# IMAGING OF ADNEXAL LESIONS - MALIGNANT

**PRESENTED BY**

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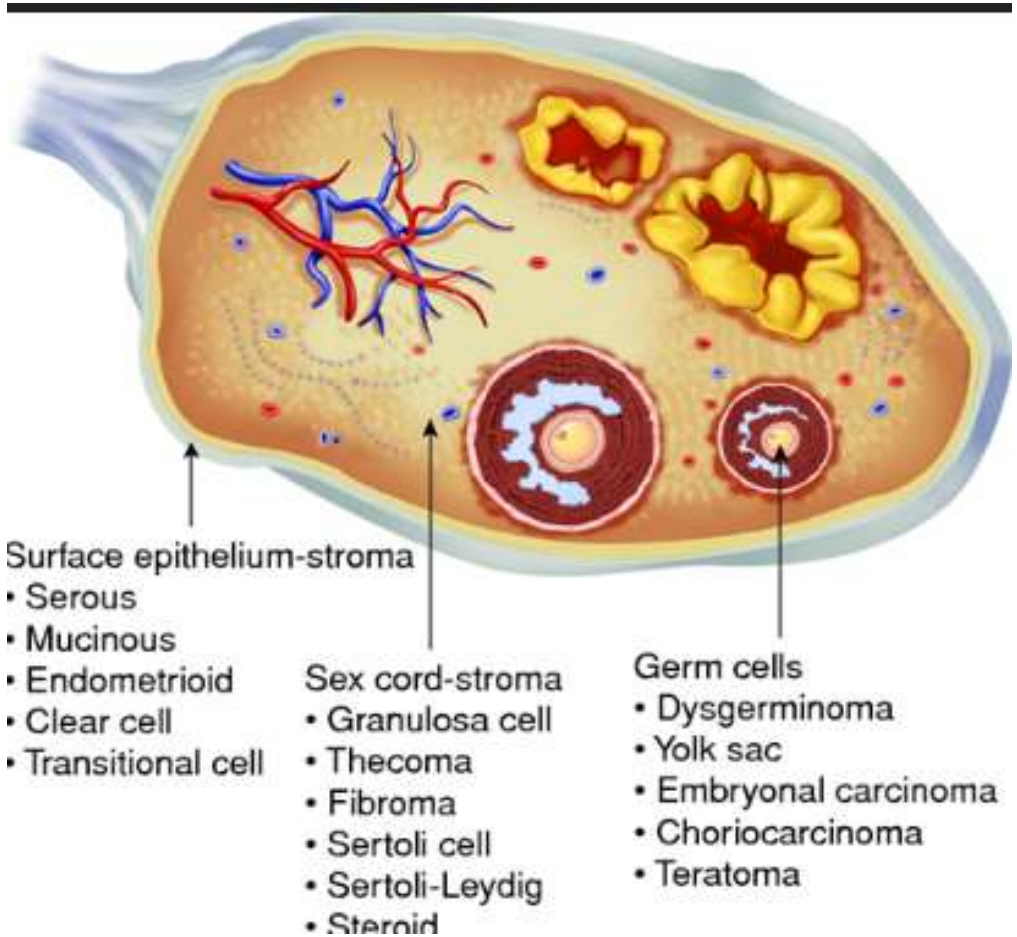
# CLASSIFICATION OF MALIGNANT ADNEXAL LESIONS

Classified into four categories :

- Epithelial cell
- Germ cell
- Sex cord stromal
- Metastases



# Epithelial cell neoplasms

- **Serous**
  - **Ovarian serous cystadenoma: ~60% of serous tumors**
  - **Ovarian borderline serous cystadenoma: ~15% of serous tumors**
  - **Ovarian serous cystadenocarcinoma: ~25% of serous tumors (most common malignant ovarian tumor)**

- **Mucinous :** 20% of all ovarian tumors
  - Ovarian mucinous cystadenoma: ~80% of mucinous tumors
  - Ovarian borderline mucinous cystadenoma: 10-15% of mucinous tumors
  - Ovarian mucinous cystadenocarcinoma: ~5-10% of mucinous tumors

- Ovarian endometrioid tumor: 8-15% of all ovarian tumors
- Clear cell ovarian carcinoma: ~5% of ovarian cancer
- Brenner tumor: 2-3% of ovarian epithelial neoplasms
- Undifferentiated carcinoma of the ovary: ~4% of all ovarian tumors

# Germ cell tumors

- Ovarian teratoma:

  commonest primary benign tumor of ovary and commonest germ cell tumor:

  - Mature (cystic) ovarian teratoma
  - Immature ovarian teratoma
  - Specialized teratomas of the ovary
    - Struma ovarii tumor
    - Ovarian carcinoid tumors
- Ovarian dysgerminoma

- Ovarian yolk sac tumor: endodermal sinus tumor
- Ovarian embryonal carcinoma
- Ovarian choriocarcinoma
- Malignant mixed germ cell tumor of the ovary

# Sex cord stromal tumor

Arise from two groups of cells in the ovary:

- stromal cells
- primitive sex cords: celomic epithelium

The group of tumors includes

- ovarian fibroma-thecoma spectrum
  - ovarian fibroma: ~4% of ovarian tumors
  - ovarian fibrothecoma: ~1% of ovarian tumors
  - ovarian thecoma: ~1% of ovarian tumors
- ovarian Sertoli-Leydig cell tumor / ovarian chondroblastoma: ~0.5% of ovarian tumors
- granulosa cell tumor of ovary: most common malignant sex cord tumor

# SEROUS CYSTADENOMA

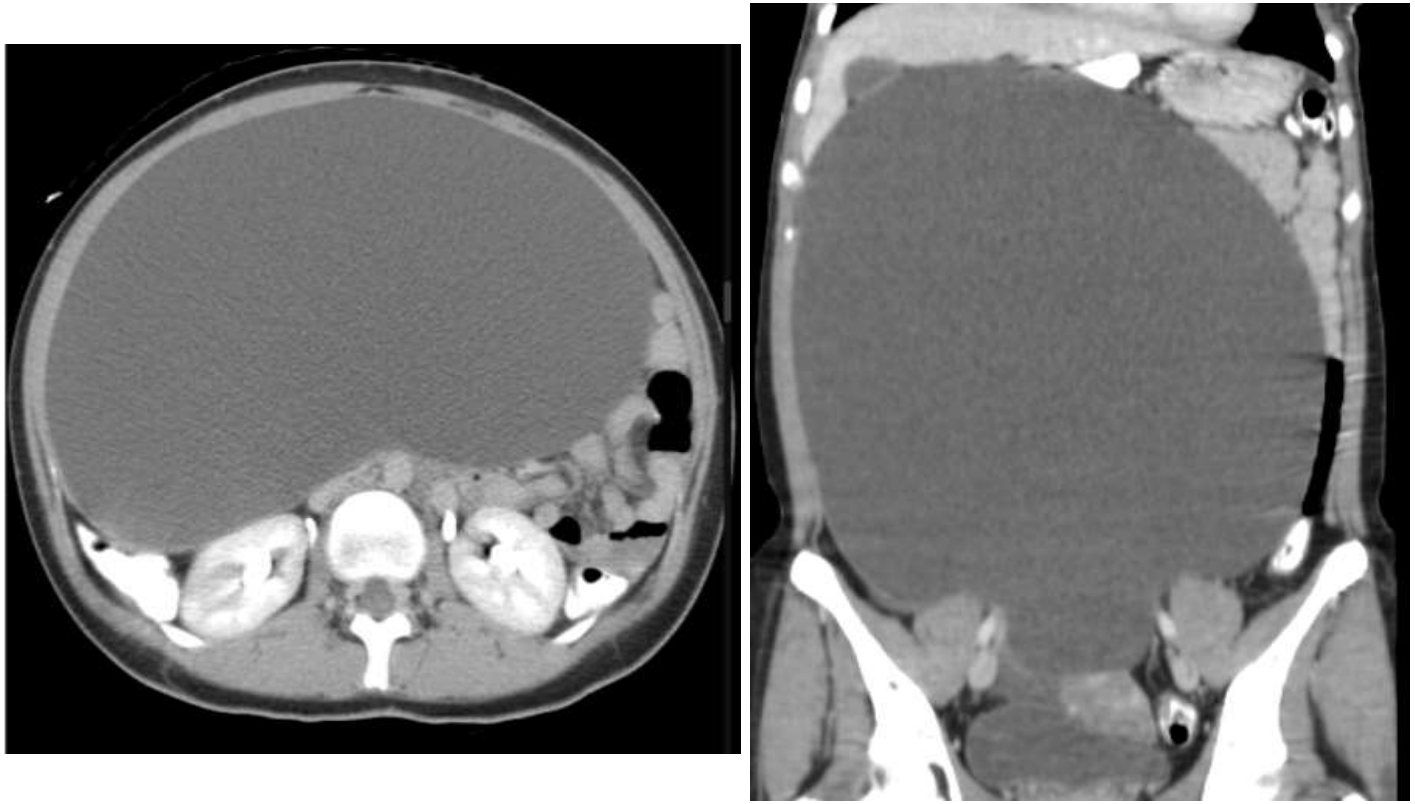
- Type of benign ovarian epithelial tumor
- Occurs predominantly between $4^{th}$ to $5^{th}$ decades of life.
- Can be bilateral

**Ultrasound**

- usually seen as a unilocular cystic/anechoic adnexal lesion
- Absent papillary projections
- No flow is detected on color doppler

**CT**

- Unilocular (typically) or multilocular cystic mass with homogeneous CT attenuation, with a thin regular wall or septum



**The axial and coronal section showing**,
A large unilocular **abdominopelvic** cystic lesion, located in the midline. There are no evident solid components, papillary projections or internal septations.

# MUCINOUS CYSTADENOMA

Benign mucin-containing epithelial ovarian tumors.

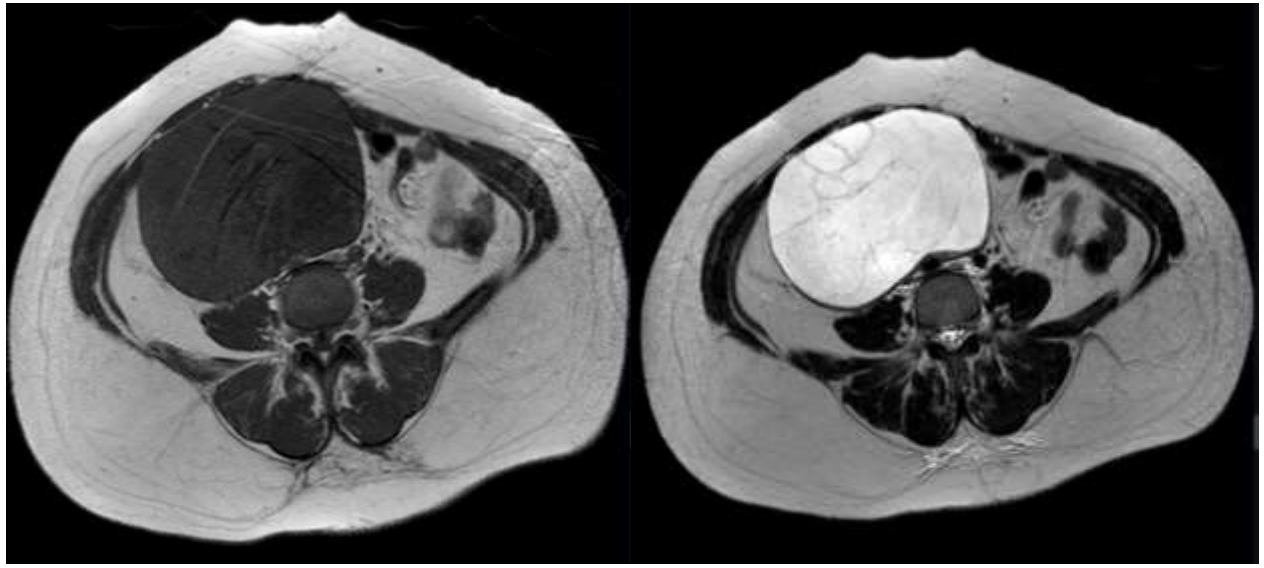
Larger than serous cystadenomas

**Ultrasound**

- Typically large cystic adnexal mass
- Multilocular with numerous thin septations
- Loculations may contain low-level internal echogenicity due to increased mucin content

**MRI**

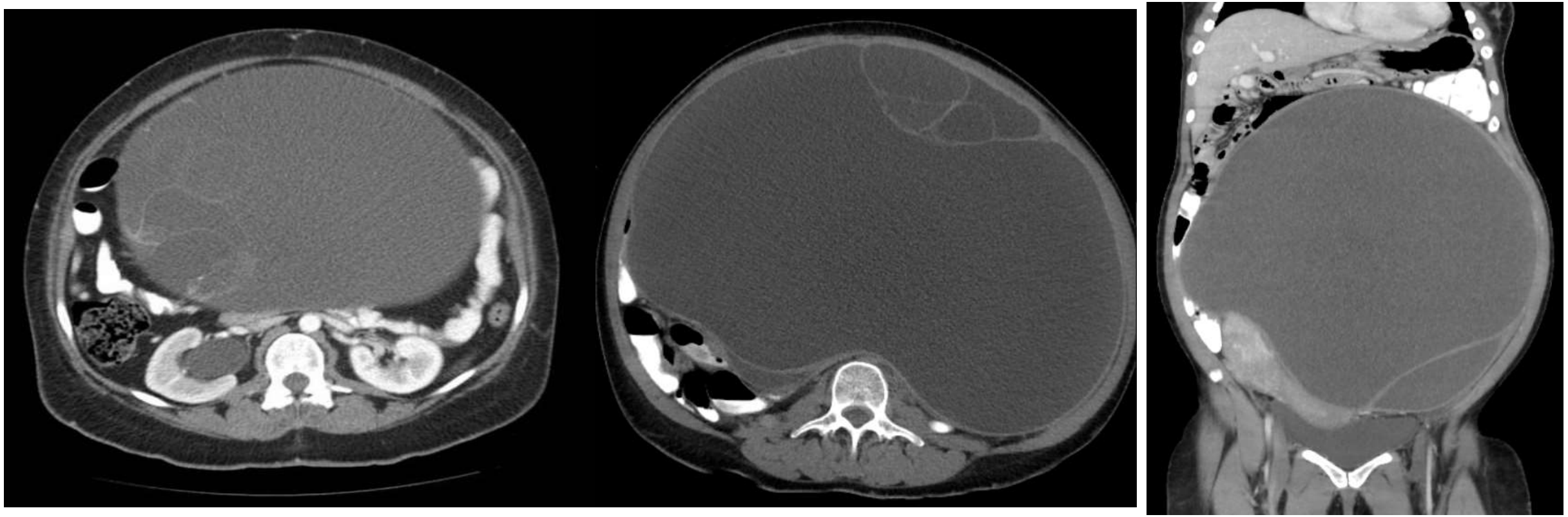
Large multilocular cysts containing fluid of various viscosity.
The loculi of the tumors often show variable signal intensities on both T1 and T2 sequences.
This can sometimes give a “stained glass” appearance.



**Hypointense on T1 WI** **Hyperintense on T2 WI**

Enhancement of the septa on post contrast study, no solid component.

# MUCINOUS CYSTADENOMA



A large abdominopelvic cystic mass with some internal septations, relatively thin wall, and no solid enhancing areas within.

# HIGH-GRADE SEROUS CYSTADENOCARCINOMA

- most common malignant ovarian neoplasm
- postmenopausal women
- originate from distal fallopian tube epithelium
- elevated serum CA-125
- cystic adnexal mass with a substantial solid component
- frequently bilateral

features suggestive of extra-ovarian metastasis include:

- ascites: often of disproportionately large volume [3]
- peritoneal nodularity with a high propensity to calcification[10]
- lymphadenopathy

## Ultrasonography

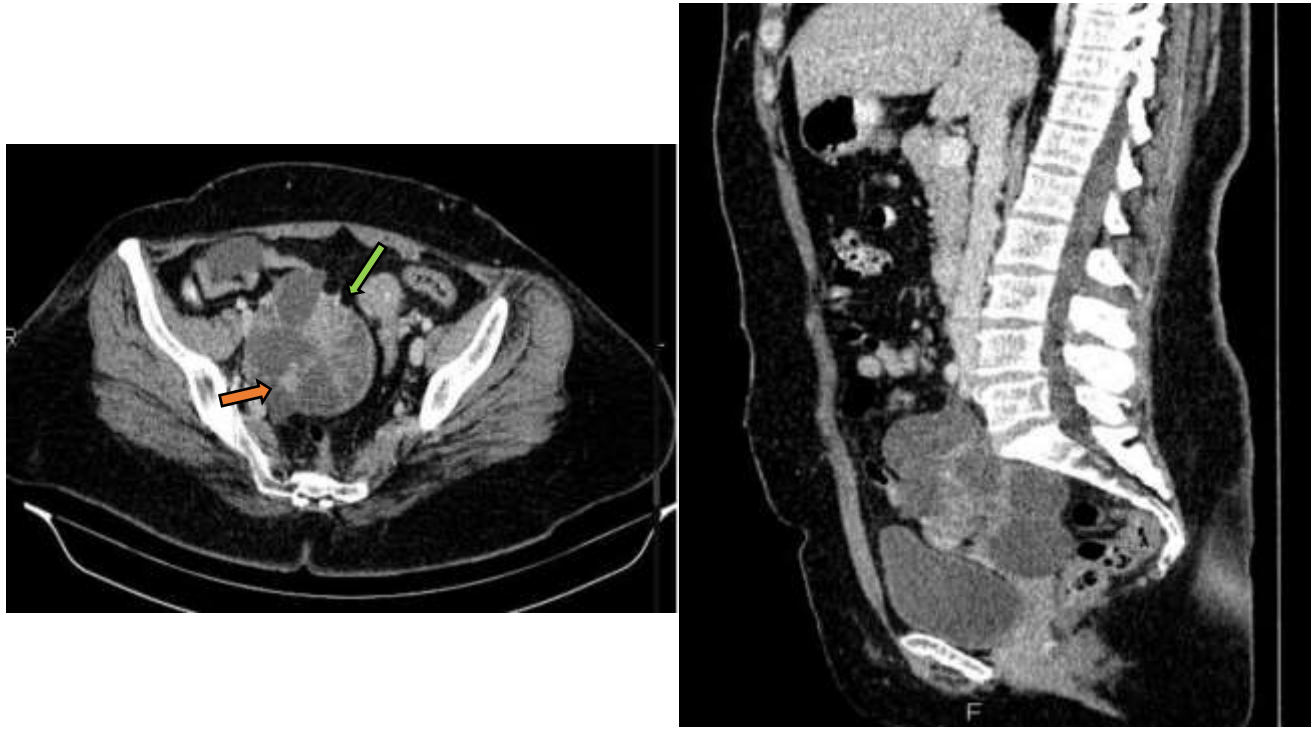
- mixed cystic/solid lesion
  - more heterogeneous
  - papillary projections, thick septations, and/or solid components
- ascites
  - peritoneal metastatic spread
  - discrete peritoneal deposits
- colour Doppler is useful to confirm vascularity of the solid components

## CT

- Use for preoperative evaluation to assess for metastatic disease, e.g. peritoneal nodularity, ascites, or intrathoracic lesions.

## MRI

- Provides the most detailed imaging evaluation and used in either preoperative evaluation or post-treatment follow-up.
- **T1**
  - cystic components - T1 hypointense unless there has been intralesional hemorrhage
- **T2**
  - cystic portions T2 hyperintense

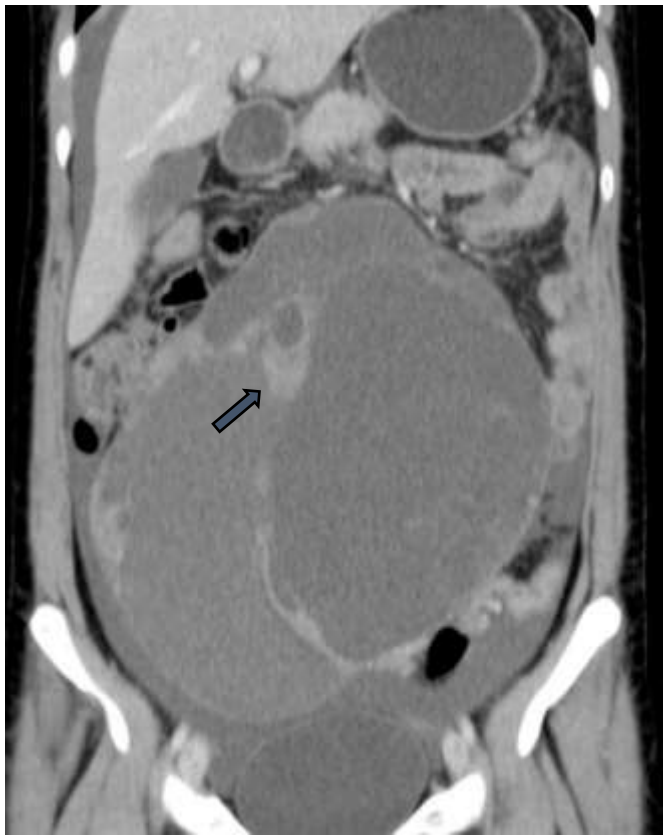


Axial and sagittal contrast-enhanced CT image - a predominantly cystic mass with enhancing papillary projections (orange arrows) and solid components (green arrow).

# MUCINOUS CYSTADENOCARCINOMA

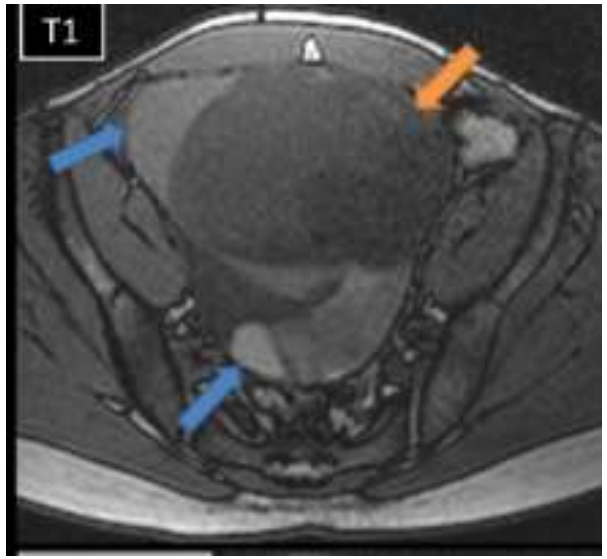
- Malignant ovarian epithelial tumor.
- Benign tumors In younger women (20-40s)
- Malignant tumors - mean presentation at 54 years
- Typically multilocular, numerous smooth, thin-walled cysts.
- Mucoid material within the cysts accompanied by hemorrhagic or cellular debris.
- Enhancing thick septa and solid nodules.
- Large masses spanning >6 cm upto 30cm.

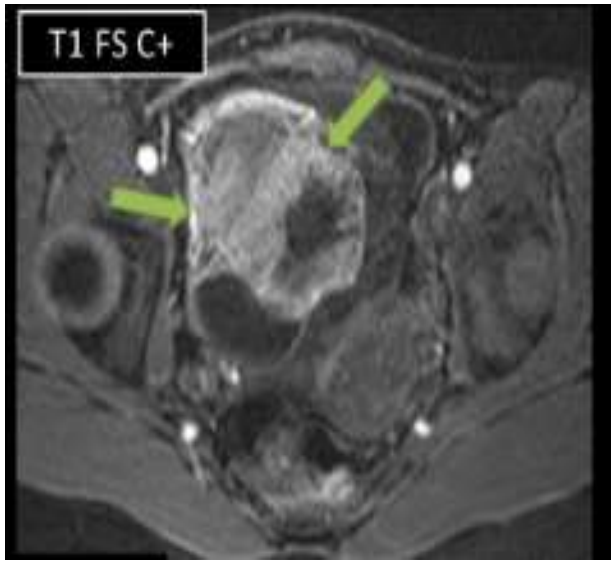
Axial contrast-enhanced CT image of the pelvis shows a large predominantly solid mass with innumerable tiny locules (dotted circles) with variable attenuation and ascites (*).

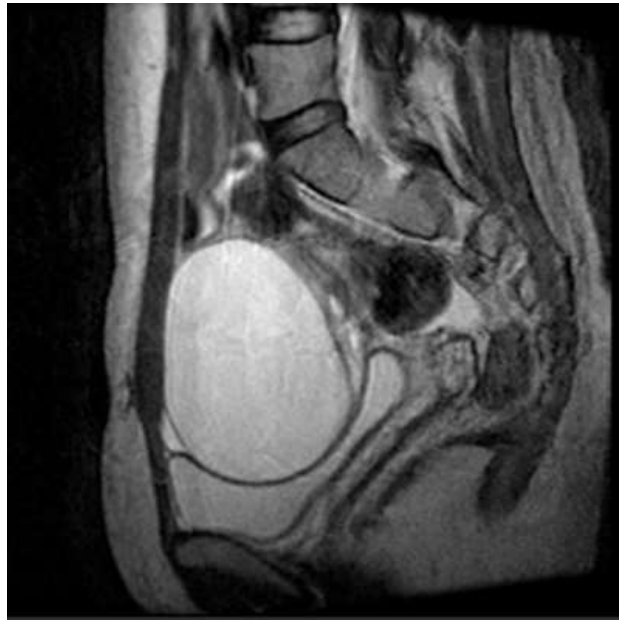


Coronal contrast-enhanced CT image

- MUCINOUS CYSTADENOCARCINOMA



# image

- **MRI**
- **T1**
  - On T1-weighted images, loculi with watery mucin have a lower signal intensity than loculi with thicker mucin
- **T2**
  - on T2-weighted images, the corresponding signal intensities are flipped, so that loculi with watery mucin have a high signal intensity and loculi with thicker mucin appear slightly hypointense

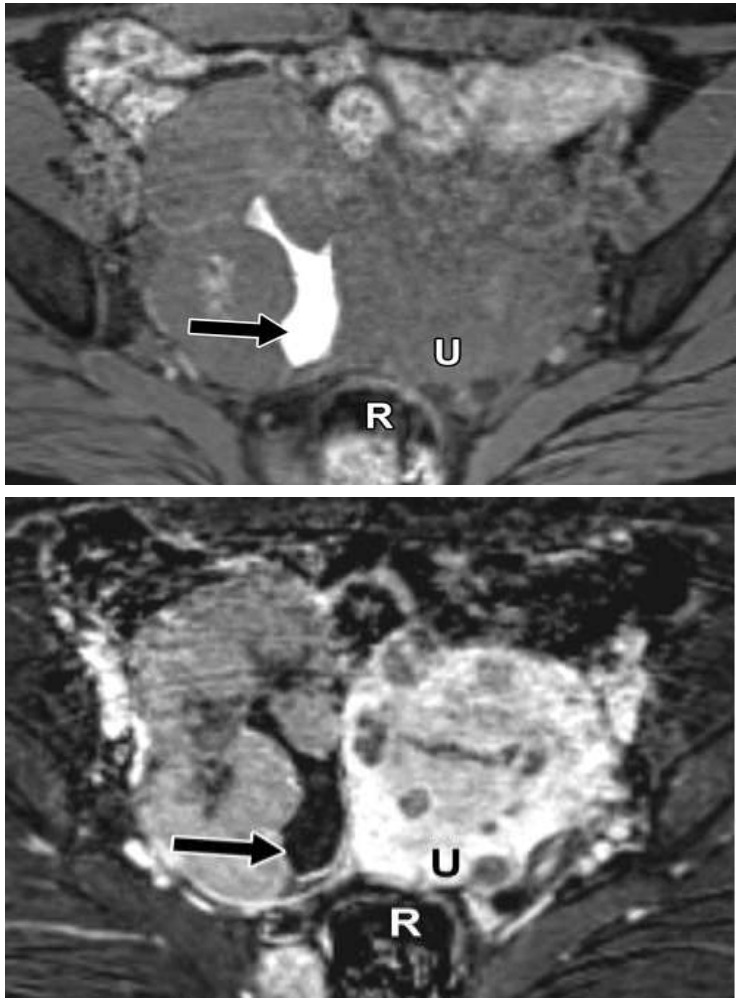
**Comparison of Serous and Mucinous Neoplasms**

| Feature | Serous | Mucinous |
|---|---|---|
| Origin and tumorigenesis | Favored to arise from fallopian tubal cells<br>Benign, borderline serous, and LGSC are distinct histologic entities from HGSC | Not well delineated<br>Continuum of tumor progression from mucinous cystadenoma to borderline to mucinous adenocarcinoma |
| Molecular abnormalities | *BRAF* or *KRAS* in borderline and LGSC<br>*TP53* and *BRCA* in HGSC | *KRAS*, *CDKN2A*, *TP53* |
| Prevalence | More common<br>HGSC is the most common cause of ovarian cancer death | Less common<br>Mucinous adenocarcinoma is rare |
| Bilateralism | Commonly bilateral | Almost always unilateral |
| Size | Variable but often smaller than mucinous | Larger |
| Patterns of spread | Early peritoneal spread | Usually confined to ovary<br>Rupture can lead to pseudomyxoma peritonei* |
| Features of borderline or malignant subtypes | Papillary projections, mural nodules, solid component, and thickened septa, especially when vascularized | Increasing and smaller size of locules (honeycomb appearance) and increasing solid tissue |
| Papillary projections | Common | Uncommon |
| Locule cyst contents | Benign: typically unilocular<br>Borderline and malignant (low and high grade): may have multiple septa or locules<br>Serous or cyst contents more homogeneous at imaging | Multilocular<br>Mucinous; differing echogenicities, attenuation, or intensities at US, CT, or MRI |
| Calcifications | Psammomatous calcifications histologically common but more rarely seen at imaging (CT) | Intramural calcifications may be present |

# ENDOMETRIOID CARCINOMA AND CLEAR CELL OVARIAN CARCINOMA

- Always invasive and malignant, although Low grade, presenting in 5th decade
- Arise from endometrial cells that implant on the ovary from either retrograde menstrual material or endometriosis implants, with cells either being malignant or undergoing malignant transformation.
- Loss of T2 shading at MRI due to dilution of hemorrhagic contents by noN hemorrhagic fluid produced by the malignant tumor.
- Clear cell Associated with thromboembolic events, the coexistence of findings of thromboembolism with a solid and cystic ovarian mass.

# ENDOMETRIOID CARCINOMA

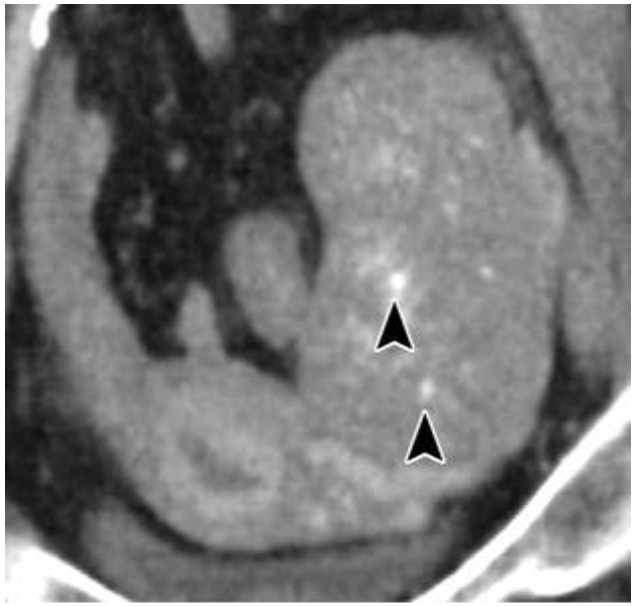



Axial precontrast and postcontrast subtracted T1-weighted fat-saturated images of the pelvis

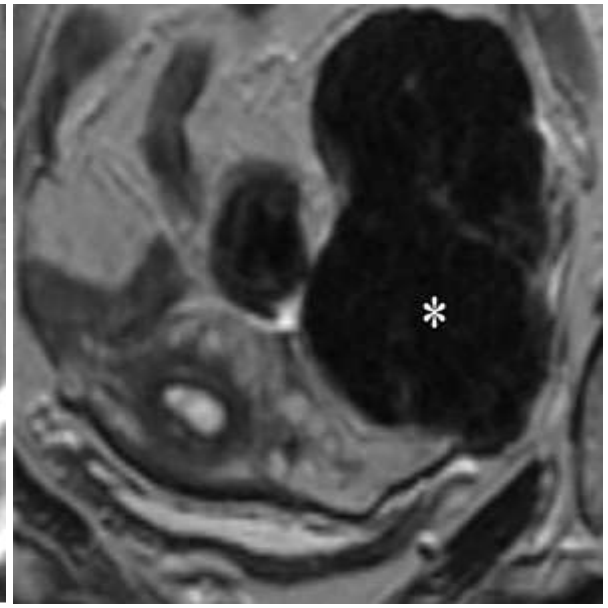
predominantly solid mass with heterogeneous enhancement and a nonenhancing intrinsically high-contrast T1 component representing hemorrhage (arrow) ,separate from the adjacent fibroid uterus *(U)* and rectum *(R)*.

# Brenner Tumor

- uncommon epithelial-stromal neoplasms of the ovary
- Always benign, are found incidentally, and often coexist with other epithelial cell neoplasms (most commonly mucinous cystadenoma)
- Small (2.5 cm), predominantly solid, and may have extensive amorphous calcifications
- Posterior acoustic shadowing with little to no color Doppler flow in the solid components
- Markedly low T2 signal intensity of the solid component (lower than muscle)
- A cystic mass adjacent to the predominantly solid mass (Brenner tumor) suggests a coexistent epithelial neoplasm, typically a mucinous cystadenoma.



Axial contrast-enhanced CT image of the pelvis demonstrates a solid, smoothly marginated mass with stippled calcifications (arrowheads)




Axial T2-weighted non–fat-saturated image shows markedly T2-hypointense signal (*) within the lesion.

# Germ Cell Neoplasms (15 – 20%)

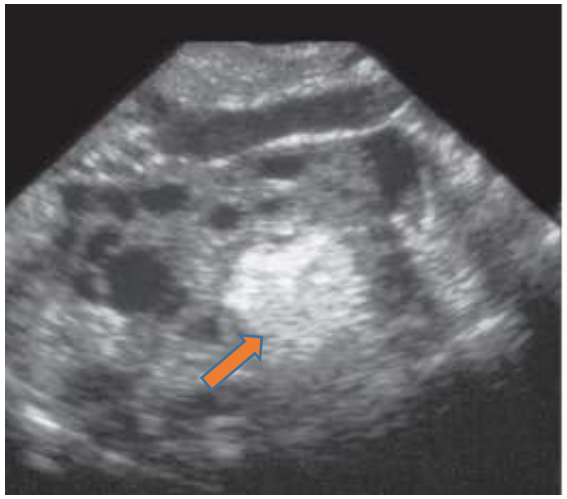
- Derived from the primitive germ cells of the embryonic

  Most common in children and young adults
- Mature cystic teratomas (Dermoids)
- Monodermal teratomas
- Immature teratomas
- Dysgerminomas
- yolk sac tumors
- Embryonal carcinomas
- choriocarcinomas

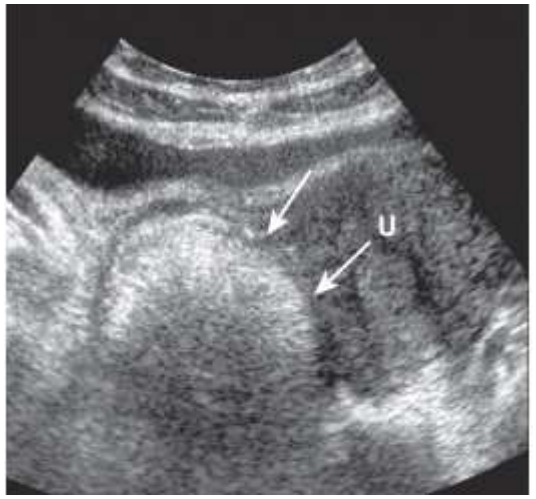
# MATURE CYSTIC TERATOMAS – DERMOIDS

(Derivatives of one or more of the three germ layers)

## Various ultra sonographical findings of dermoid / mature cystic teratoma



**Focal brightly echogenic area with sound attenuation (arrow) in an otherwise normal ovary**




**TAS image shows the uterus. In the right adnexal region, highly echogenic and attenuating mass (arrows), the “tip of the iceberg” sign.**

**TAS image showing mass with fat-fluid level, with echogenic non-dependent layer. Note the shadow (arrows) created by the echogenic dermoid plug**

# Various ultra sonographical findings of dermoid / mature cystic teratoma

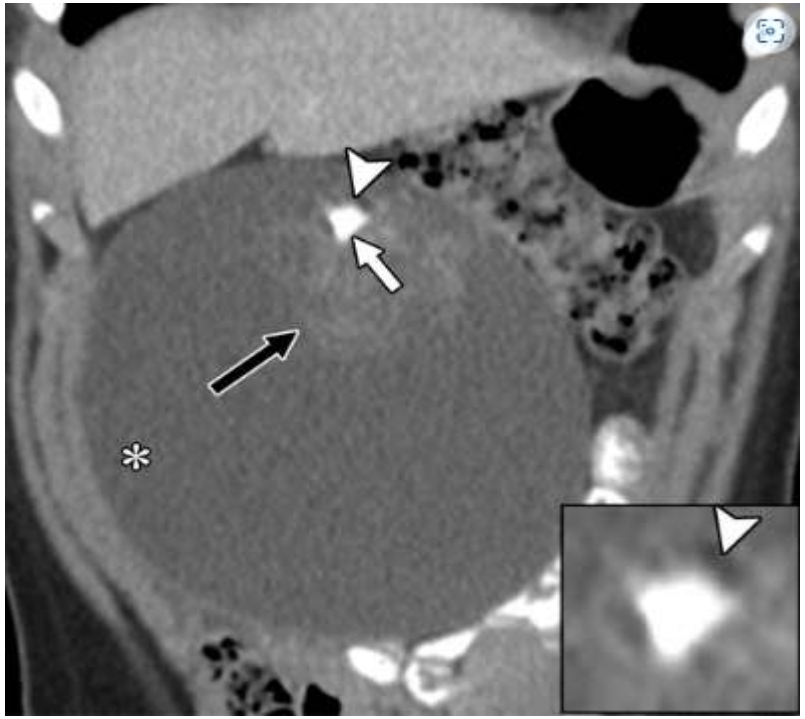
**Dermoid mesh**, multiple linear hyperechogenic interfaces (lines and dots) floating within cystic mass.

Combination of dermoid mesh and dermoid plug appearances

- **Dermoid plug** consisting of calcified structures like bone and teeth, clumps of hair, or fat in a **Rokitansky protuberance**.
- **"Tip of the iceberg" sign -** Sebum has relatively poor sound transmission obscures visualization of the back wall of the mass.

# Immature teratomas

- Malignant counterpart to mature teratomas
- Seen in younger women and are larger (median size, 18 cm).
- Present as a palpable mass
- more heterogeneous with an increased amount of solid enhancing tissue and smaller scattered foci of fat and irregular calcifications as opposed to coarsened or toothlike calcifications seen in mature teratoma, best characterized at CT and MRI.
- Often have cystic components more likely to contain simple fluid, rather than fat



Coronal CT image shows a large mass occupying the majority of the right abdomen with cystic contents made up of simple fluid (*), areas of enhancing soft tissue (black arrow), calcification (white arrow), and tiny foci of fat (arrowhead)

# IMMATURE CYSTIC TERATOMA

- less than 1% of ovarian teratomas
- younger age group in 1st two decades
- Symptoms- palpable pelvic mass or less commonly with abdominal pain
- presence of immature or embryonic tissue, as well as the mature tissue elements seen in a mature teratoma.
- MARKERS- usually, does not produce beta HCG

  Serum alpha feto proten rise in 50% [2]
- Radiological feature - large, heterogeneous mass with a prominent solid component.

# DYSGERMINOMA

- Women under 30 years
- 15% Bilateral.
- Highly radiosensitive
- Elevated LDH, b-HCG and serum alpha-fetoprotein (AFP).
- Sonographically, solid and large (4-21 cm in one series), with 5% of tumors showing small anechoic spaces due to hemorrhage or necrosis.
- On color Doppler signal is readily demonstrable in over 90% of these tumors, which mirrors the uniformly solid enhancement shown with CT and MRI.
- MRI
  Show T2- hypointense fibrovascular septa interspersed throughout the tumor, corresponding to vessels seen on ultrasound.

# YOLK SAC TUMOR

- Rapidly < 20 years.
- Almost always symptomatic with pain related to rapid growth, hemorrhage, or torsion.
- Elevated serum AFP, sometimes with elevated CA 125.
- yolk sac tumors are far more likely to have multiple cystic areas and are practically always unilateral
- The “bright dot "sign refers to demonstration of small dots of color Doppler signal on sonographic evaluation, corresponding to flow voids on MR and enhancing vessels on CT

# SEX CORD STROMAL NEOPLASMS

Types :

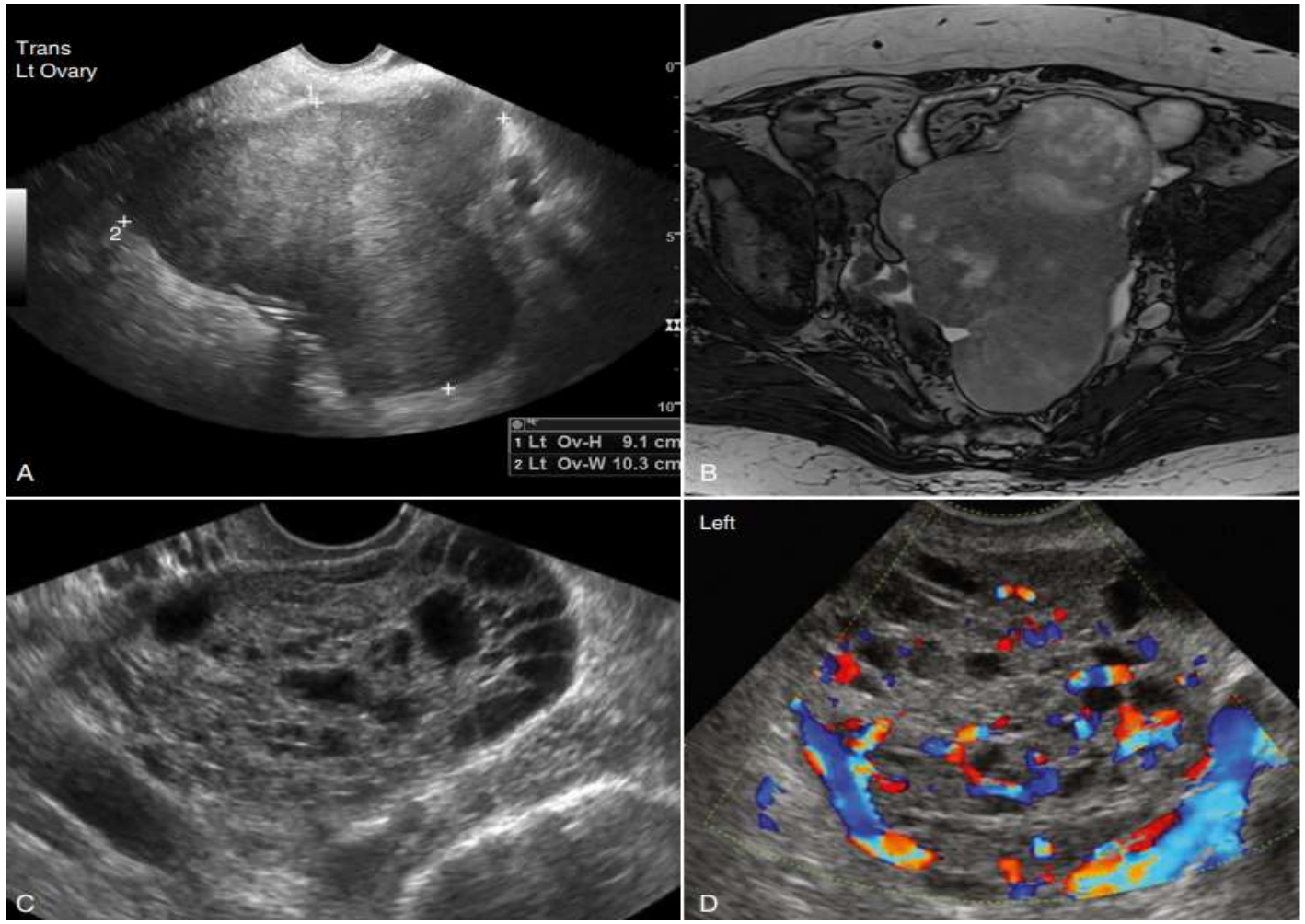
(1) pure sex cord tumors, of which granulosa cell tumor is most common

(2) pure stromal tumors, of which fibroma, thecoma, and fibrothecoma are most common

(3) mixed sex cord stromal tumors, with the rare Sertoli-Leydig cell tumor

# Granulosa cell tumor

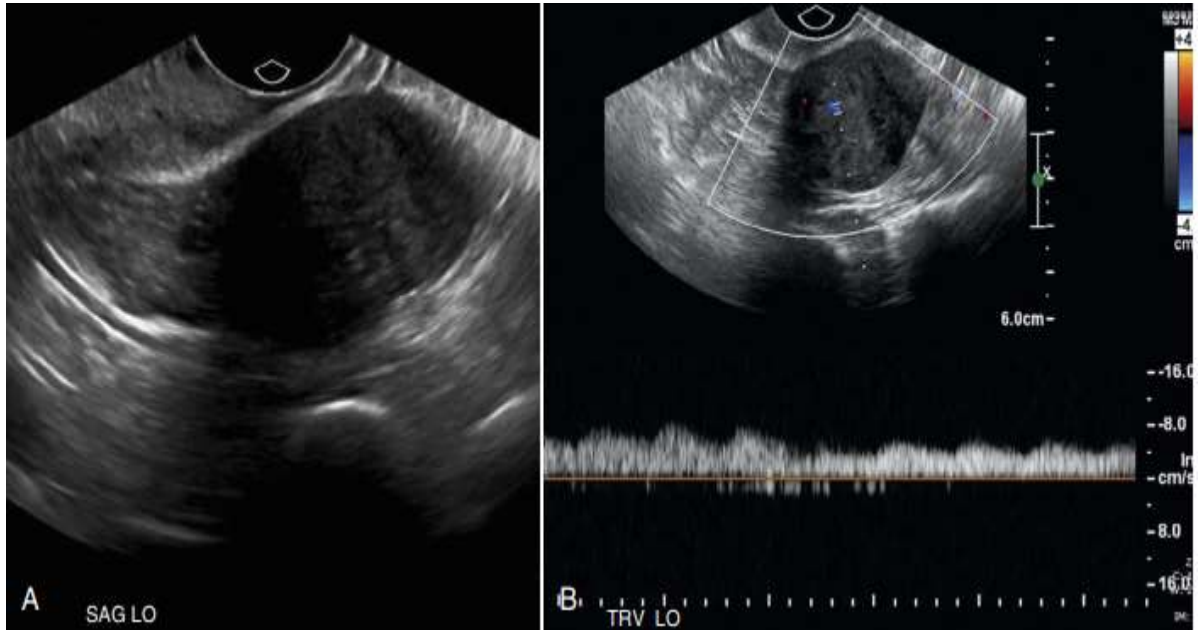
- Adult type, Perimenopausal and postmenopausal women
- A unilateral mass with abnormal uterine bleeding (from endometrial hyperplasia or endometrial carcinoma) stemming from hypersecretion of estrogen.
- Juvenile subtype, associated with enchondromatosis in the Maffucci syndrome and in Ollier disease, occurring in girls who may present with precocious puberty
- Granulosa cell tumors are large, well-vascularized solid masses with heterogeneous echogenicity of the solid tissue, or solid and cystic masses with numerous locules likened to a "**Swiss cheese" appearance.**




(A) Transvaginal image shows a large relatively homogeneous solid ovarian mass over 10 cm in maximum diameter. (B) T2 image from MR demonstrates variable internal signal with small hyperintense regions due to necrosis. (C) and (D), the granulosa cell tumor shows the Swiss-cheese appearance, different than the more homogeneous solid appearance in A and B, with abundant vascularity on color Doppler imaging

# Fibroma, Fibrothecoma, and Thecoma

- Tumors with an abundance of thecal cells are classified as thecomas
- Those with fewer thecal cells and abundant fibrous tissue are classified as fibrothecomas or fibromas
- Thecomas and fibrothecomas can show clinical signs of estrogen production from theca cells, a phenomenon not associated with pure fibromas.
- Fibromas and fibrothecomas are the most common associated with ascites and pleural effusions in the **Meigs syndrome**.
- Sonographically, fibromas and fibrothecomas are solid with poor sound transmission mimicking the appearance of a pedunculated or broad ligament leiomyoma.
- Poor color Doppler signal is typical with fibromas, manifest as minimal enhancement on MRI.



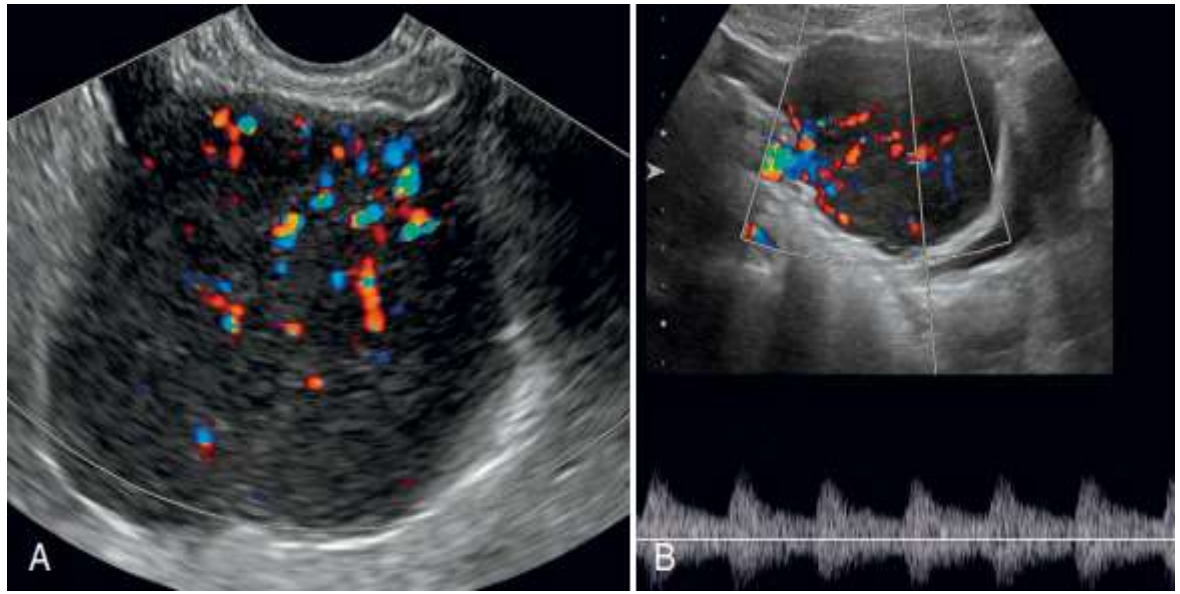

Ovarian Fibroma. (A) Transvaginal (TVS) image show a hypoechoic mass with some posterior attenuation. (B) Spectral Doppler demonstrates internal flow confirming a solid mass.

# Sertoli-Leydig Cell Tumor

- Women younger than 30 years of age, with some series having occasional patients up to 68 years of age.
- High levels of excess androgen production striking virilization at clinical presentation,
- A smaller proportion of these tumors have excess estrogen production leading to presentation with vaginal bleeding.
- Sertoli-Leydig cell tumors are cystic and solid, with the remainder being solid at imaging, the solid features predominate, with heterogeneous appearance of the solid area on sonographic evaluation and cystic areas being small.

# Metastatic Neoplasm

- 5% to 10% of ovarian neoplasms - metastatic in origin, most commonly from gastrointestinal tract is primary sources
- Endometrial carcinoma can spread to the ovary, but metastatic endometrial carcinoma may be difficult to distinguish from primary endometrioid carcinoma.
- Bilateral ovarian involvement is the rule with metastatic disease
- Ovarian metastasis from breast, stomach, and uterus are solid.
- Those from the colon and rectum are heterogeneous, multicystic with irregular borders.
- Lymphoma almost always involves the ovary secondarily.




Metastatic Disease and Lymphoma.
(A,B) solid ovarian masses or Krukenberg tumors in young woman with colon cancer
Predominantly solid ovarian masses in young woman with lymphoma

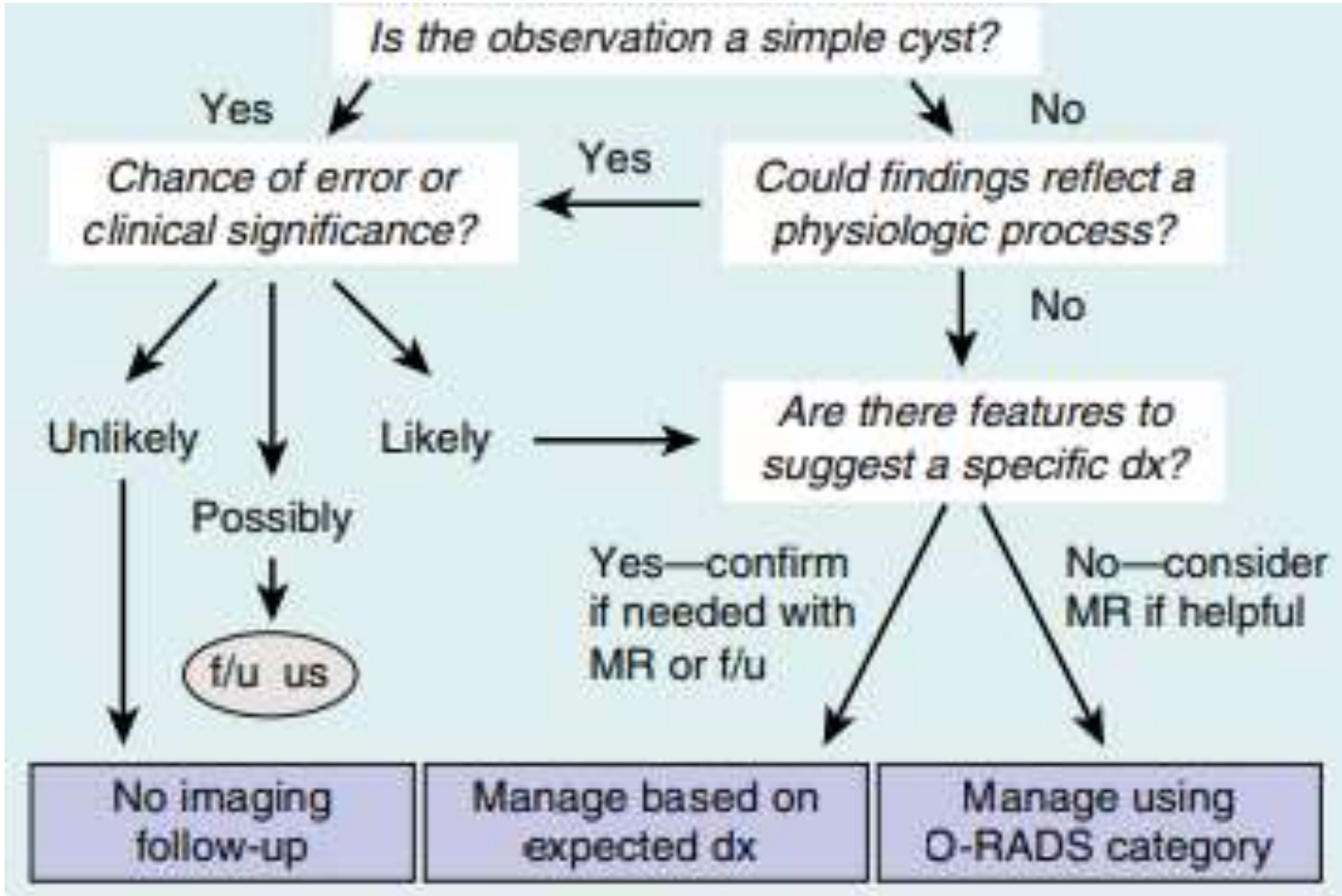
# DIAGNOSTIC APPROACH TO THE ADNEXAL MASS:

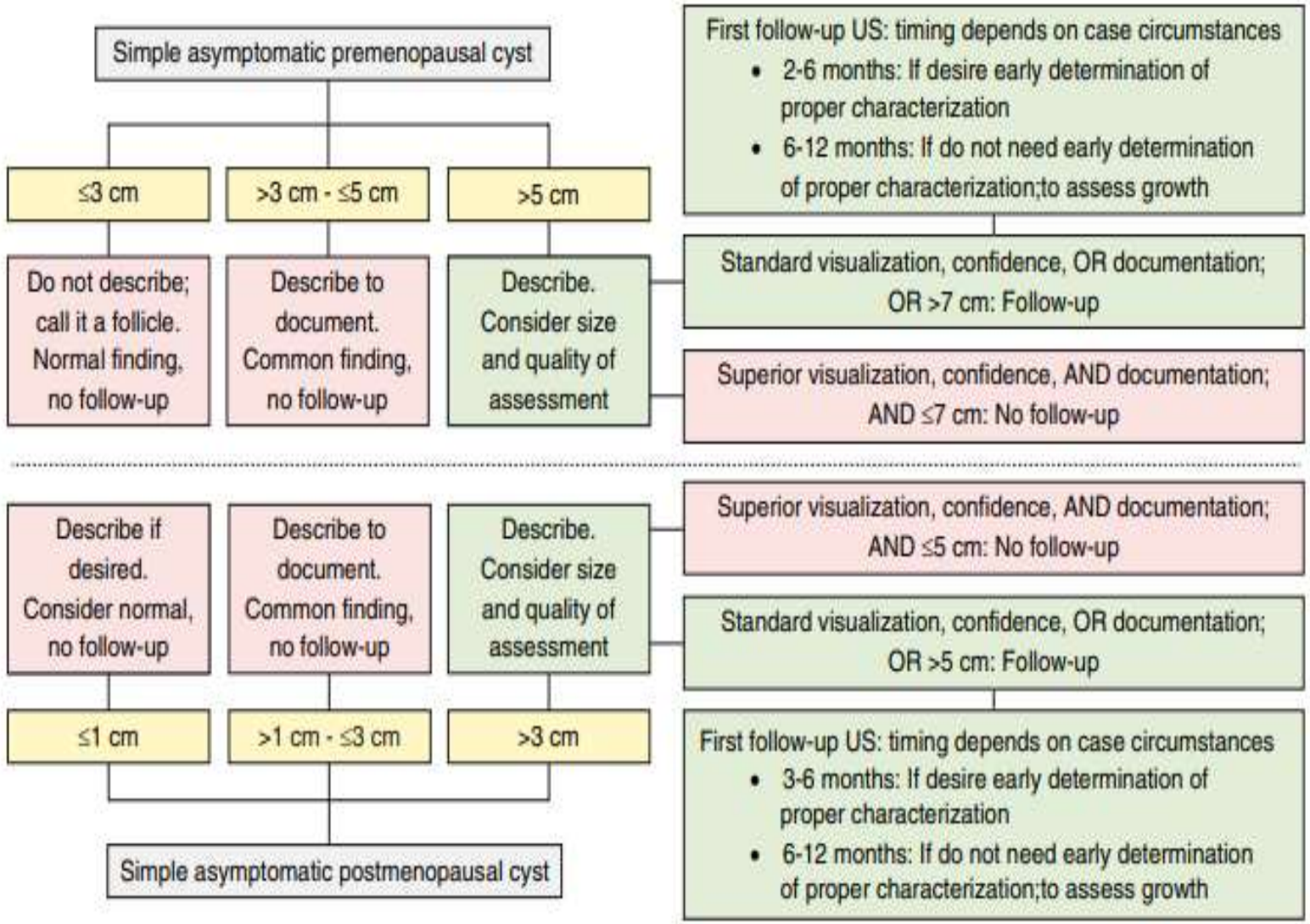
4 specific management strategies:

- (1) likely related to a **non-neoplastic process**, no need of imaging follow-up
- (2) **almost certainly benign ,even if neoplastic**- imaging needed to characterize growth rate of mass.
- (3) Not necessarily benign but **low likelihood of malignancy**- further imaging or surgical intervention
- (4**) moderate or high likelihood of malignancy -** initial gynecologic oncology surgical intervention.

# O-RADS( Ovarian-Adnexal Reporting and Data System)

- (1) normal ovary
- (2) almost certainly benign
- (3) low risk of malignancy ( 1% to 10%)
- (4)intermediate risk of malignancy (10% to <50%)
- (5) high risk of malignancy (50%)


Is the observation a simple cyst?
Yes
No
Chance of error or clinical significance?
Yes
Could findings reflect a physiologic process?
No
Unlikely
Possibly
Likely
Are there features to suggest a specific dx?
f/u us
Yes—confirm if needed with MR or f/u
No—consider MR if helpful
No imaging follow-up
Manage based on expected dx
Manage using O-RADS category


Simple asymptomatic premenopausal cyst
≤3 cm
>3 cm - ≤5 cm
>5 cm
Do not describe; call it a follicle. Normal finding, no follow-up
Describe to document. Common finding, no follow-up
Describe. Consider size and quality of assessment
First follow-up US: timing depends on case circumstances
2-6 months: If desire early determination of proper characterization
6-12 months: If do not need early determination of proper characterization;to assess growth
Standard visualization, confidence, OR documentation; OR >7 cm: Follow-up
Superior visualization, confidence, AND documentation; AND ≤7 cm: No follow-up
Describe if desired. Consider normal, no follow-up
Describe to document. Common finding, no follow-up
Describe. Consider size and quality of assessment
Superior visualization, confidence, AND documentation; AND ≤5 cm: No follow-up
Standard visualization, confidence, OR documentation; OR >5 cm: Follow-up
≤1 cm
>1 cm - ≤3 cm
>3 cm
First follow-up US: timing depends on case circumstances
3-6 months: If desire early determination of proper characterization
6-12 months: If do not need early determination of proper characterization;to assess growth
Simple asymptomatic postmenopausal cyst

**Features that suggest a malignant over a benign cystic neoplasm include:**

Large cystic mass
Thick irregular walls and septa
Papillary projections
Large soft tissue component
Ascites
Evidence of invasive spread

| CATEGORY | TYPE | CHARACTERISTICS |
|---|---|---|
| Epithelial | Mucinous | • Large multilocular without papillary projections<br>• “Stained glass” appearance: different echogenicity of locules on ultrasound (with CT attenuation and MR signal having similar varied appearance) |
| | Endometrioid and Clear cell | • Associated with endometriosis and endometrial carcinoma<br>• Can look like endometrioma with solid areas<br>• Thromboembolic association with clear cell carcinoma |
| | Brenner | • Solid, most likely to be calcified<br>• Low T2 signal on MRI |

| | | |
|---|---|---|
| Germ cell | Teratoma | Regional or diffuse echogenic areas, shadowing echodensity (dermoid plug), dot-dash (dermoid mesh), echogenic globules<br>Can look solid but has no internal flow<br>Can overlook or undermeasure on ultrasound even when large when it blends into the peritoneal fat or simulates bowel |
| | Dysgerminoma | Young(<30 years)<br>Malignant but good prognosis<br>Solid, large, well-vascularized<br>Elevated LDH |
| | Yolk sac tumor | Young symptomatic patient (rapid growth)<br>• Well-vascularized but necrotic areas<br>• Elevated AFP<br>• Bright dot sign |

| • | | |
|---|---|---|
| Sex cord stromal | Granulosa cell tumor | Solid or diffuse small cystic areas (Swiss-cheese appearance)<br>• Association with endometrial bleeding (due to tumor secreting estrogen and associated endometrial lesions) |
| | Fibroma | Usually large<br>• Solid, poor sound transmission<br>• Limited color Doppler signal<br>• Low T2 signal on MRI<br>Meigs syndrome: pleural effusion and ascites |
| | **Sertoli-Leydig cell** | Predominantly solid<br>Markedly virilizing in a third of patients<br>• Mildly androgenic effects in another 10% |
| Various Metastatic | • Bilateral, predominantly solid, older patient<br>• “Moth-eaten” cystic<br>• Rare homogeneous and hypervascular (lymphoma) | |

# THANK YOU