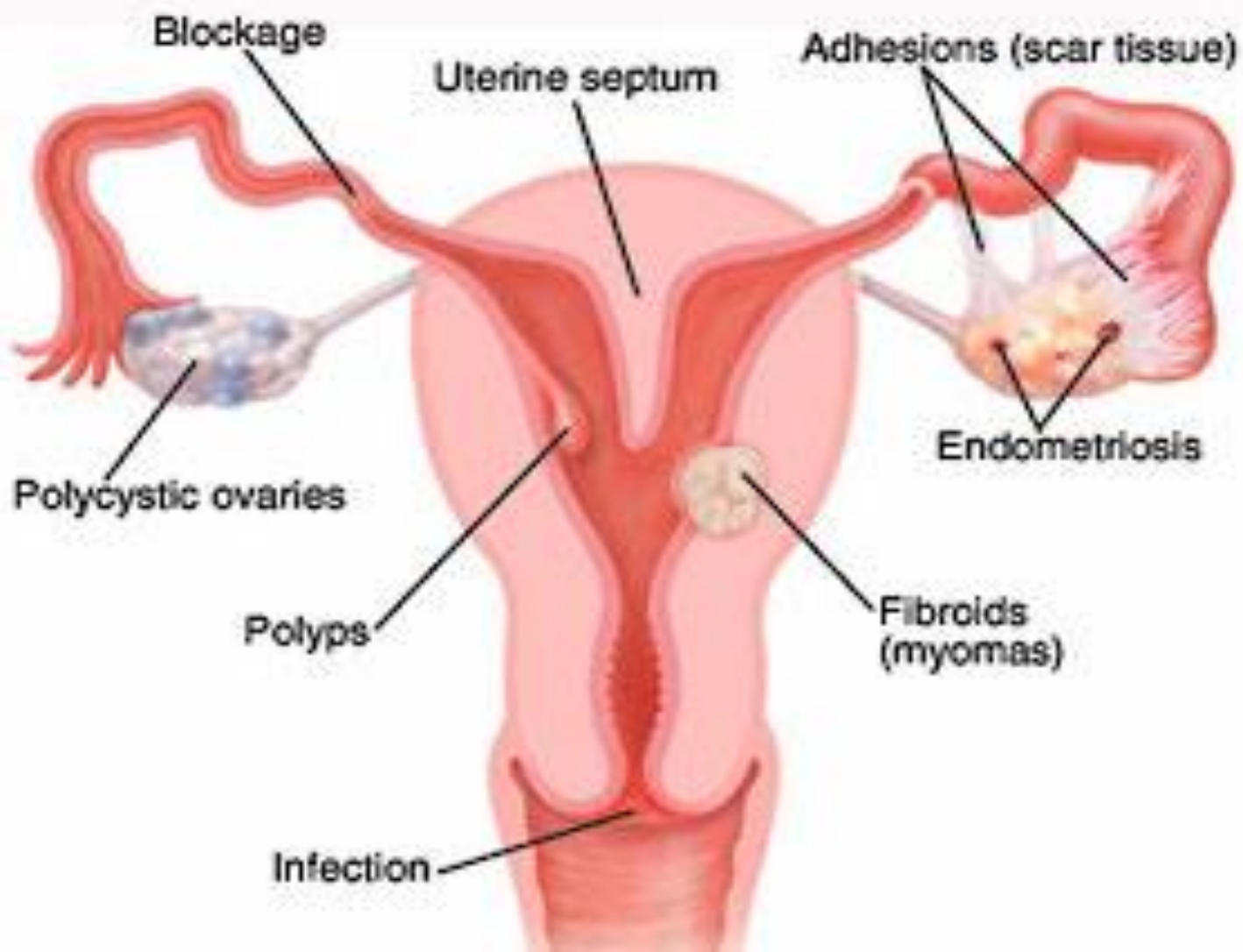


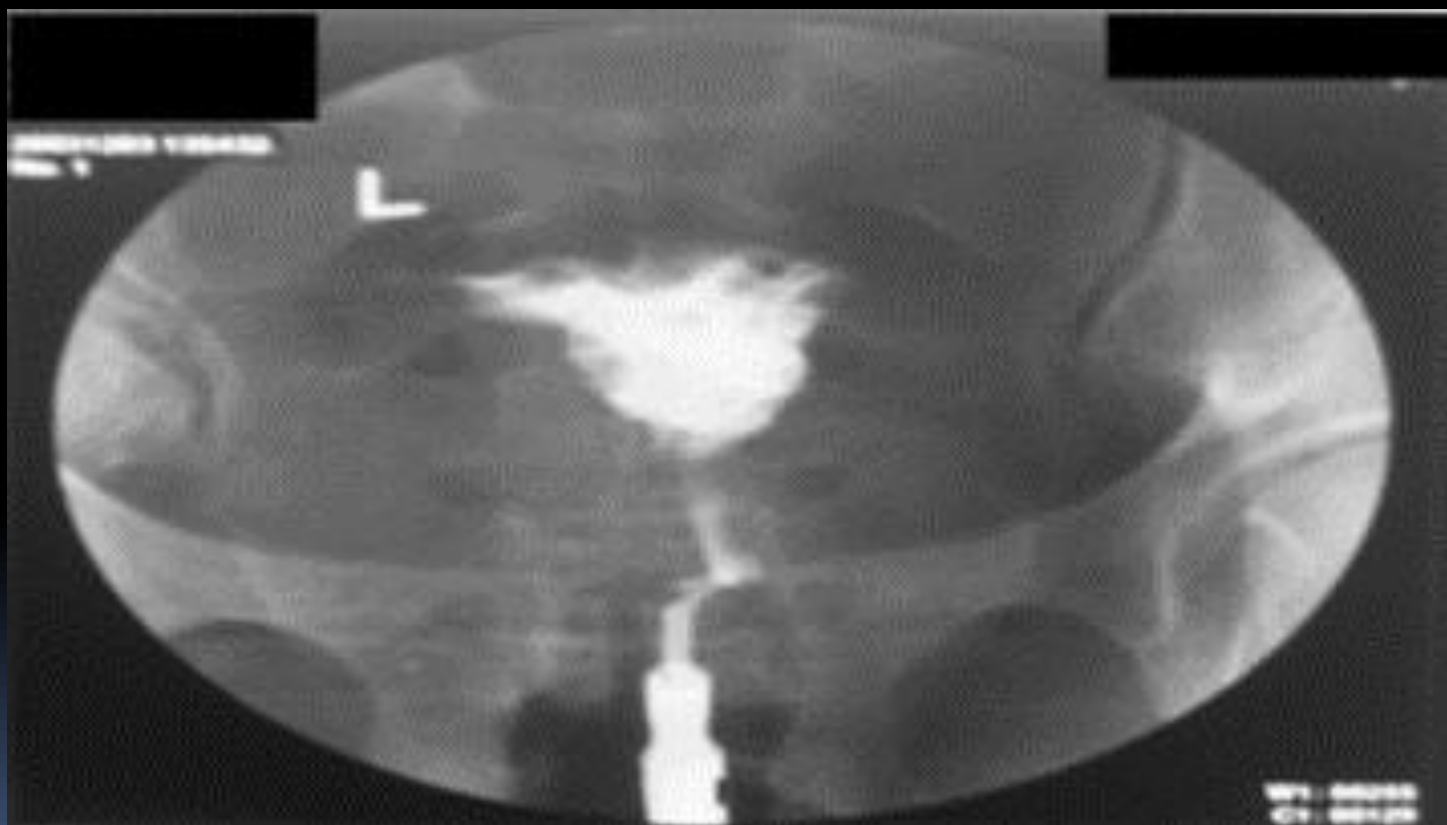
Conclusion

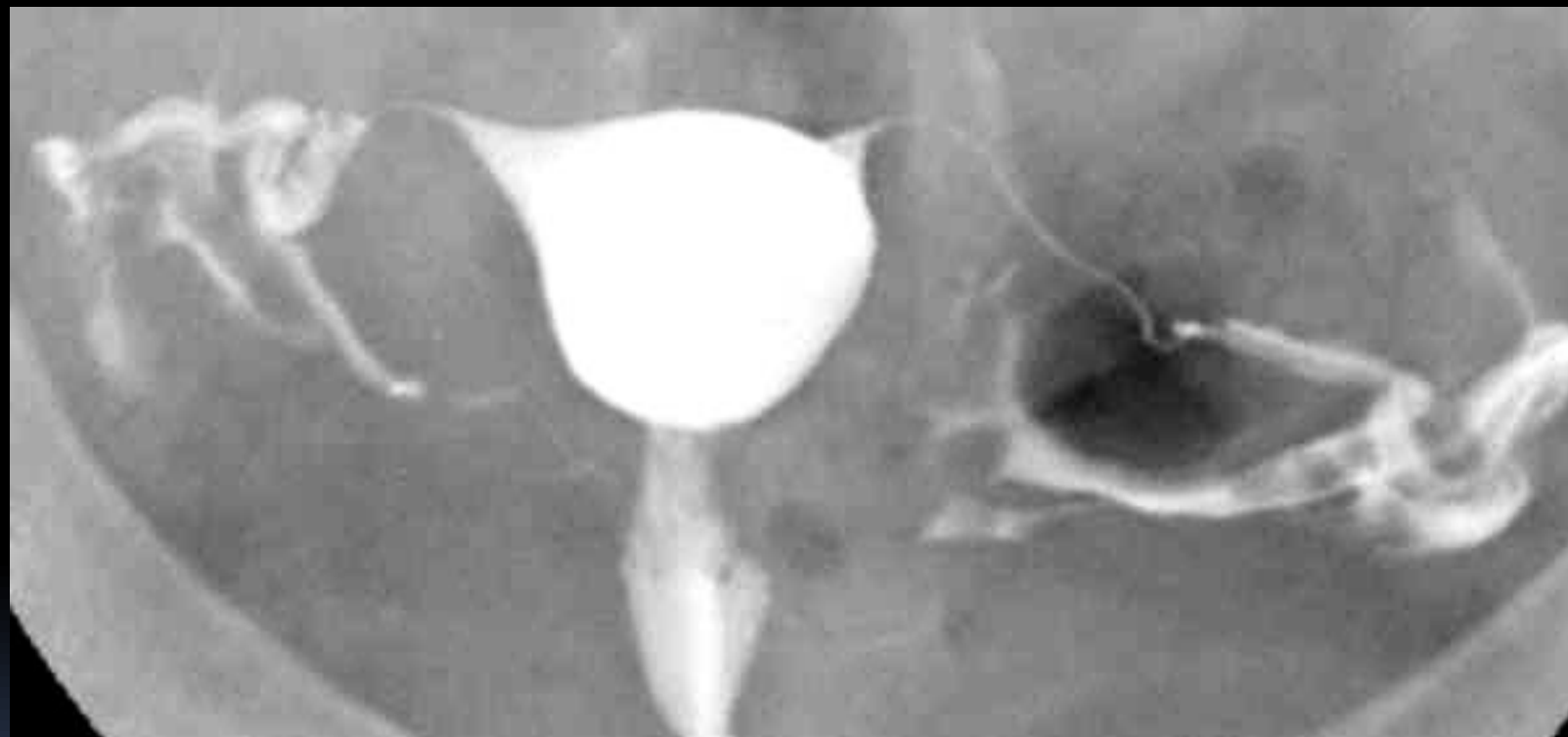
- HSG remains the front-line imaging modality in the investigation of infertility.
- It is an accurate means of accessing the uterine cavity and tubal patency.
- but it has a low sensitivity for the diagnosis of pelvic adhesions, ←it cannot replace laparoscopy.
- It requires knowledge of the female anatomy as well as skillful technique in order to avoid pitfalls and misinterpretations.

CASES & Quiz











CHOCOMACPORTSMITH DEPT DIGITAL IMAGE

Se 001
Im 007
M1



42 DCM / 14 DCM / M10
W 255 L 134

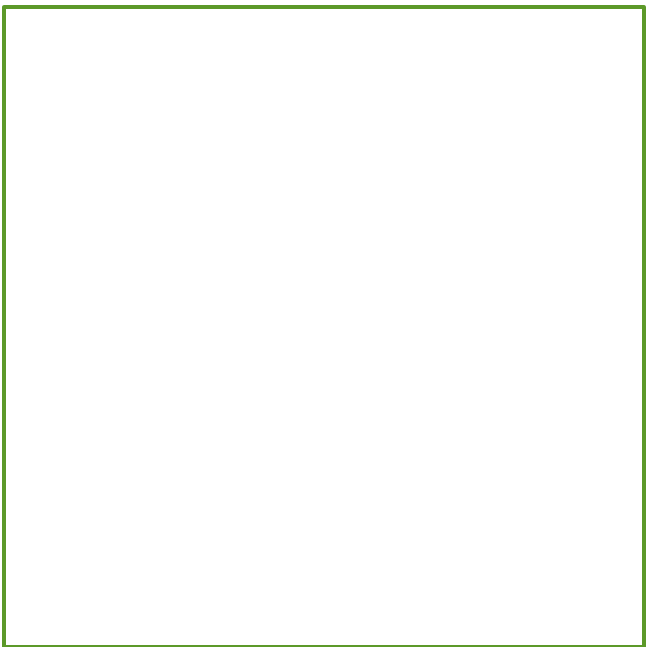
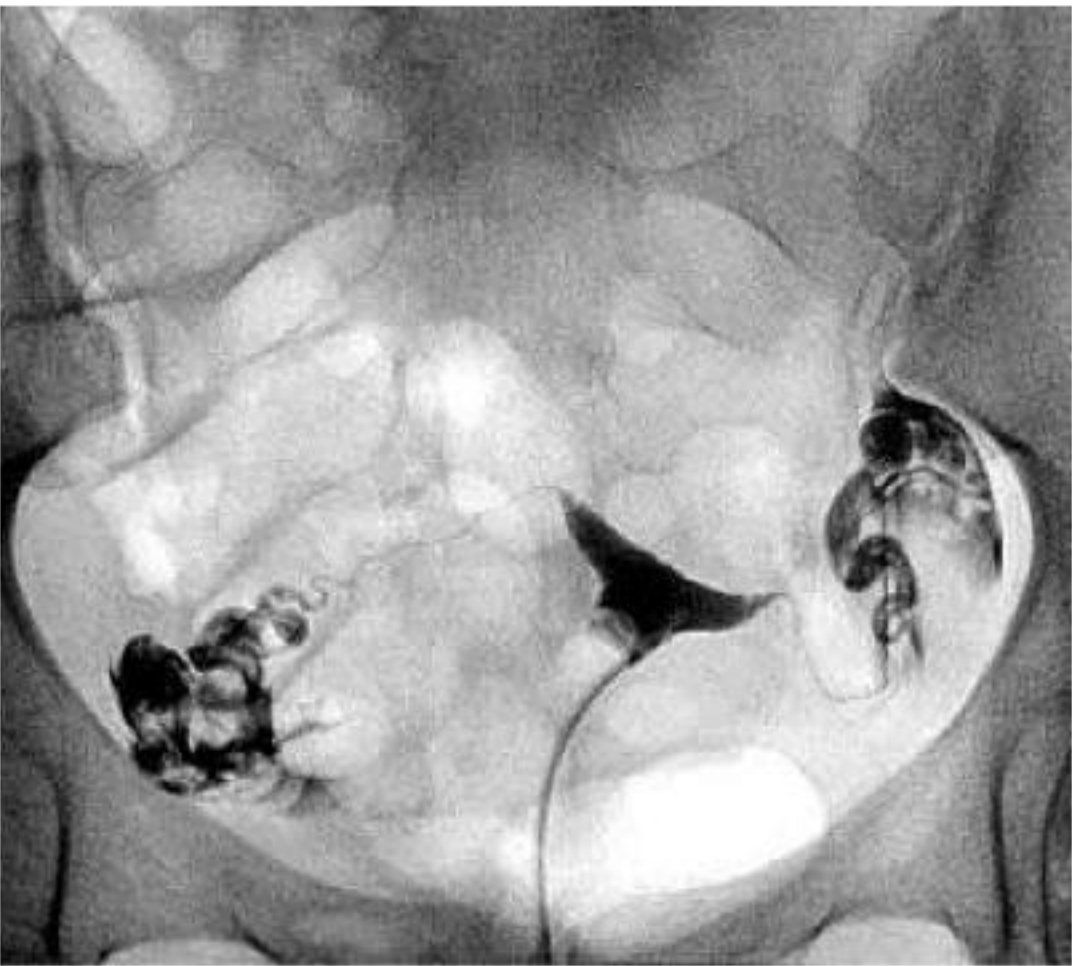






R

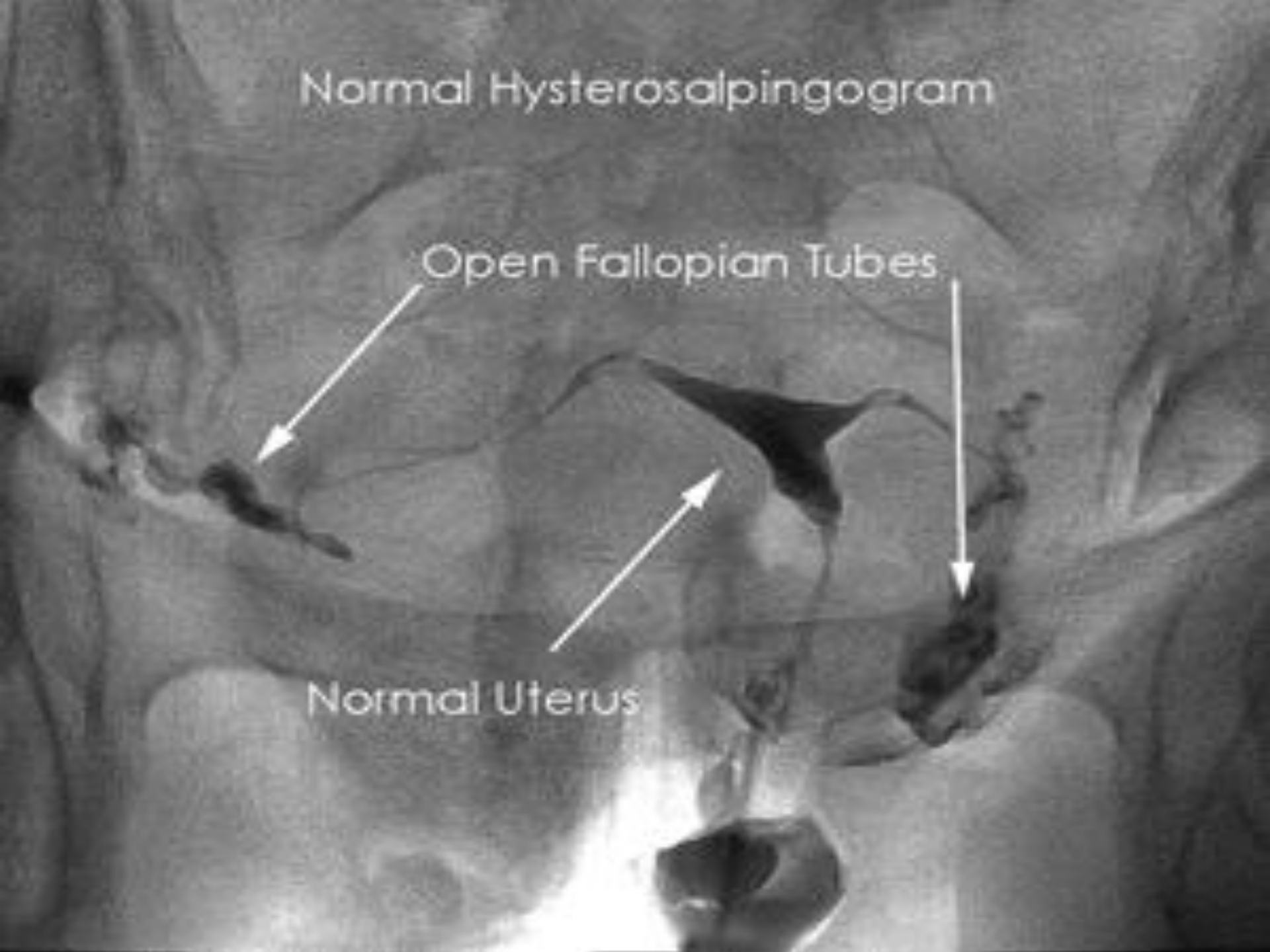


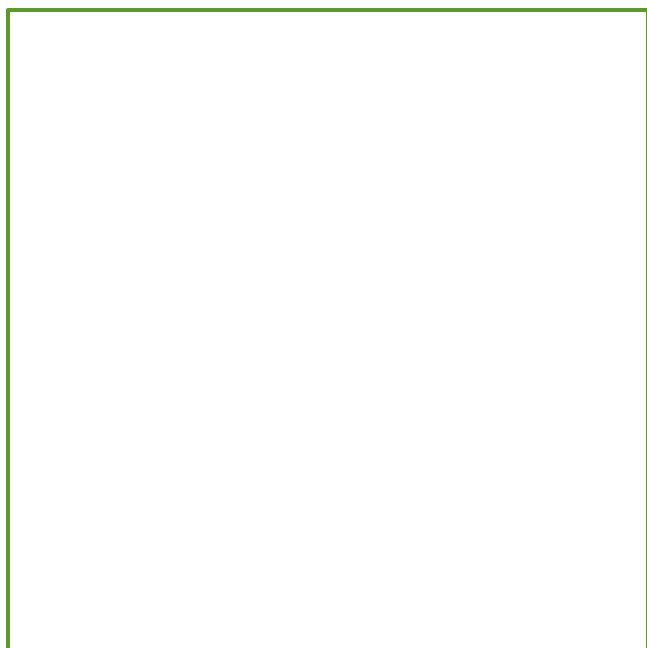


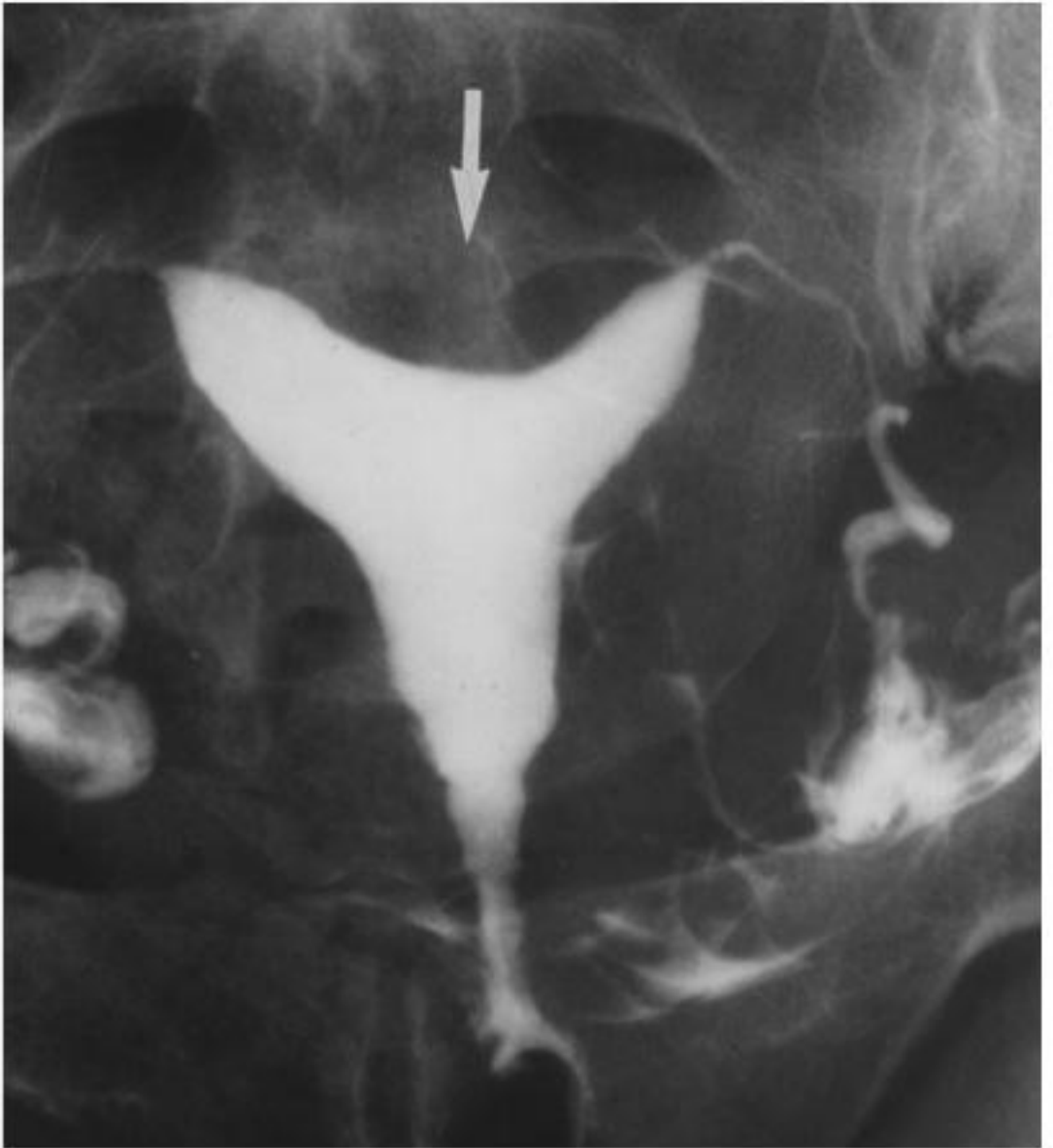
Normal Hysterosalpingogram

Open Fallopian Tubes

Normal Uterus













References:

- Hysterosalpingography: Technique and Applications ., Athanasios Chalazonitis, MD., et al , Curr Probl Diagn Radiol, September/October 2009.
- The WHO manual of diagnostic imaging, Radiographic Technique and Projections. Editors Harald Ostensen M.D.
- HSG film reading_Dr Rasha Kamal



For More Lectures visit our web pages:

- <http://students-of-prof-mamdouh-mahfouz.blogspot.com>
- <http://Radiology-sohag.blogspot.com>

THANK YOU

*Ahmad Mokhtar Abodahab
Ass. Lecturer of Radiology
Sohag University
24 Mar 2014*