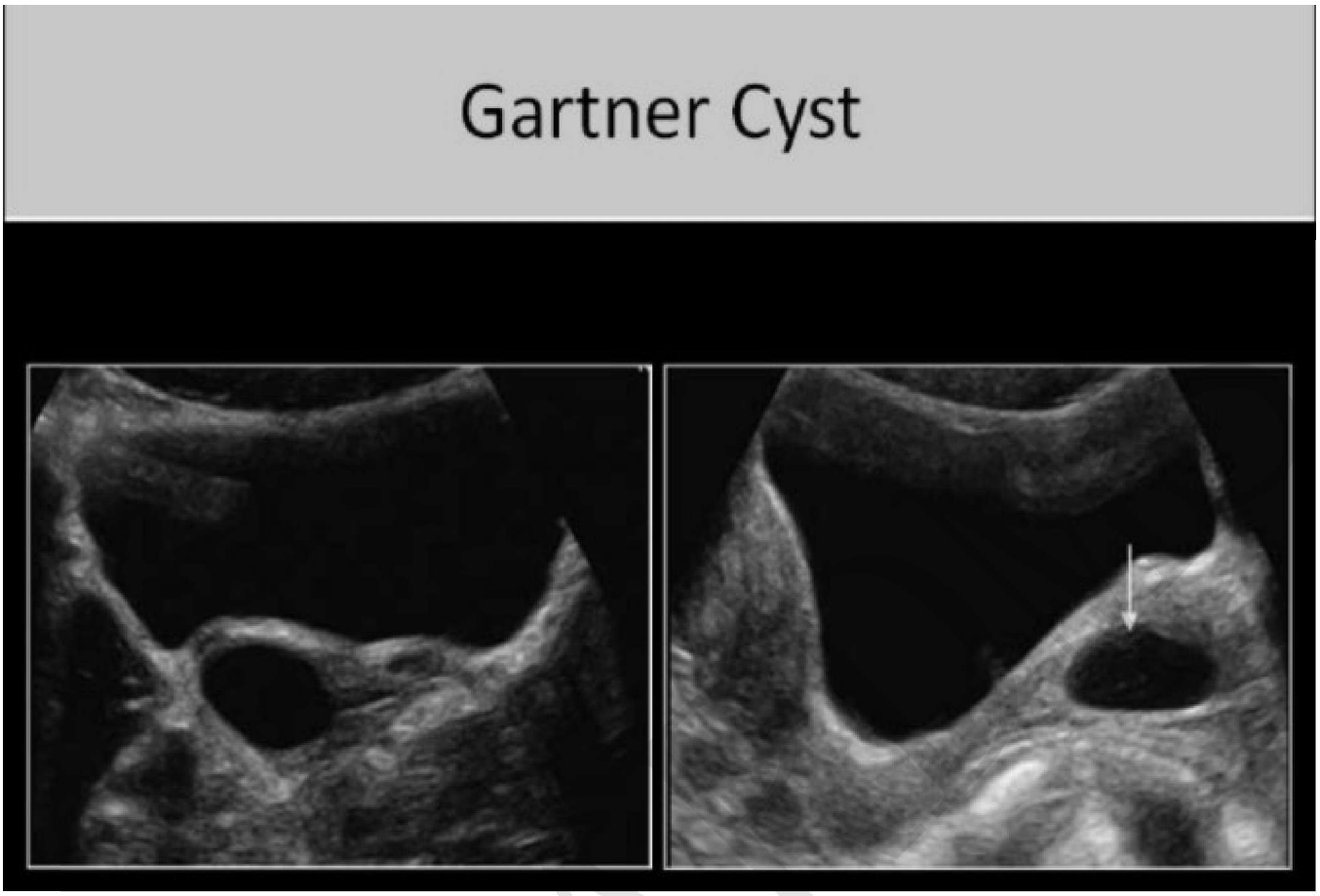



## Leiomyomas and Other Uterine Abnormalities

*Fibroids:*

- AKA Leiomyoma or Myoma
- Symptoms include menorrhagia, menometrorrhagia, back pain, urinary frequency, bloating, constipation
- Most common benign neoplasm of the uterus
- Most common solid mass found with pregnancy
- 30% females over 35yrs have fibroids
- Can cause infertility
- More common in African American women
- Also associated with obesity, early menarche, and a diet rich in red meat
- Growth stimulated by estrogen
- Pregnancy, HRT and OCP increases growth rate
- Postmenopausal increase in size could mean malignancy is present
- If a large fibroid uterus is present, the kidneys should be evaluated for related abnormalities such as hydronephrosis
- If surgical removal of a fibroid (or other mass) is required during pregnancy, the procedure should be performed between 16-20 weeks gestation

- Treatment:
  - Typically reserved for symptomatic patients; heavy, irregular bleeding, pain
  - Oral contraceptives used to reduce and regulate bleeding
  - Myomectomy - surgical removal of a fibroid
  - Uterine artery embolization - catheter inserted into the femoral artery and advanced to the uterine artery, small particles are injected to block the blood supply to the fibroid and cause it to atrophy
  - Ultrasound guided radiofrequency ablation - RF catheter is inserted into the fibroid to cause damage and atrophy
  - Hysterectomy

*Uterine Artery Embolization (UAE):*

- A catheter is used to inject small plastic or gelatin particles into the arteries supplying blood to the fibroids
- MRI is the gold standard for preprocedural evaluation of patients having UAE
- US is used to assess post procedural complications
- Contraindications include menopause, submucosal leiomyoma, significant amount of adenomyosis, active GU infection, pregnancy, suspected uterine cancer

1. *Submucosal:*

- Beneath the endometrium
- Disturbs and distorts the endometrium
- Cause more abnormal bleeding than fibroids in other locations

2. *Subserosai:*

- Just beneath the serosal outer layer of the uterus
- Can distort the contour of the uterus

3. *Interstitial or Intramural:*

- Within the muscular wall
- Most common type

4. *Pedunculated:*

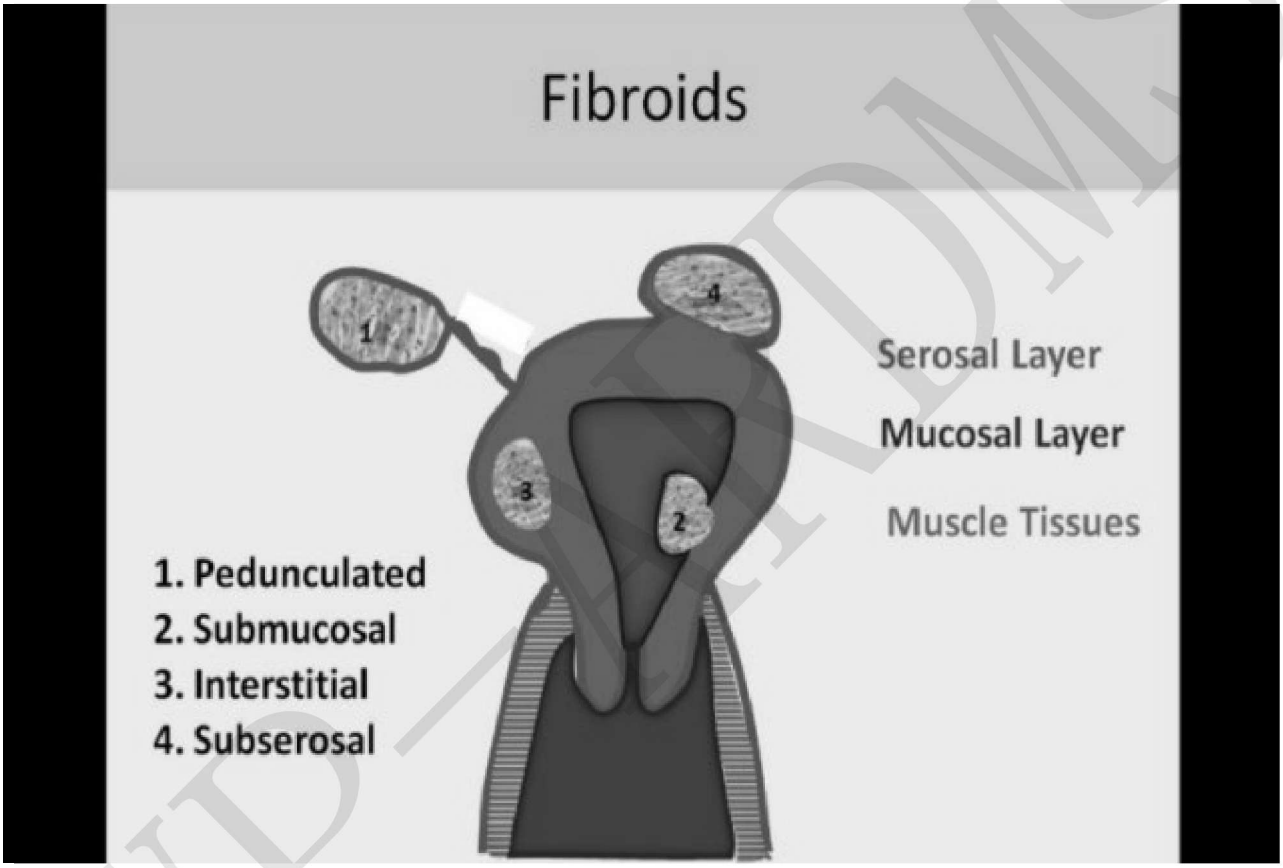
- Connected by a stalk or stem to the uterus
- At risk for torsion

*Symptoms:*

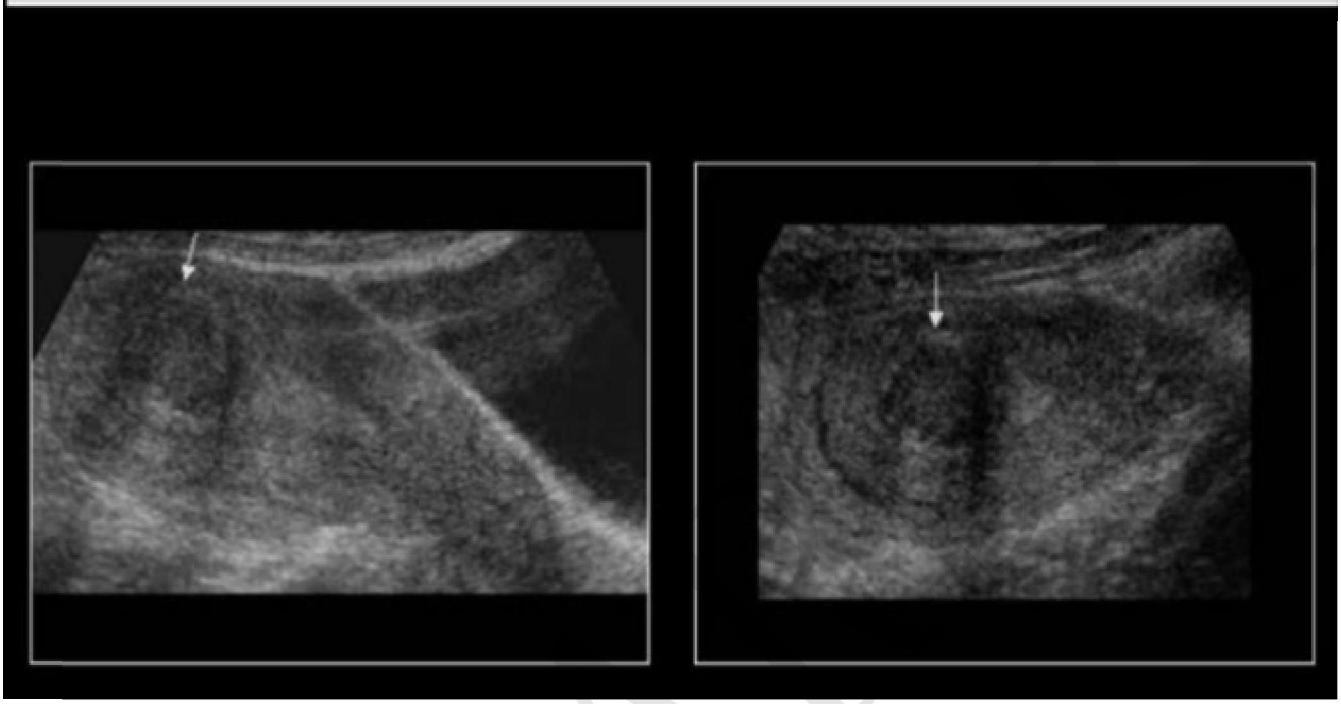
- Abdominal distension
- Pelvic pressure and bloating
- Menometrorrhagia
- Dysmenorrhea
- Anemia
- Urinary frequency and difficulty
- Constipation

- Infertility
- Dyspareunia

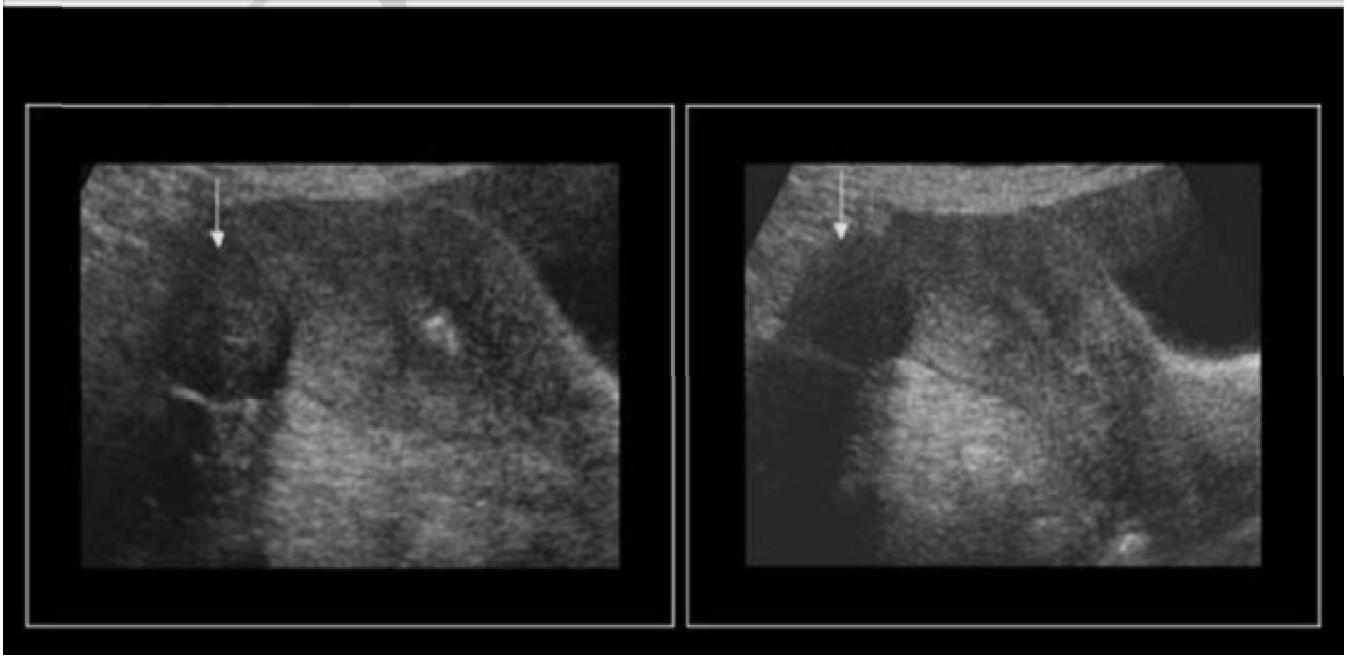
*Sonographic Appearance:*
- Sharply marginated, solid hypoechoic, inhomogeneous mass
- Pseudocapsule can be visualized due to compression of surrounding myometrium
- May see sound attenuation or absorption with posterior shadowing
- Varies in size
- May see calcification



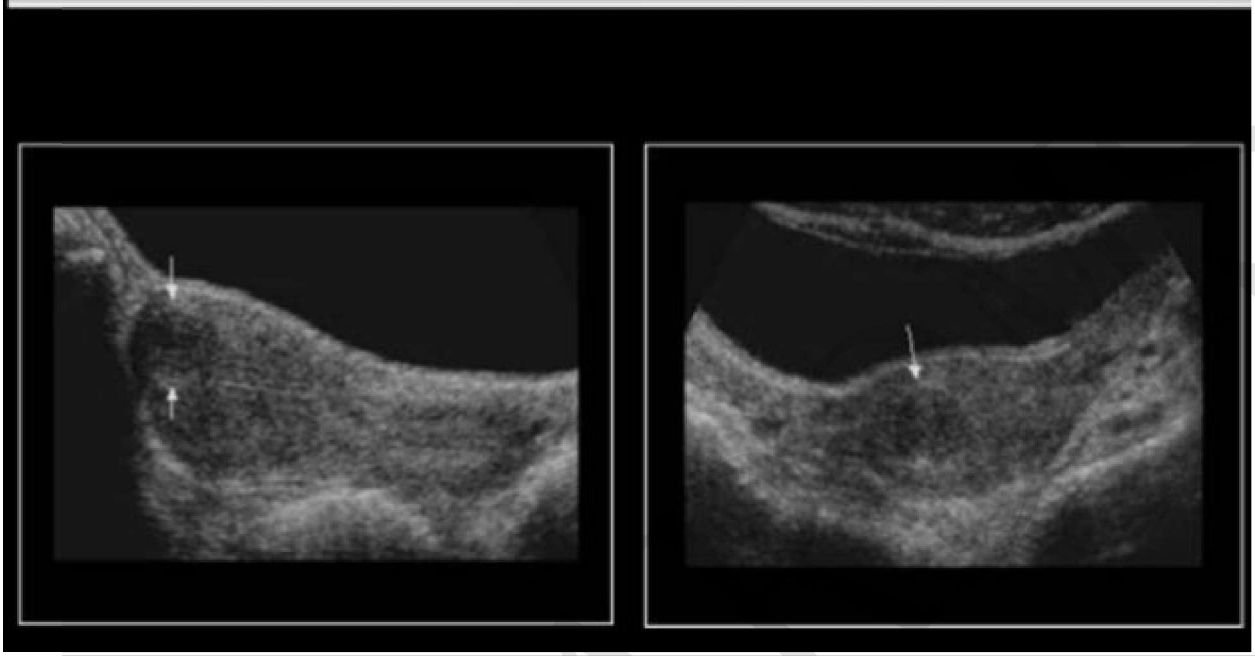
## Submucosal Fibroid



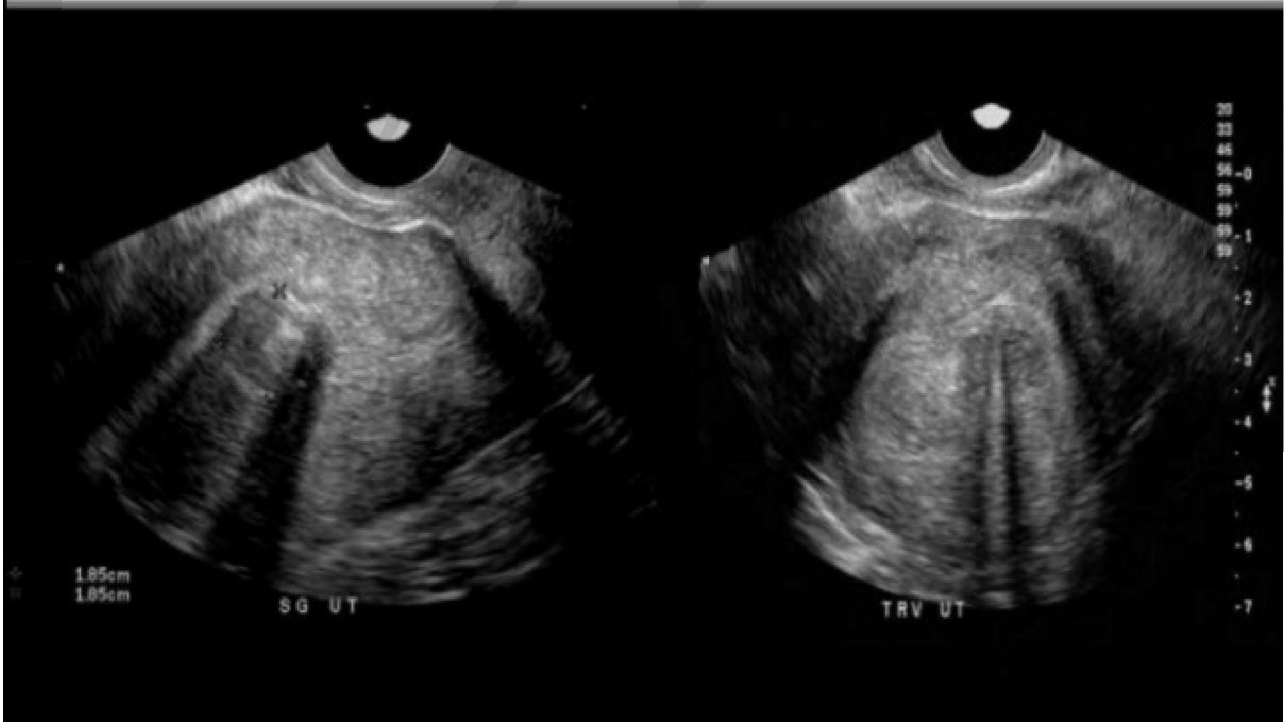
## Subserosal Fibroid



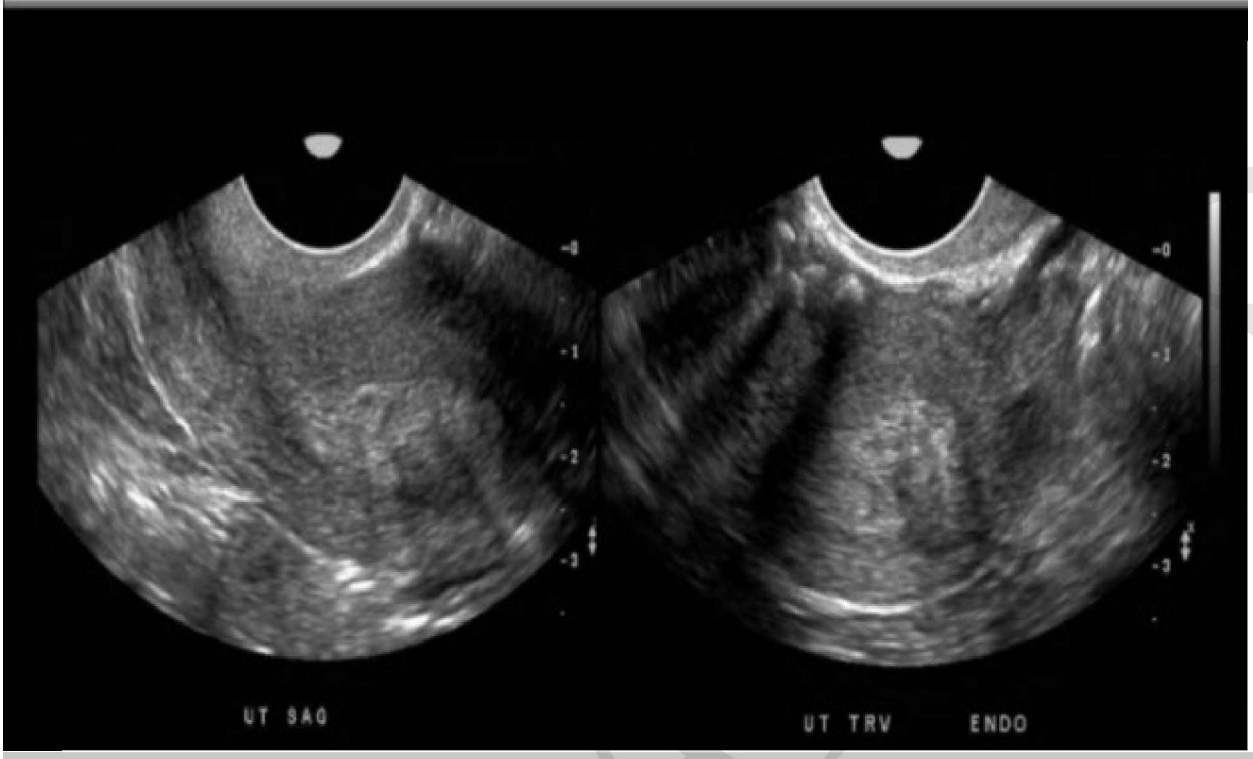
# Intramural Fibroid



# Submucosal Fibroid



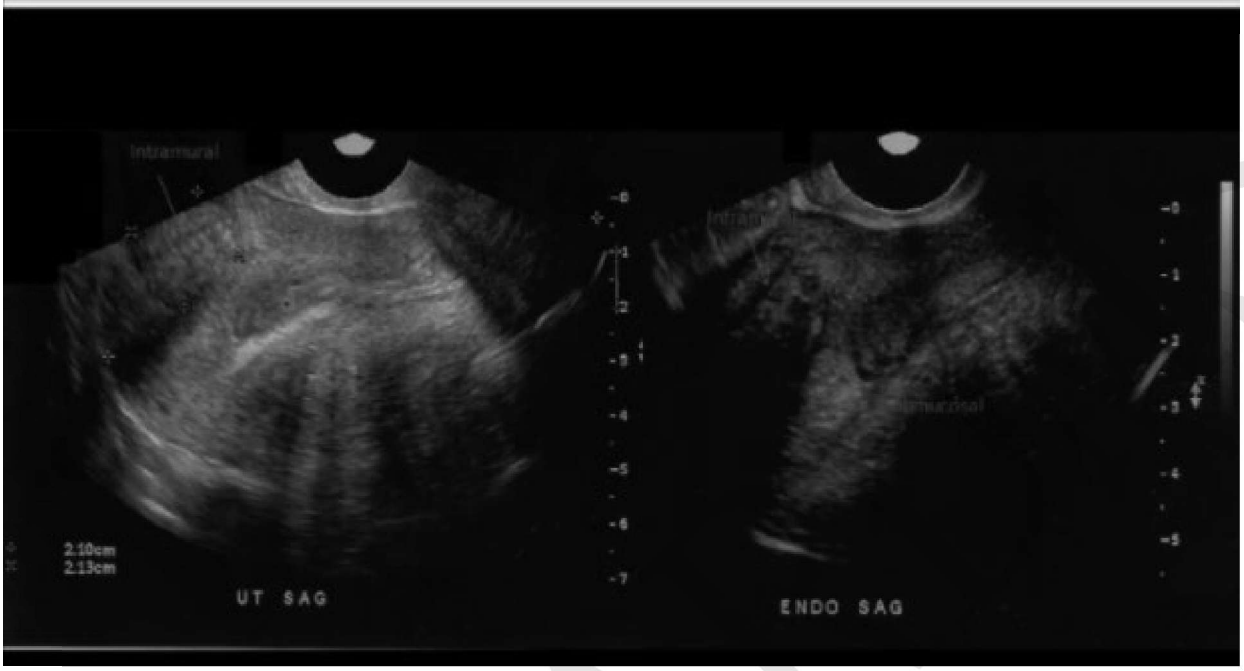
# Submucosal Fibroid




# Sumbmucosal Fibroid

Adapted from: Radiological appearances of uterine fibroids.
Wilde S, Scott-Barrett S - Indian J Radiol Imaging (2009 Jul-Sep)

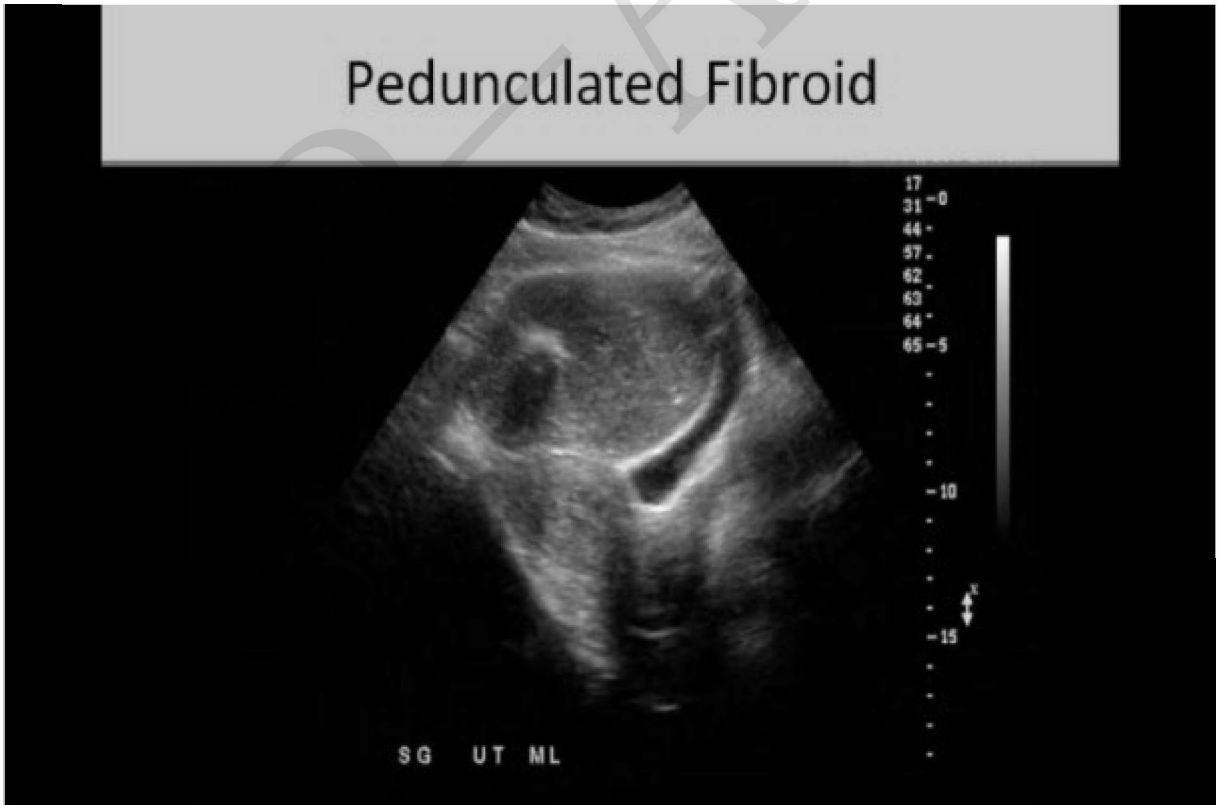
# Intramural/Interstitial Fibroid



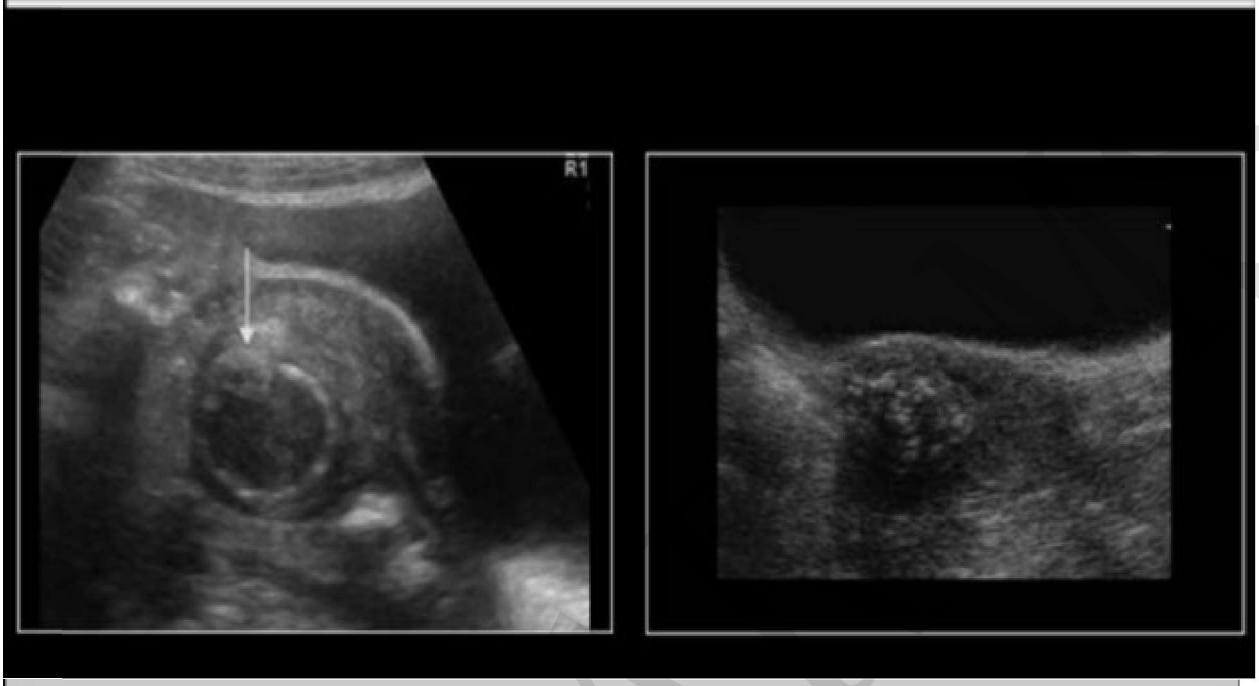

# Subserosal Fibroids

# Subserosal Fibroids

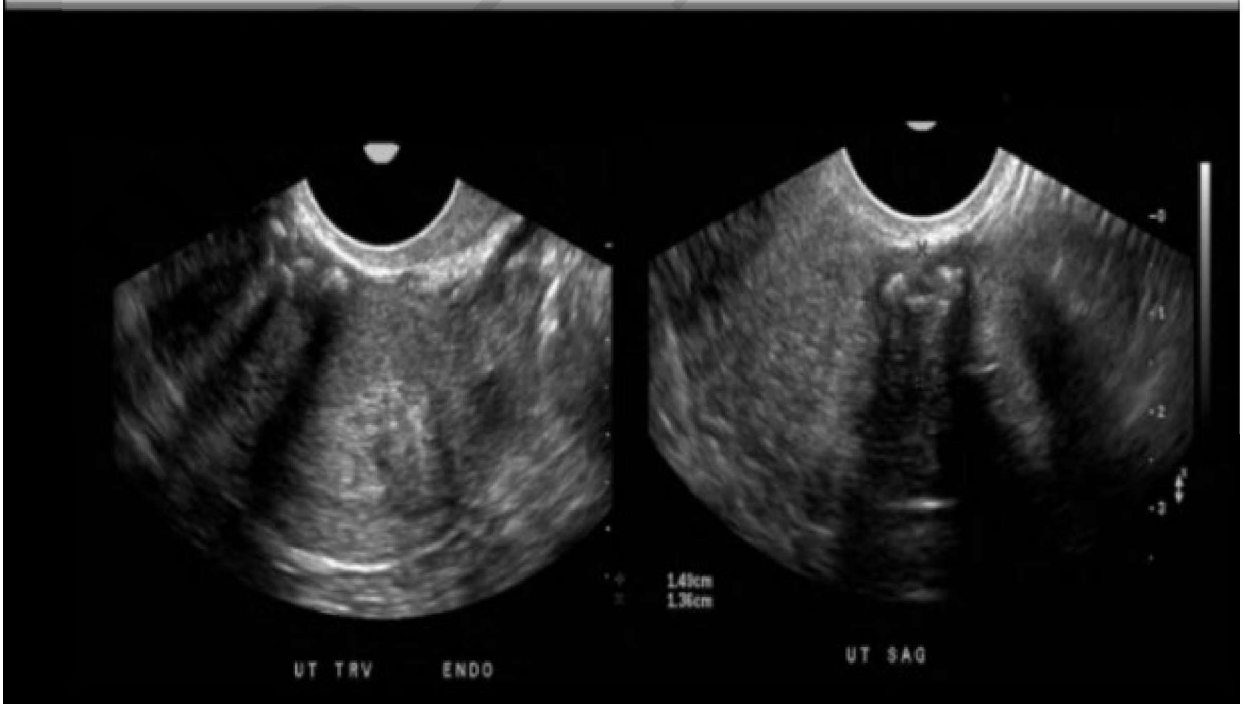

# Pedunculated Fibroid



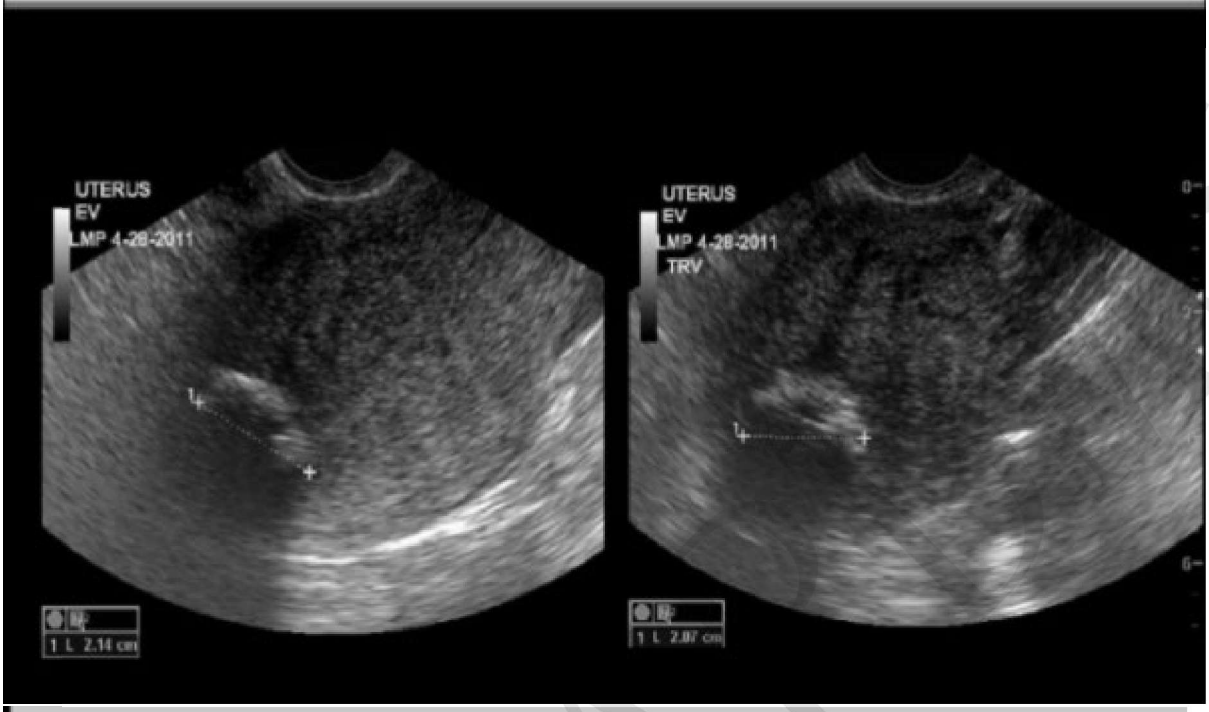
# Calcified Fibroid



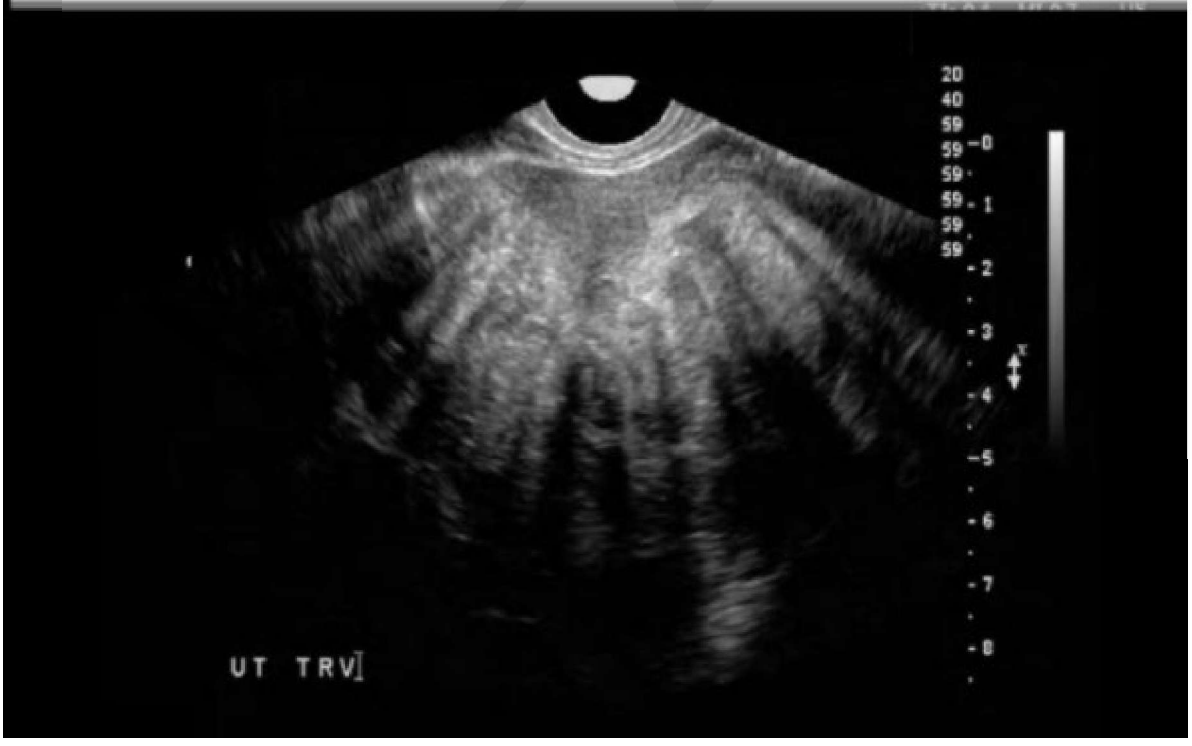

# Calcified Fibroid

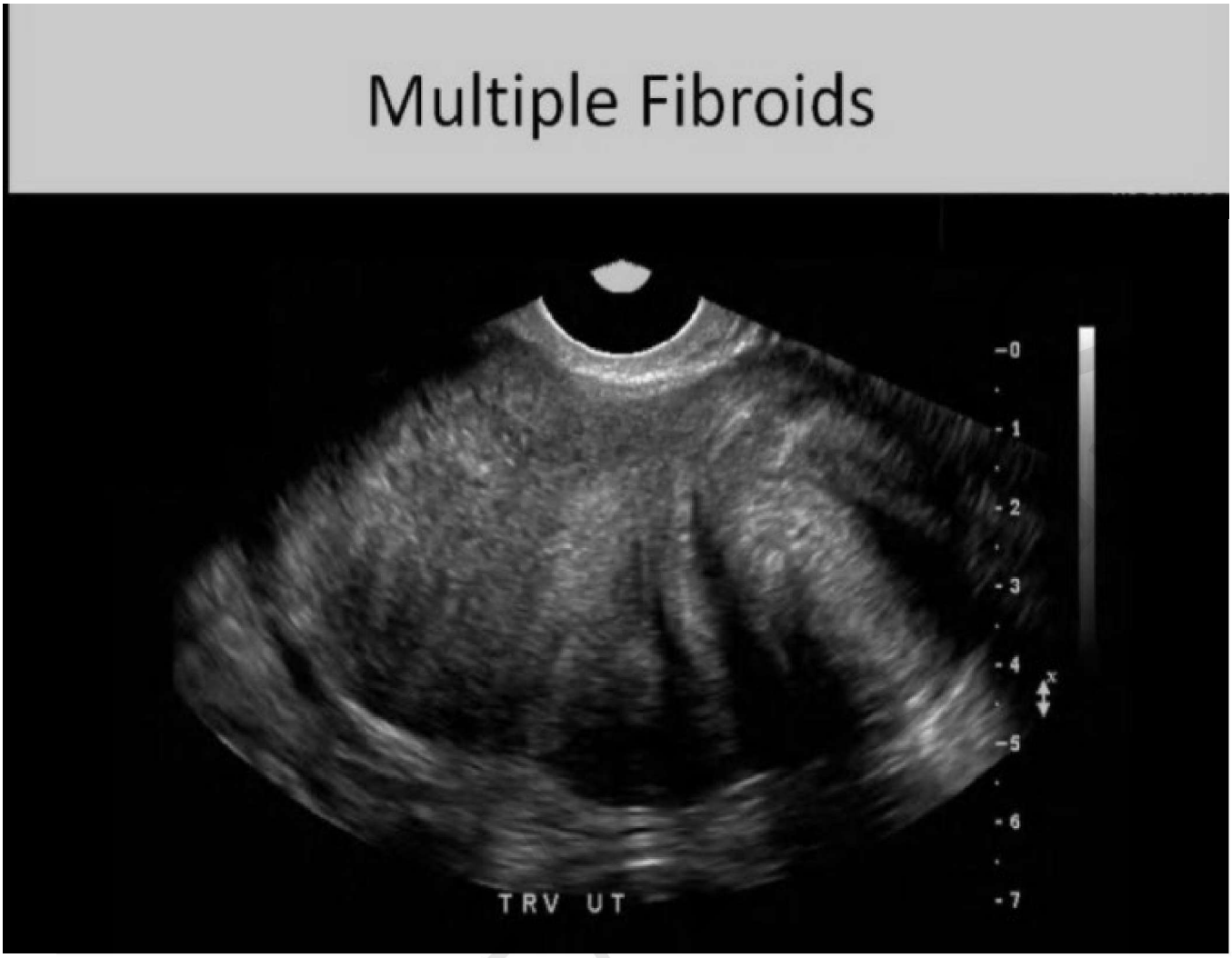


# Calcified Fibroid




# Multiple Fibroids






**Lipoleiomyoma:**

- Degeneration of smooth muscle cells in a leiomyoma
- Symptoms are similar to leiomyomas of the same size and location

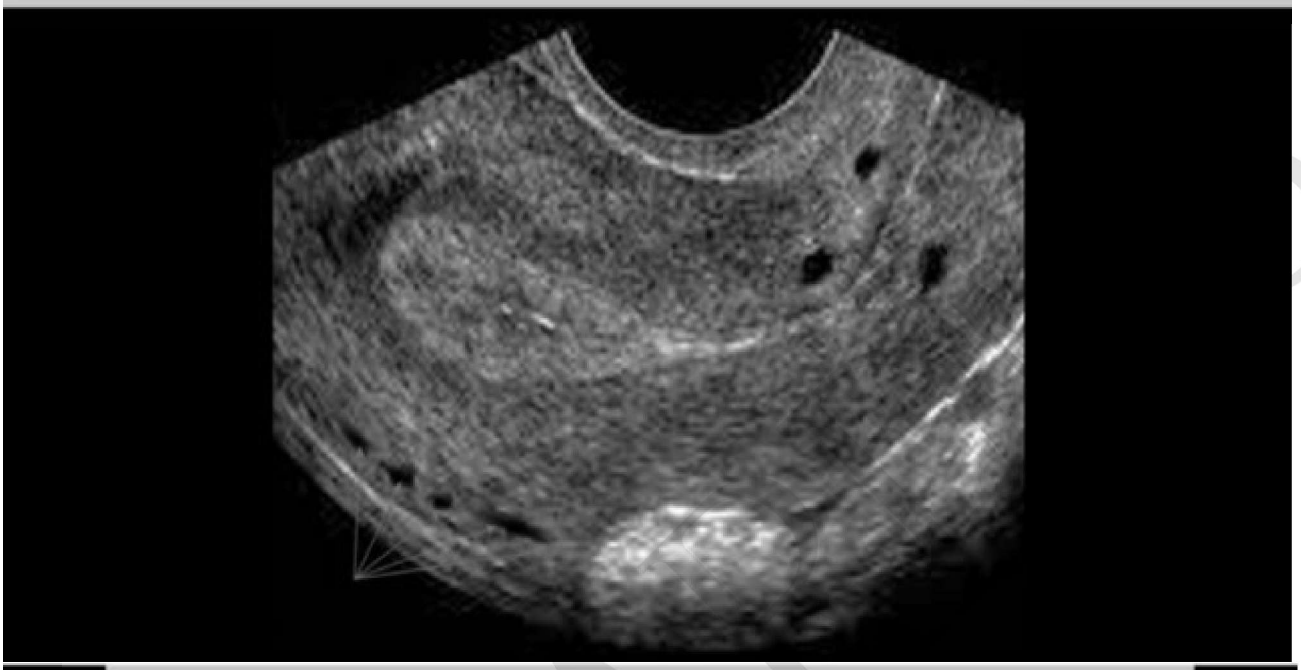
**Sonographic Appearance:**

- Hyperechoic fatty mass with a partially hy
- poechoic muscular rimPosterior acoustic attenuation

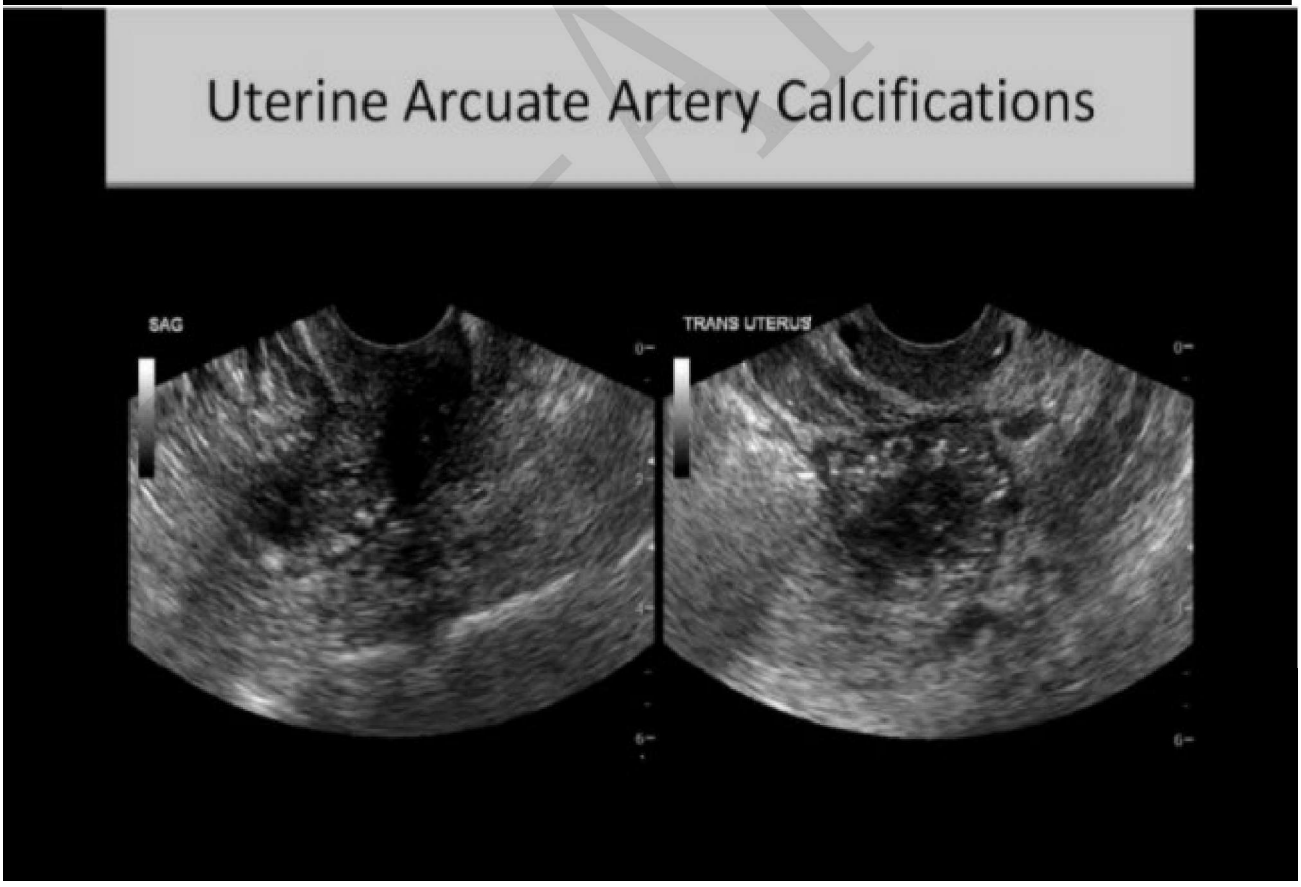
**Uterine Arcuate Artery Calcifications**

- Usually seen in postmenopausal patients with diabetes
- Multiple echogenic foci throughout endometrium

## Arcuate Arteries



## Uterine Arcuate Artery Calcifications



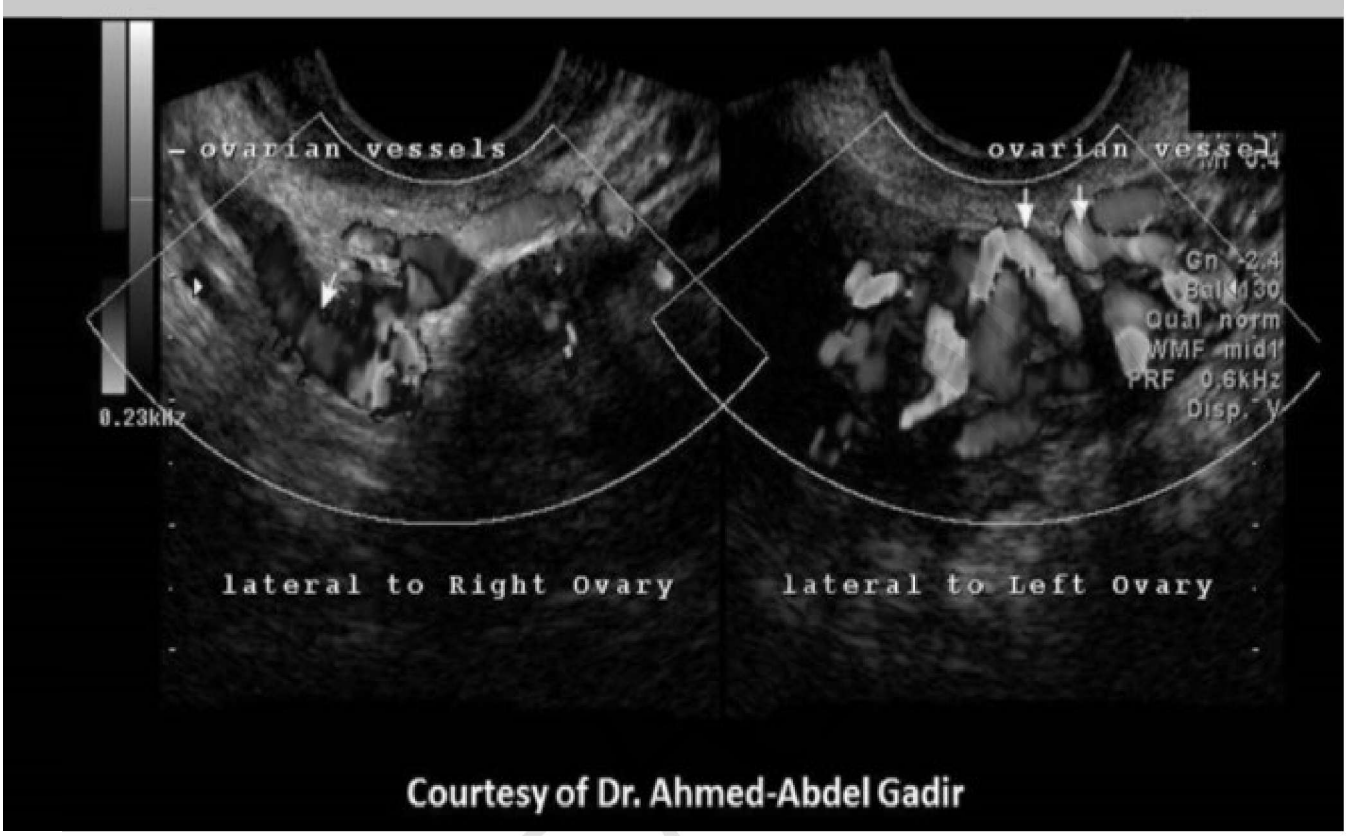
Cervical Stenosis:

- Caused by tumors, infection, polyps, scar tissue formation from radiation therapy or prior surgery
- Fluid is retained in the endocervical canal
- May be asymptomatic if the stenosis is mild
- Can cause amenorrhea in cases of significant stenosis

*Pelvic Congestion Syndrome:*

- Most commonly caused by an incompetent left ovarian vein or venous HTN due to Nutcracker Syndrome
- Symptoms include chronic dull aching pelvic pain that worsens with bending, lifting, walking or prolonged standing
- Associated with vulvar, perineal and upper thigh varices
- The left ovarian vein can be identified by following the left renal vein laterally and rotating the transducer 90 degrees
- The right ovarian vein (ROV) can be identified by following the IVC from the iliac confluence up to the area of the right renal vein junction; Rotate the transducer to visualize the ovarian vein as it enters the IVC at an acute angle
- Average vein diameter in nulliparous women = 2.6mm
- Average vein diameter in parous women = 3.4mm
- May require a transvaginal ultrasound to evaluate the broad ligament for varicosities
- Raise the back of the bed while scanning to about 60 degrees to aid in dilatation of any varicosities
- Asking the patient to perform the Valsalva strain maneuver can increase the size of the varicosities
- Multiple dilated periuterine veins (>5mm) with flow moving at a velocity less than 5cm/s
- Color Doppler will demonstrate flow filling the tubular structures
- Venography is the gold standard exam for evaluation of pelvic congestion

# Pelvic Congestion

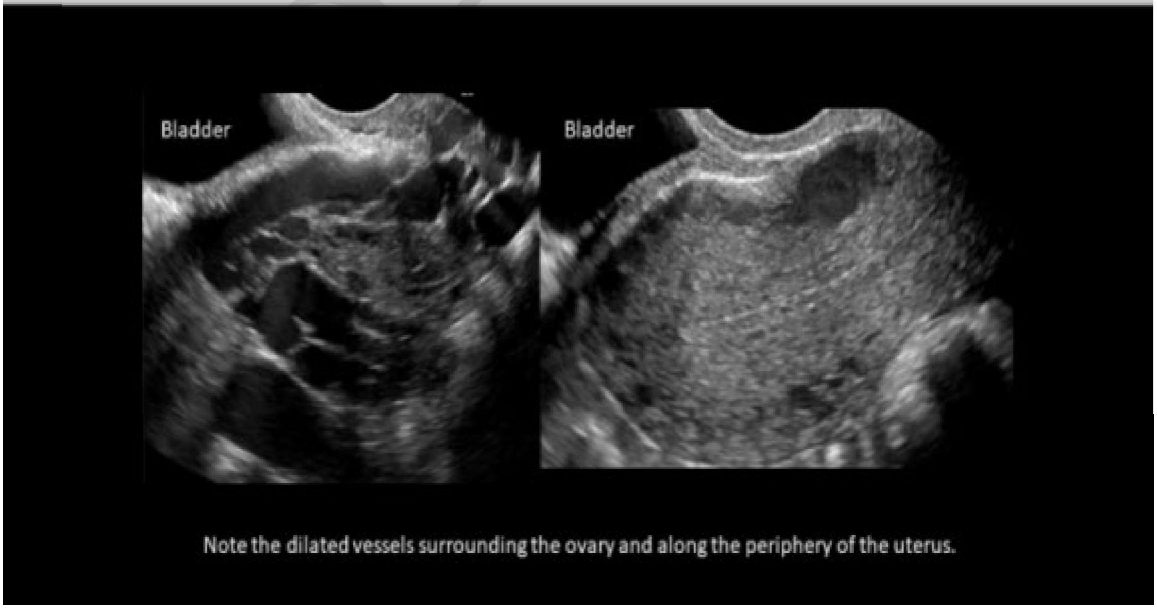



Courtesy of Dr. Ahmed-Abdel Gadir

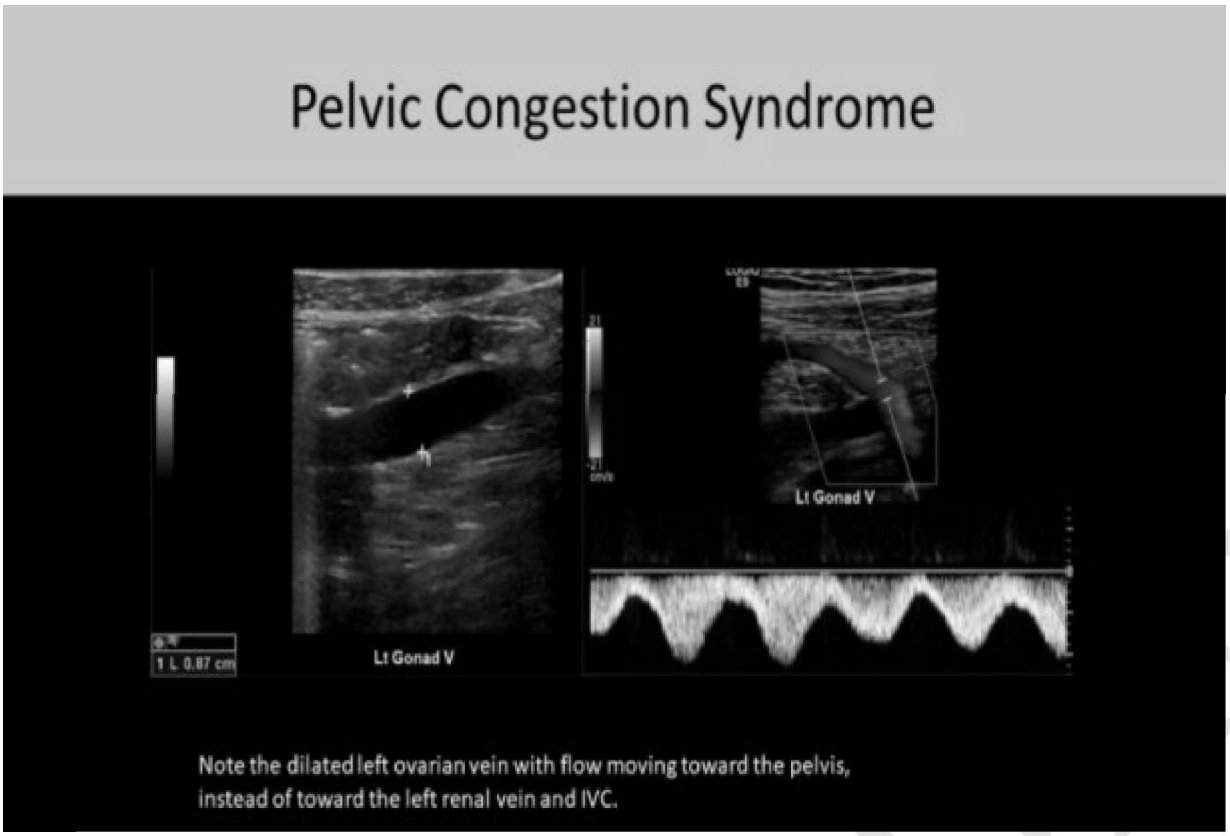
# Pelvic Congestion


Courtesy of Dr. Ahmed-Abdel Gadir

# Pelvic Congestion Syndrome




Note the dilated vessels surrounding the ovary and along the periphery of the uterus.



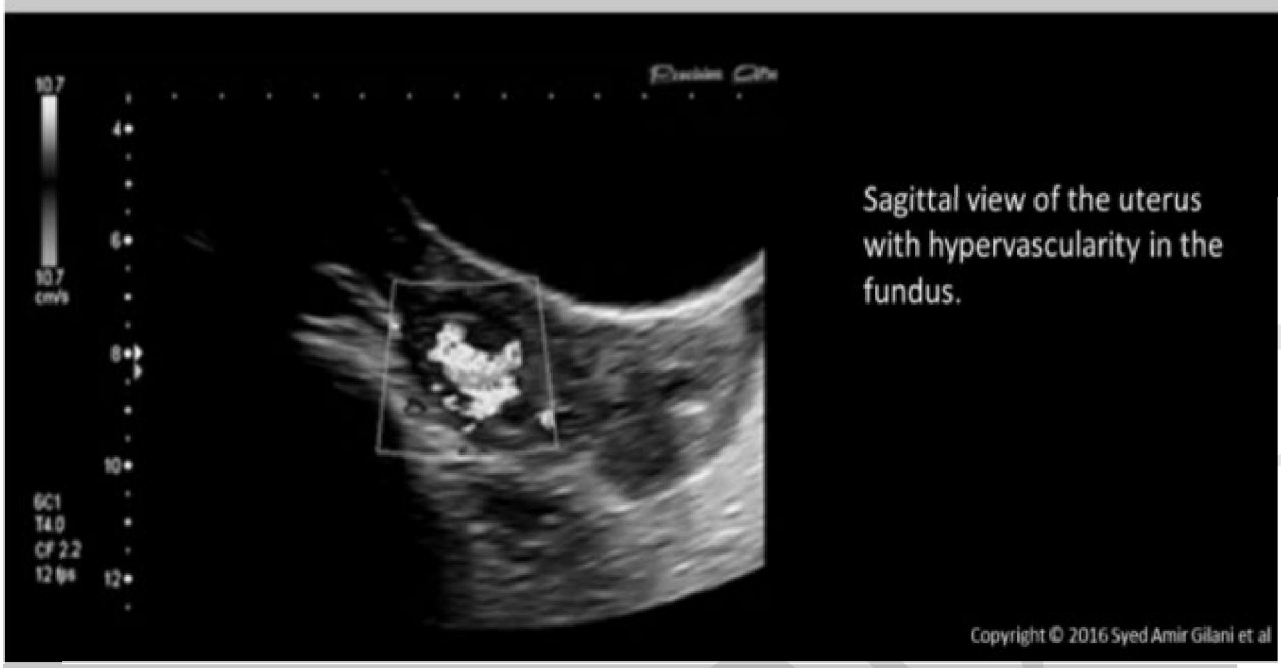

**Congenital Uterine AV Malformation:**

- Congenital formation of multiple connections between arteries and veins
- There are no capillaries between the arteries and veins

**Acquired Uterine AV Malformation:**

- Usually referred to as an AV fistula
- Connection between an artery and vein caused by trauma, surgery or invasive procedures
- Usually involves vessels of the myometrium and periuterine veins
- Retained products of conception is an abnormality of the endometrium
- Symptoms include menorrhagia, abnormal uterine bleeding
- Doppler is used to differentiate an AVM from hydrosalpinx, fluid filled bowel, and pelvic varicosities
- Cluster of blood vessels may be seen 2D and they easily fill with color on Doppler evaluation
- PW Doppler demonstrates high-velocity, low-resistance waveforms in the feeding artery and pulsatile high-velocity flow inthe draining vein
- The venous and arterial waveforms may be indistinquishable
- Because molar pregnancy and retained products of conception can demonstrate similar Doppler findings, serum hCG levelscan be evaluated (no elevated hCG level with AVF/AVM)
- Treated by uterine artery embolization or hyseterctomy in severe cases

# Uterine AV Malformation – Congenital

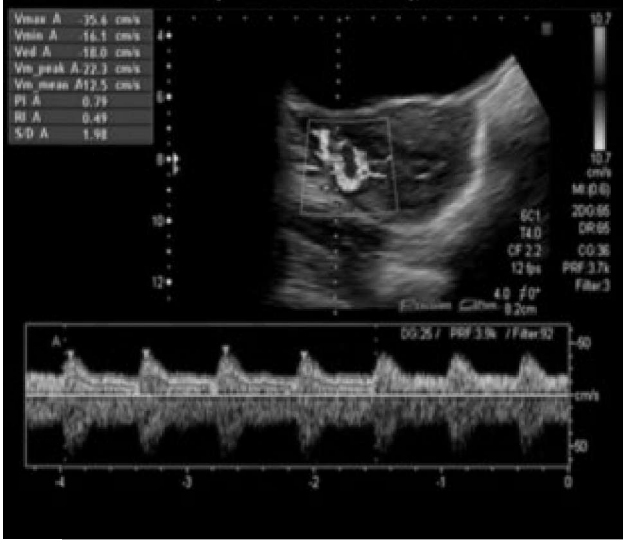


Sagittal view of the uterus with hypervascularity in the fundus.

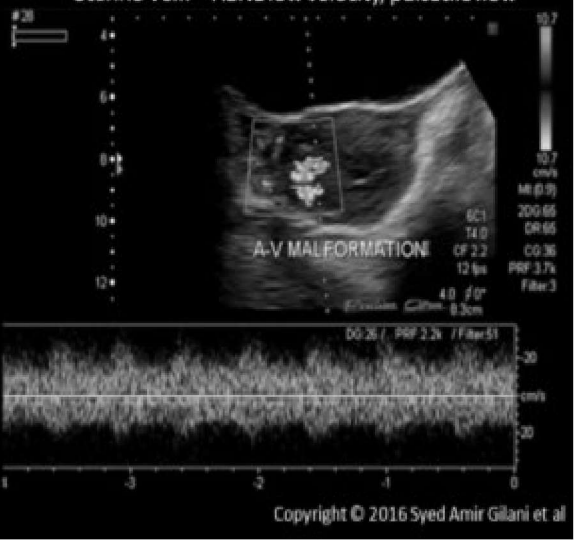


# Uterine AV Malformation – Congenital

Uterine Artery – ABNL low velocity, low resistance

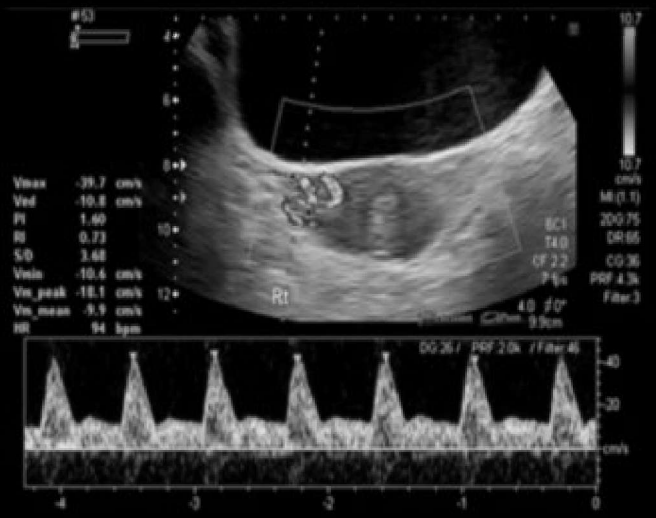


Uterine Vein – ABNL low velocity, pulsatile flow

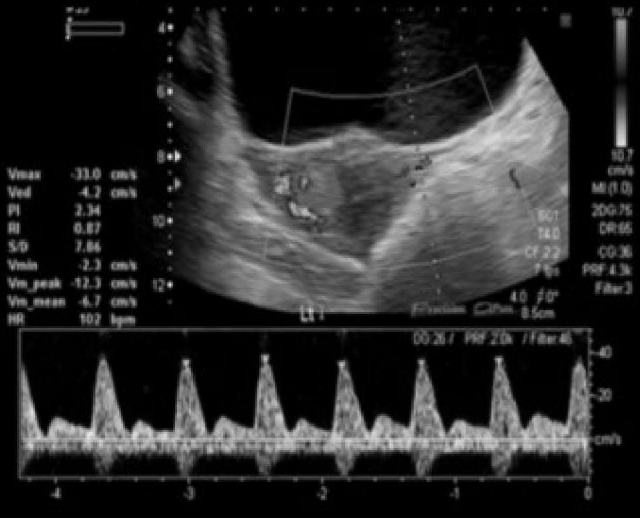


# Uterine AV Malformation – Congenital

Right Uterine Artery – Abnormal lower resistance with continuous diastolic flow

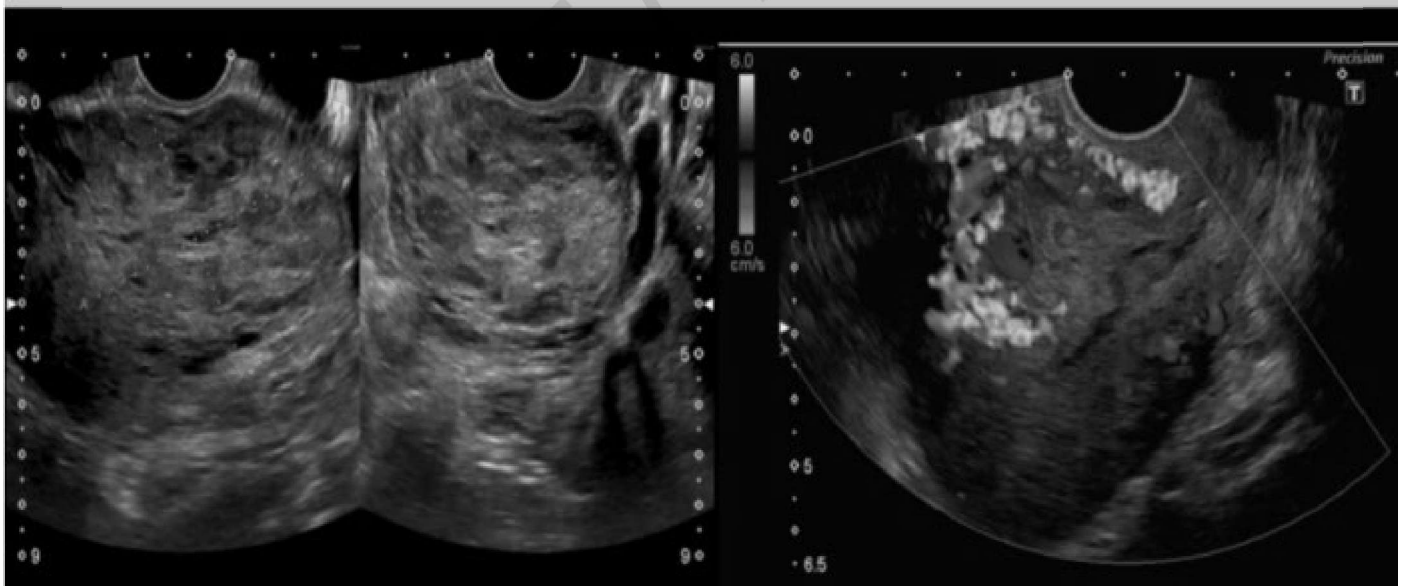



Left Uterine Artery – Normal flow for a non-gravid uterus, higher resistance with diastolic notching



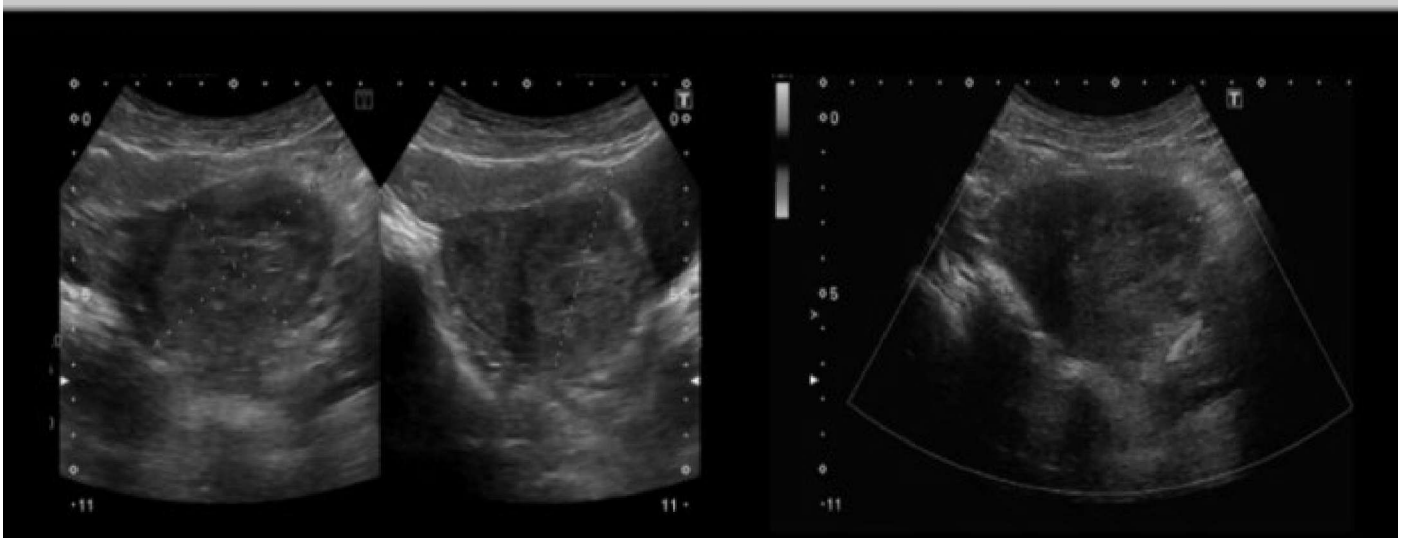



# Uterine AV Fistula – Trauma




Patient had a recent D&C procedure that was stopped due to hemorrhage. Not the heterogenous, hypervascular area of uterine tissue.

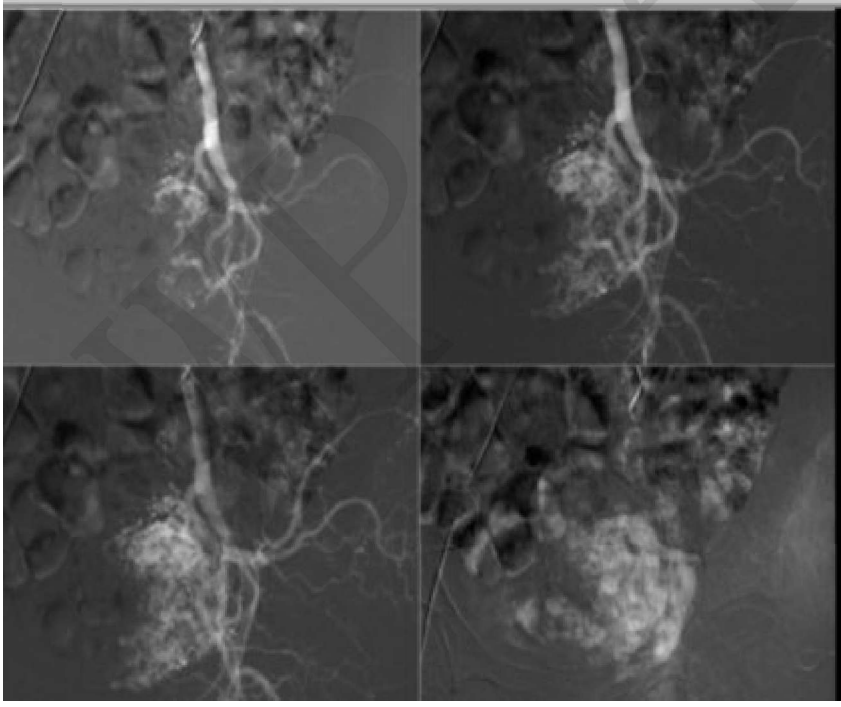
# Uterine AV Fistula – Post-Intervention



After the uterine artery embolization (UAE), there is no abnormal flow in the area of interest.



# Uterine AV Fistula – Angiography



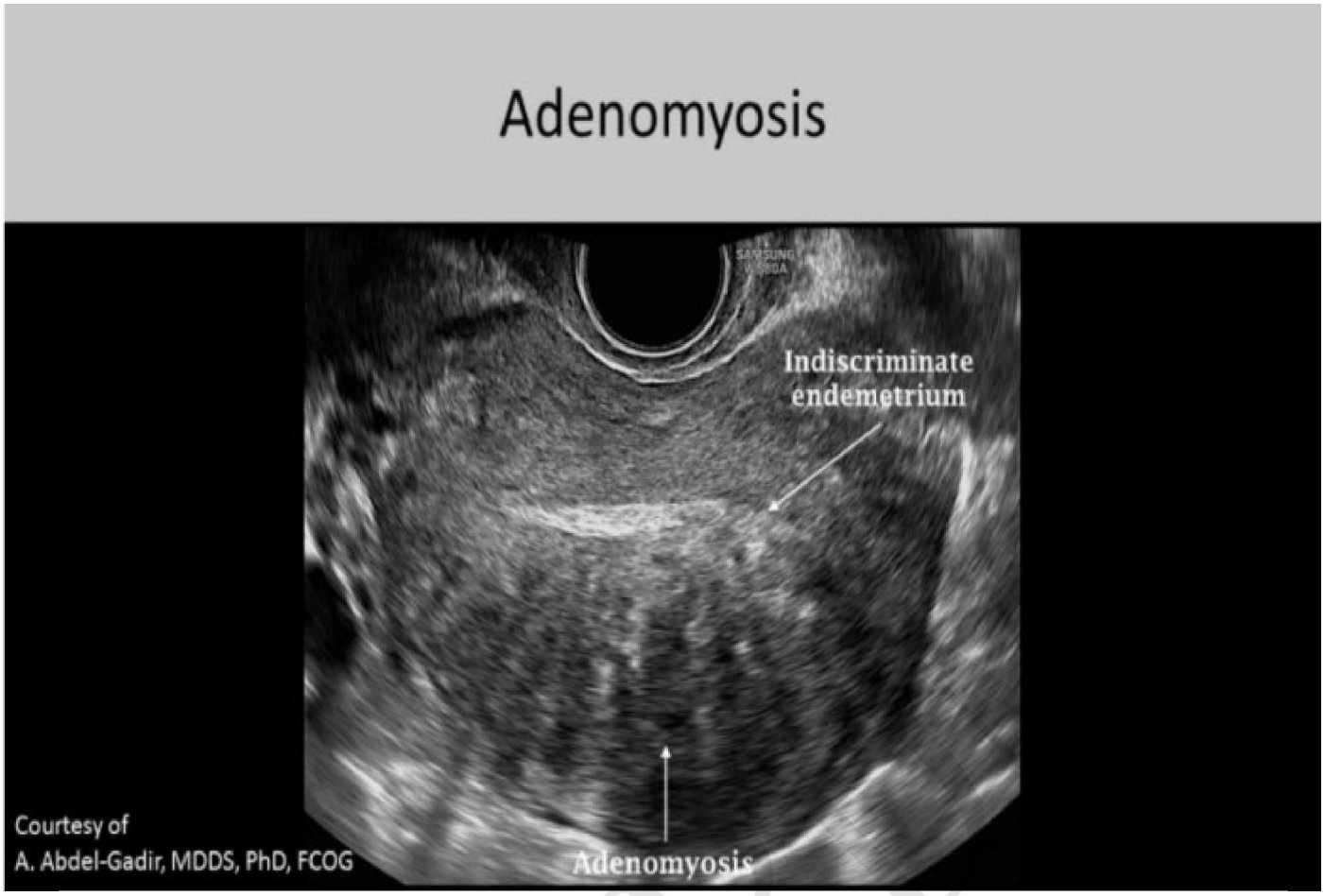
Note the contrast pooling in the area of recent uterine trauma. There is a connection between the uterine arterial and venous systems.

***Adenomyosis:***

- Abnormal location of endometrial tissue in the myometrium
- Unknown cause
- Dysmenorrhea, dyspareunia, menometrorrhagia
- Can be associated with multiparous patients
- Can be associated with fibroids
- Precursor to endometrial carcinoma
- May see polyps or cysts
- Best evaluated with sonohysterogram

*Sonographic Appearance:*

- Increased echogenicity of endometrial implants within myometrium
- Thickened, heterogeneous myometrium
- Subendometrial echogenic nodules
- Small myometrial cysts / subendometrial cysts (<6mm)
- "Swiss cheese" appearance of muscle
- Striated vertical edge shadows/ "Venetian blind" shadowing without a discrete mass
- Enlarged globular uterus with smooth contour (fibroid formation usually causes lobulated uterine contour)
- Diffuse increased vascularity of the affected area (fibroids demonstrate peripheral vascularity)



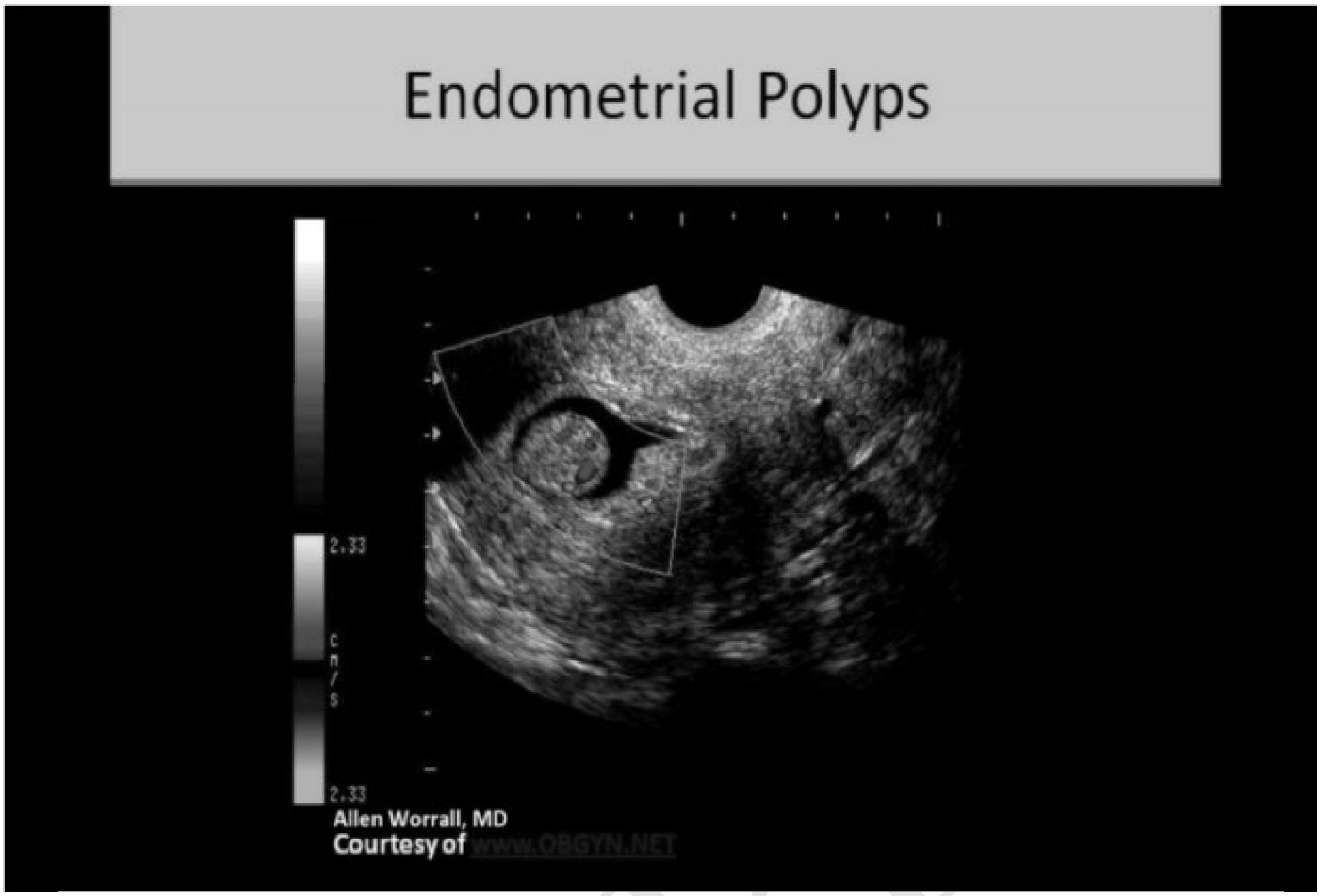

*Endometrial Polyps:*

- Most common age 40-50yrs
- Focal benign overgrowth of the endometrium
- Can be single or multiple
- Symptoms include abnormal premenopausal or postmenopausal bleeding and infertility history
- Menometrorrhagia (intermenstrual bleeding)
- Do not usually cause pain or cramping with abnormal bleeding
- Best time to evaluate polyps is during the early proliferative phase when the normal endometrium is thinnest
- Most commonly identified in endometrial canal in the uterine fundus
- Polyps usually appear isoechoic or hyperechoic to the endometrium, while submucosal fibroids are usually hypoechoic to the surrounding tissues
- Saline sonohysterography is the superior imaging technique for evaluating polyps
- Saline sonohysterography can be used to differentiate a submucosal fibroid from a polyp
- Polypectomy - surgical removal of a polyp, usually performed during hysteroscopy

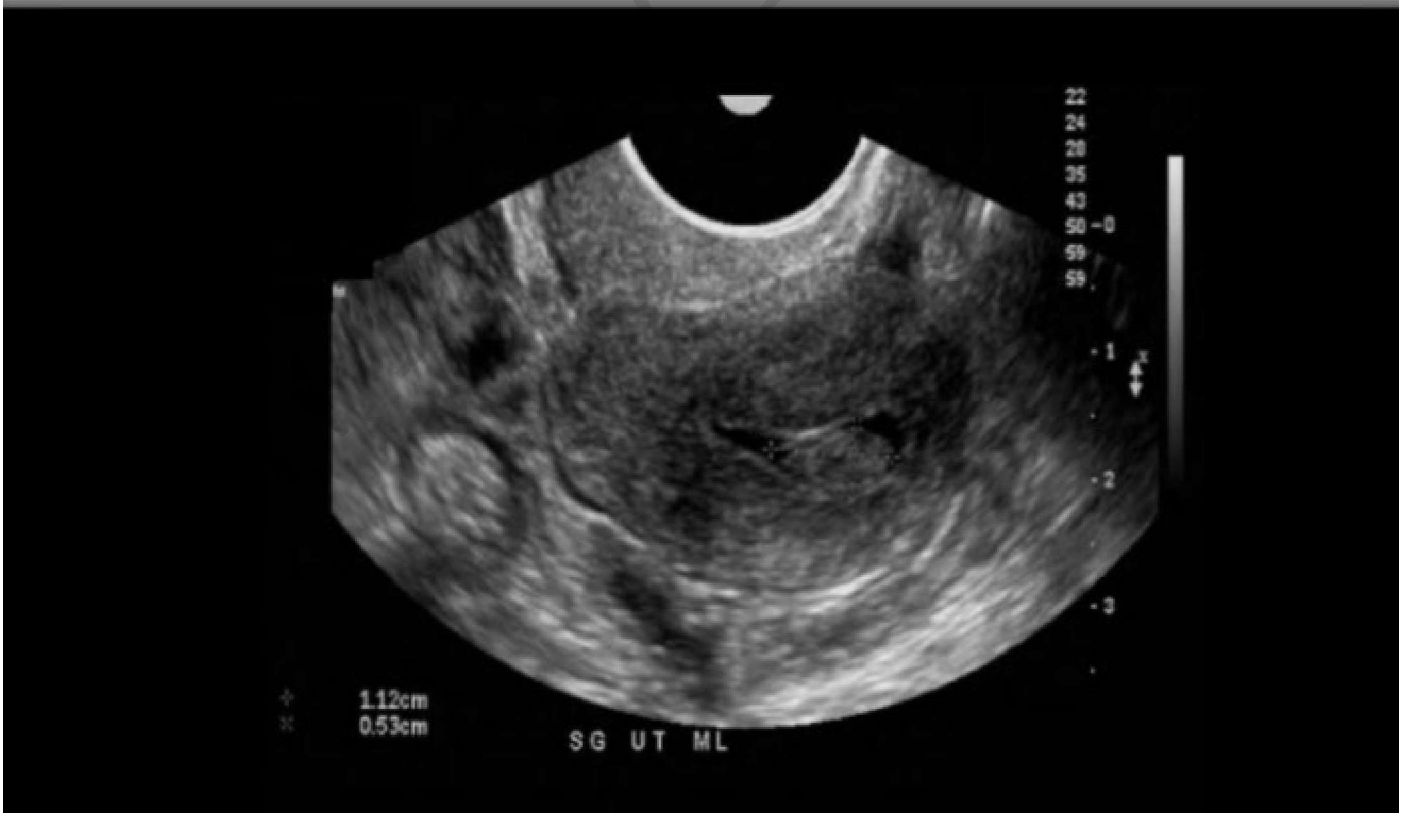
*Sonographic Appearance:*

- Rounded mass with smooth borders
- Isoechoic to endometrial tissue
- Connected to endometrial lining with a neck/stalk
- Color Doppler demonstrates flow within mass of tissue and is helpful in localizing the stalk

# Endometrial Polyps




# Endometrial Polyps



# Endometrial Polyps


# Cervical Polyp

***Endometriosis:***

- *Endometrial tissue in abnormal location; diffuse or focal*
- *Most common implantation sites: ovaries #1, rectum, broad ligament, bowel, ureter or bladder*
- *The anterior abdominal wall is the most common site of extrapelvic implantation*
- *Engorges with blood and causes pain during menstrual cycle*
- *75% patients are age 30-40 yrs*
- *More common in white, nulliparous women*
- *Commonly seen with retroverted uterus*
- *Leading cause of infertility*
- *Lab Values - Elevated CA-125*
- *Pain*
- *Menorrhagia - regular cycles that are heavier and more painful*
- *Bleeding between menstrual cycles is NOT a complication of endometriosis*
- *Hypermenorrhea - increased menses flow*
- *Dysmenorrhea - difficult menses*
- *Dyspareunia - painful sex*
- *Dysuria - difficult urination*
- *Dyschezia - difficult defecation*
- *Treated with HRT and/or surgery*
- *Can be confused with PID*
- *Usually cystic, thick walled structure with low level internal echoes*
- *May contain fluid levels*
- *Usually ovoid or irregular in shape*
- *AKA Chocolate Cyst*

***Sonographic Appearance:***

- **Cystic mass with low level internal echoes ("ground glass" appearance)**
- **Enhancement and through transmission**
- **Varying echogenicity**
- **May have fluid levels**
- **Can be multi-loculated**
- **Usually demonstrates peripheral vascularity**

# Endometriosis – Chocolate Cyst

Color Doppler used to assess the area of the mass that appears solid. Lack of vascularity indicates thrombus instead of tissue.

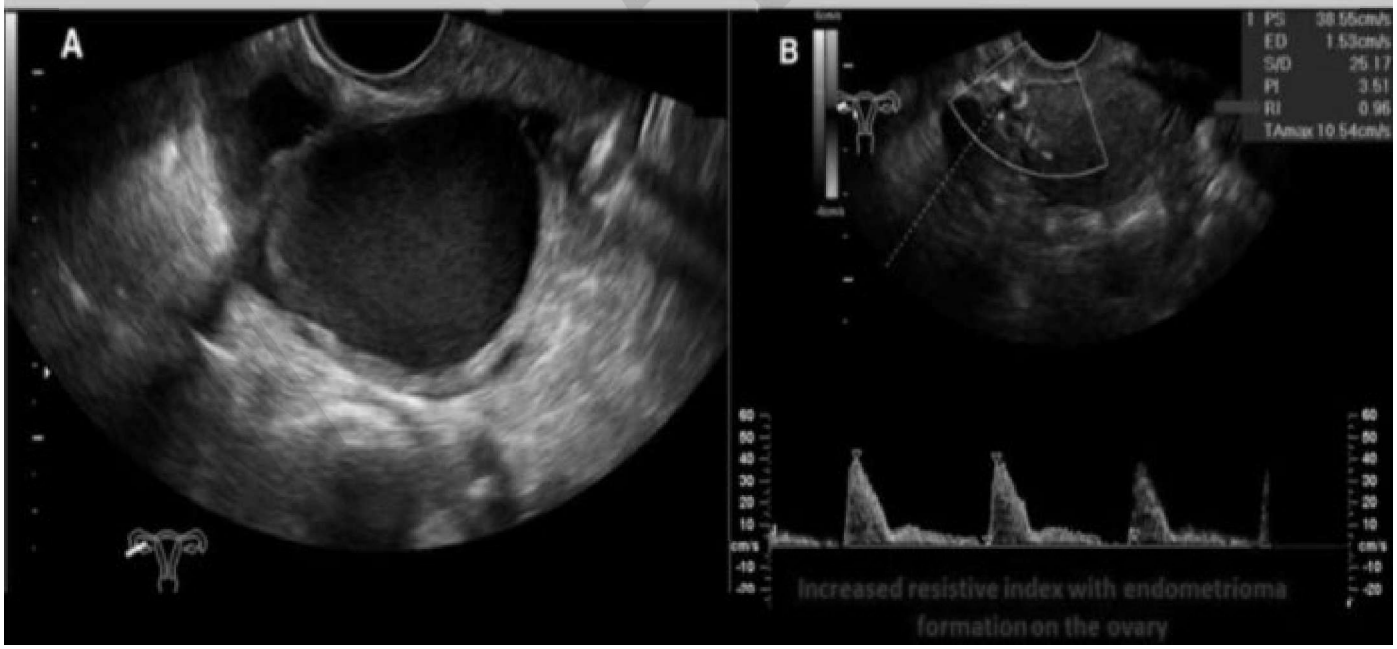
Courtesy of Dr. Taco Geertsma

wwMtuirra soundcases.info

# Endometriosis – Chocolate Cyst

Courtesy of Dr. Taco Geertsma
www.ultrasoundcases.info

# Endometrioma




Adapted from: Impaired uterine artery flow associated with the presence of ovarian endometrioma: preliminary results of a prospective study.

Porpora MG, Tomao F, Manganaro L, Yazdanian D, Fuggetta E, Pkcioni MG, Benedetti Panici P, Benagiano G - J Ovarian Res (2014)

## Chocolate Cyst


## Endometrioma

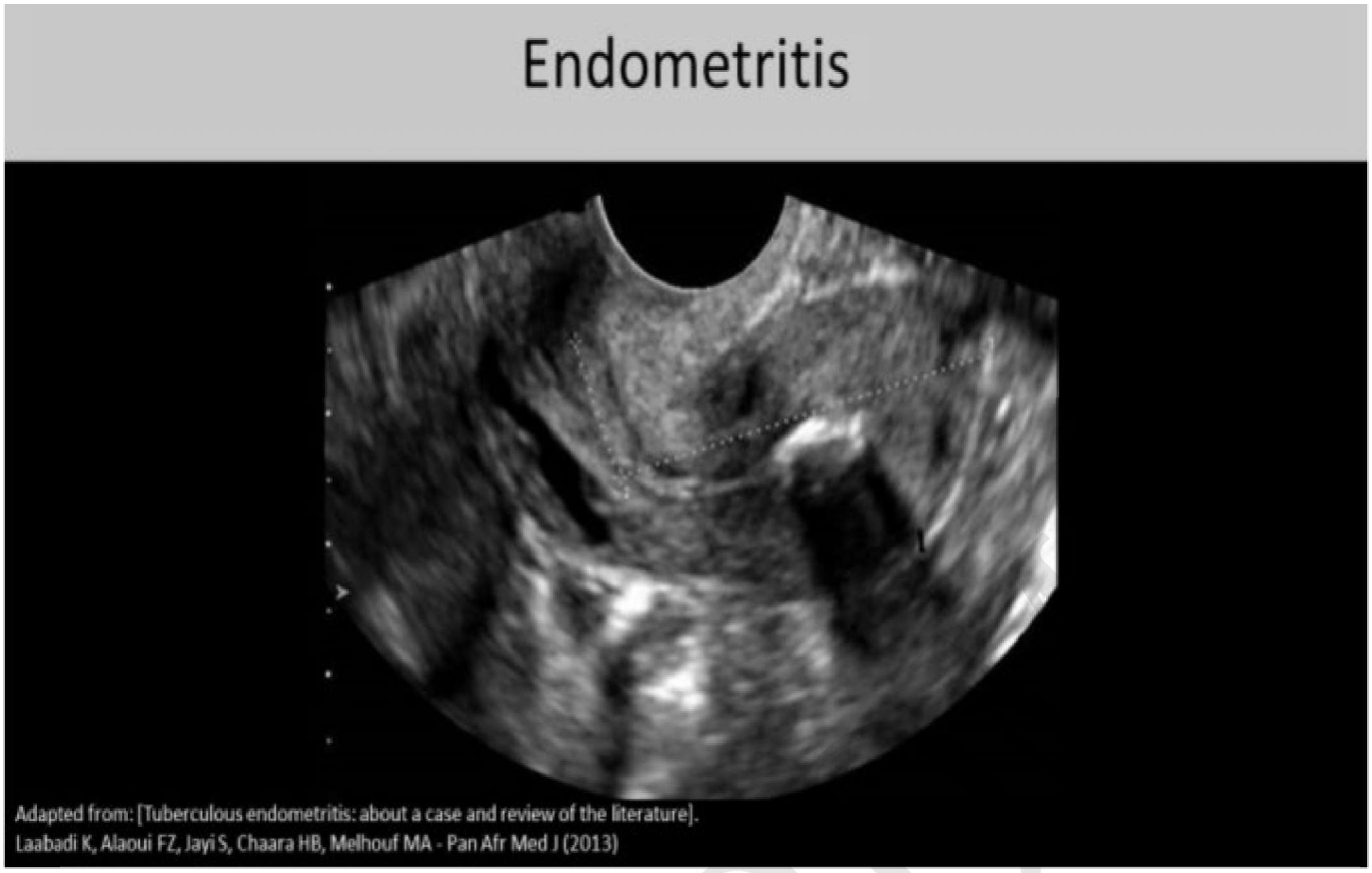
Adapted from: Endometriosis in **a**


*Endometritis:*

- Inflammation/infection of the endometrium
- First stage of PID
- Associated with recent C-Section, abortion, IUD perforation, retained products, biopsy
- Symptoms include pain, fever, discharge, dysmenorrhea, menorrhagia, leukocytosis (increased white blood cell count)

*Sonographic Appearance:*

- May have normal scan
- May see enlarged uterus
- Prominent, irregular endometrium
- May see air in endometrial cavity (ring down artifact)
- Fluid in posterior cul-de-sac
- May be associated with hydrosalpinx




*Endometrial Atrophy:*

- As the endometrium atrophies and thins in the postmenopausal patient, a small amount of vaginal bleeding can occur
- Most common cause of postmenopausal bleeding
- Most commonly caused by menopause
- Ultrasound will demonstrate an endometrium <5mm in thickness, if the bleeding is due to normal changes with menopause

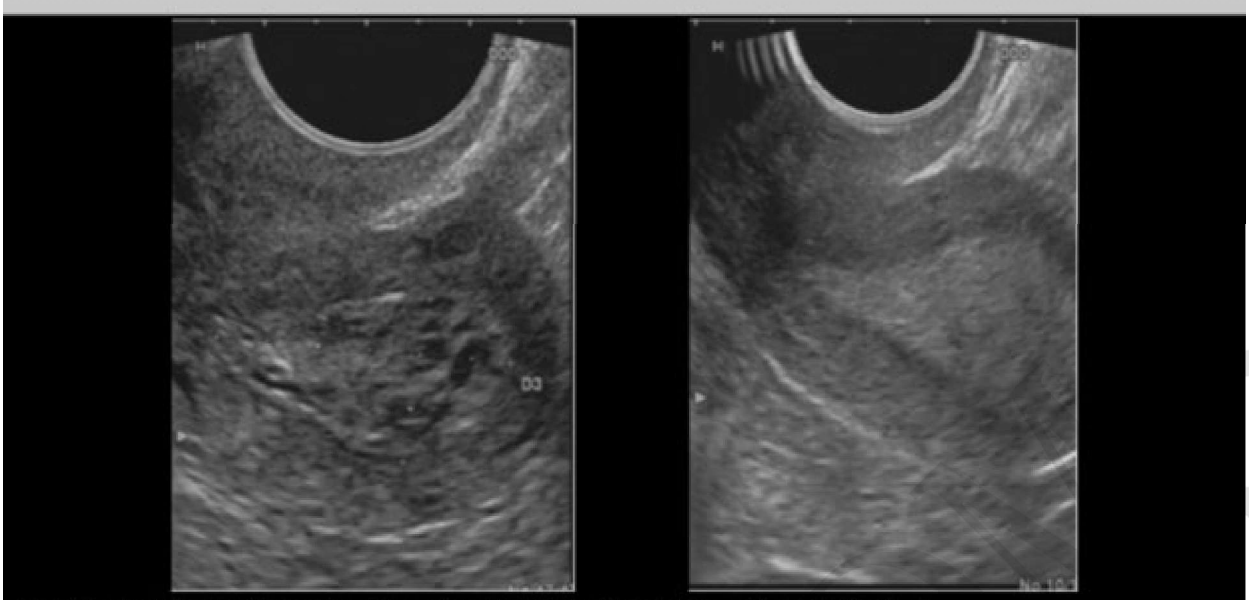
*Endometrial Hyperplasia:*

- Caused by hormonal imbalance and increased estrogen levels
- Can occur in women of all ages
- Examination should be performed at the end of the menstrual cycle
- If hyperplasia is present, there is increased risk for developing into carcinoma
- Impossible to distinguish from adenocarcinoma without endometrial biopsy
- Can be related to Tamoxifen therapy
- Primary symptom = dysfunctional bleeding

*Sonographic Appearance:*

- Overproliferation of glandular tissue
- May see cystic areas within endometrium
- >18mm thickness in premenopausal patients in secretory phase
- >5mm thickness ABNORMAL for postmenopausal patient with no HRT and abnormal bleeding
- >8mm thickness ABNORMAL for postmenopausal patient with no HRT and NO bleeding
- HRT Unopposed Estrogen = endometrium >8mm thickness ABNL
- HRT Estrogen and Progestin = endometrium >10-12mm thickness ABNL

# Endometrial Hyperplasia

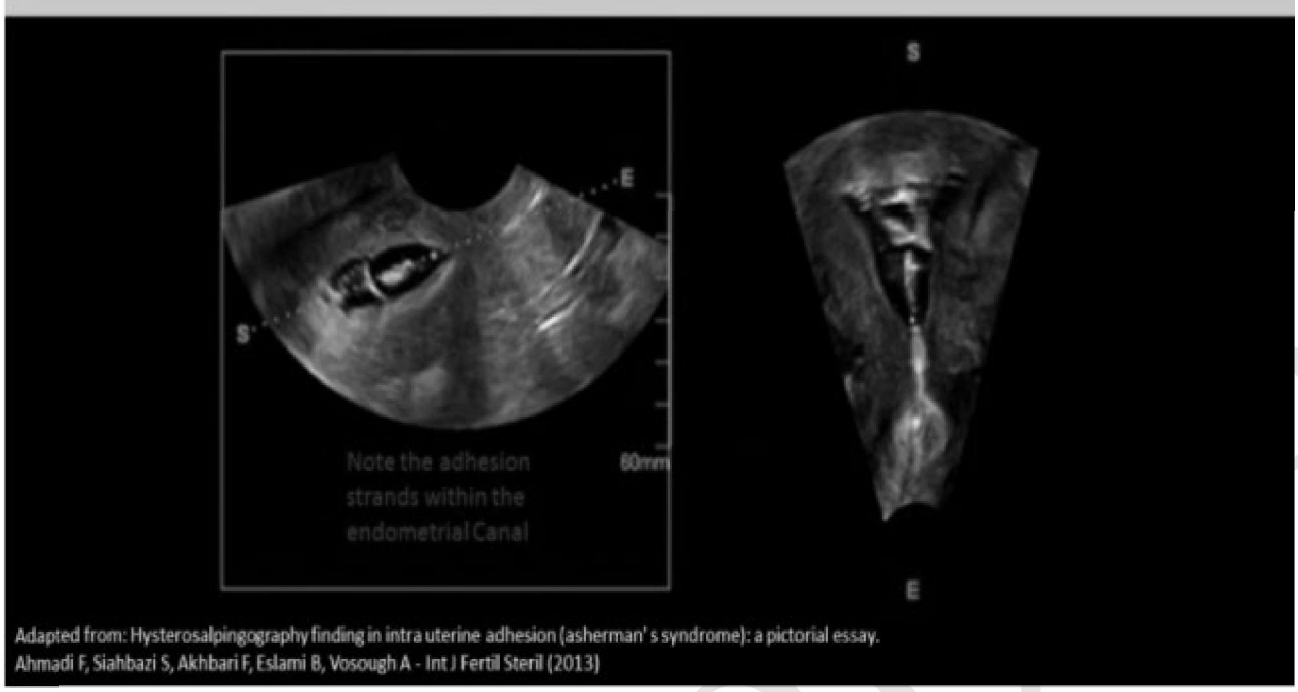


Adapted from: Predictive diagnosis of endometrial hyperplasia and personalized therapeutic strategy in women of fertile age.
Goncharenko VM, Beniuk VA, Kalenska OV, Demchenko OM, Spivak MY, Bubnov RV - EPMA J (2013)

***Asherman Syndrome:***

- Adhesions of the endometrial lining due to uterine trauma
- Due to history of C-section or D&C
- Symptoms include amenorrhea, hypomenorrhea, recurrent miscarriage and infertility
- Sonohysterography necessary for diagnosis
- Saline administered into endometrial canal to visualize the bridge-like bands of tissue in the canal
- Can cause early termination of sonohysterography procedure because adhesions prevent dilatation of the canal

# Asherman Syndrome




Adapted from: Hysterosalpingography finding in intra uterine adhesion (asherman' s syndrome): a pictorial essay. Ahmadi F, Siahbazi S, Akhbari F, Eslami B, Vosough A - Int J Fertil Steril (2013)

*Endometrial Ablation:*

- Performed to treat heavy bleeding in patients with a known uterine cause for the bleeding
- The destruction of the endometrial lining of the uterus by a device that uses extreme cold, heated fluids, microwave energy or high-energy radiofreguencies
- Not used for treatment of submucosal fibroids or polyps; hysteroscopic resection of the fibroid and polypectomy used now
- Contraindications include: pregnancy, IUD, congenital anomaly, active GU infection, suspected endometrial carcinoma
- Complications: infection, uterine perforation, hematometra, thermal injury to adjacent structures



## MALIGNANCY OF THE UTERUS

*A denocarcinoma:*

- AKA Endometrial Carcinoma
- Most common gynecological cancer
- Linked with estrogen imbalance
- Associated with family history, nulliparity, obesity, diabetes, HTN, PCOD, tamoxifen and unopposed estrogen therapy
- Rare before age 40, usually occurs in patients 60-79 yrs of age
- Most common symptom is postmenopausal bloody or watery discharge
- Elevated CA 125
- Pain occurs later in progression
- Slow progressive enlargement of the uterus with hematometra or mucometra
- Lymph nodes may be identified

*Sonographic Appearance:*

- Enlarged uterus
- Thickened, irregular heterogeneous endometrium
- Myometrium can also develop abnormal echotexture
- >5mm endometrium, bleeding postmenopausal without HRT
- Identical to endometrial hyperplasia early on
- May see halo around endometrial cavity
- Fluid within endometrial canal

*Stages:*

0 : Suggestive of cancer, inconclusive

7. : Confined to the body of uterus
8. : Extends to cervix
9. : Extends beyond uterus but inside true pelvis
10. : Metastasis to other organs

# Endometrial Carcinoma

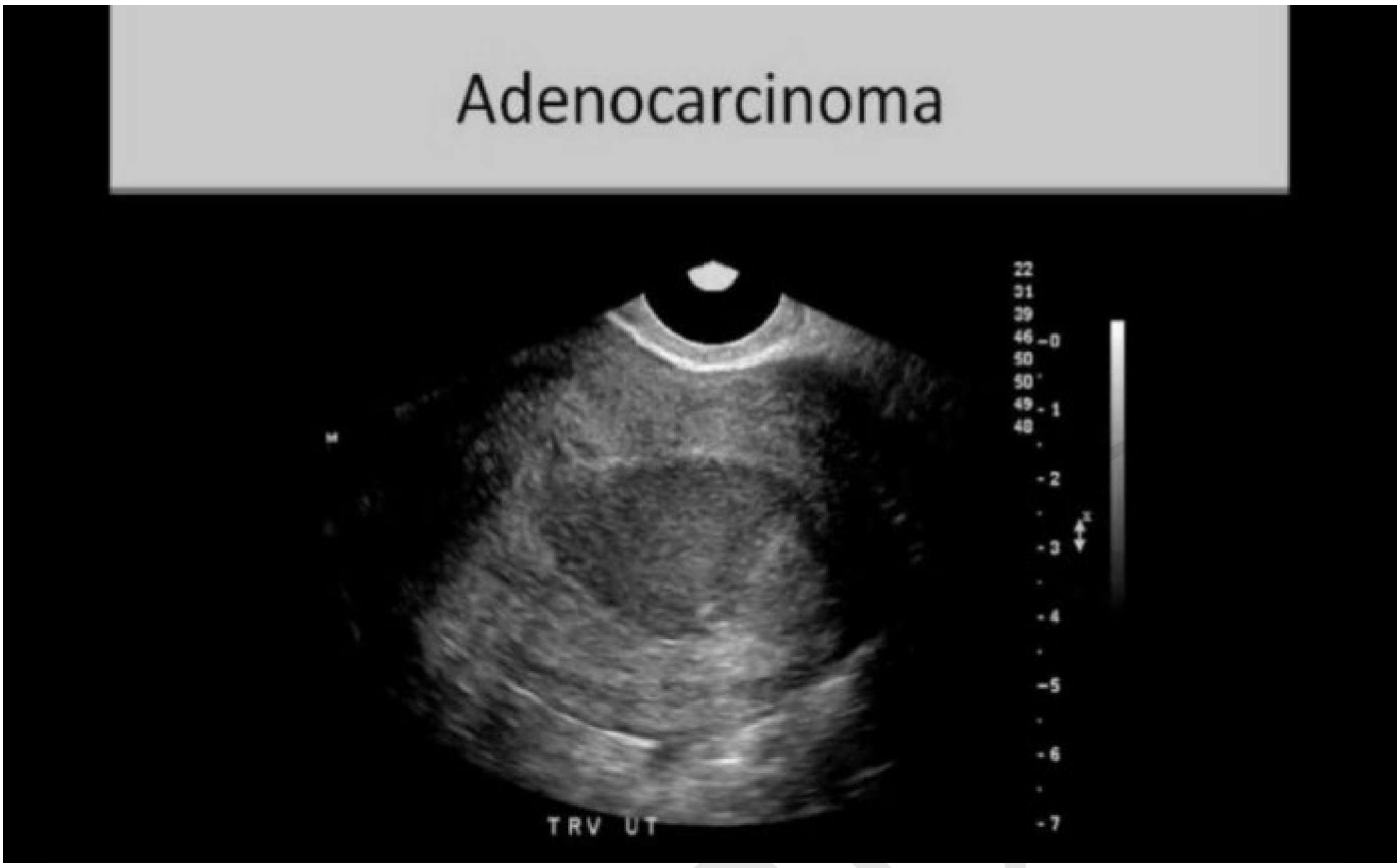
# Adenocarcinoma

# Adenocarcinoma

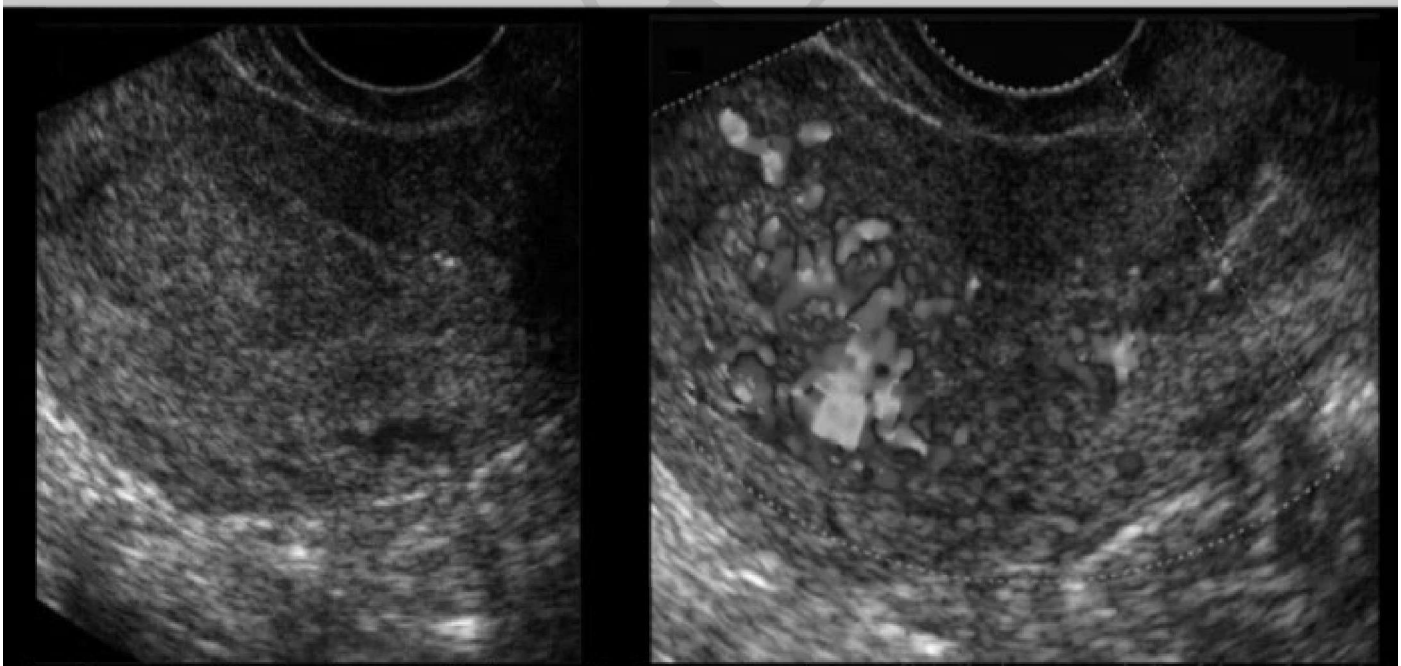

# Adenocarcinoma


Adapted from: Endometrial Adenocarcinoma in A 31-Year Old Woman: A Case Report.
Ahmadi F, Akhbari F, Rashidi Z, Hemmat M - Int J Fertil Steril (2015)

# Adenocarcinoma




# Adenocarcinoma



Adapted from: Endometrial carcinoma in a young subfertile woman with polycystic ovarian syndrome. Jayakrishnan K, Anupama R, Koshy A, Raju R - J Hum Reprod Sci (2010)

Note the hypervascularity of the endometrium associated with adenocarcinoma

*L eiomyosarcoma:*

- Rare, malignant tumor of myometrium
- Leiomyoma + sarcoma
- Usually occurs mid 50s
- Similar symptoms as benign leiomyoma
- Can arise from existing fibroid
- Rapid increase in size can indicate malignancy
- Internal necrosis and degeneration
- Very hard to differentiate from benign leiomyoma
- Hysterectomy required
- Extremely aggressive with poor prognosis

*Cervical Carcinoma:*

- Squamous Cell Carcinoma
- Most common cancer in females less than 50 years of age
- Usually occurs in women of child bearing age and/or those with multiple sex partners
- More common in females who became sexually active early in life, those with multiple sexual partners, HPV infection, mothers who took DES
- Rare among Jewish women
- Early Stages: bleeding after intercourse or pap tests
- Advanced Stages: pain, bladder discomfort, enlarged lymph nodes

*Sonographic Appearance:*

- Enlarged cervix (> 4cm width)
- Mass may be identified within
- Biopsy necessary for staging

*Stages:*

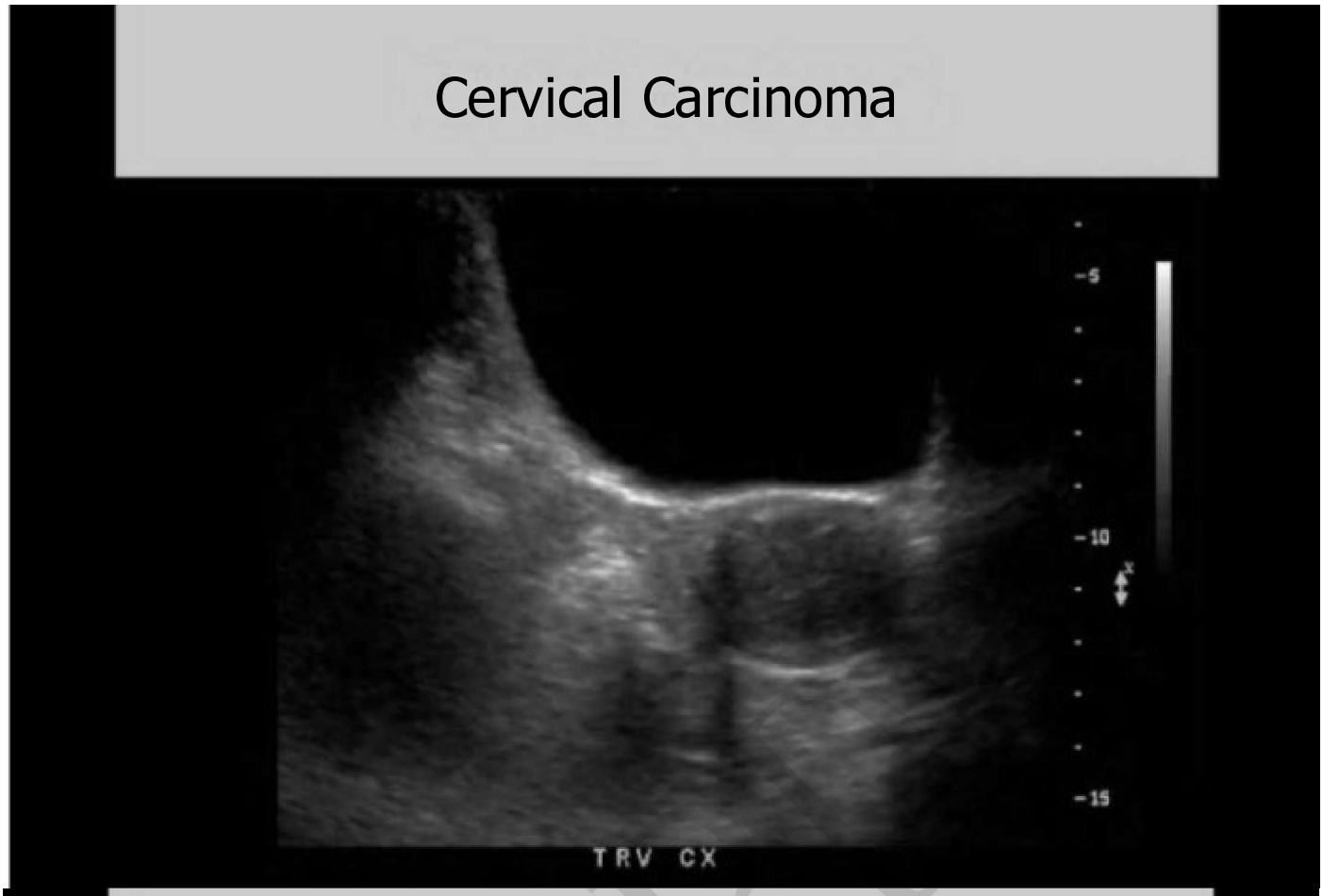
0 : In situ, precancerous celts

- : Confined to cervix
- : Extends beyond cervix but has not reached lower 1/3 of vagina or pelvic wall

III: Extends beyond cervix and has reached lower 1/3 of vagina or pelvic wall

IV : Extends beyond true pelvis into rectum or bladder

# Cervical Carcinoma




# Cervical Carcinoma

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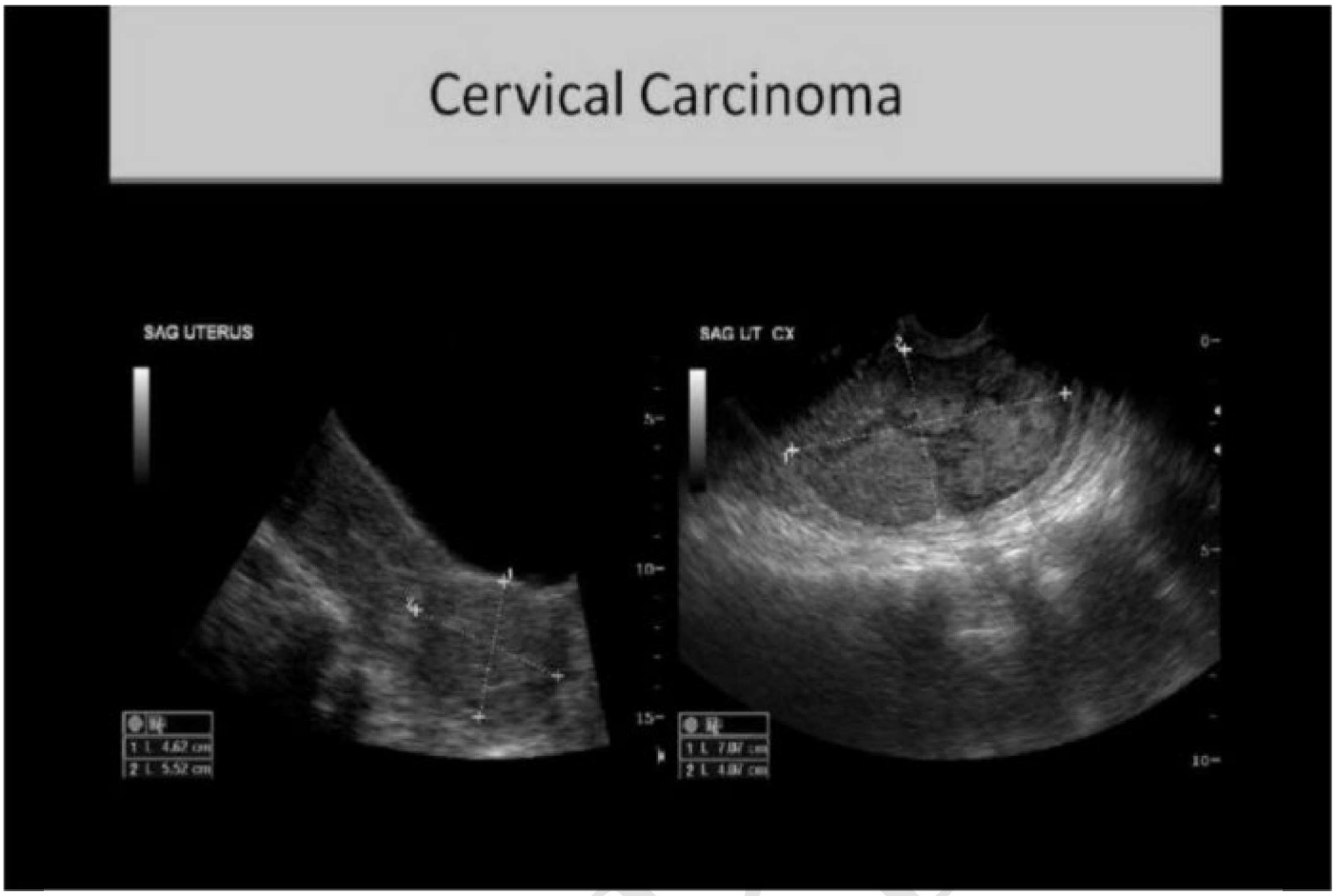



*Carcinosarcoma:*

- Combination of cancers of endometrium and myometrium
- Usually 50-60yrs
- Bleeding, pain, weight loss, edema in lower extremities
- Uterus appears heterogeneous
- Enlarged uterus filled with polypoid structures

*Sonographic Appearance:*

- Uterus appears heterogeneous
- Enlarged uterus filled with polypoid structures

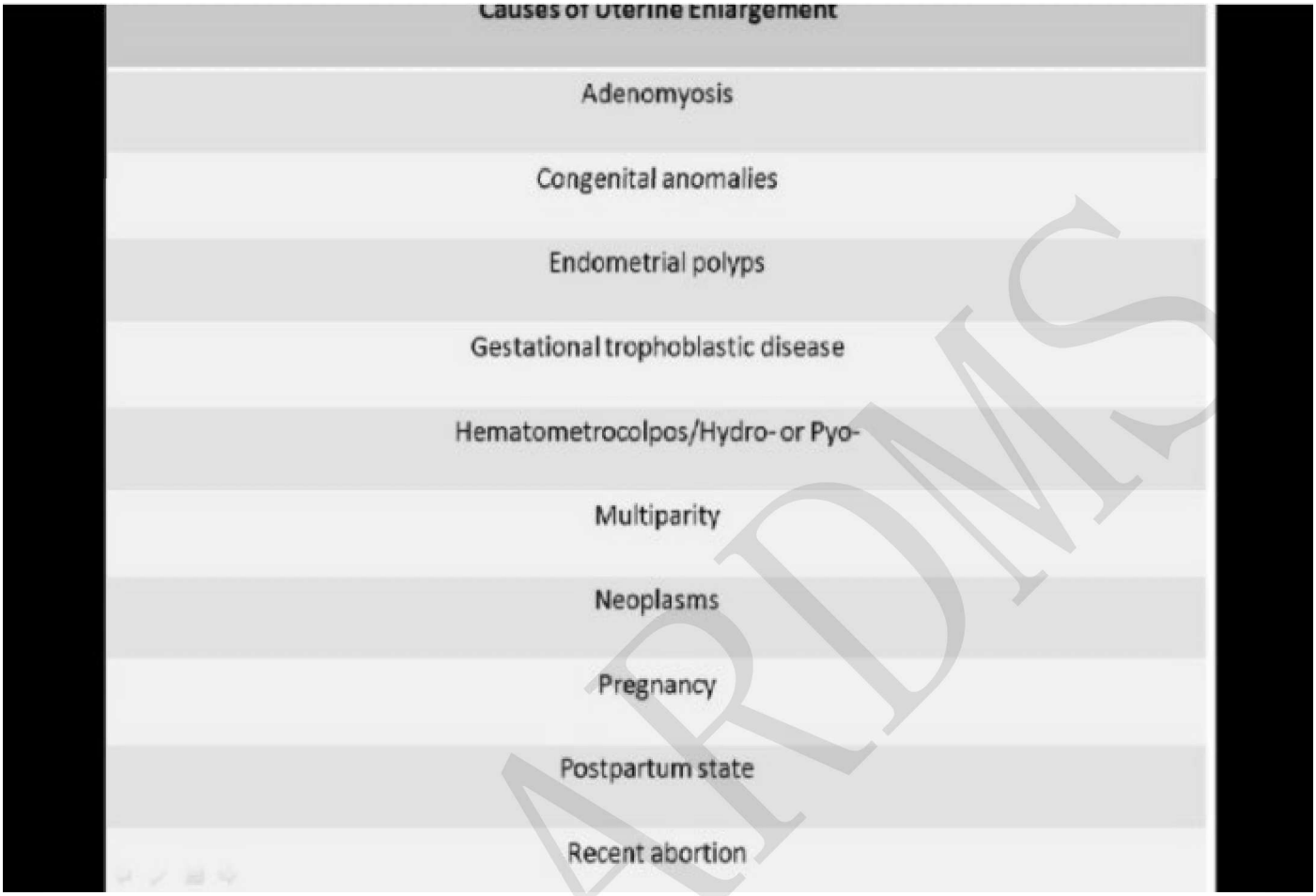
*Treatment Options for Uterine Abnormalities:*

- Dilatation and Curettage - cervix is dilated and the endometrial layer is scraped out to diagnose or treat an abnormality; can cause adhesions and fertility issues
- Dilatation and Evacuation - cervix is dilated and the uterine contents are suctioned out (miscarriage, abortion, RPOC); can cause adhesions and fertility issues
- Endometrial Ablation - special catheter used to destroy tissue
- Polypectomy - surgical removal of a polyp, usually performed during hysteroscopy
- Myomectomy - surgical removal of a leiomyoma (fibroid)
- Uterine Artery Embolization - blood supply to the leiomyoma is obstructed
- Hysterectomy - surgical removal of the uterus
  - Partial - uterus removed, ovaries remain
  - Complete - uterus and ovaries removed

*Post-Hysterectomy E valuation:*

- Important to question the patient regarding the status of the ovaries

- Partial hysterectomy - one or both ovaries remain
- Total hysterectomy - uterus and ovaries removed
- Document the cervical remnant - AP measurement measurement should 4.4cm or less
- If there is no cervical remnant, document the vaginal cuff is less than 2 cm in AP dimension



| Alterations of Uterine Texture |
| --- |
| Adenomyosis |
| Gestational trophoblastic disease |
| Hemato/Hydro/Pyometrocolpos |
| Neoplasms |
| Pregnancy |
| **Abnormalities of Uterine Contour** |
| Fibroids |
| Endometriosis |
| Neoplasms |
| PID |
| Post-surgery |
| Retroposition |

| Uterine Abnormalities Causing Shadowing |
| --- |
| Calcifications |
| Gas |
| IUD |
| Retained products of conception |
| Sutures |
| Tampon |

| Prominence of Endometrial Cavity |
| --- |
| Early IUP |
| Ectopic |
| Polyps |
| Hyperplasia |
| Endometritis |
| Retained products of conception |

| "Most Common" |
| --- |
| Septate uterus is the most common congenital anomaly of the uterus and bicornuate uterus is the most common abnormality of fusion |
| Gartner Duct Cyst is the most common failure of disappearance defect |
| Hematometrocolpos is most commonly caused by an imperforate hymen |
| The most common location for fluid accumulation is the posterior cul-de-sac<br>The Space of Retzius is indicated by the green arrow and is the least common location for fluid accumulation |
| Endometrial polyps most commonly form in the endometrial canal near the fundus |
| Endometriosis is more common in white, nulliparous women and is the leading cause of infertility |
| Endometrial atrophy is the most common cause for postmenopausal bleeding |
| Chlamydia is the most common cause for pelvic inflammatory disease |
| Fibroids are the most common uterine mass/tumor and the most common solid mass seen with pregnancy |
| Intramural fibroids are most common |
| Endometrial cancer is the most common gynecological cancer |
| The most common symptom of endometrial cancer is postmenopausal bloody or watery discharge |

## *Ovarian Abnormalities - Cysts*

### *Evaluating Cysts:*

- Most common adnexal mass
- May cause torsion, infection, rupture, bleeding, malignancy
- Most resolve on their own
- Cysts that don't resolve may be inflammatory, malignant or endometriosis
- Surgery required for cysts > 5-6cm and that persist for more than four months

*Factors to Evaluate For AH Cysts:*

- Size
- Persistence
- Bilateral vs. unilateral
- Surface nodularity
- Shape
- Internal echogenicity
- Septations
- Wall thickness
- Cul-de-sac fluid
- Cysts over 3.5cm are not considered functional and should be followed
- Benign unilocular cysts usually do not exceed a diameter of 5cm
- Thick walls are usually associated with inflammation, endometriosis or malignancy
- Benign mass PI > 1.0, RI > 0.40; higher resistance
- Malignant mass PI < 1.0, RI < 0.40; lower resistance

### *FUNCTIONAL CYSTS:*

#### *Follicular Cyst:*

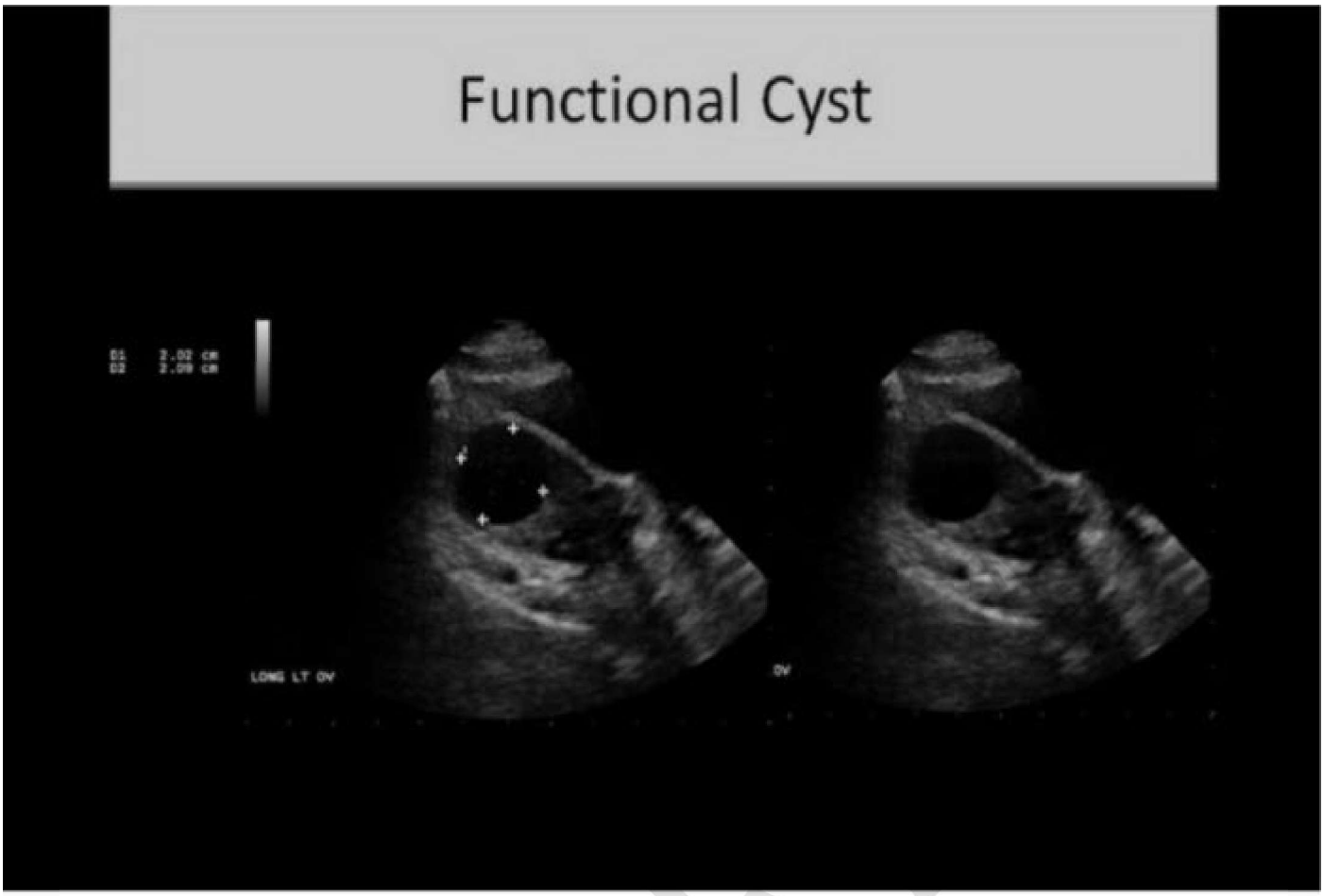
- Mostly asymptomatic
- Within cortex of ovary
- Thin walled, unilocular
- Normally enlarge 2-3mm a day up to a diameter of 1.5-2.5cm
- Should regress spontaneously
- Usually multiple and bilateral
- Pergonal and Clomid stimulate follicle production
- Oral contraceptives prevent the development of a dominant follicle and ovulation
- Dominant follicular cyst usually reaches a maximum diameter of 2.5cm just prior to ovulation
- Dominant follicle also called Graafian follicle
- Non-dominant follicles usually do not exceed 11 mm in diameter
- Non-dominant follicles can enlarge to 3 - 8cm in size
- Should regress spontaneously but may require surgical removal

*Sonographic Appearance:*

- Dominant <25mm size; Non-dominant <11 mm
- Anechoic

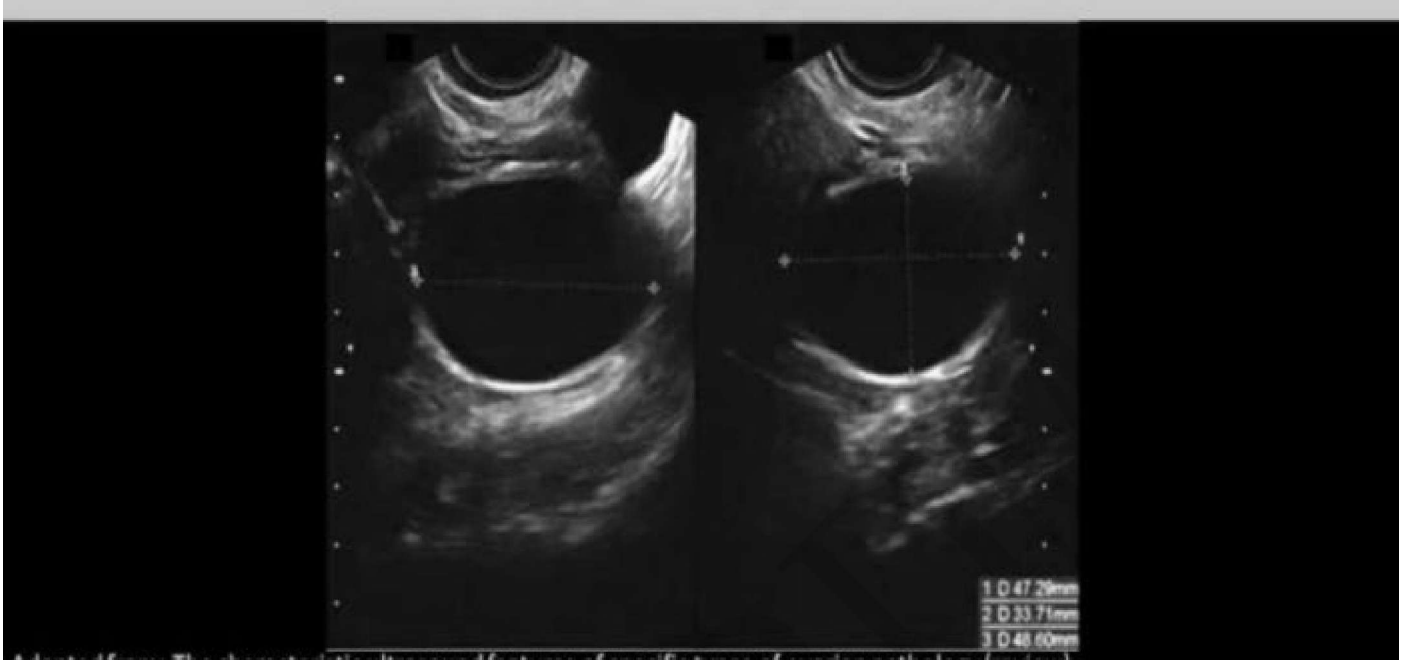
- Smooth borders
- Through transmission
- Posterior enhancement
- Doppler evaluation of the tissues surrounding the dominant follicle will demonstrate increased peripheral flow with high velocity, low resistance waveform on PW Doppler

# Functional Cyst




# Follicular Cysts

# Follicular Cyst




Adapted from: The characteristic ultrasound features of specific types of ovarian pathology (review). Sayasneh A, Ekechi C, Ferrara L, Kaijser J, Stalder C, Sur S, Timmerman D, Bourne T - Int. J. Oncol. (2014)

# Follicular Cysts

***Corpus Luteal Cysts:***

- Functional, regresses 14 days after ovulation if fertilization does not occur
- Formed after rupture of the dominant follicle
- If fertilization occurs, bhCG will cause the corpus luteal cyst to remain in the ovary and produce progesterone to stimulate the decidual reaction
- Unilateral, unilocular, thin smooth walls
- Contain echoes due to hemorrhage
- Size is usually <5cm
- Secretes progesterone
- Develop due to menstruation - increase in size until day 22 of cycle
- Maintained with pregnancy - reaches max size 8-10wks, regresses around 14th week and should be completely gone by week 16
- Most common cystic mass seen with pregnancy

*Sonographic Appearance:*

- When differentiating an intraovarian mass from an extraovarian mass, such as a corpus luteal cyst versus ectopic, use the TV transducer to apply pressure in the adnexal region and observe the motion of the mass relative to the ovary
- An intraovarian mass will move with the ovary and an extraovarian mass will move separately from the ovary
- Unilateral, unilocular, thin smooth walls
- Anechoic but with internal echoes from debris
- Posterior enhancement
- May have irregular walls and septations due to involution
- Low resistance Doppler waveforms with increased diastolic flow seen in surrounding ovarian tissue
- Usually regress 14 days after unfertilized ovulation occurs or after 14th week of pregnancy
- Not normally identified after 16 weeks

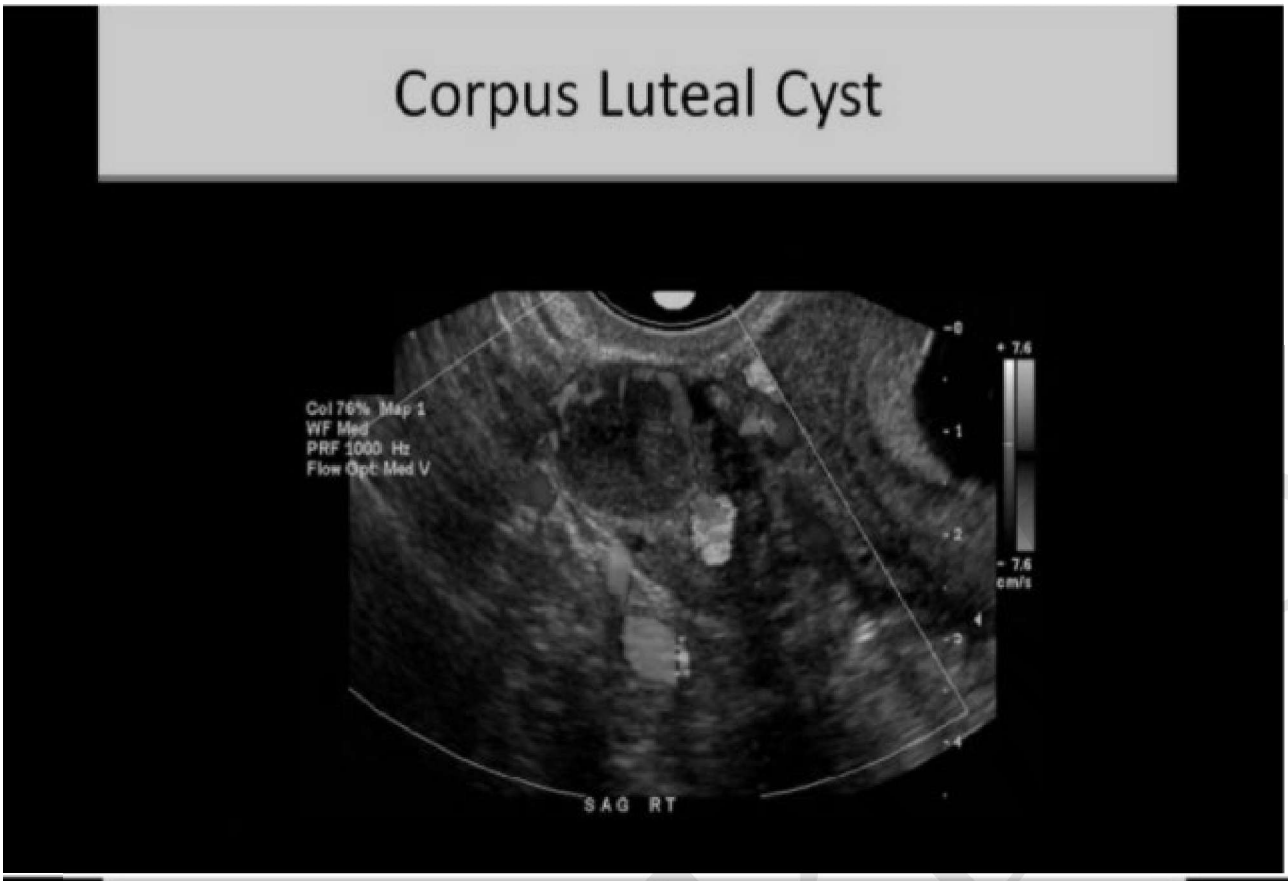
# Corpus Luteum

*Wouter Veldhuis, Robin Smithuis, Oguz Akin and Hedvig Hricak*

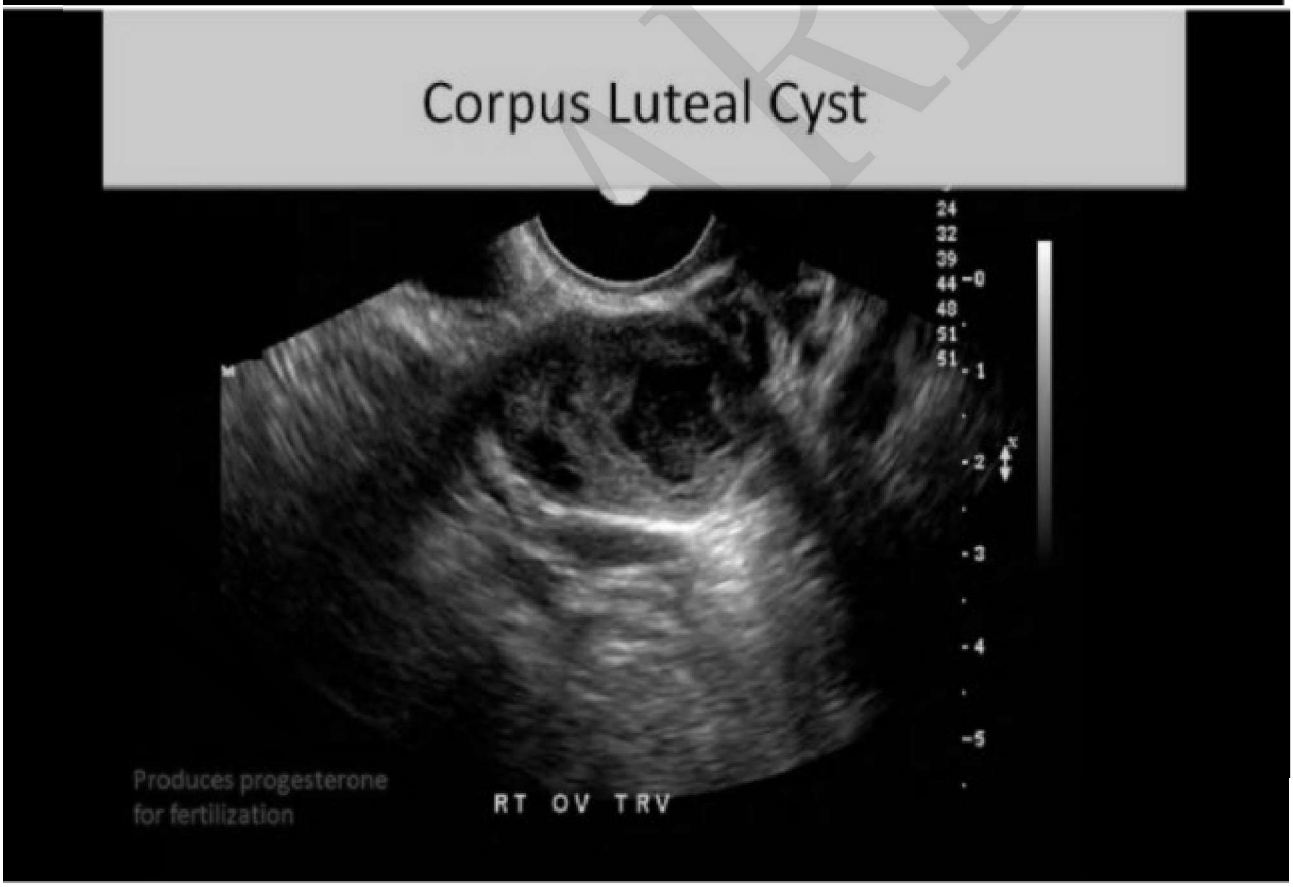
www.radiologyassistant.nl

# Corpus Luteal Cyst

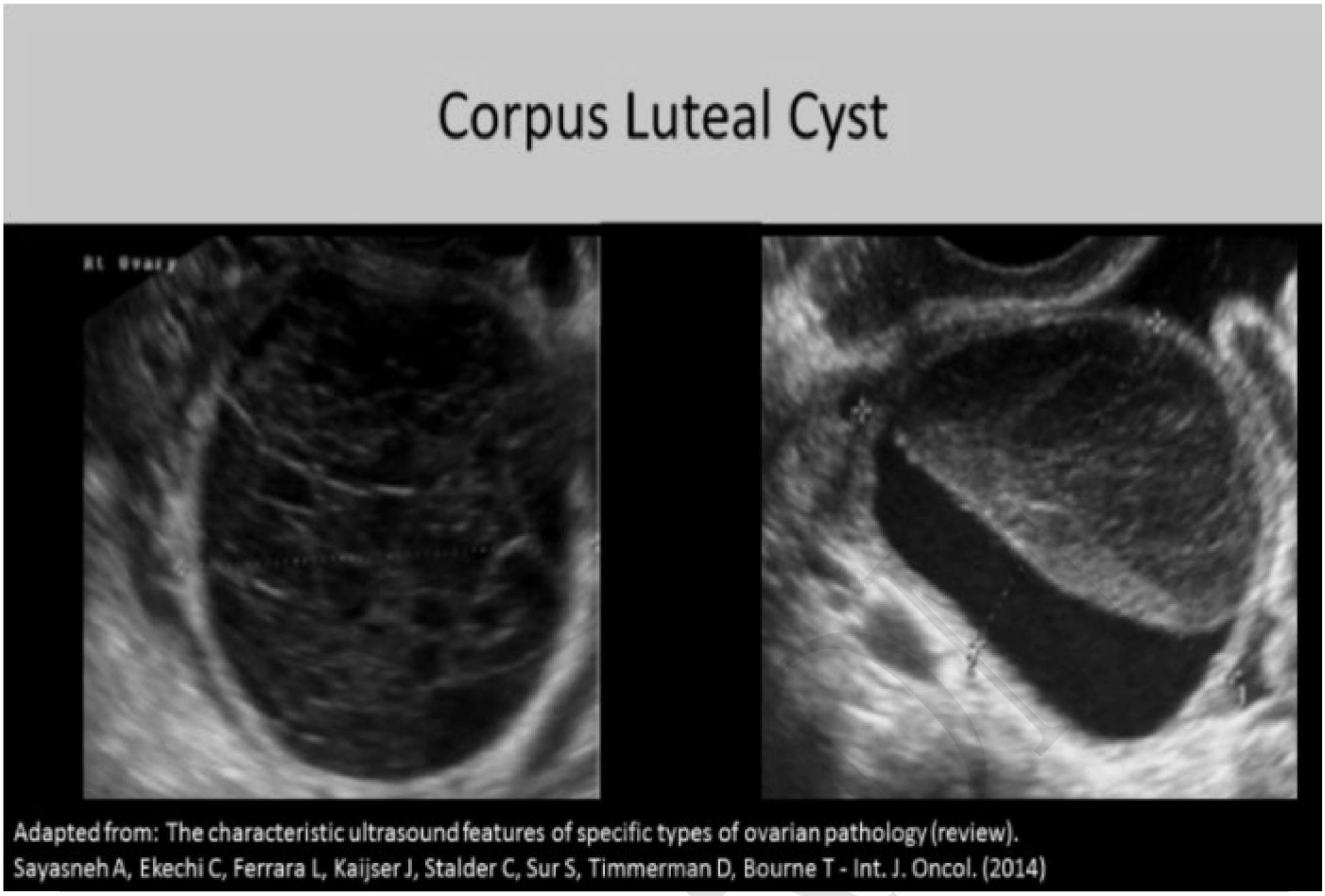
# Corpus Luteal Cyst




# Corpus Luteal Cyst




Produces progesterone for fertilization



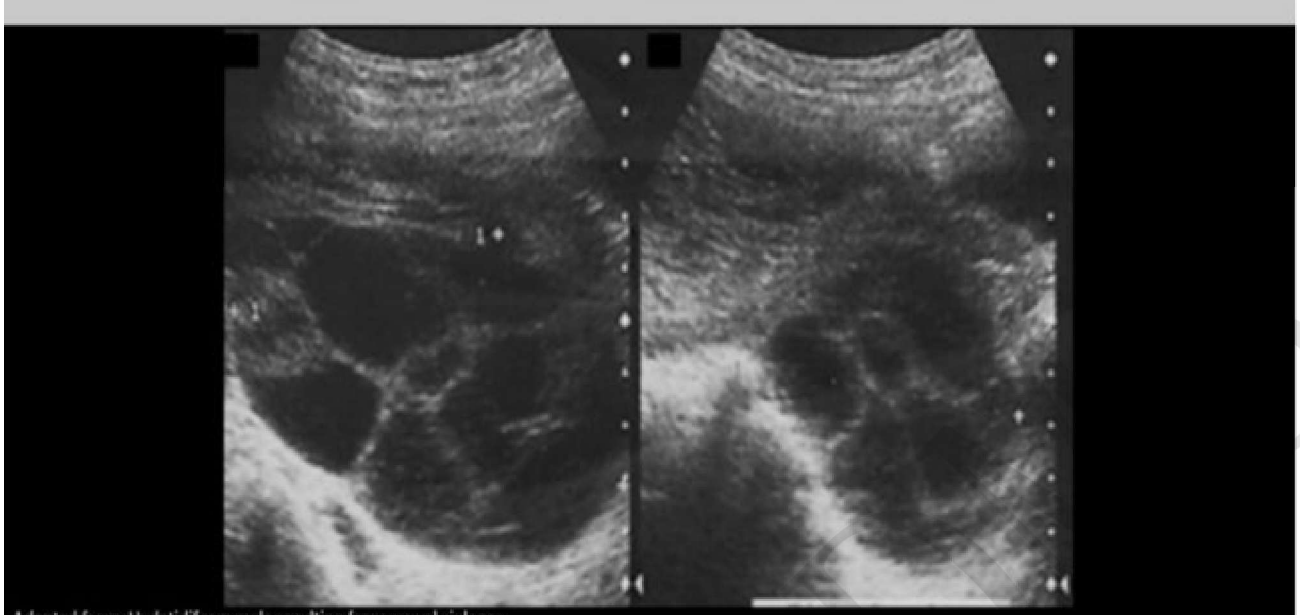

***Theca Lutein Cysts:***

- Largest functional cyst
- Associated with high levels of human chorionic gonadotropin (hCG)
- Usually occur with multiple gestations, gestational trophoblastic disease, choriocarcinoma
- Also seen with ovarian hyperstimulation and fertility medications
- Causes overstimulation of follicles
- Involutes when the source of hCG is removed, takes 2-4 months
- If present with pregnancy, the cysts will regress as the bhCG levels drop after 8 weeks gestation
- Causes nausea and vomiting due to high hCG levels
- Increased risk of ovarian torsion with large cyst formation

*Sonographic Appearance:*

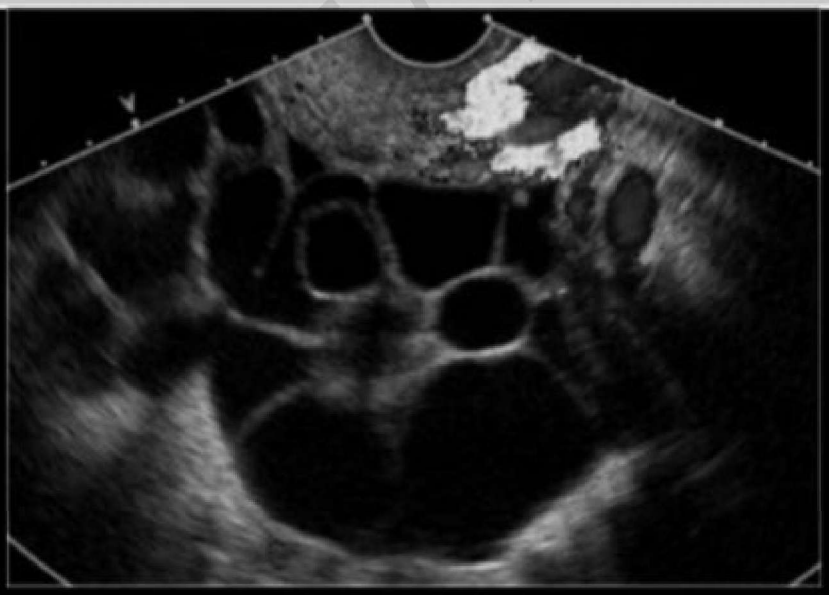
- Complex masses with thick irregular walls
- Always bilateral
- Multiple, multilocular cysts
- Size range 3-20cm, can get very large!!

# Theca Lutein Cyst



Adapted from: Hydatidiform mole resulting from sexual violence.
Drezett J, Kurobe FC, Nobumoto CT, Pedroso D, Blake M, Valenti VE, Vanderlei LC, Adami F, Vanderlei FM, de Araujo Moraes SD, Vertamatti MA, Reis AO, de Mello Monteiro CB, Rossi RC, de Abreu LC - Int Arch Med (2012)

# Theca Lutein Cysts



*Wouter Veldhuis, Robin Smithuis, Oguz Akin and Hedvig Hricak*
www.radiologyassistant.nl

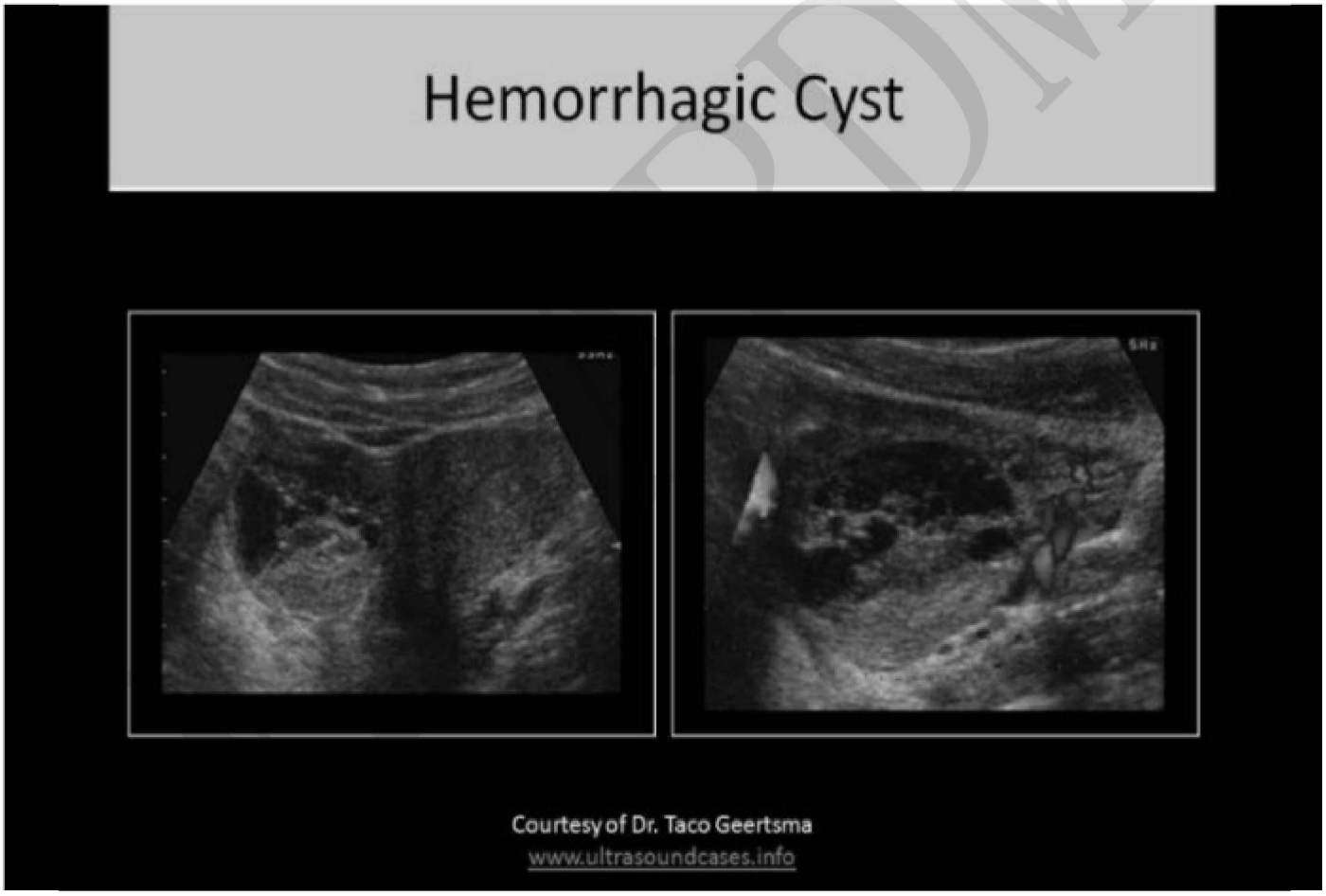
**Hemorrhagic Cysts:**

- *Functional cyst with hemorrhage*
- *May see fluid levels and thrombus*
- *Usually resolve spontaneously*

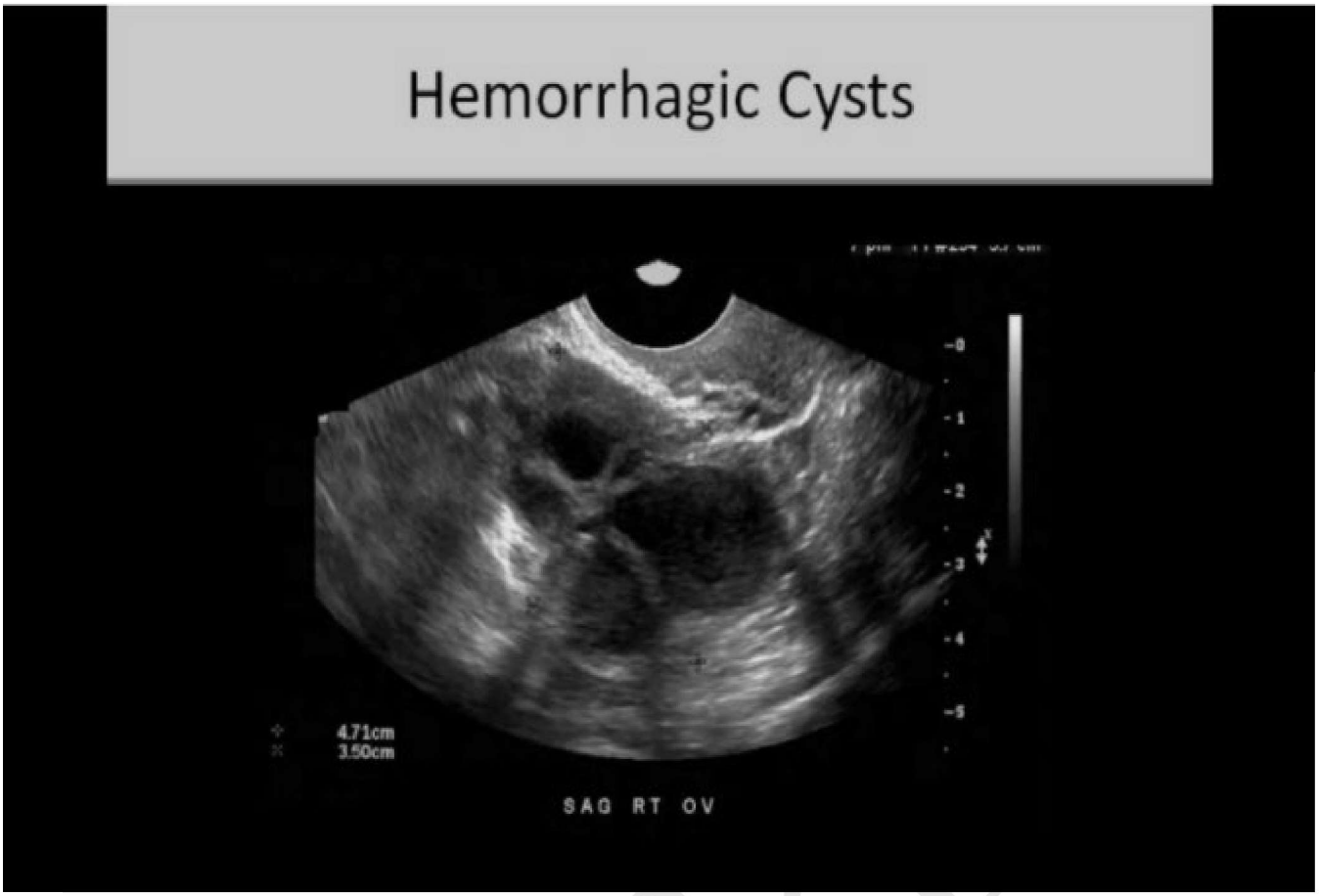
Sonographic Appearance:

- *Round; well defined borders*
- *Vary in size*
- *May see posterior enhancement with acute hemorrhagic changes*
- *Internal echogenicity varies with age of thrombus*
- *Thin or thick walls*
- *Septations*

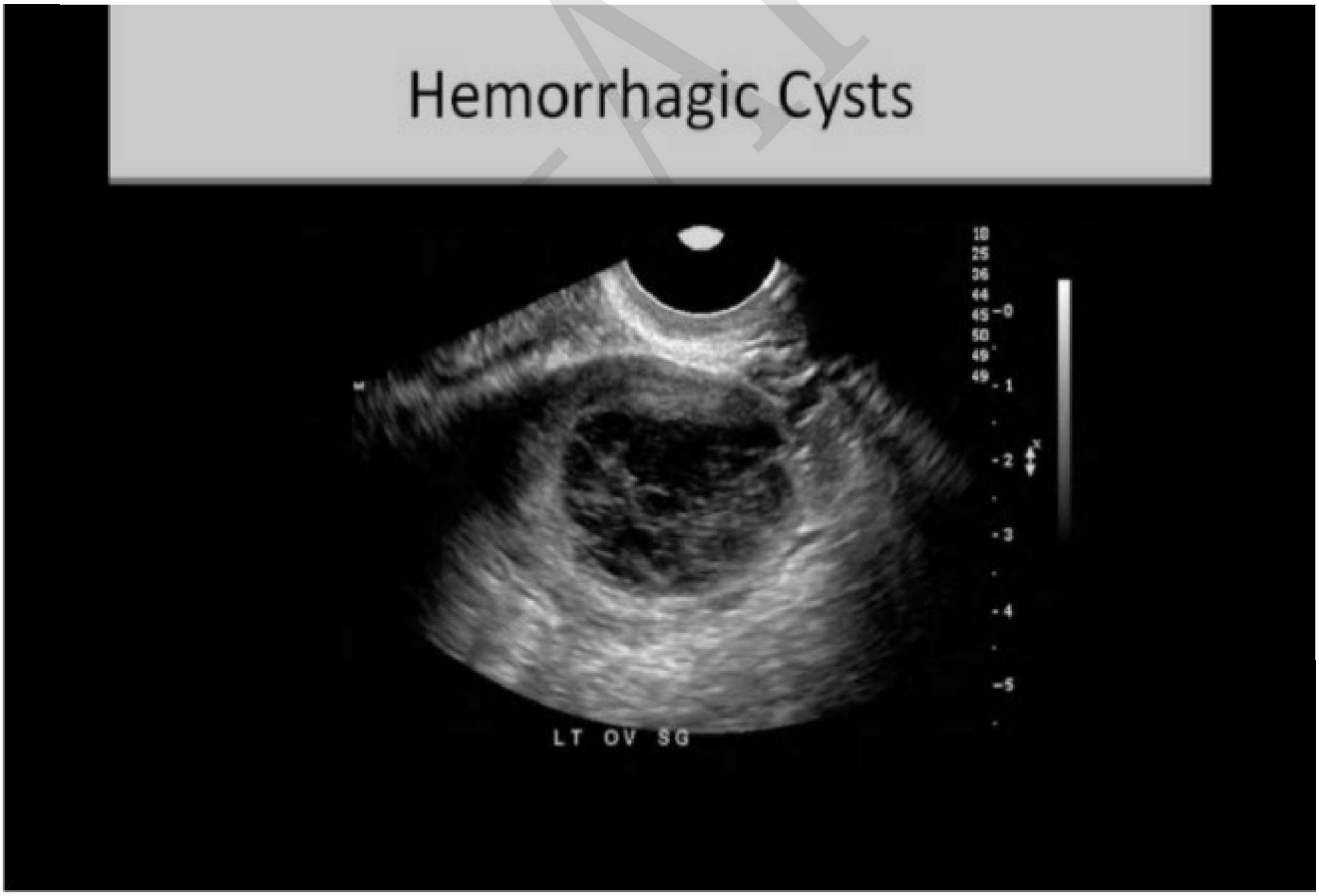
May cause fluid in cul-de-sac



# Hemorrhagic Cysts




# Hemorrhagic Cysts



***OTHER TYPES OF CYST FORMA TION:***

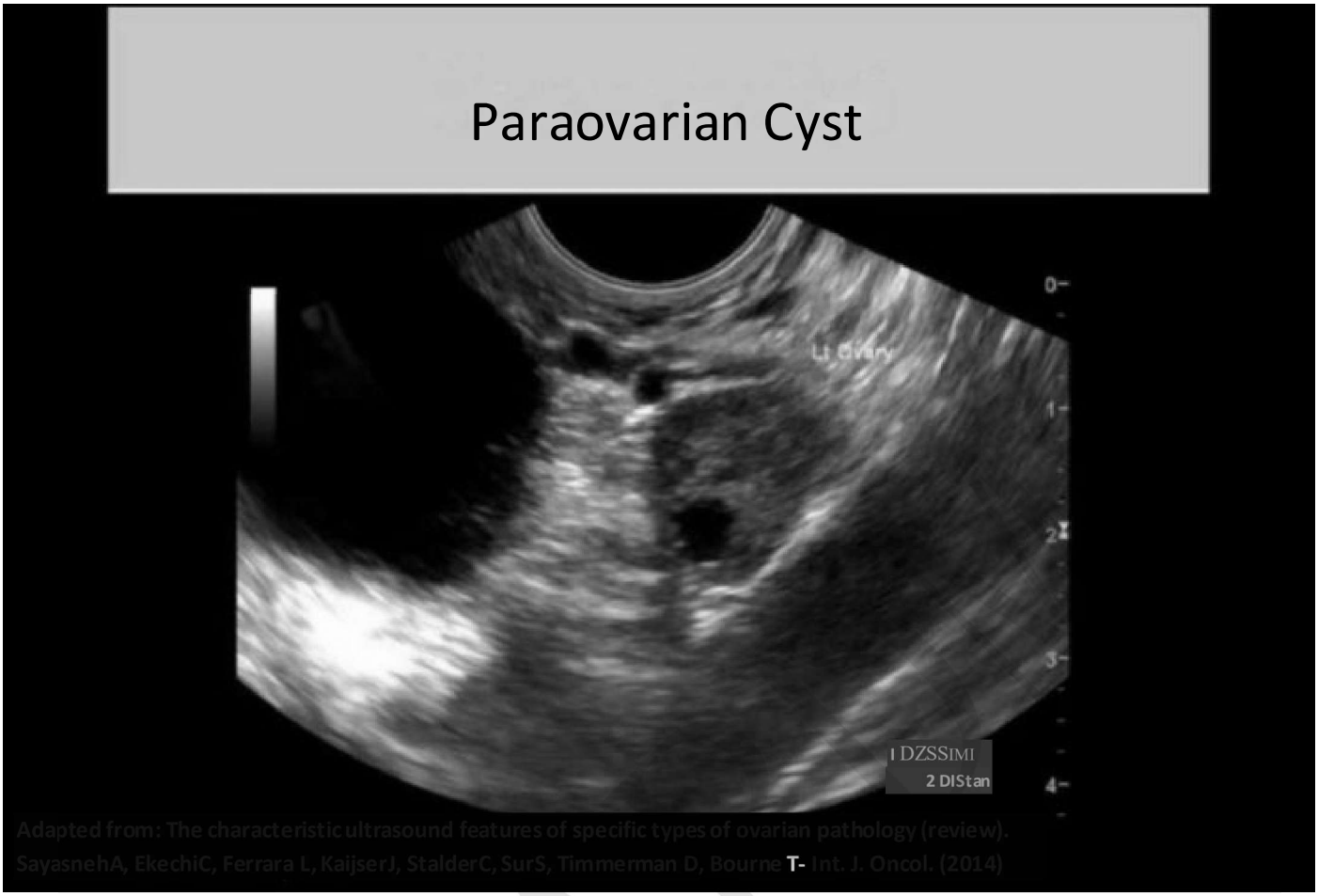
**Paraovarian Cysts:**

- *Non functional cyst*
- *Arise from Wolffian duct system within the mesovarium*
- *AKA Broad ligament cysts, mesonephric cysts, Morgagni cysts*
- *Usually uni I ocular*
- *Thin waited, fairly large*

Sonographic Appearance:

- *Thin walled, anechoic structure (simple cyst)*
- *Located between uterus and ovary*
- *Through transmission*

Posterior enhancement



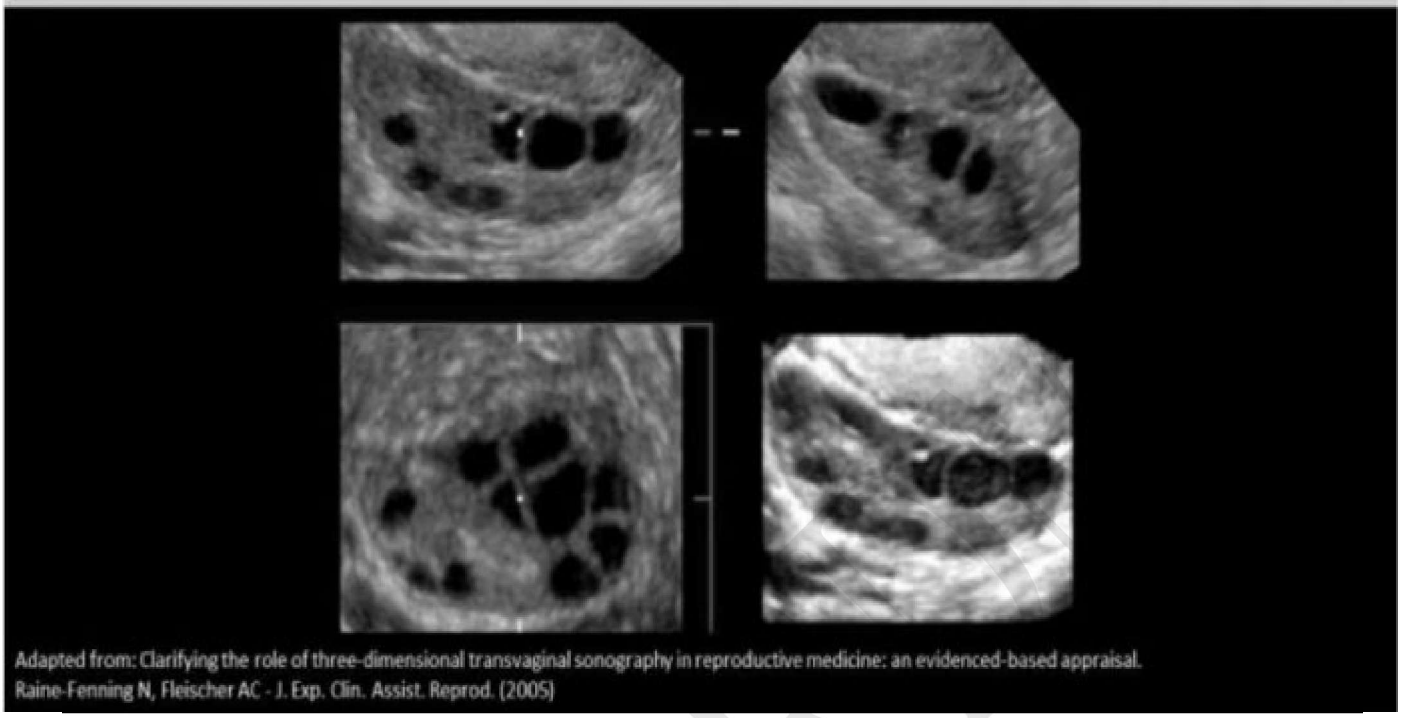

***Polycystic Ovarian Disease:***

- Endocrine disorder - imbalance of LH and FSH causes excessive estrogen and androgen production
- Elevated testosterone levels can lead to hirsutism/virilization
- Elevated estrogen levels can cause fibroid growth and endometrial changes
- Causes anovulation and infertility
- Small uterus and breasts
- Can be seen with Cushing Syndrome
- A part of Stein Leventhal Syndrome
  - Amenorrhea/Oligomenorrhea
  - Obesity
  - Hirsutism

*Sonographic Appearance:*

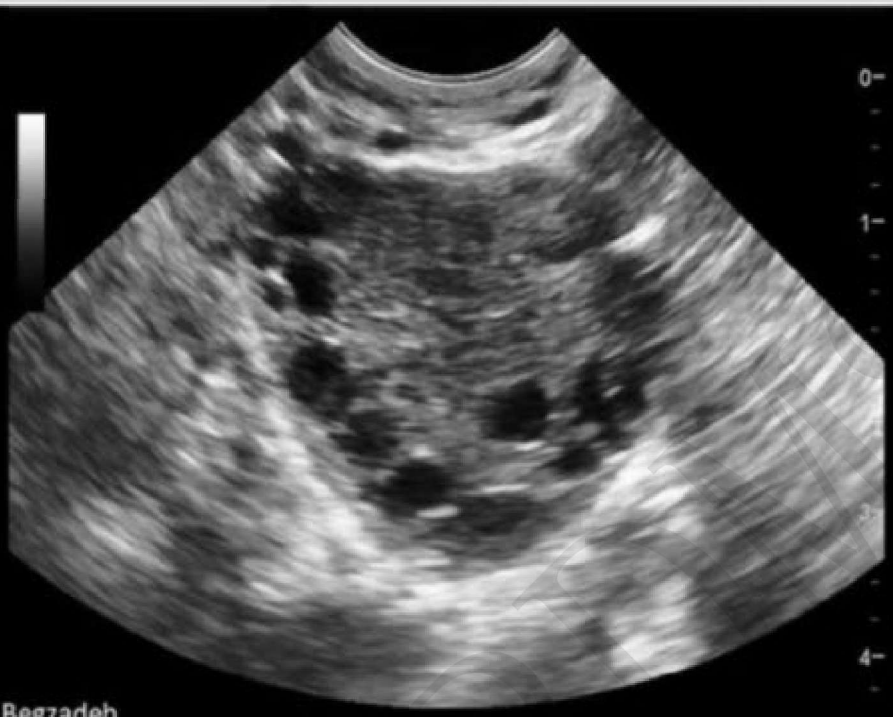
- Increased echogenicity of the stromal tissue due to microscopic cysts
- Increased volume >10cc
- Demonstrates multiple follicles <10mm along the periphery of the ovary
- 10 or more immature follicles along periphery (string of pearls sign)
- 15 or more immature follicles throughout the ovary

# Polycystic Ovaries



Adapted from: Clarifying the role of three-dimensional transvaginal sonography in reproductive medicine: an evidenced-based appraisal. Raine-Fenning N, Fleischer AC - J. Exp. Clin. Assist. Reprod. (2005)

# PCOD

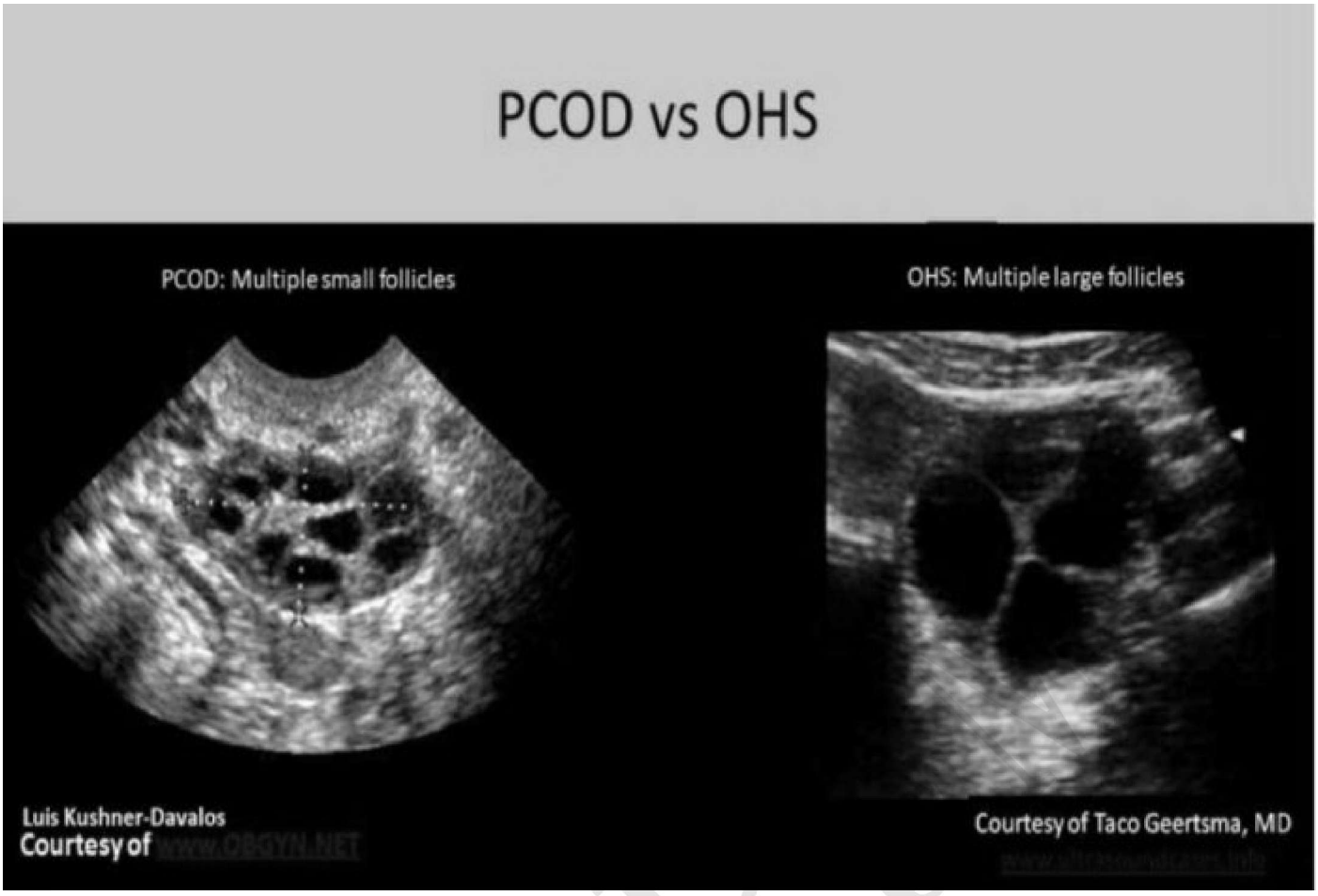


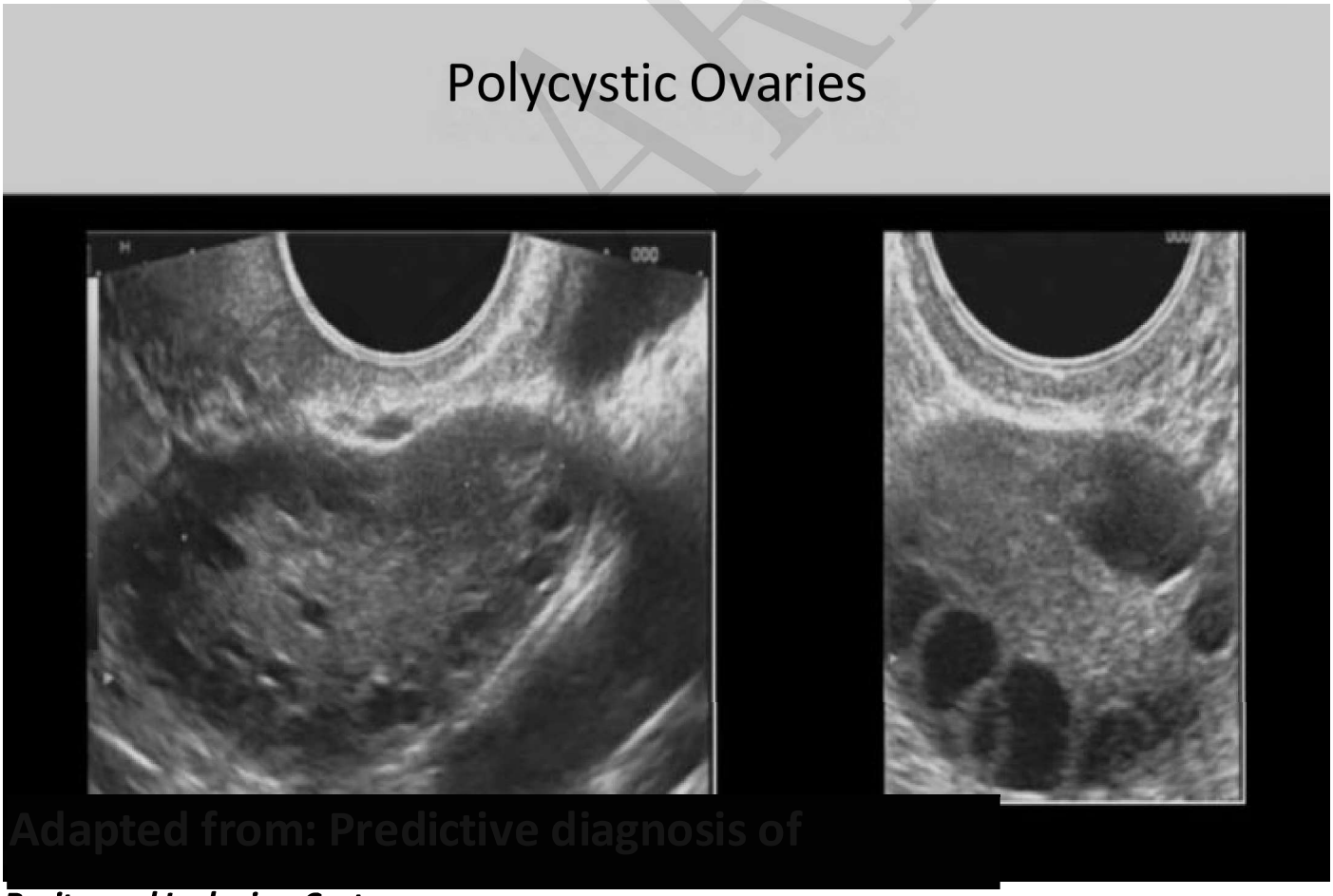

Dr. Hasan Begzadeh

# PCOD

3,02cm
1,71cm

Luis Kushner-Davalos
Courtesy of




***Peritoneal Inclusion Cyst:***

- Usually form secondary to intra-abdominal inflammation
- Seen in premenopausal women with history of PID, inflammatory bowel syndrome,

endometriosis or abdominal or pelvic surgery
- Inflammation causes fluid to surround the ovary
- Fibrous bands may be seen suspending the ovary within the fluid ( "spoke wheel" or "spider web" appearance)
- Because the fluid collection has no true 'wall', the cyst typically conforms to the shape of the surrounding structures or cavity



*Pelvic Inflammatory Disease (P/D):*
- Infectious disease of the female reproductive organs
- Ascending infection usually from vagina, starts in uterus and extends into tubes/adnexa
- Vaginitis is the first symptom of infection
- Metritis refers to inflammation of the uterus
- Endometritis refers to inflammation of the endometrium
- Can lead to Fitz-Hugh-Curtis Syndrome - inflammation of the peritoneum and the Glisson capsule which causes perihepatic adhesions and fluid
- Leads to increased risk of ectopic pregnancy due to tubal damage/adhesions from PID
- Chronic infection can lead to the formation of cervical polyps
- PID can cause infertility

*4 Stages ofPiD:*
- Stage 1: Acute endometritis:
  - Endometrial fluid/debris/air
  - Fluid in posterior cul-de-sac
  - Increased vascularity on Doppler ultrasound
- Stage 2: Acute salpingitis
  - Fluid or pus within tubes
  - "Shaggy" appearance of tube walls
  - Thick-walled tubes with acute infection (>5mm)
  - Cogwheel sign - demonstrated in cross-sectional view; longitudinal folds of the fallopian tube may become thickened
- Stage 3: Acute tubo-ovarian abscess:
  - Multilocular complex retro-uterine/adnexal mass(es) with debris
  - May see comet tail artifact due to air produced with bacterial infection
  - Septations
  - Irregular thick walls
  - Commonly bilateral
  - May see echogenic debris in the pelvis
- Stage 4: Chronic Infection:
  - Hydrosalpinx - fluid in the tubes
  - Pyosalpinx - pus in the tubes
  - Hematosalpinx - blood in the tubes
  - Thin-walled fallopian tube (<5mm)

- Beads-on-a-String sign - remnants of the endosalpingeal folds demonstrate multiple 2-3mm nodules that project into the lumen
- Peritoneal inclusion cyst may also be seen as a loculated fluid collection surrounding the uterus and ovaries
- Hydrosalpinx and pyosalpinx are differentiated from pelvic veins using color Doppler
- Hydrosalpinx and pyosalpinx are differentiated from bowel loops by visualizing peristalsis within the bowel

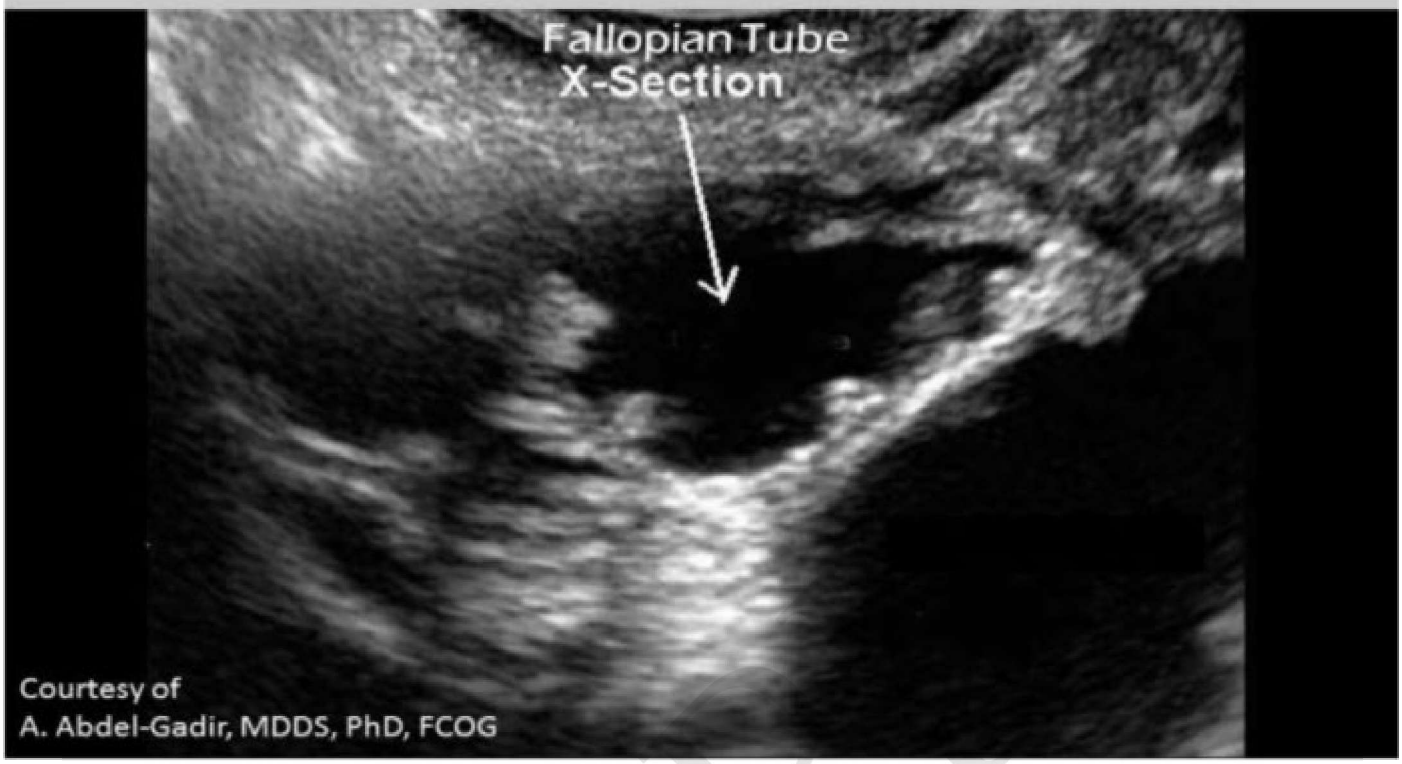
Associated with:
- Chlamydia (#1)
- Gonorrhea
- TORCH infections
- Poor hygiene
- Tuberculosis
- Mon-sterile surgical instruments
- Child birth
- Intrauterine contraception
- Intercourse with a man with urethritis
- Ruptured appendix

Symptoms:
- Vaginitis - most common
- Bleeding
- Discharge
- Pain
- Nausea, vomiting
- Dysuria
- Fever
- Increased white blood cell count
- Elevated CA-12 5
- Rapid pulse
- Palpable mass

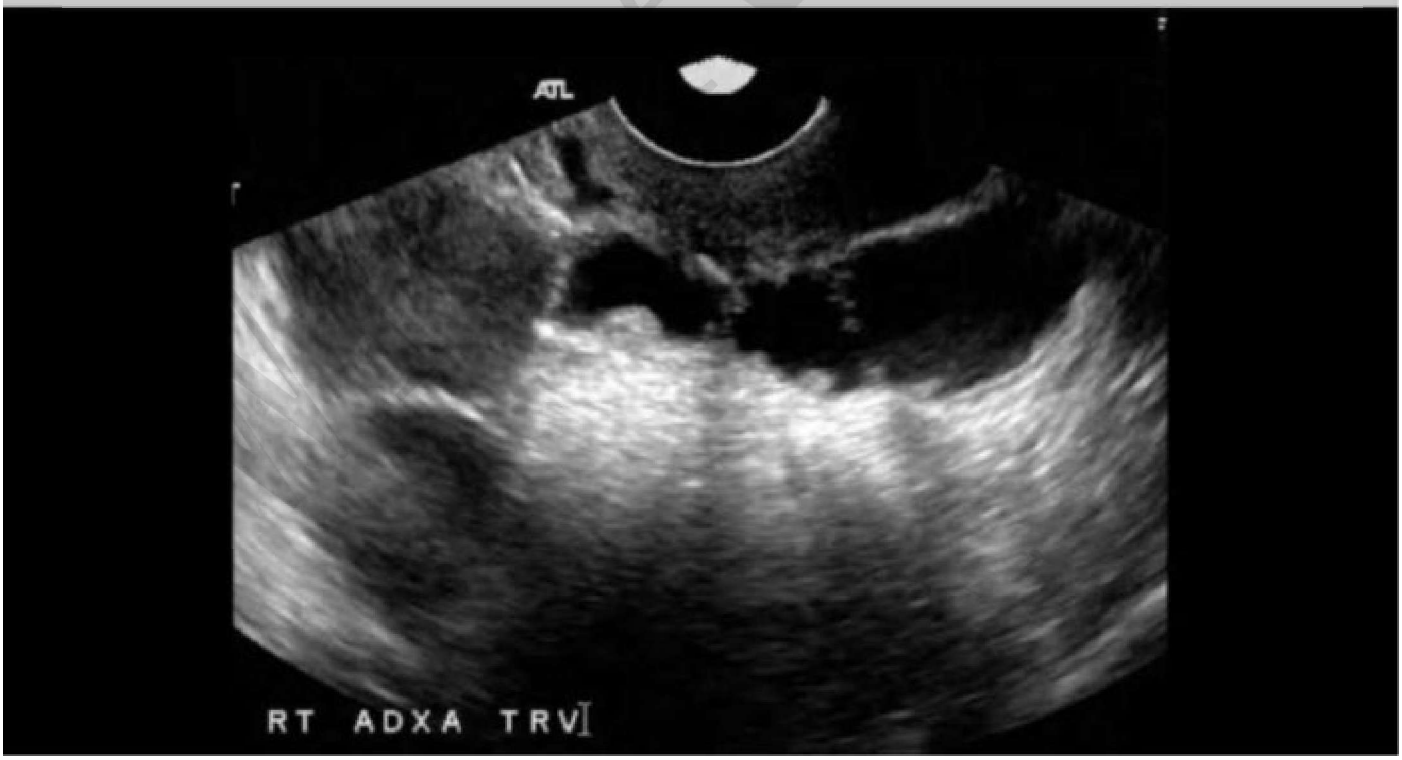
*Sonographic Appearance -Acute:*
- Enlarged, swollen uterus
- Prominent and or irregular endometrium
- Fluid in cul-de-sac
- Edematous adnexa
- Hydrosalpinx/pyosalpinx
- Hypervascularity of the tubal walls
- Tubal wails may have nodular appearance

*Sonographic Appearance - Chronic:*
- Normal sized uterus
- Fluid in cul-de-sac
- Ascites
- Hydrosalpinx/pyosalpinx
- Abscess

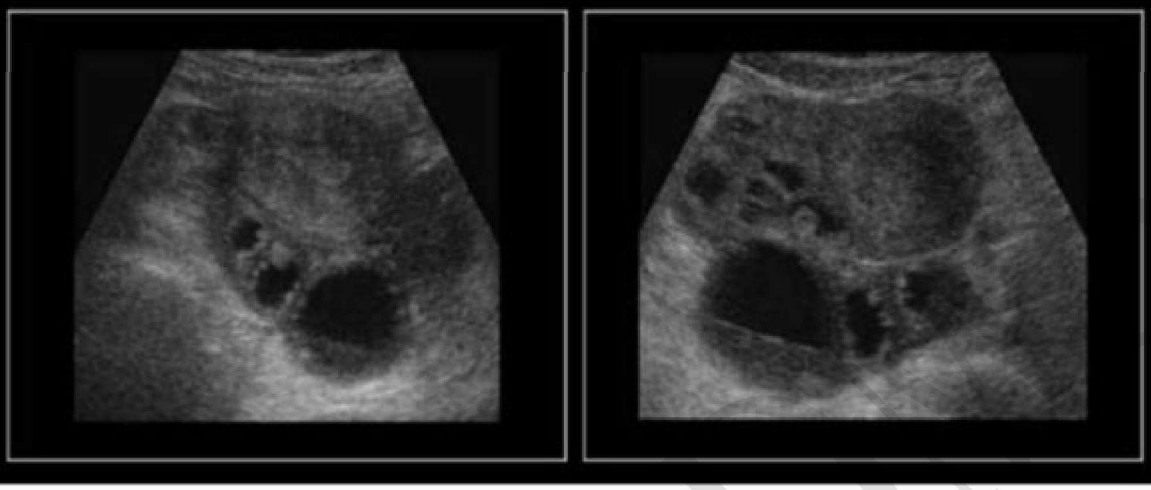
# Acute PID – Cogwheel Sign



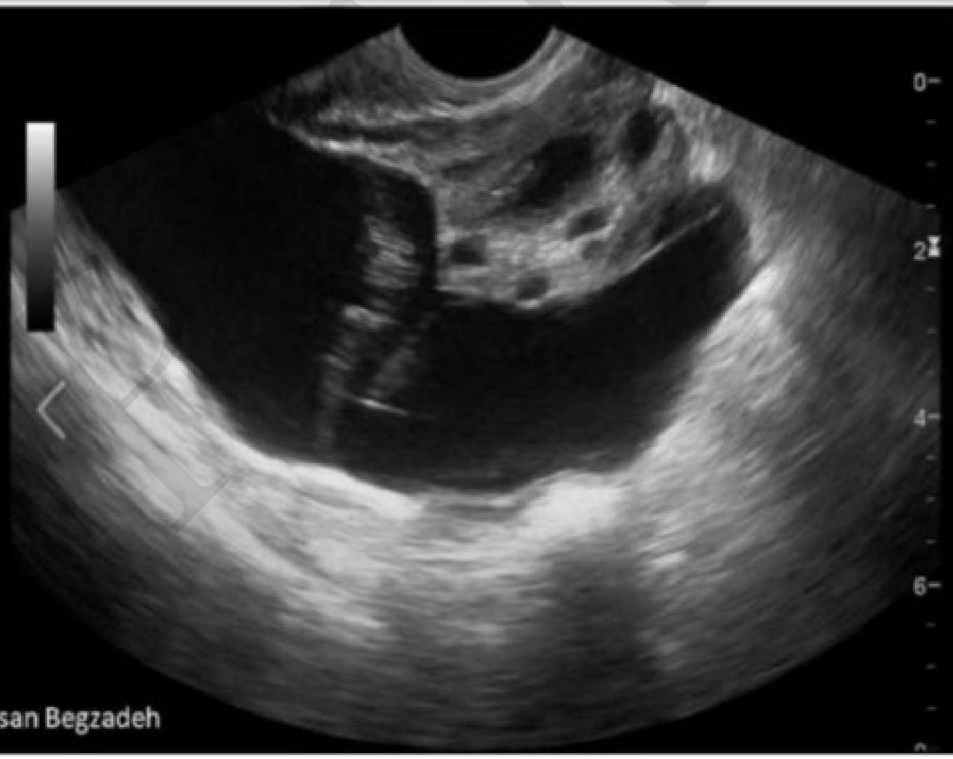

# Chronic PID - Beads on a String



# PID



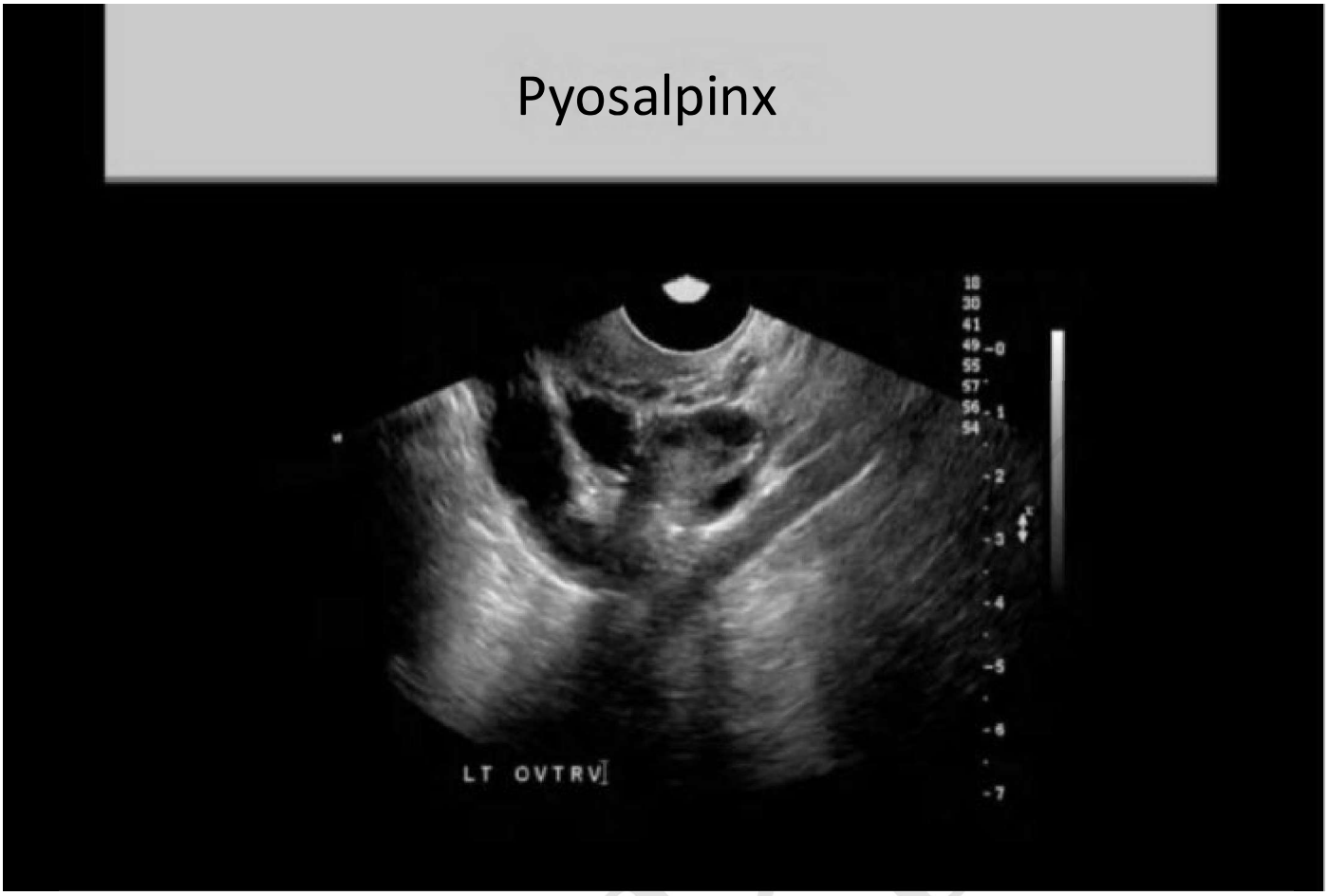
# Hydrosalpinx



# Hydrosalpinx


# Hydrosalpinx

# Pyosalpinx

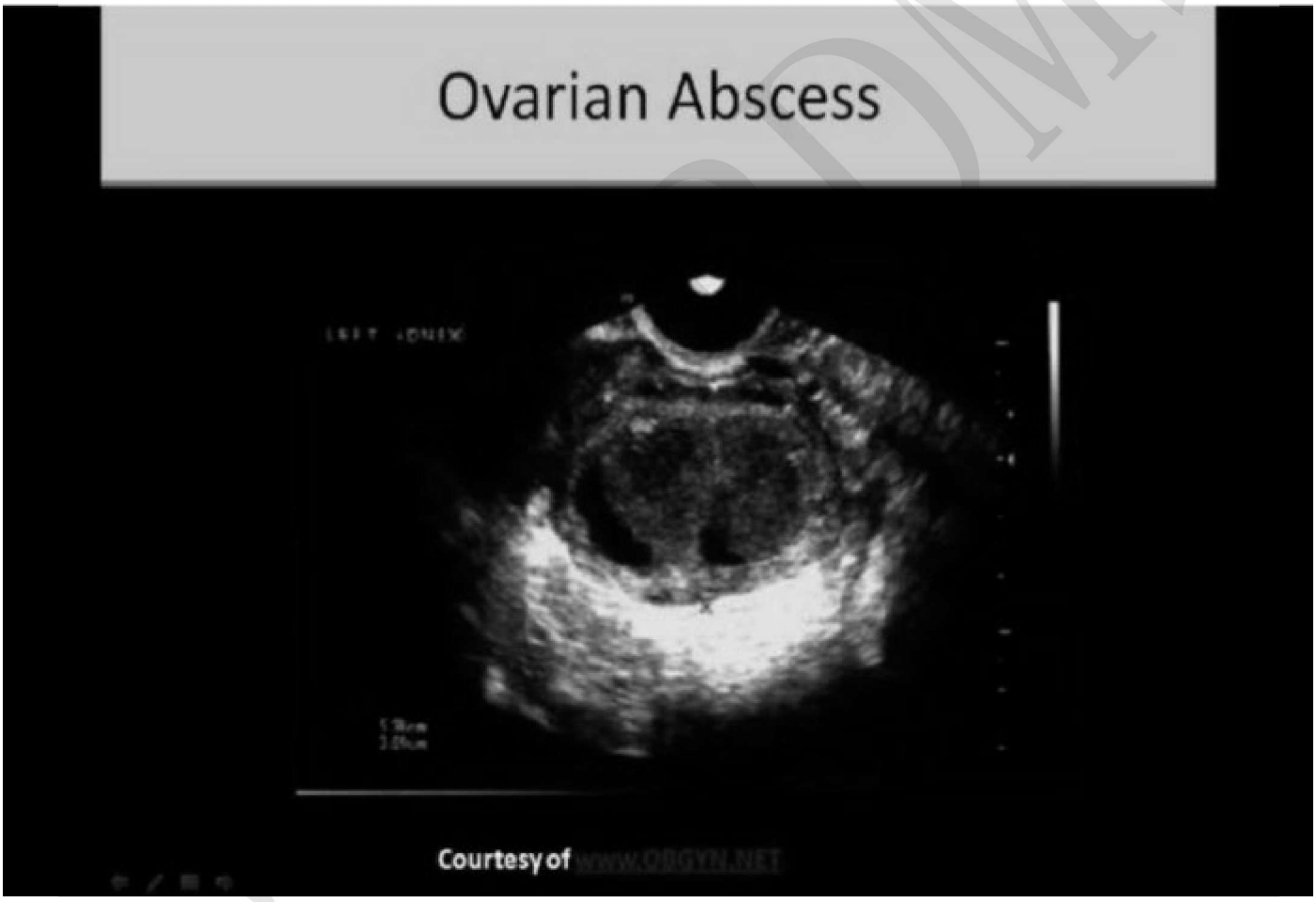


***Tubo-Ovarian Abscess:***

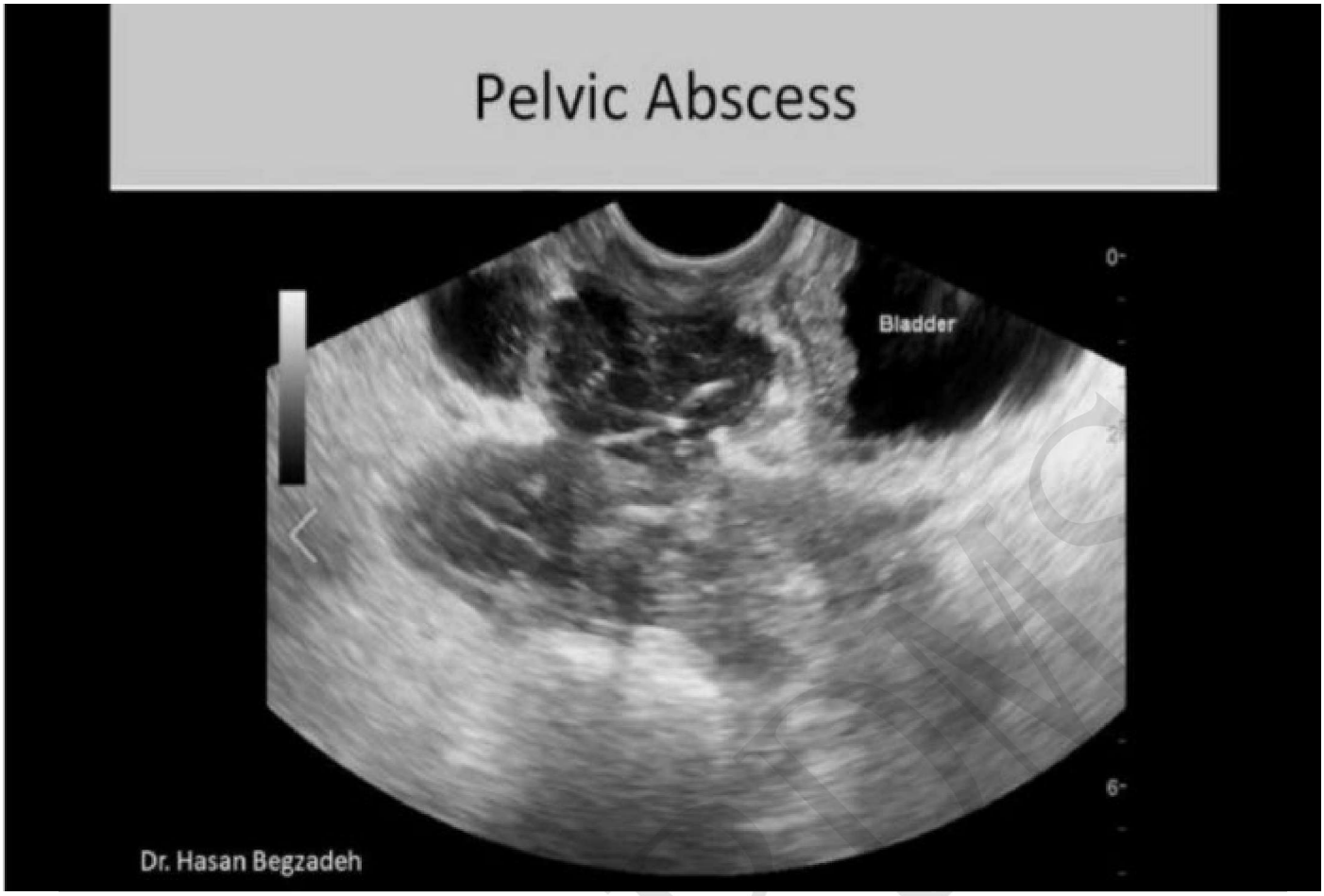
- Associated with PID
- Usually bilateral with chronic PID
- Irregular complex mass adjacent to ovary
- May see shadowing from gas in abscess
- Associated with IUDs
- Caused by ascending infection
- Pain, fever, nausea, leukocytosis

*Sonographic Appearance:*

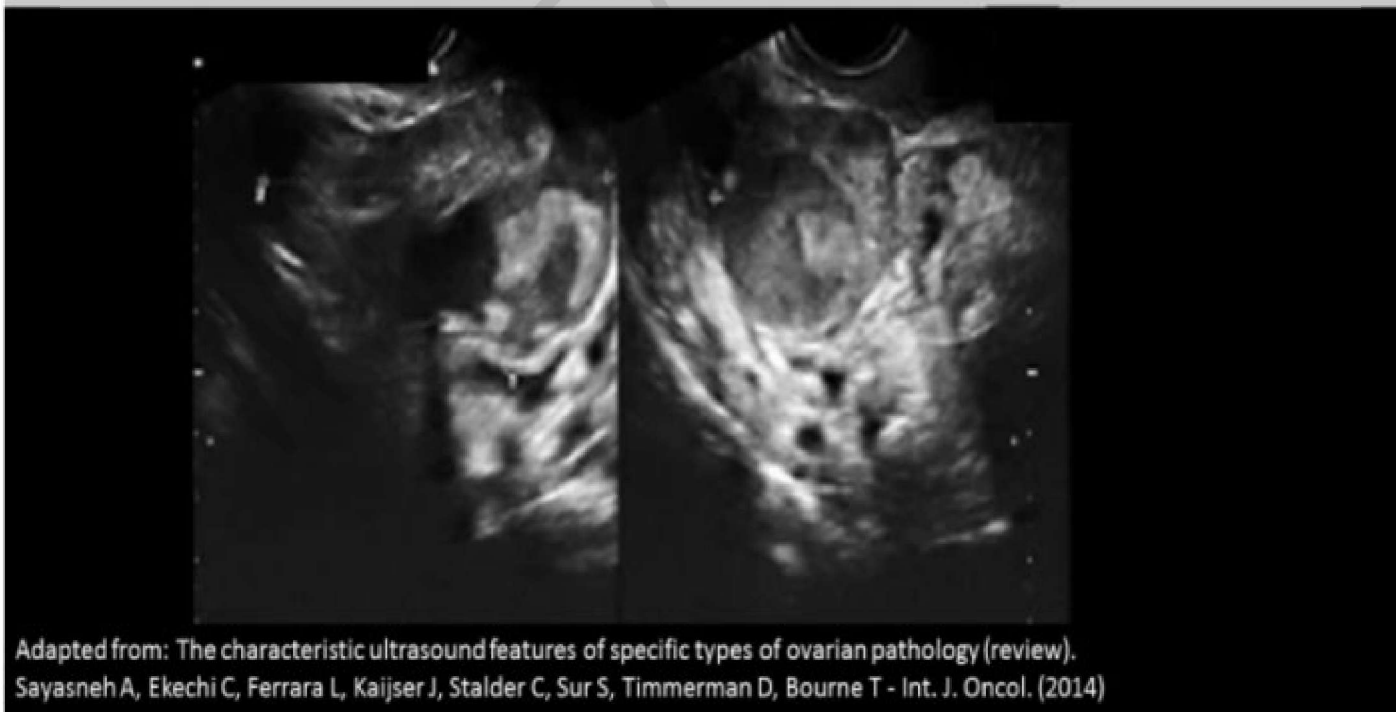
- Abnormally thickened endometrium
- Hydrosalpinx/pyosalpinx
- Complex adnexal mass
  - o Irregular borders
  - o Septations and debris
  - o Gassy (dirty) shadowing may be seen



# Pelvic Abscess




# Tubo-ovarian Complex



Adapted from: The characteristic ultrasound features of specific types of ovarian pathology (review). Sayasneh A, Ekechi C, Ferrara L, Kaijser J, Stalder C, Sur S, Timmerman D, Bourne T - Int. J. Oncol. (2014)

*Other Infectious Processes of the Pelvis:*

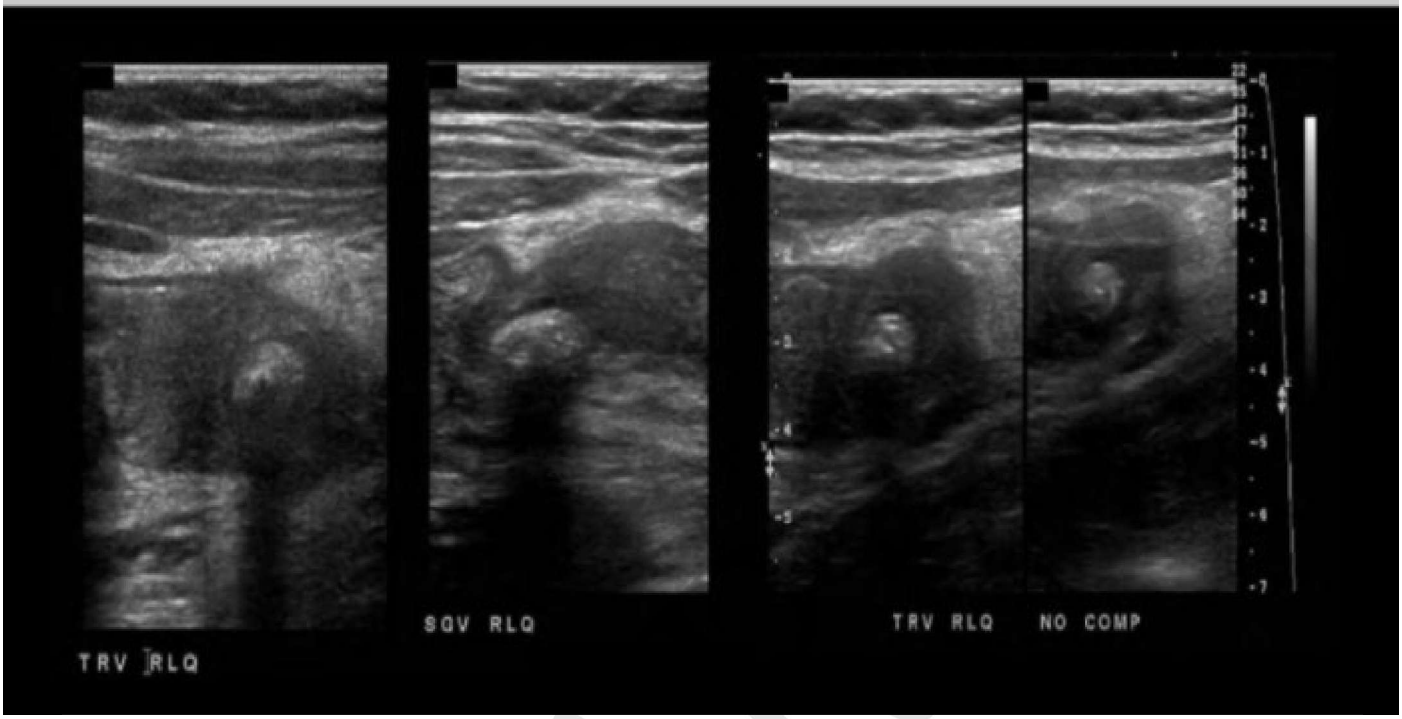
*Acute Appendicitis:*

- Most common cause of the acute abdomen
- Appendix located posterior to the terminal ileum and anterior to the iliac vessels
- RLQ pain, increased WBC, rebound tenderness with transducer compression
- Utilize compression techniques for diagnosis, normal bowel loops will compress and peristalsis will be noted
- *McBurney Point*
  - Draw a line from the right anterior superior iliac spine to the umbilicus
  - The midpoint should be the location of the origin of the appendix
  - Related to the location in the RLQ of the most tenderness associated with appendicitis
- Bacterial infection leads to gangrene and possible perforation
- Perforation leads to peritonitis
- A fecalith is a hard stony mass of feces in the intestinal tract that can obstruct the appendix, leading to appendicitis
- Fecaliths are also known as coprolith and stercolith

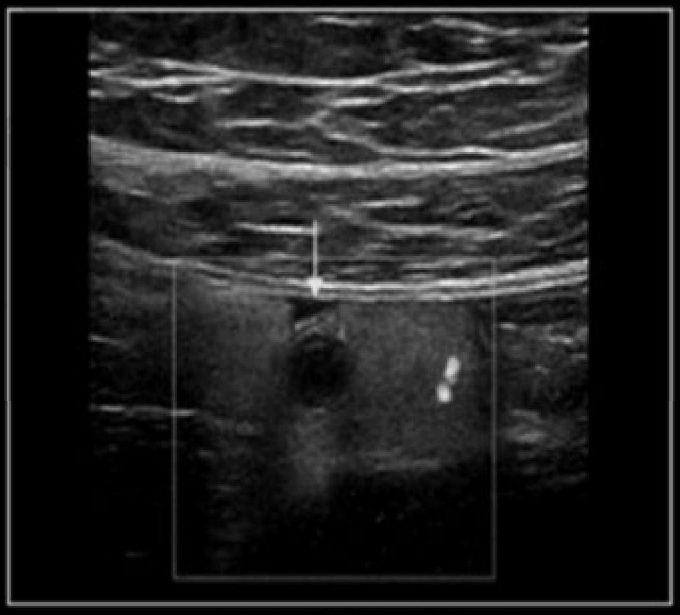
*Sonographic Appearance:*

- Graded Compression techniques are used to try to compress the bowel in the area under the transducer to cause peristalsis
- Blind ended structure that will not respond to compression techniques
- Aperistaltic tube with gut signature that arises from cecum base
- Diameter >6mm, wall >2mm
- Transverse view demonstrates target sign
- Fluid collection
- Inflamed perienteric fat
- Increased vascularity in the gut walls
- Loss of the normal echogenic submucosal layer and lack of color flow suggests gangrenous appendix
- Echogenic, shadowing fecalith may be identified inside the appendix

# Appendicitis

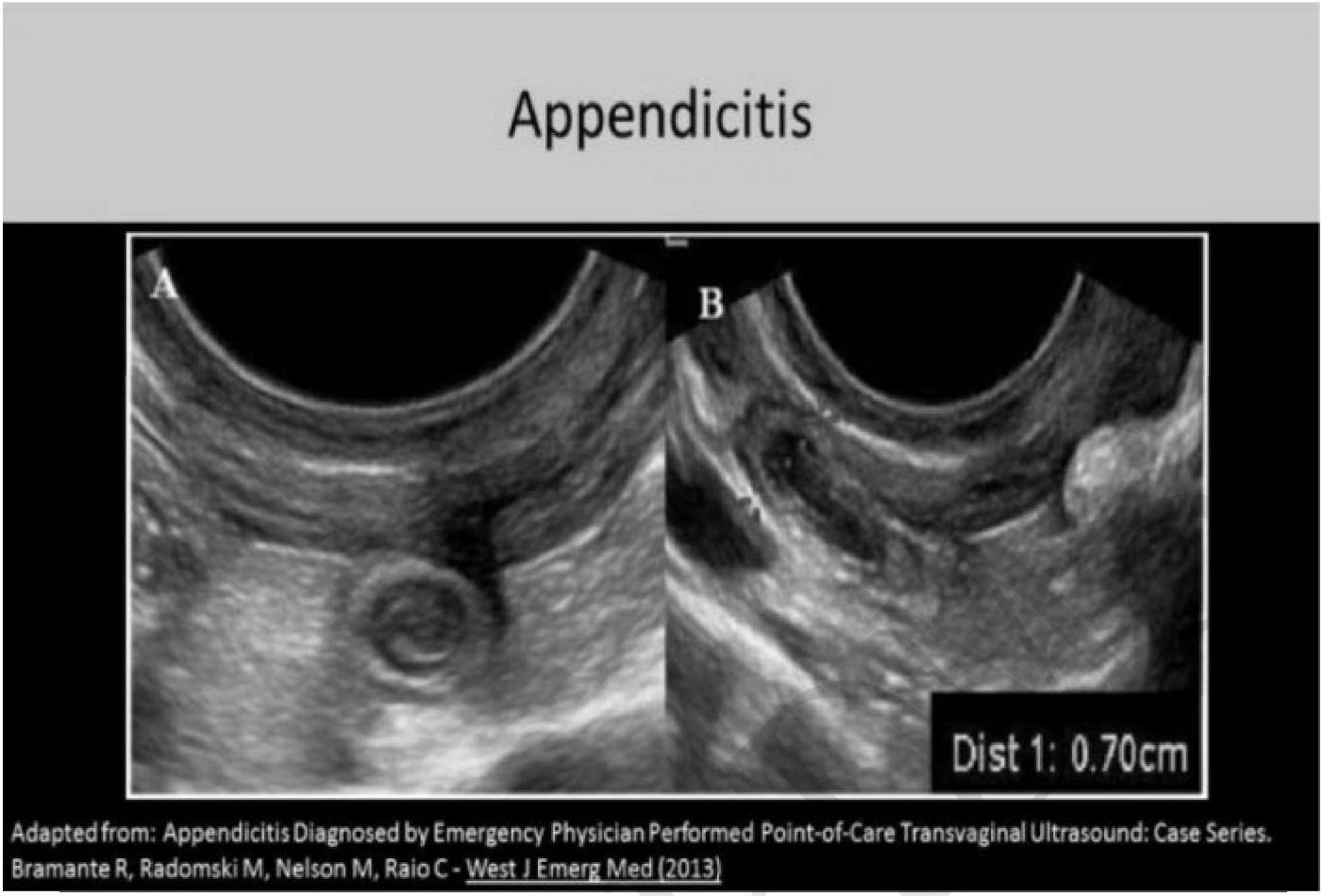



# Appendicitis



Note the inflamed mesenteric fat surrounding the thickened appendix.

Courtesy of Dr. Taco Geertsma
www.ultrasoundcases.info




***Diverticulitis:***

- LLQ pain, fever, increased WBC
- Segmental, concentric, thickening of the wall
- Most common in the sigmoid colon

*Sonographic Appearance:*

- Inflamed diverticula (out-pouching of wall >4mm)
- Echogenic areas in wall
- Pseudokidney sign - abnormal bowel thickening

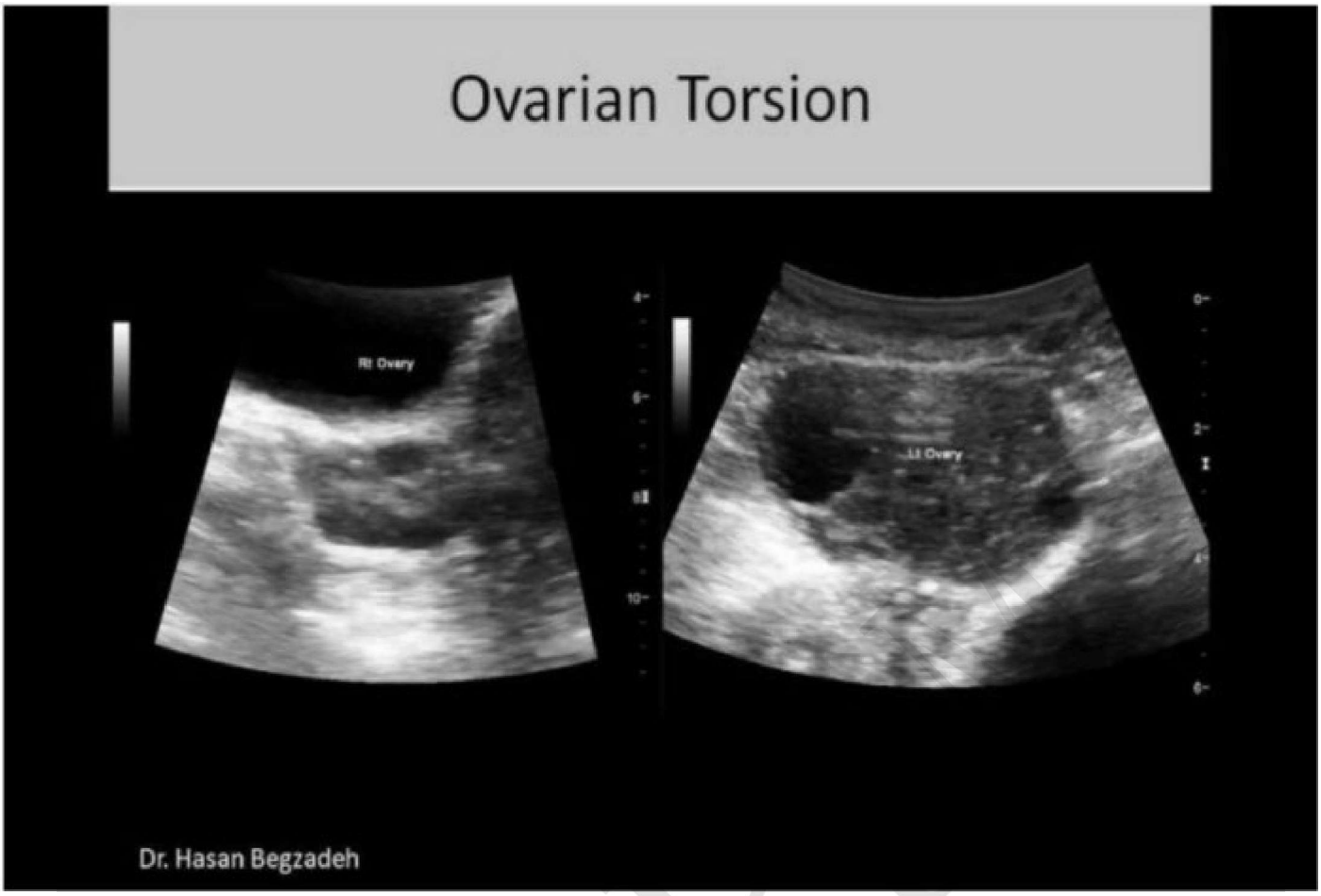
## Vascular Abnormalities

*Ovarian Torsion:*

- Acute condition requiring immediate surgical intervention
- Complete or partial rotation of the ovary
- Causes ovarian congestion and infarction
- Usually seen in childhood and teen years

- Most commonly occurs on the right side
- More common with ovarian enlargement due to cysts or tumors
- Associated with ovarian hyperstimulation syndrome
- Symptoms include acute onset of severe pain, nausea, vomiting, palpable mass
- White blood cell levels increase
- Those with ovarian mass/cyst have increased risk

*Sonographic Appearance:*
- Unilaterally enlarged ovary
- Absent blood flow
- Twisting of the vascular pedicle may appear as an ill-defined adnexal mass adjacent to the ovary
- In cross section, the adjacent mass can have a target appearance = "whirlpool" sign
- Ascites is a commonly associated finding
- Follicular Ring Sign - perifollicular hyperechoic rim, 1 to 2 mm in thickness, identified with the peripheral ovarian follicles
- Compare to the normal ovary
- Always use low PRF color doppler and power Doppler to assess presence/absence of flow
- If flow detected by color/power Doppler, PW Doppler waveform should be obtained to confirm the absence of torsion
- Flow in the normal ovaries and with a corpus luteal cyst will be low resistance with an RI value between 0.4-0.6
- Partial torsion will demonstrate high resistance flow, so PW Doppler waveform is very important to obtain




*Ovarian Vein Thrombosis:*

- Thrombus formation in the ovarian vein
- increased risk with vascular changes that occur with pregnancy and delivery
- Most commonly occurs in C-section deliveries
- The right ovarian vein is more commonly affected

*Ovarian Vein Dilatation:*

- Average vein diameter in nulliparous women = 2.6mm
- Average vein diameter in parous women = 3.4mm
- Will normally dilate with pregnancy due to increased flow volume
- Can also dilate with Nutcracker Syndrome
  - o Left renal vein is compressed between the superior mesenteric artery and the aorta o The left ovarian vein empties into the left renal vein

- Incompetence of the ovarian veins can cause pelvic congestion syndrome

***Benign Ovarian Abnormalities***

## *Cystic Teratoma (Dermoid Cyst):*

- Most common benign neoplasm of the ovary
- Most commonly occurring germ cell tumor of the ovary
- Most common complex mass during pregnancy
- Most common solid ovarian tumor seen in pediatric patients
- Contains ectodermal elements - skin, hair, teeth, and fat
- Usually found in women of child bearing age
- Usually asymptomatic

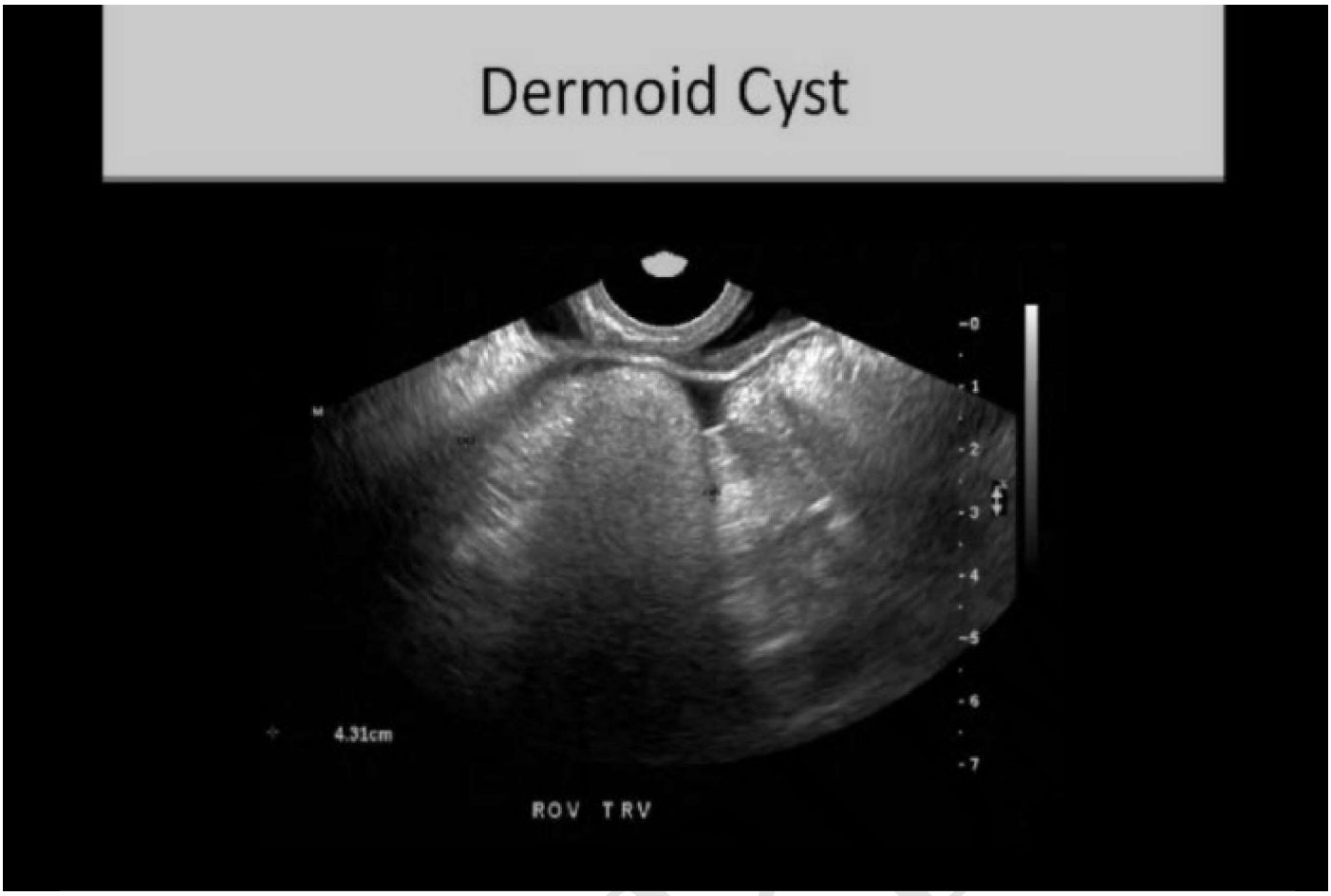
« Slow growing

- Usually unilateral and almost always benign
- Most common complication is torsion
- Leakage can result in peritonitis
- Rupture can result in acute abdominal crisis

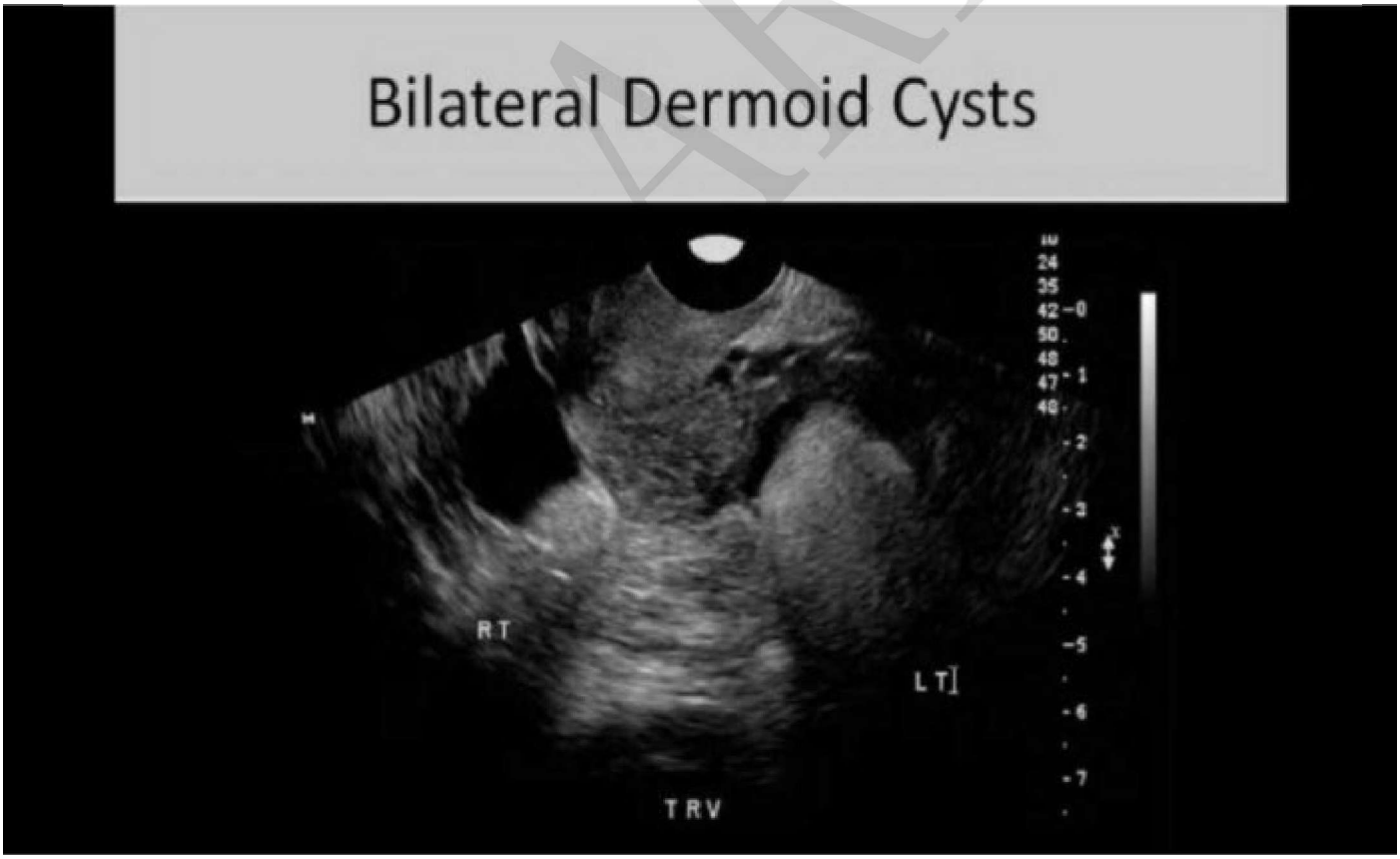
*Sonographic Appearance:*

- Dermoid Plug - echogenic nodule that causes posterior shadowing; AKA Rokitansky nodule
- Dermoid Mesh - short and long echogenic lines caused by hair in the mass; dot-dash pattern
- Tip of the Iceberg Sign - very dense echogenic portion that casts shadow over posterior wall of cyst
- Usually complex, predominantly solid
- Fluid/fluid levels
- Thick walls
- Calcifications
- Usually unilocular
- May be difficult to distinguish from gas in adjacent bowel
- From 4mm to 40lbs, most < 15cm
- Usually asymptomatic unless large

# Dermoid Cyst



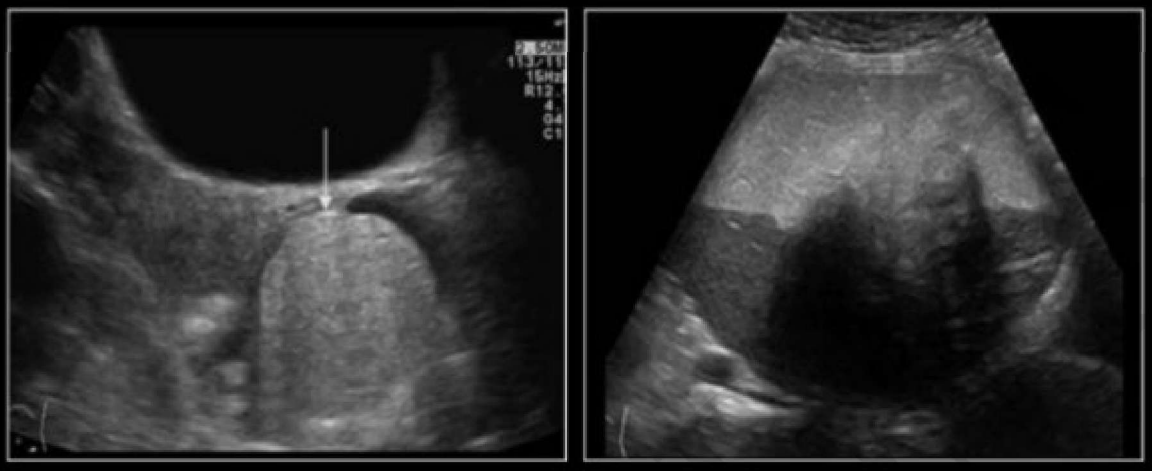

# Bilateral Dermoid Cysts



# Dermoid Cyst

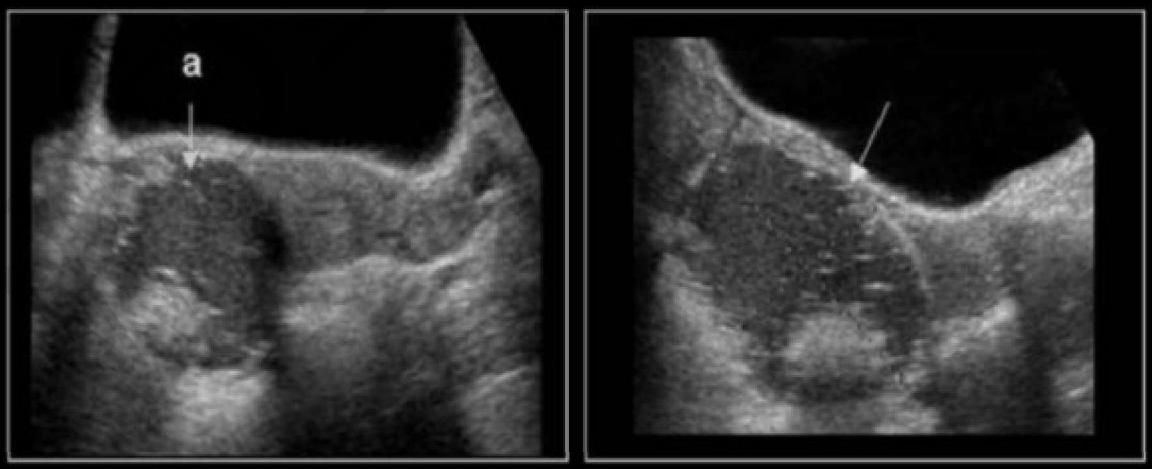

# Dermoid Cyst

# Dermoid Cyst



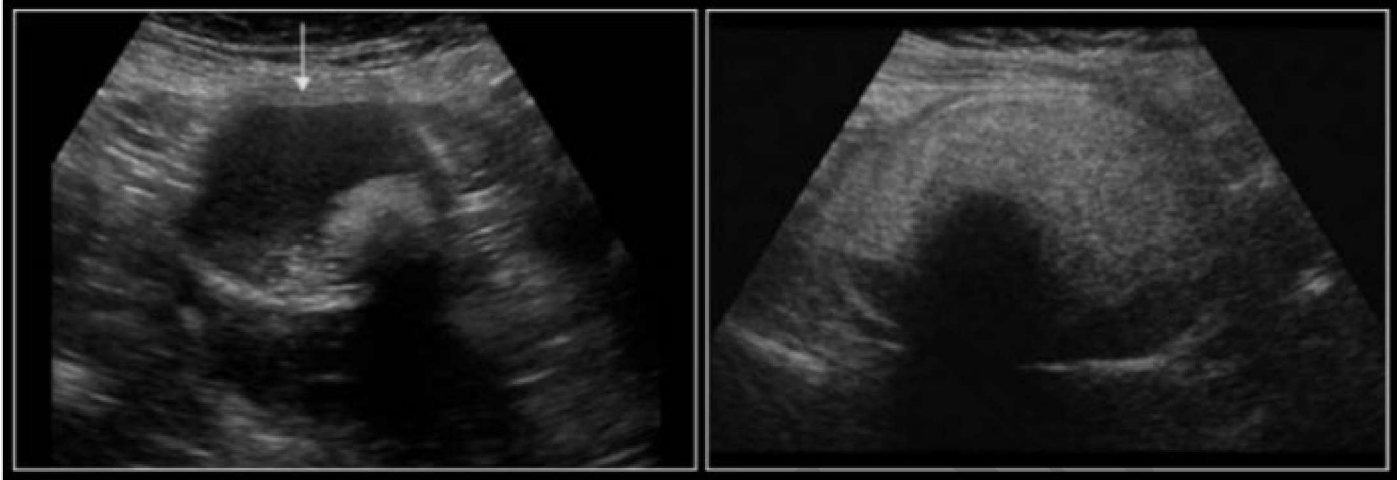
Courtesy of Dr. Taco Geertsma
www.ultrasoundcases.info

# Dermoid Cyst




Courtesy of Dr. Taco Geertsma
www.ultrasoundcases.info

# Cystic Teratoma



Courtesy of Dr. Taco Geertsma

# Cystic Teratoma with Pregnancy

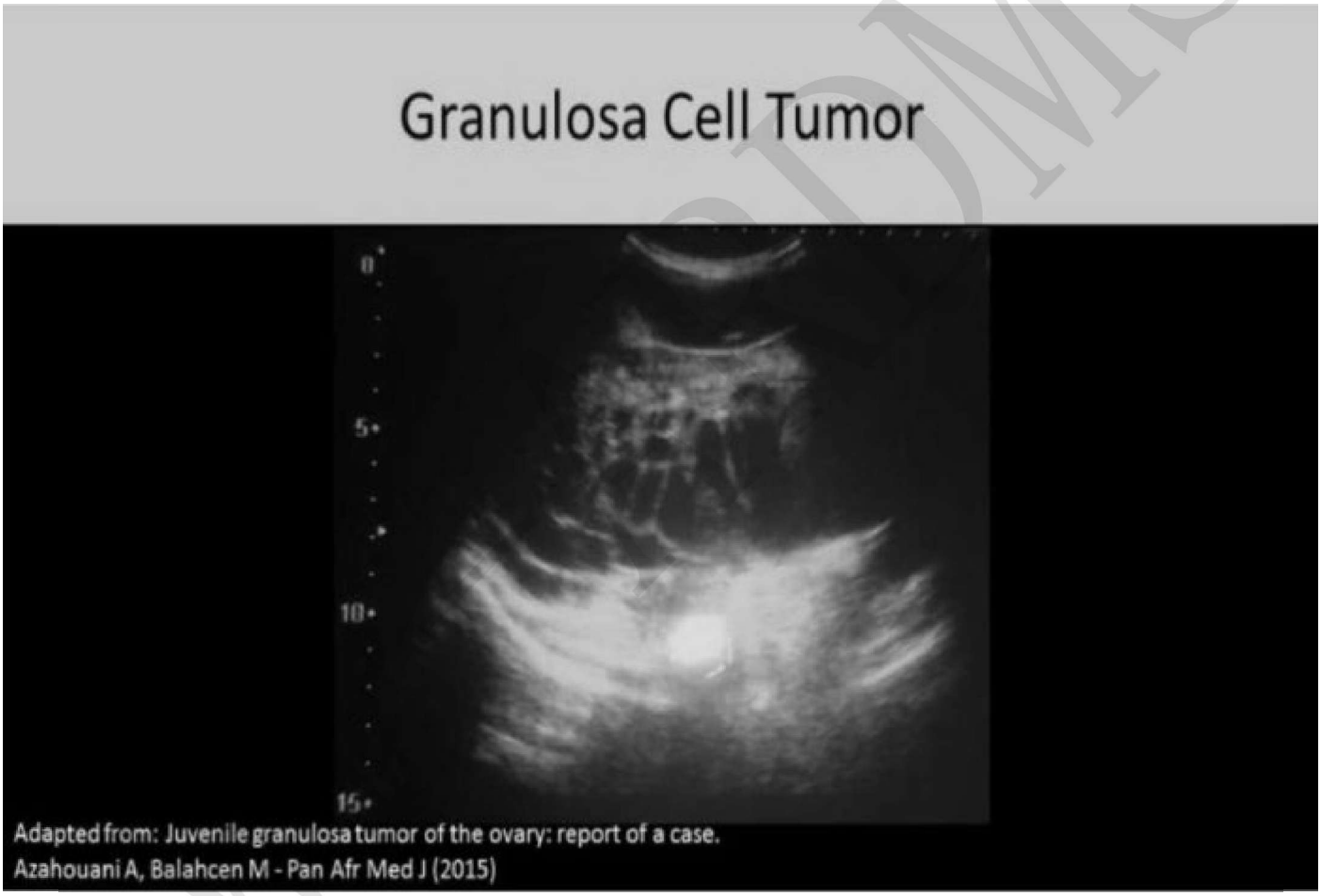
Courtesy of Dr. Taco Geertsma

***Granulosa Cell Tumor:***

- Type of theca cell tumor
- Benign
- 95% occur in postmenopausal women
- Produces estrogen
- Causes postmenopausal bleeding and breast changes
- If found in young patients, leads to precocious puberty
- Usually unilateral

*Sonographic Appearance:*

- Complex
- Hypoechoic, may see cystic changes
- Similar in appearance to the androblastoma
- Small tumors appear more homogenous, large tumors appear more complex due to internal necrosis



***Thecoma:***

- Benign neoplasms composed only of theca cells
- Classified as sex cord-stromal tumors
- 80% postmenopausal
- Most patients present with abnormal uterine bleeding
- Typically estrogen producing which can lead to fibroid enlargement and postmenopausal bleeding
- 5-16cm solid mass
- 20% have associated endometrial carcinoma
- Can be associated with Meigs syndrome, but less common than fibroma

*Sonographic Appearance:*

- Hypoechoic
- Posterior shadowing
- Resembles fibroma
- Endometrial thickening due to increased estrogen levels

***Fibroma***

- Usually occurs in postmenopausal women; age 50-70yrs
- Composed of benign ovarian stromal tissues
- Does NOT produce estrogen

*Sonographic Appearance:*

- Solid
- Homogeneous to mildly heterogeneous and hypoechoic
- Commonly demonstrates posterior shadowing with loss of posterior border definition
- Resembles thecoma, pedunculated fibroid or Brenner tumor
- Usually associated with ascites and pleural effusion

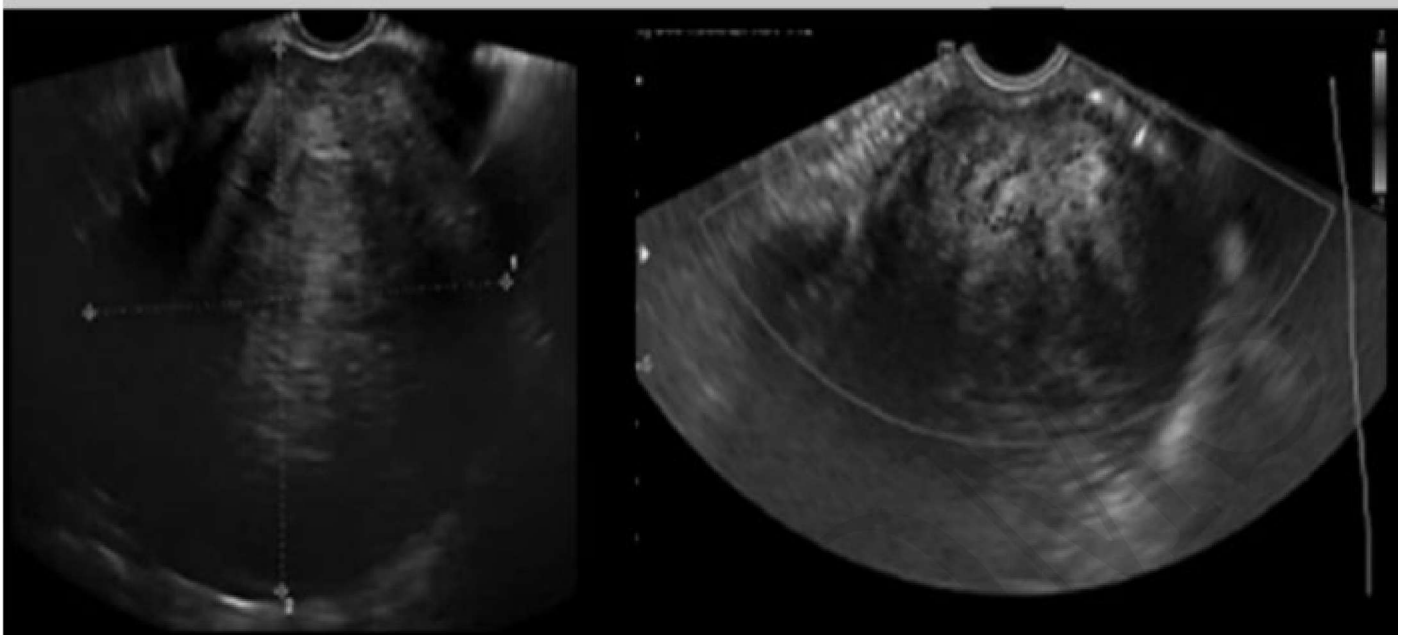
**Meigs Syndrome:**

1.Ovarian Neoplasm (Most commonly a fibroma;

2.Ascites

3.Hydrothorax (pleural effusion)

# Fibroma



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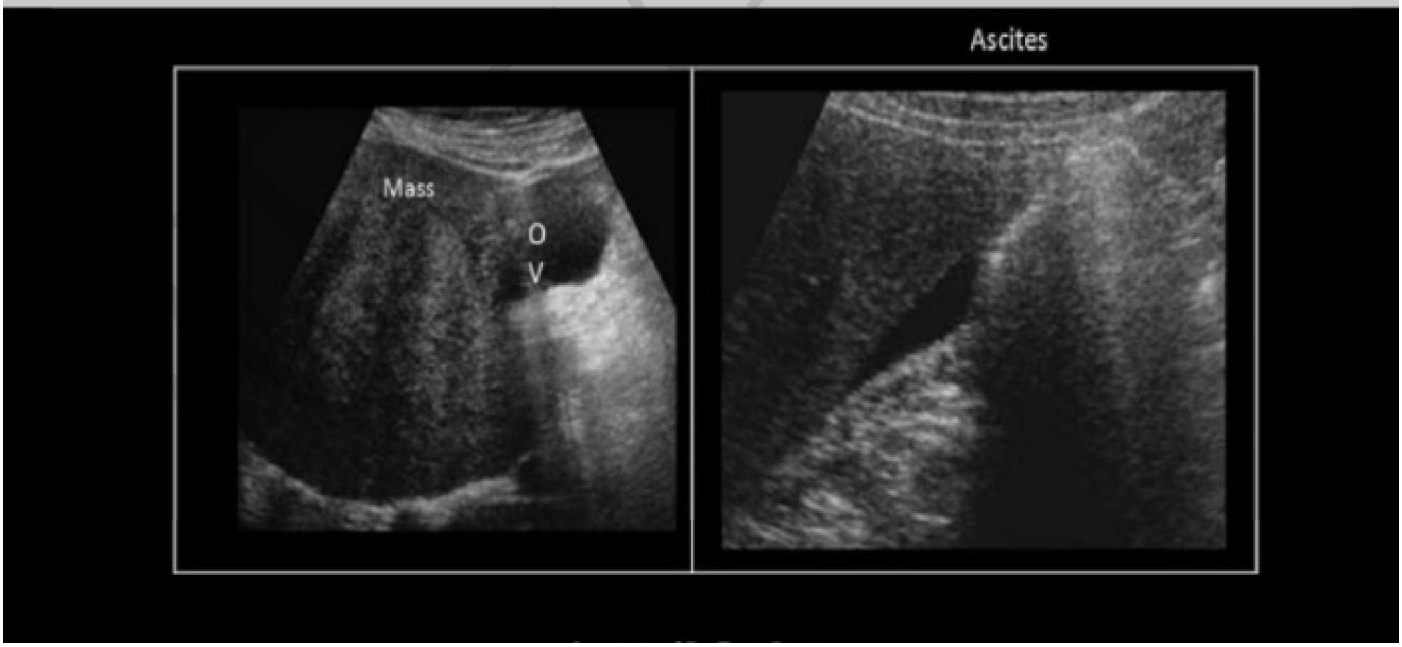
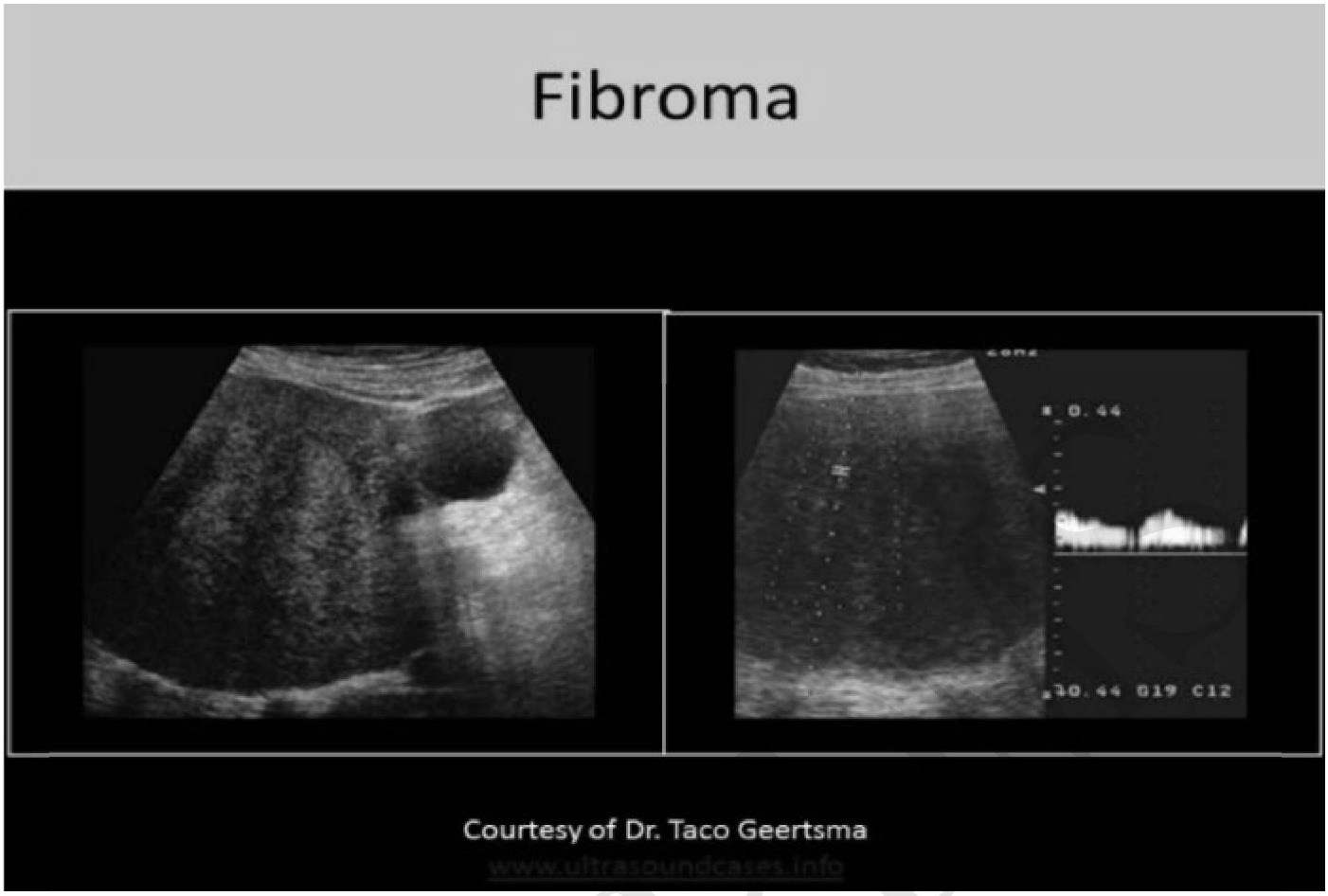
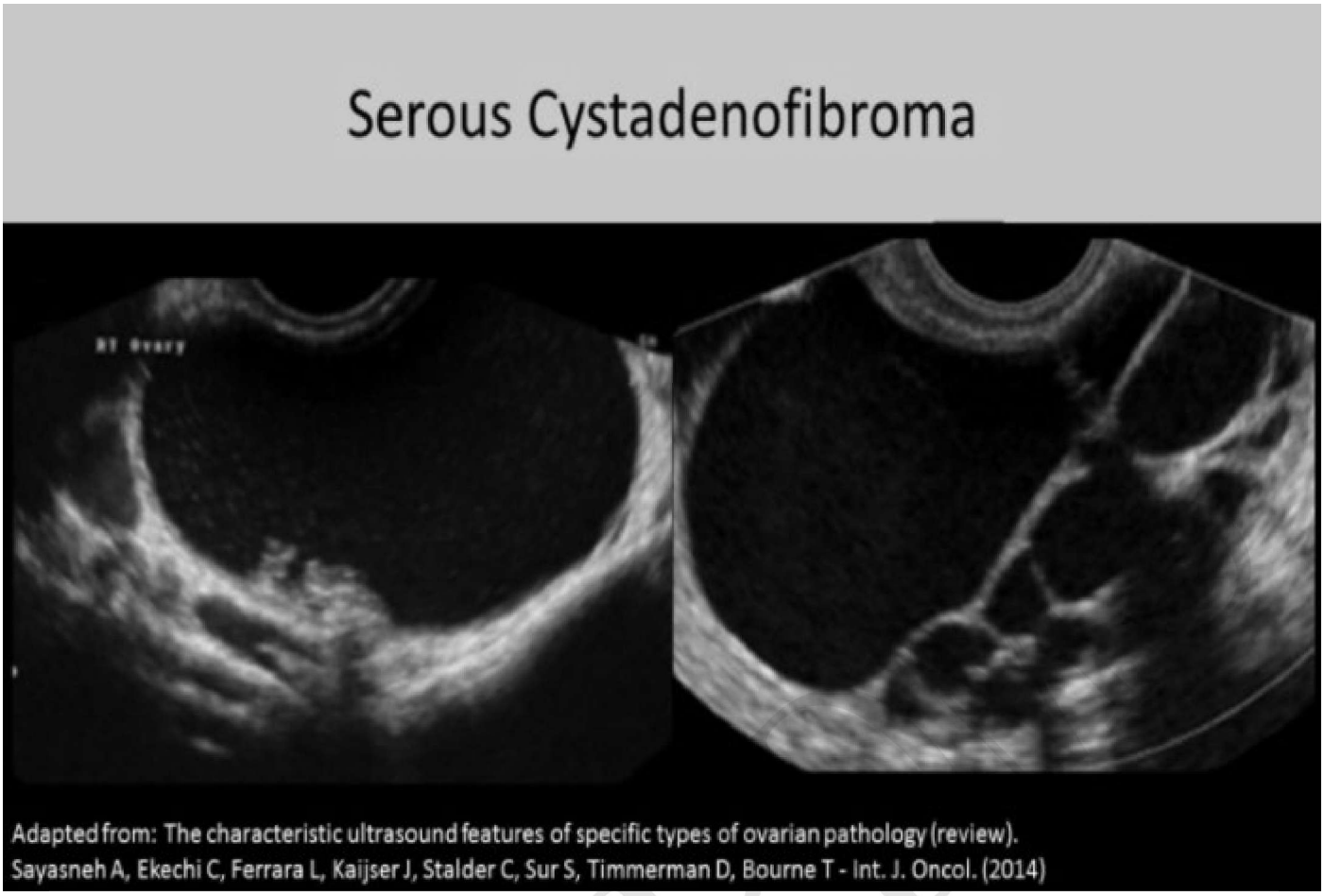
# Fibroma






Cystadenofibroma:

- Composed of epithelial and stromal tissues
- Usually unilateral
- Predominantly cystic on ultrasound with septations seen in 1/3 of cases
- Papillary projections or solid nodules have been identified in just over 1/2 of cases

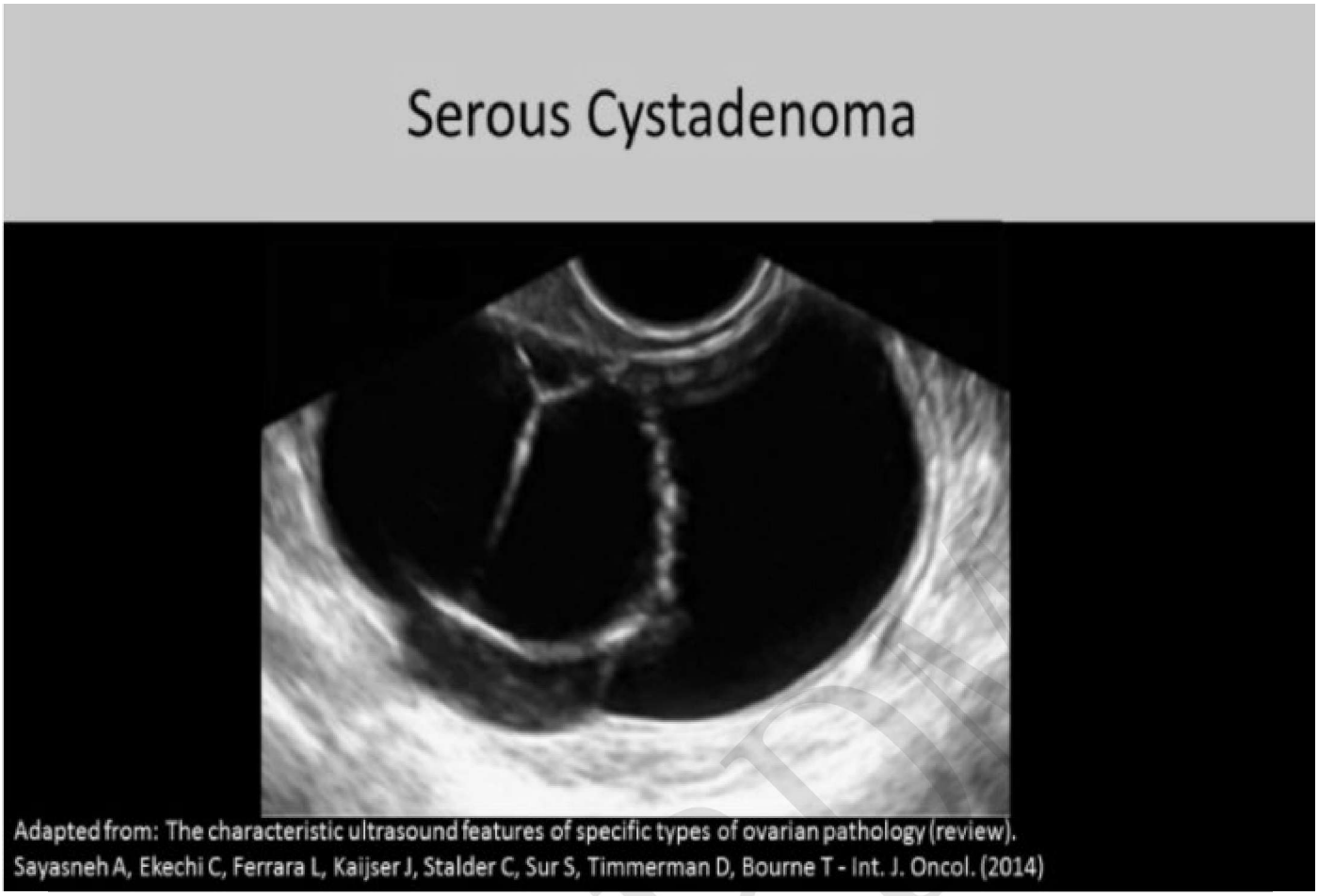



***Serous Cystadenoma:***

- *Usually premenopausal, age 20-50*
- *Can get very large*
- *Size range 15-20cm*
- *Benign epithelial tumor*
- *Filled with serous fluid that can leak into the peritoneal cavity causing ascites*

***Sonographic Appearance.***

- *Thin walled*
- *Usually large and unilateral*
- *Filled with serous fluid*
- *Can have septations*
- *Unable to determine benign versus malignant without biopsy*




***Mucinous Cystadenoma:***

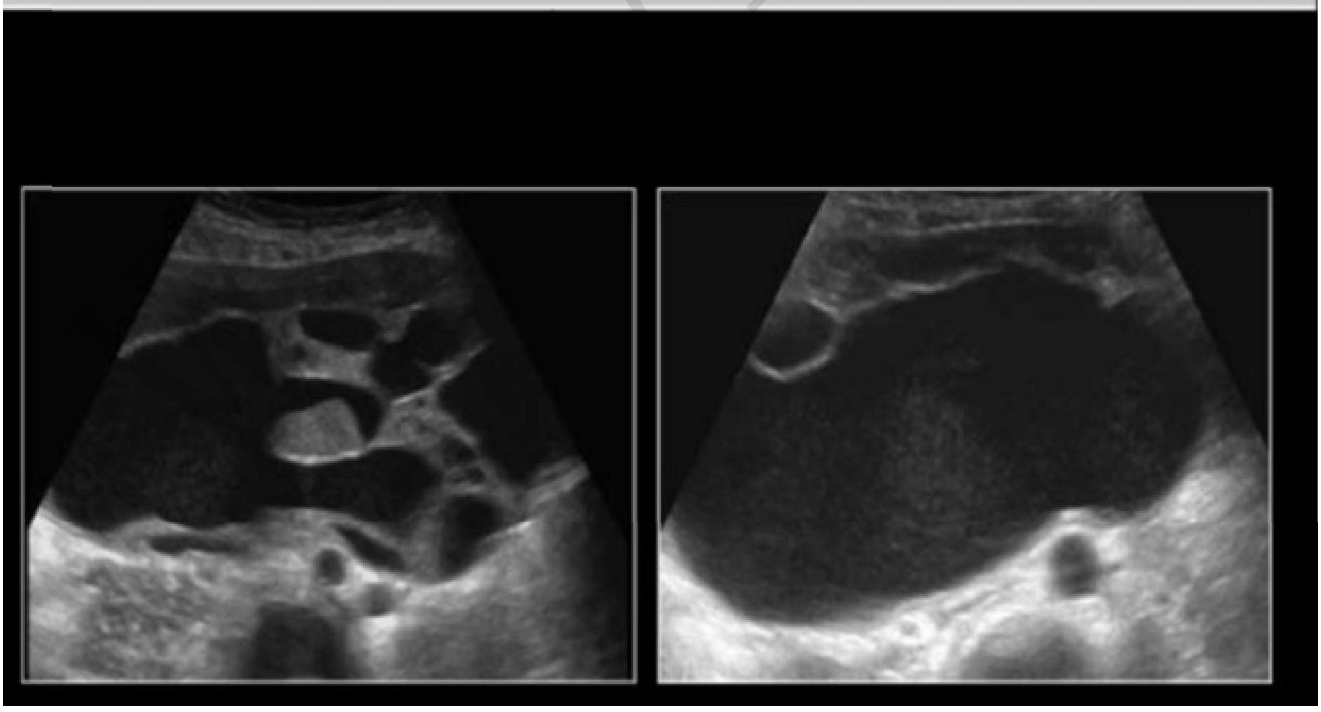
- *Ovarian epithelial tumors*
- *Usually found in premenopausal women age 20-50yrs*
- *More commonly benign*
- *CA125 elevated with cystadenocarcinoma*
- *Usually unilateral*
- *Benign cystadenoma is largest abdominal tumor*

***Sonographic Appearance:***

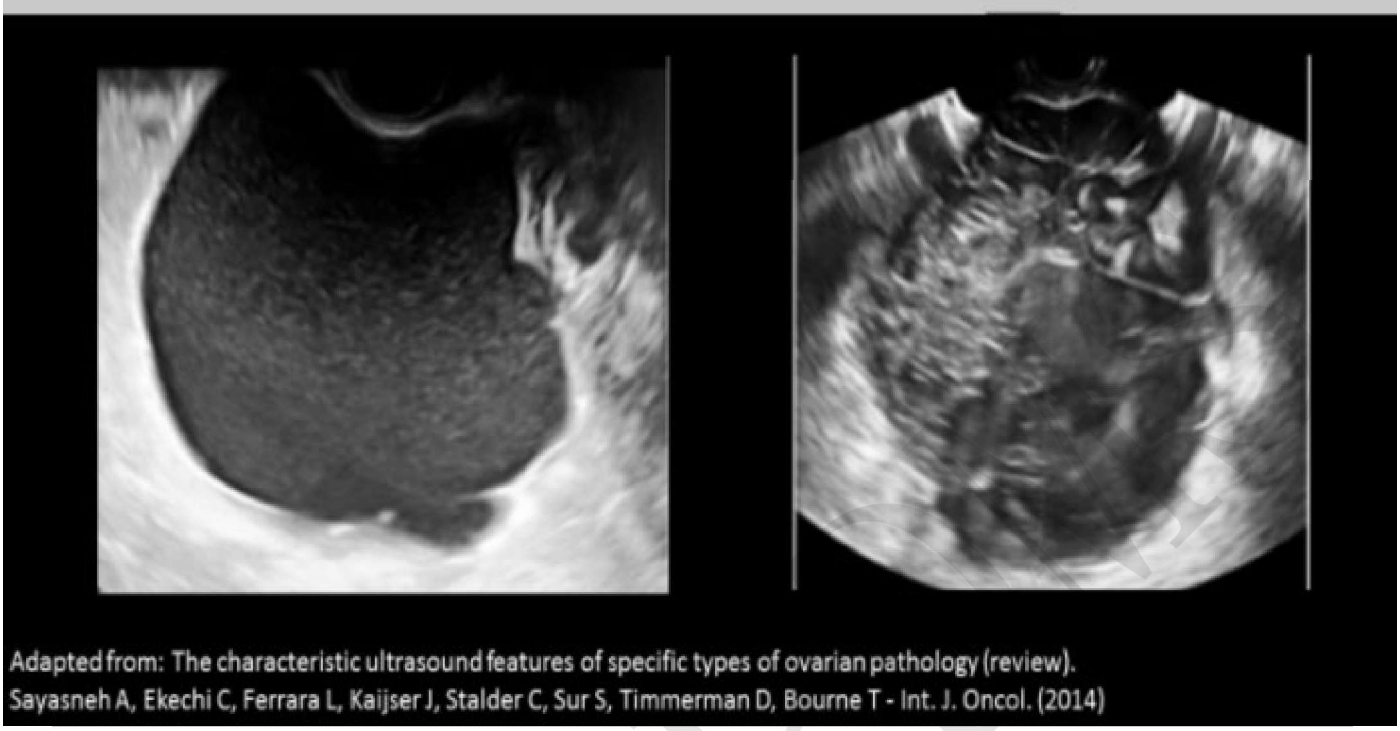
- *Large cystic masses with septations and low level echoes from mucin within*
- *Thin septations = benign*
- *Thick septations/solid nodules = malignant*
- *Multilocular*
- *Usually unilateral*
- *Filled with mucous substance that may present as debris within the cystUnable to determine benign versus malignant without biopsy*

# Mucinous Cystadenoma


# Benign Mucinous Cystadenoma



## Mucinous Cystadenoma



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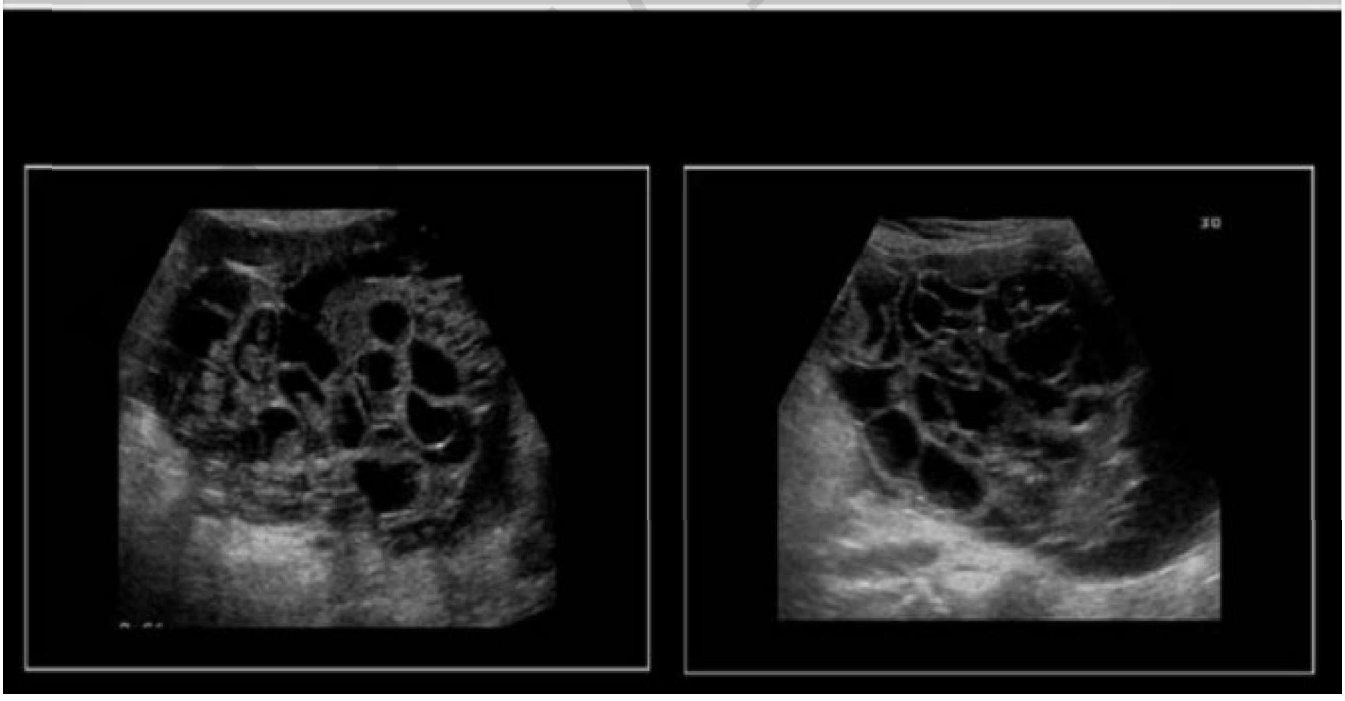
## Benign Mucinous Cystadenoma



***Brenner Tumors:***

- *Usually occurs over age 40yrs*

- *Usually small 3-8cm*
- *Usually lobulated and unilateral*
- *More commonly benign*
- *Transitional epithelium mixed with fibrous tissue*
- *Usually asymptomatic, but can lead to dysfunctional uterine bleeding.*

***SonographicAppearance：***

- *Most commonly an incidental finding*
- *Hypoechoic*
- *Solid mass*
- *May see calcifications*
- *Similar to fibroma*
- *May be a part of Meigs Syndrome*

***Androblastoma or Arrhenoblastoma***

- *AKA Sertoli-Leydig cell tumor*
- *Can be malignant or benign*
- *Usually occurs premenopausal, age 20-40yrsOligomenorrhea followed by amenorrhea*
- *Causes increased testosterone levels which can lead to masculinization (virilization)Virilization refers to a female that develops male sex characteristicsHirsutism.*

*0Male pattern baldness*

*gVoice deepens*

*Decreased breast size0*

- *Similar in appearance to the granular cell tumor*
- *Echogenic or hypoechoic: may have cystic component*



*Malignant Ovarian Neoplasms*

***Ovarian Cancer Facts:***

- 5th leading cause of cancer death in women (American Cancer Society 2019)
- Most women have stage III or greater when diagnosed
- Postmenopausal ovaries should not exceed 2cm in any dimension or 8cc volume
- Increased risk for ovarian cancer with echogenic foci in ovarian parenchyma
- Screening performed annually for those with a family history

*Risk Factors:*

- Age 50-59
- Nulliparity
- Family history
- CA125
  - Tumor marker found in blood with some malignancies
  - 80% patients with epithelial-stromal tumors
  - Non-specific marker - can also be elevated for benign processes, such as endometriosis or fibroids

***Evaluation of Ovarian Neoplasms:***

- Common signs of ovarian malignancy:

- Papillary excrescences
- Mural nodules
- The more solid areas present, the greater the likelihood that a malignancy is present
- Irregular walls
- Thick septations
- Can contain echogenic material (mucin or protein debris)
- Ascites is a sign of peritoneal spread

- If a suspected malignancy is identified in the ovary, the bladder, liver, kidneys and pelvic lymph nodes should be evaluated for associated complications
- Color Doppler cannot distinguish a malignant tumor from a benign tumor, but can be used to differentiate debris/thrombus in a cyst from mass formation
- Closely evaluate the area of interest using Color Doppler to identify internal vascularity and the pedicle attaching the mass to the ovarian cortex
- PW Doppler evaluation of flow allows for the evaluation of the peak systolic and diastolic velocities that are used to calculate the resistive index (RI)
- The peak velocity of flow within the ovaries should be relatively consistent between the two ovaries, no matter the point in the ovarian cycle
  - Early follicular phase: high resistance, low velocity flow, little or no diastolic flow; RI = 0.9 - 1.0
  - In the ovary with the dominant follicle
    5. Late follicular phase: resistance decreases and diastolic flow increases
    6. Ovulation: systolic velocities increase, diastolic flow velocities increase significantly; RI = 0.4
    7. Luteal phase: resistance remaiins low, but velocities decrease

- A benign finding, such as a corpus luteal cyst, will also demonstrate low resistance (prominent diastolic flow), low velocity flow in the surrounding ovarian tissues
- Doppler evaluation of a suspected malignant ovarian mass should be performed in the early follicular phase to avoid mistaken Doppler evaluation of flow around the dominant follicle
- A malignant finding will usually demonstrate high velocity, low resistance blood flow
- A malignant tumor will demonstrate a higher level of diastolic flow than a benign mass
- The resistive index(RI) is much lower for malignant ovarian tumors at 0.4 or less
- The pulsatility index is 1.0 or less with malignant ovarian tumors
- If high resistance flow is expected, but low resistance flow is detected, neovascularization should be suspected
- Neovascularization refers to vasculogenesis and angiogenesis
- Vasculogenesis is the process that forms the circulatory system in the embryo
- Angiogenesis is the formation of new blood vessels to expand the circulatory network
- It can indicate malignant tumor growth
- Inhibiting angiogenesis can be therapeutic in cancer and rheumatoid arthritis
- Stimulation of angiogenesis can be therapeutic in ischemic heart disease and peripheral arterial disease
- In patients undergoing infertility treatment, PW Doppler should not be used to evaluate ovarian blood flow due to increased beam intensity with PW Doppler techniques.

***Epithelial-Stromal Tumors:***

- Most common type of ovarian malignancy (up to 90%)

1. Serous
2. Mucinous
3. Endometrioid
4. Transitional cell
5. Clear cell

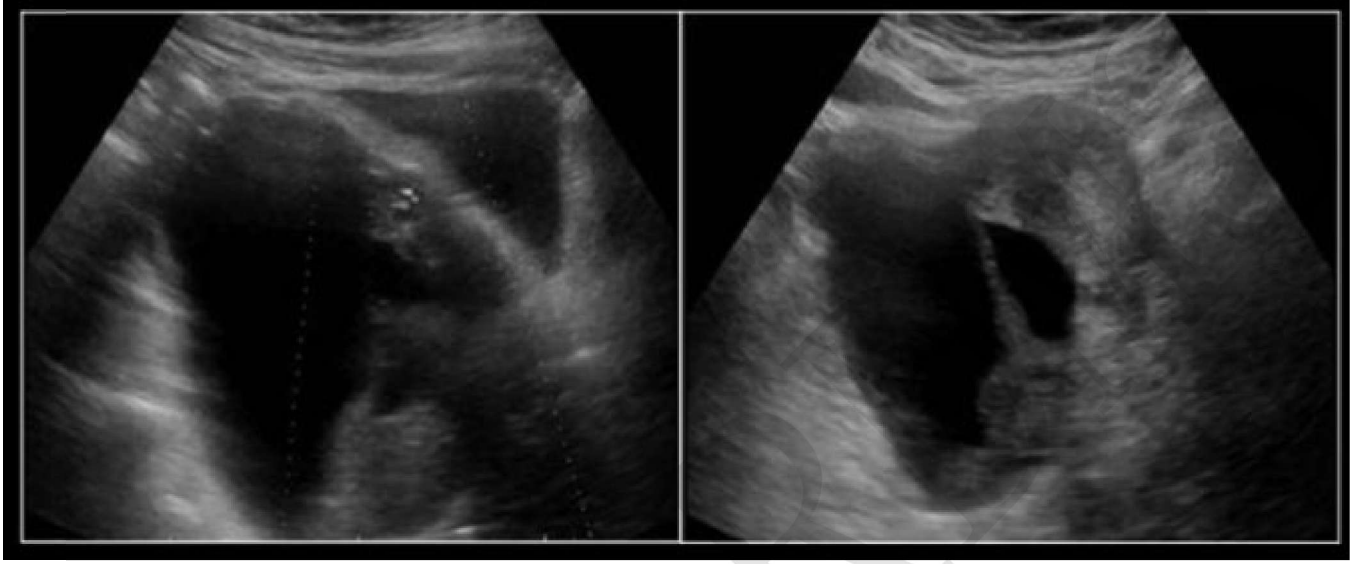
**Serous Cystadenocarcinoma:**

- *Malignant version of serous cystadenoma*
- *Very large tumors*
- *Elevated CA-125*

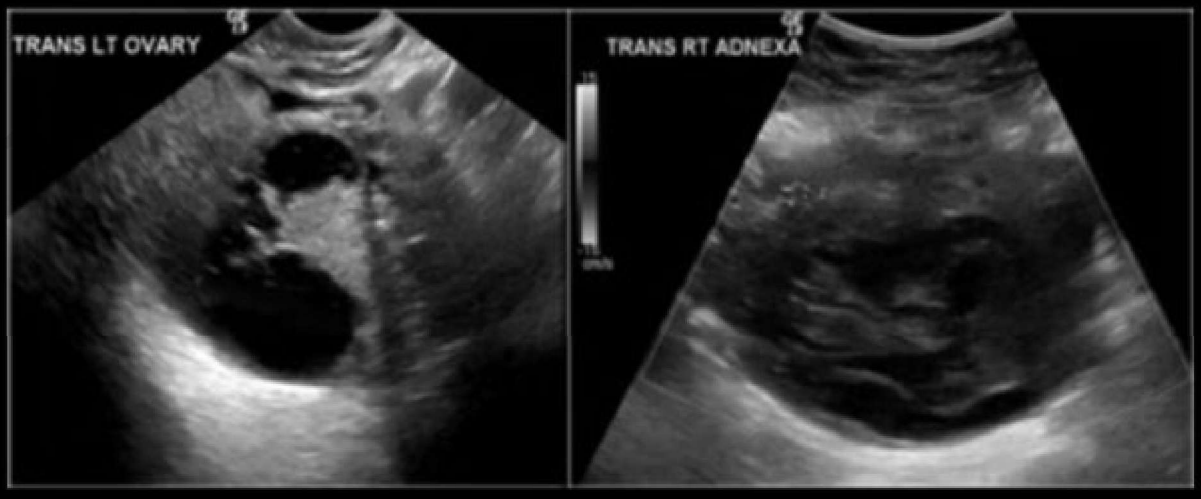
***Sonographic Appearance:***

- *Thin waited but with soft tissue nodule formation(s)*
- *Nodules referred to as papillary projections or excrescences*
- *Multi loculated*
- *Usually unilateral*
- *Filled with serous fluid*
- *Associated with ascites due to serous ffuid leaking into abdominal cavity*
- *Unable to determine benign versus malignant without biopsy*

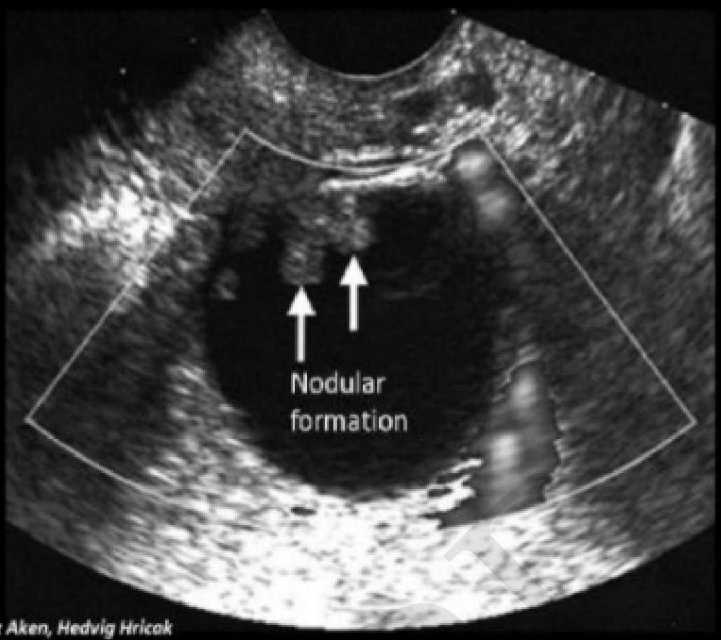
# Serous Cystadenocarcinoma



# Serous Cystadenocarcinoma



# Ovarian Cystadenocarcinoma




*Wouter Veldhuis, Robin Smithuis, Oguz Aken, Hedvig Hricak*
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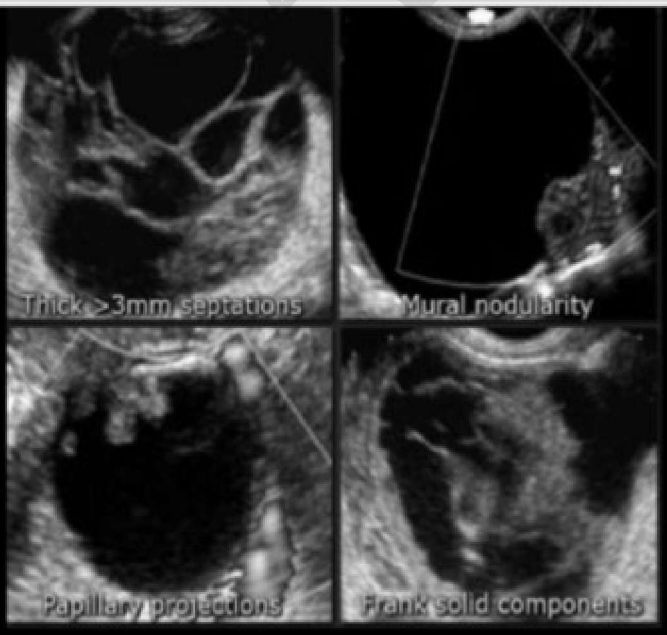
# Cystadenocarcinoma

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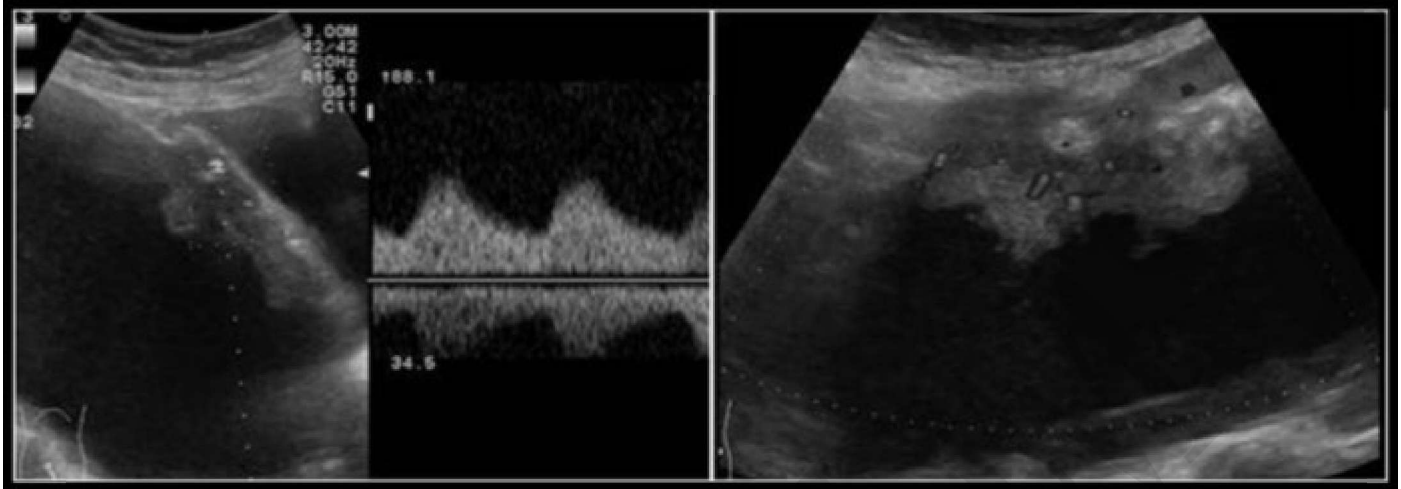
# Serous Cystadenocarcinoma




Courtesy of Dr. Taco Geertsma



# Ovarian Doppler
# Benign vs. Malignant

Note the increase in flow volume, flow velocity and diastolic flow in the malignant mass



Courtesy of Dr. Taco Geertsma

Mucinous Cystadenocarcinoma:

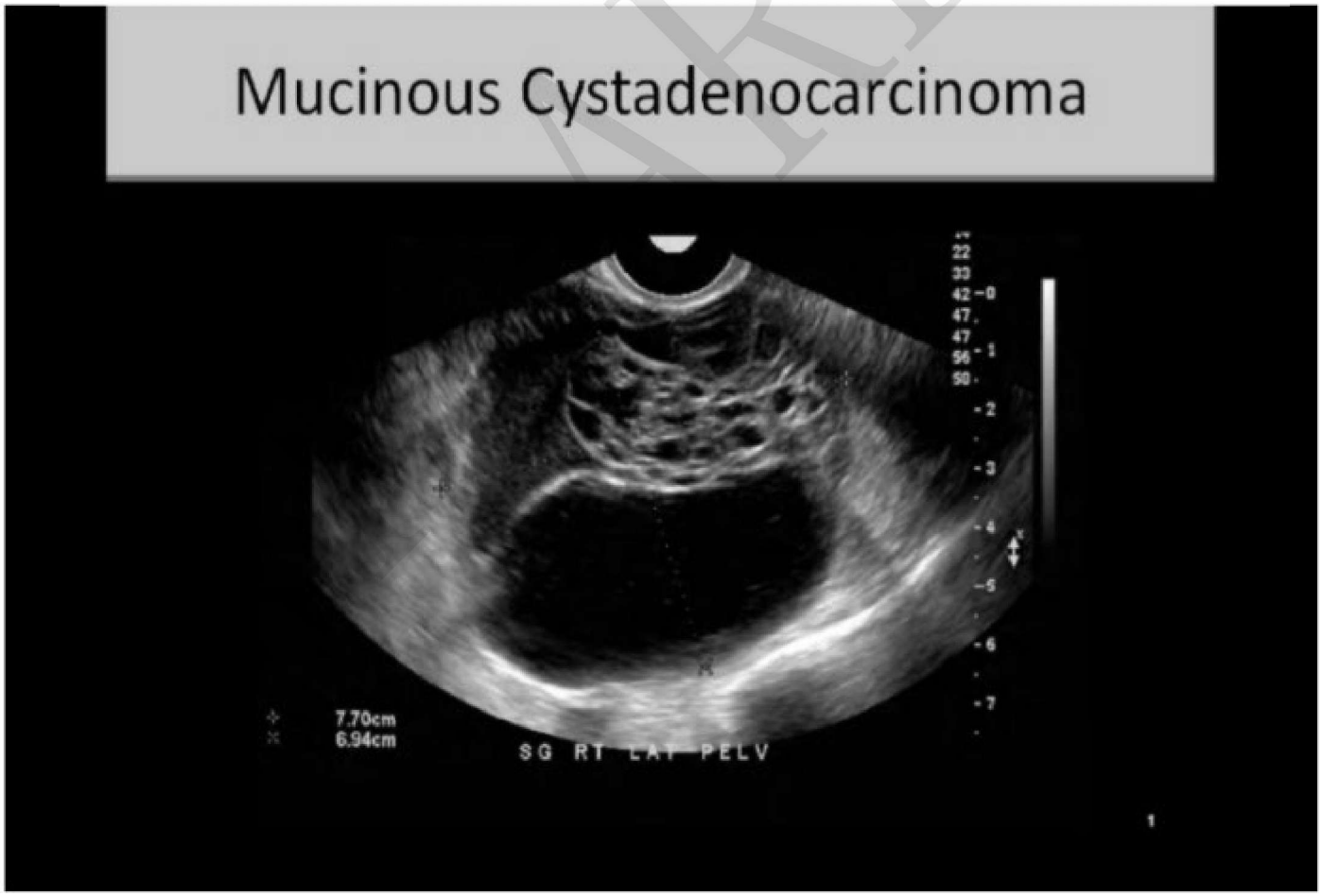
- Usually found in postmenopausal women
- CA125 elevated
- Usually unilateral
- More commonly benign
- Can cause pseudomyxoma peritonei from mucinous secretions of tumor "leaking' into peritoneal cavity

*Sonographic Appearance:*

- Large cystic masses with septations and low level echoes from mucin within
- Thin septations = benign
- Thick septations/solid nodules = malignant
- Multilocular
- Usually unilateral
- Filled with mucous substance
- Unable to determine benign versus malignant without biopsy

# Mucinous Cystadenocarcinoma


# Mucinous Cystadenocarcinoma



# Mucinous Cystadenocarcinoma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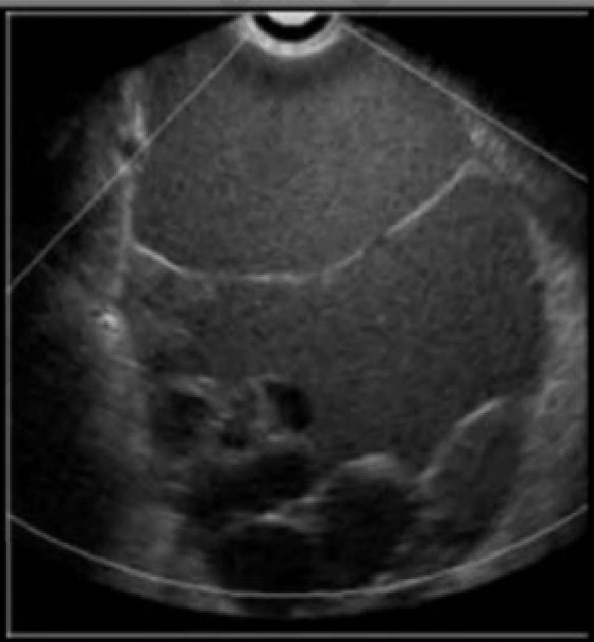

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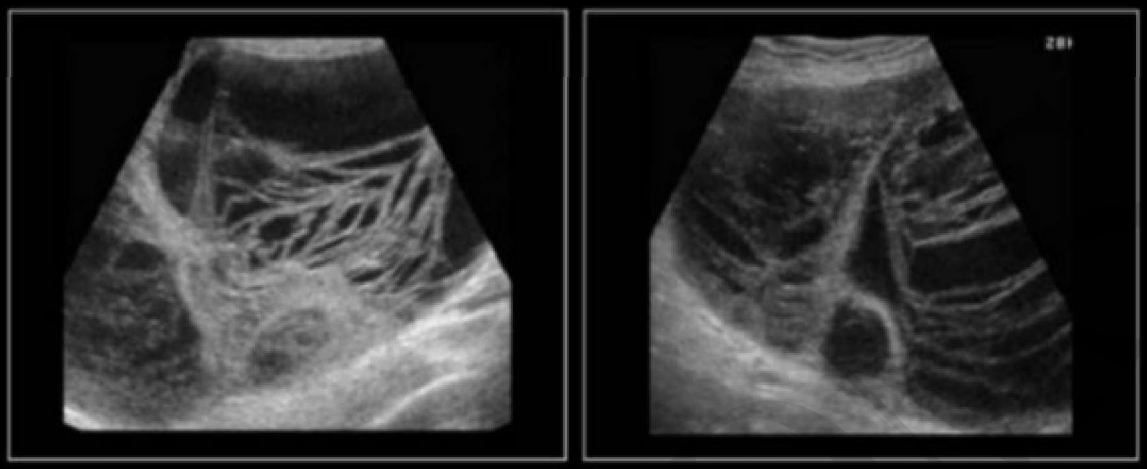
# Mucinous Adenocarcinoma



Courtesy of Dr. Taco Geertsma
www.ultrasoundcases.info

Malignant Germ Cell Tumors:

- Arise from germ cells of ovary
- Can see elevated CA125
- Most common age 5-25yrs

1. Dysgerminoma
2. Endodermal Sinus Tumor
3. Solid Teratoma
4. Choriocarcinoma

***Dysgerminoma:***

- Rare malignancy, but one of most common ovarian malignancies seen with pregnancy
- Usually seen in adolescence and those less than 3Oyrs of age
- Can lead to precocious puberty
- Usually unilateral
- Wide size range
- Compared to seminoma in testicles
- Usually asymptomatic but can experience pain and increased abdominal girth with larger tumors
- Increased CA 125
- Elevated human chorionic gonadotropin(hCG) levels in a non-pregnant patient
- Elevated lactate dehydrogenase(LDH)

*Sonographic Appearance:*

- Solid mass with rapid growth
- Mostly echogenic
- May contain areas of necrosis/hemorrhage

**Endodermal Sinus Tumor:**

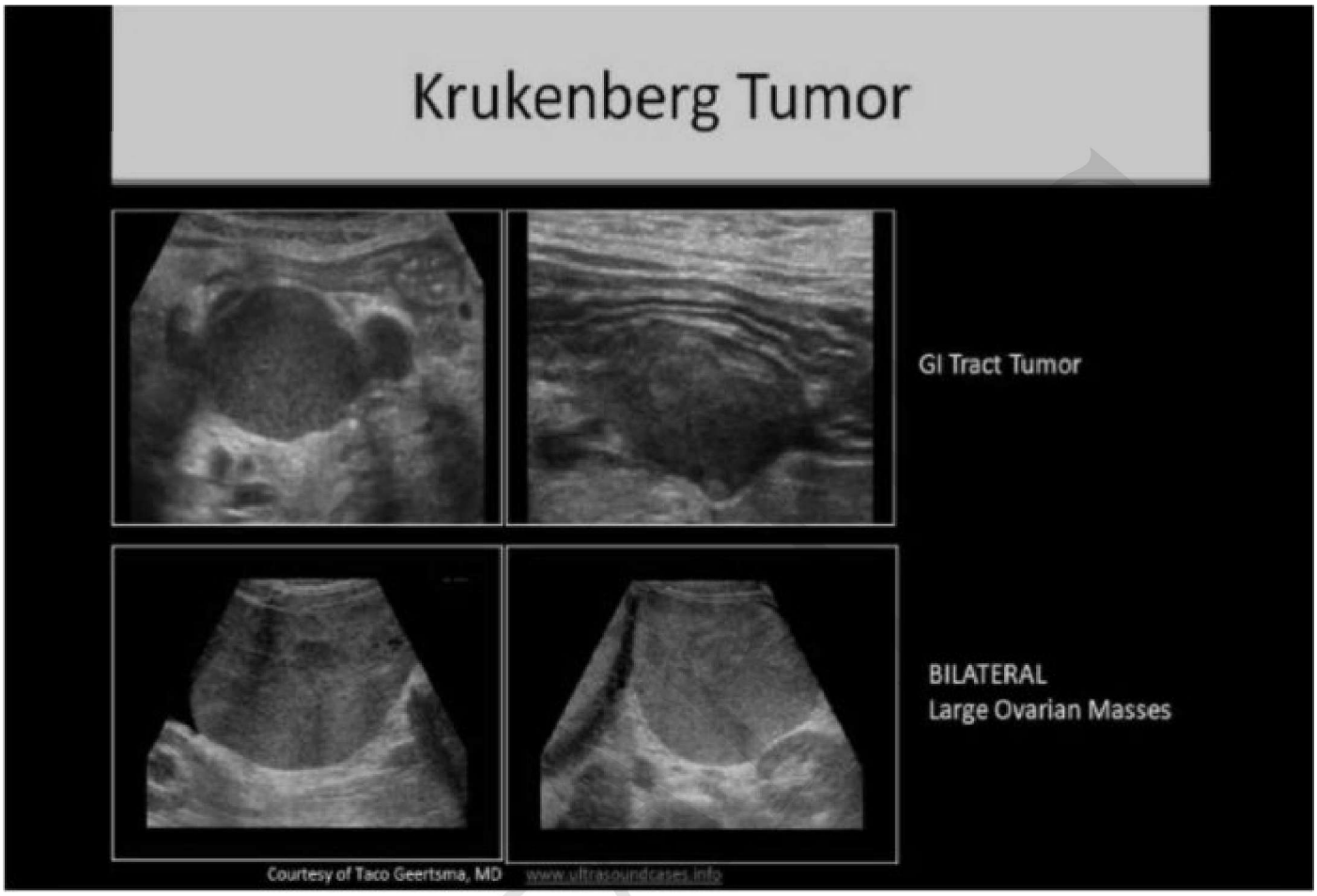
- *AKA yolk sac tumor*
- *Highly malignant*
- *Most commonly presents in adolescence*
- *Increased AFP levels*
- *High recurrence rate*
- *Varied sonographic appearance*
- *Can be seen with teratoma, dermoid or choriocarcinoma*

**Krukenberg Tumors:**

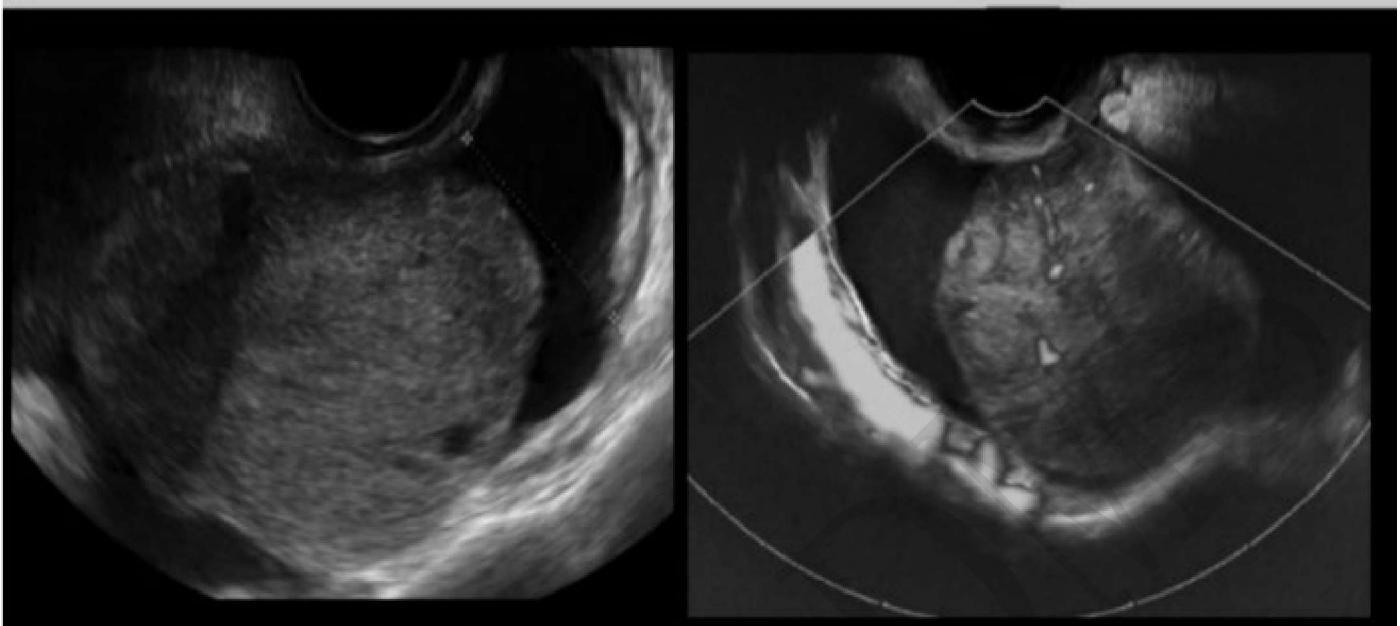
- *Metastatic ovarian disease*
- *Gl tract cancer most common primary associated with ovarian metastasis*
- *Can also occur with pancreas or breast primary*
- *Usually bilateral, metastasis to the ovaries is usually a bilateral process*
- *Moderate in size*

Sonographic Appearance:

- *Bilateral solid masses*
- *Necrotic changes*
- *Ascites*
- *Pelvic lymphadenopathy*



# Ovarian Metastasis



Adapted from: The characteristic ultrasound features of specific types of ovarian pathology (review).
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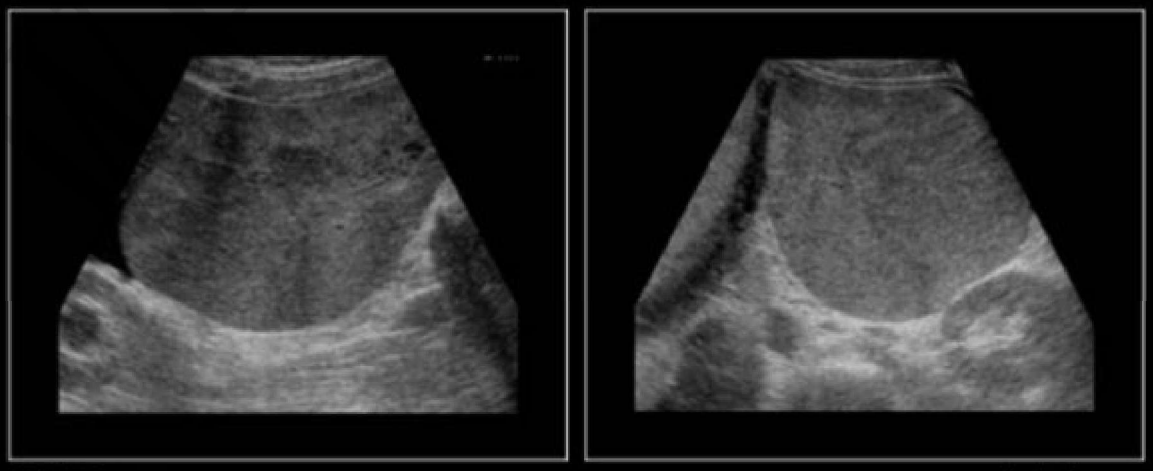


Right Ovary

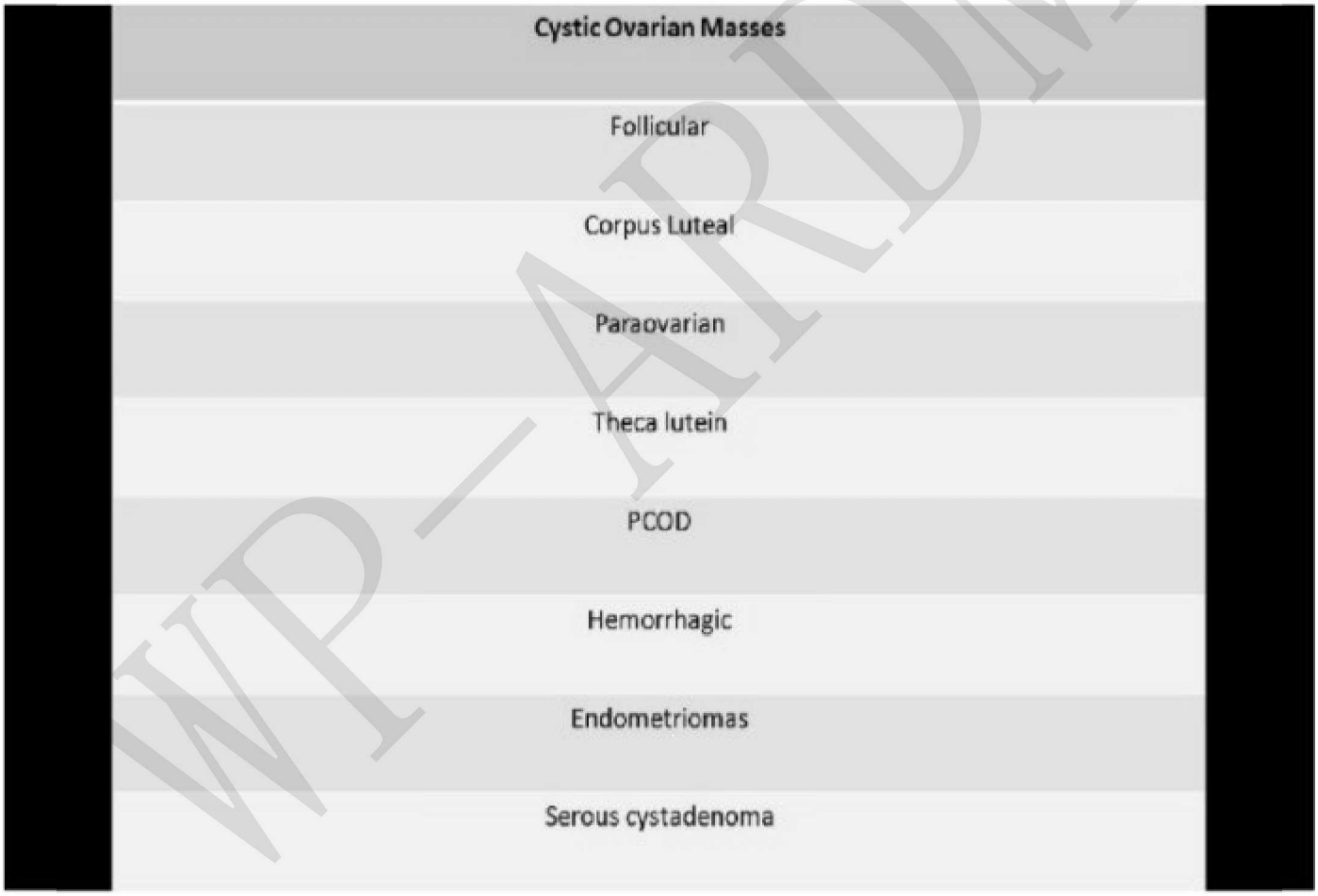
Left Ovary

***Primary Carcinoma of the Fallopian Tube:***

- Most rare GYN cancer
- Discharge, bleeding, pain
- Elevated CA 125 ' '
- Most patients age 40-65yrs
- Increased risk with BRCA gene mutation and nulliparity
- Associated with chronic salpingitis and TB
- Complex mass adjacent to ovary
- May be mistaken for ovarian mass

*Sonographic Appearance:*

- Complex mass adjacent to ovary
- May be mistaken for ovarian mass
- Usually associated with hydrosalpinx



| Solid Ovarian Masses |
| --- |
| Solid Teratoma |
| Fibroma |
| Brenner's Tumor |
| Dysgerminoma |
| Choriocarcinoma |
| Carcinoma |
| Adenocarcinoma |

| Complex Ovarian Masses |
| --- |
| Cystic Teratoma (dermoid) |
| Ectopic |
| Hemorrhagic Cyst |
| Cystadenoma |
| Cystadencarcinoma |
| Cystadenofibroma |
| Abscess |

# ASSISTED REPRODUCTIVE TECHNOLOGY (ART)

*APPUCA T/ONS:*

- Monitor follicle development and growth
- Identify ovarian hyperstimulation
- Guide oocyte retrieval
- Guide insemination

*Causes of Infertility:*

- Defined as the inability to conceive a child after 1 year of unprotected sex <35years and >6 months for >35 years
- Ovulation difficulties are the most common cause of infertility
- Fibroids
- Tubal damage
- Endometriosis
- Abnormal sperm
- IUD
- Sex chromosome abnormalities
  - o Turner syndrome - ovaries replaced by non-functional fibrous tissue (streak gonads)

*Sonographer Responsibilities During ART Procedures:*

- Sonography used to predict the ovarian reserve by estimating ovarian volume and antral follicle count
  - o Ovarian reserve - quantity of remaining follicles, used to predict success of ART
  - o Antral follicle count - the number of 2-1 Omm follicles identified early in the ovarian cycle
  - o Between day 2 and 4 of the menstrual cycle, a transvaginal ultrasound is performed
  - o The inner diameter of all 2-1 Omm antral follicles are documented and these values are averaged together to obtain a mean follicle diameter
  - o All ovarian follicles are then counted
  - o Any follicles measuring greater than 10mm are subtracted from the total number of follicles
  - o These two measurements are used to assess the antral follicle count for a patient
- Sonography is used to assess follicle growth in stimulated ovaries and guide the physician on proper dosage of stimulating medications
  - o Some medications are used to stimulate growth and ovulation from a single follicle, others are used to stimulate multiple follicles
  - o Stimulated ovaries will be serially scanned in short intervals to document follicle growth
  - o All follicles should be counted and the size documented on those 10mm or greater
- Sonography is used to guide follicle retrieval for storage or fertilization and transfer
  - o Sonographers should not make recommendations regarding possible the number and

location of appropriate follicles for retrieval - report the size and number of follicles over 2cm and the physician will choose the appropriate follicles for retrieval and discuss with the patient

- Assemble supplies for the retrieval/transfer procedure
- Have patient sign informed consent after they have any questions answered by the physician
- Assist with ultrasound guidance during the procedures by manipulating the machine controls outside the sterile field

*Ovarian Stimulation:*

- Estrogen and Estradiol serum levels are monitored when undergoing ovarian stimulation
- hCG is a hormone administered via intramuscular injection to cause the follicles to mature and produce eggs
- Pergonal, Metrodin, Clomid are medications used to stimulate follicular maturation and ovulation
  - o Clomid is the most commonly used ovarian stimulation drug
  - o Suppresses estrogen and causes pituitary gland to release more ESH and LH
- If the single follicle stimulation method does not work, a regimen of gonadotropins are used that result in multiple follicles
- Patients give themselves daily injections and the first transvaginal scan is performed after 4-5 days of treatment and then daily transvaginal ultrasound exams to monitor follicle growth
- Most common complication of drug induced follicle stimulation is hyperstimulation
- Multiple follicles are usually present causing an increase in overall ovarian size/volume
- When the follicles near maturation and ovulation, TV ultrasound is performed every 1 to 2 days
- Serum estradiol measurements are used to predict the most likely time of ovulation
- Most follicles are harvested when they are 18-24mm in size

*Ovarian Hyperstimulation Syndrome:*

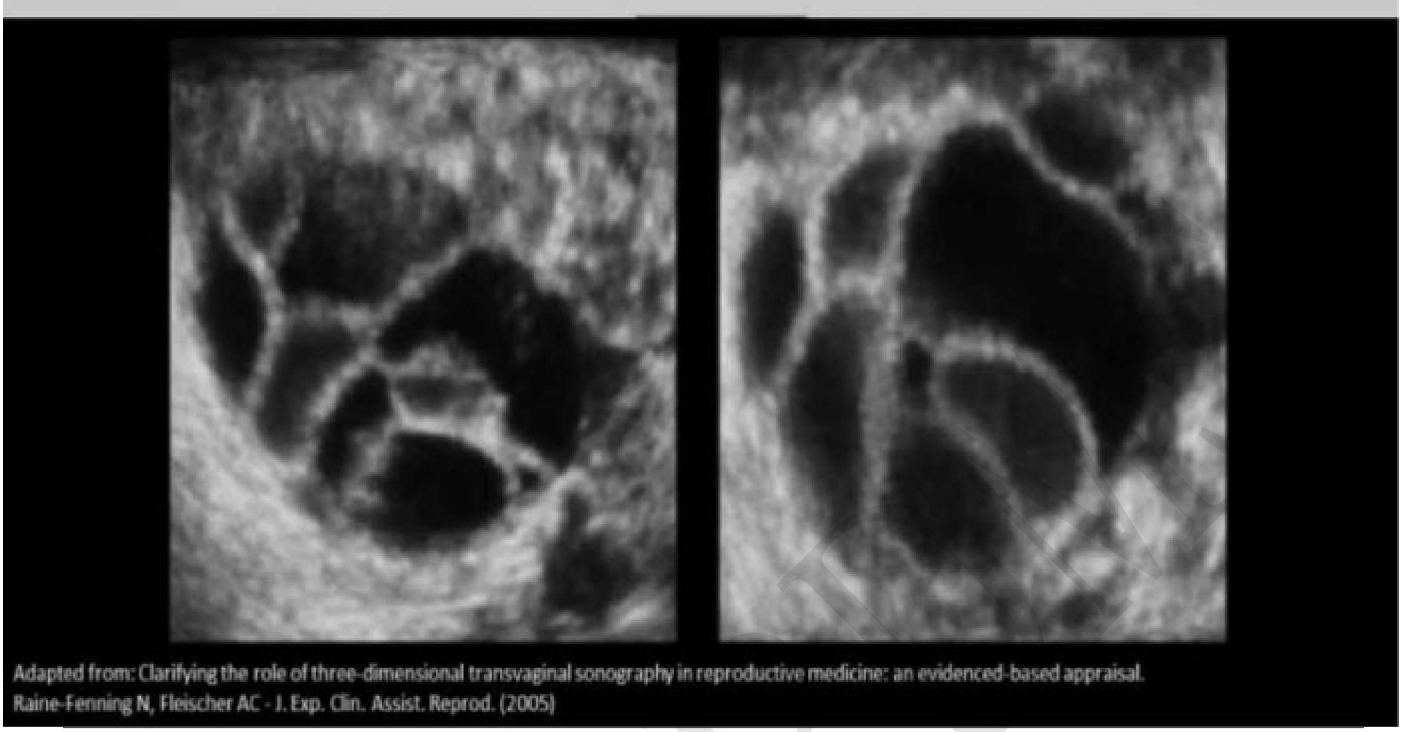
- Usually occurs in patients on gonadotropin stimulation regimen
- Can be associated with PCOD
- Increased risk of torsion due to increased ovarian size
- Associated with nausea, vomiting
- Abdominal distension, ascites and pleural effusion can be associated with ovarian hyperstimulation due to changes in blood characteristics and reduced renal filtration function
- Without pregnancy, OHSS typically resolves within a few days after the stimulation is stopped
- If pregnancy occurs, OHSS often resolves after 6-8 weeks, but paracentesis may be necessary to drain fluid collections in the abdomen

*Sonographic Appearance:*

- Bilateral formation of numerous follicles
- Ovaries mostly consumed by follicles with minimal visible parenchymal tissue
- Ovaries increased in size >5cm
- Simple cysts > 2cm
- Similar to theca lutein cysts
- Free fluid, ascites, pleural effusion

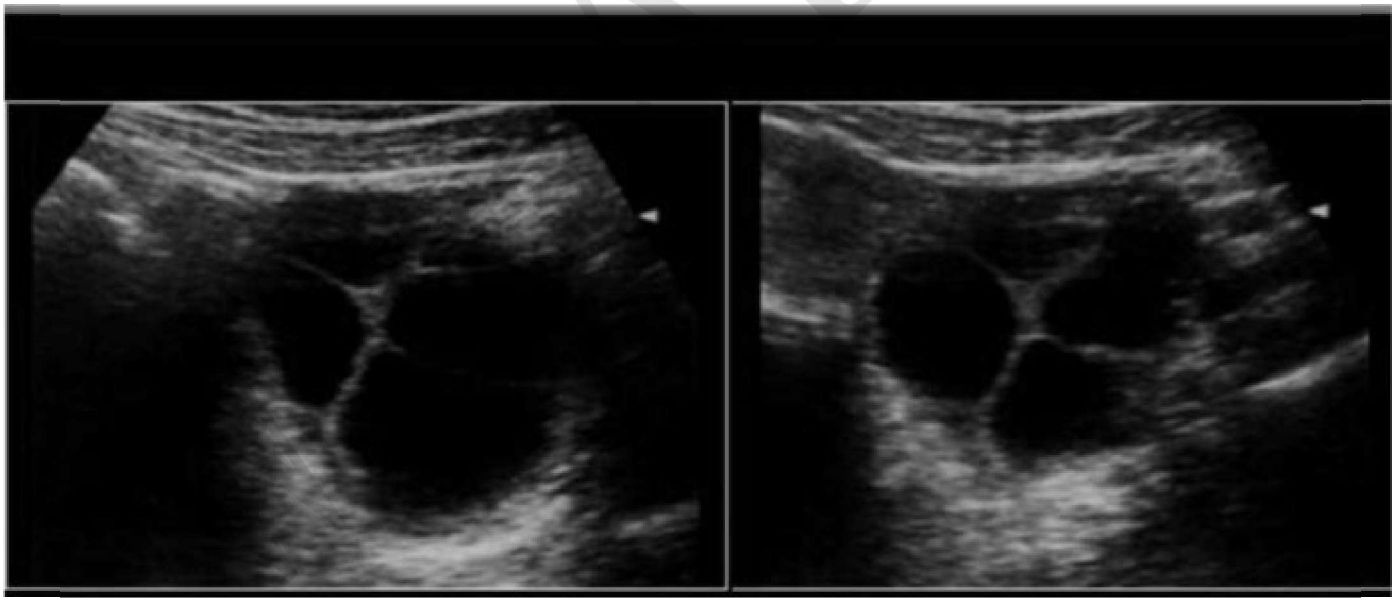
- In patients undergoing infertility treatment, PW Doppler should not be used to evaluate ovarian blood flow due to increased beam intensity with PW Doppler techniques

# Ovarian Hyperstimulation Syndrome



Adapted from: Clarifying the role of three-dimensional transvaginal sonography in reproductive medicine: an evidenced-based appraisal. Raine-Fenning N, Fleischer AC - J. Exp. Clin. Assist. Reprod. (2005)

**OHS**



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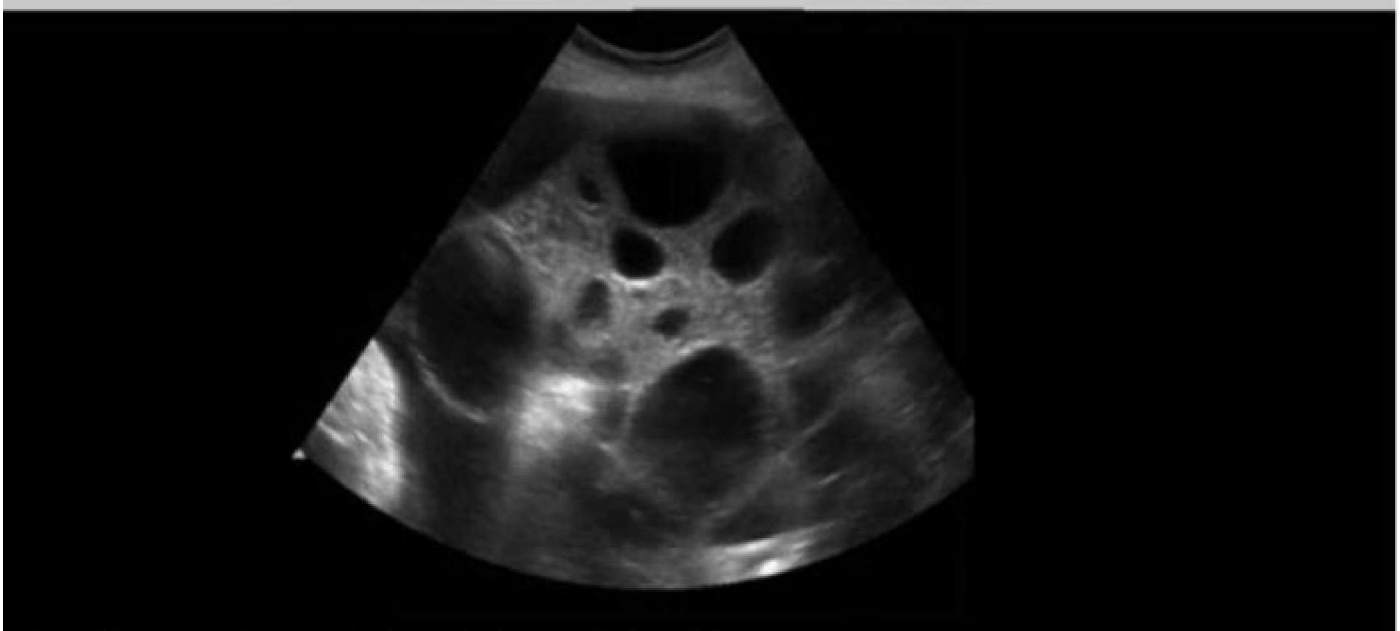
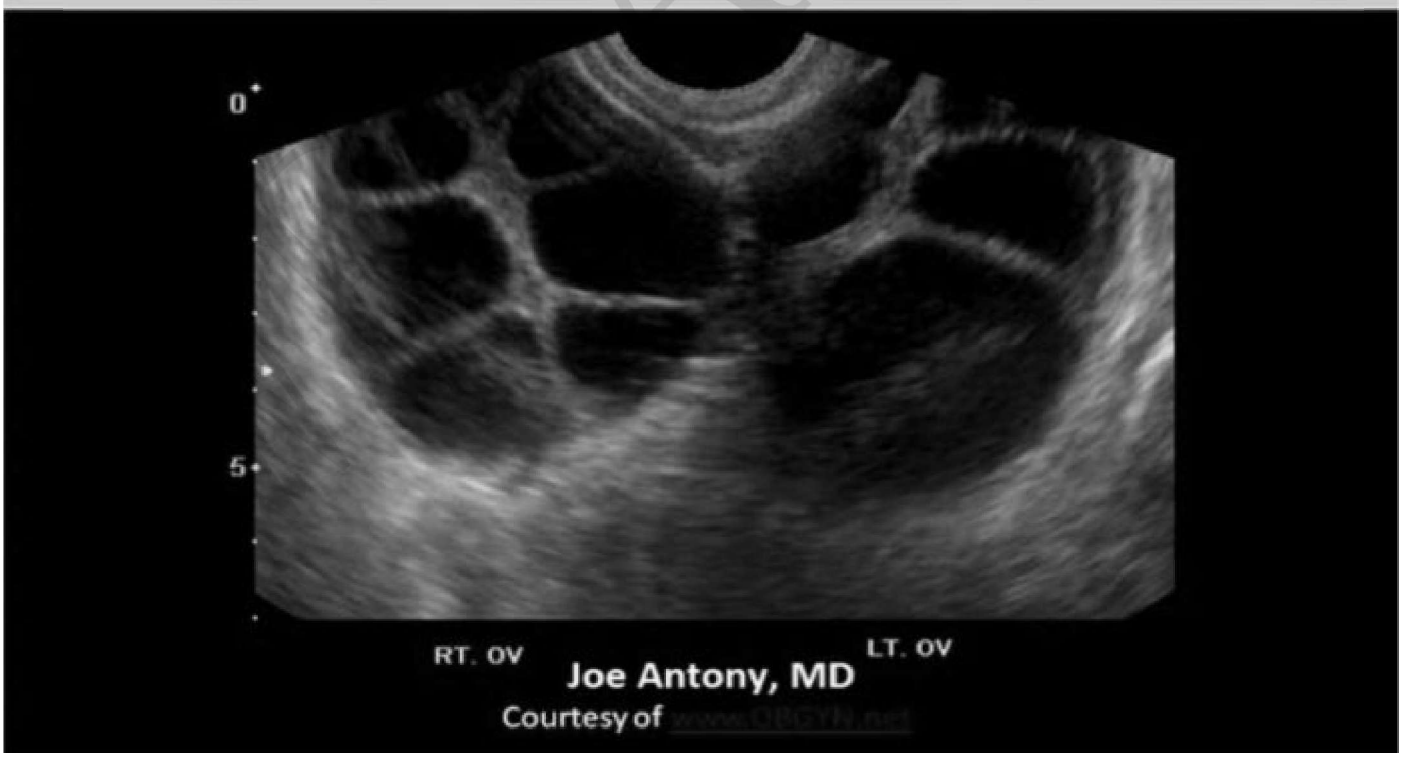


Adapted from: Ovarian Hyperstimulation Syndrome with pleural effusion: a case report.
Yildizhan R, Adali E, Kolusari A, Kurdoglu M, Ozgokce C, Adali F - Cases J (2008)

# OHS



*Sonography Assisted Follicle Aspiration:*

- Performed using transvaginal ultrasound and a needle inserted through a biopsy guide
- Sedative medication used in most cases, general anesthesia not typically required
- Performed with the table in lithotomy position
- Gel placed on transducer face and covered with a sterile probe cover
- Sterile drapes used to cover the patient and the vagina is flushed with sterile solution
- Sterile saline should be used as a lubricant on the probe cover, instead of ultrasound gel due to spermicidal action and embryotoxicity
- US guides the needle to each follicle that will be drained and the ovum are suctioned into a collection container
- Procedure performed in about 10 minutes
- Complications include:
  - Puncture of the iliac vein - use color Doppler to identify the pelvic vasculature
  - Pelvic inflammatory disease

*Intrauterine Insemination (IUI):*

- Sperm placed into uterine fundus to encourage fertilization

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*In Vitro Fertilization:*

- Commonly referred to as IVF
- Process of fertilization by manually combining an egg and sperm outside the body
- Preimplantation genetic screening (PGS) - aneuploidy testing is performed to screen for chromosomal abnormalities in the embryo before implantation
- Only those embryos with normal results are transferred
- When the IVF procedure is successful, the embryo is physically placed into the uterus after a few days
- Usually multiple embryos are placed in the uterus using a catheter that is placed into the vagina and through the cervical canal
- If too many of the embryos survive implantation, selective reduction is performed
- Normally the embryo(s) implanted closest to the cervix and in the lower uterine body are selected for reduction
- One exception in which clinical information is more accurate than ultrasound is when assigning gestational age for pregnancies conceived by ART
- Conceptual age: the exact date of conception + 2 weeks = gestational age
- Sonographer responsibilities during the embryo transfer

- Describe the transfer procedure
- Obtain an informed consent form that describes the procedure, lists the number and stage of the embryos being transferred and potential complications
- Explain any aftercare instructions and assist patient as needed for exiting the facility

*Gamete Intrafallopian Transfer:*

- Commonly referred to as GIFT
- Type of artificial insemination
- Retrieval of oocytes from the ovary, followed by laparoscopic placement of the oocytes and sperm in the fallopian tubes
- Higher success rates than IVF
- Fallopian tube obstruction or adhesions are contraindications of this procedure = could lead to ectopic pregnancy

*Zygote Intrafallopian Transfer:*

- Commonly known as ZIFT
- Retrieval of oocytes from the ovary, fertilization and culture in vitro
- Laparoscopic placement of the resulting zygotes in the fallopian tubes 24 hours after oocyte retrieval
- Higher success rates than IVF

| "Most Common" |
| --- |
| Piriformis muscles most commonly mistaken for ovaries on ultrasound |
| Ovarian cyst is the most common adnexal mass |
| Corpus Luteal Cyst is the most common cystic mass seen with pregnancy |
| Clomid is the most commonly used ovarian stimulation drug |
| The most common complication of drug induced follicle stimulation is hyperstimulation |
| Benign Cystic Teratoma is the most common benign neoplasm of the ovary, most commonly occurring germ cell tumor of the ovary and the most common complex mass during pregnancy |
| The most common complication of a germ cell tumor of the ovary is torsion |
| Ovarian torsion most commonly occurs due to cyst or mass formation; It occurs more on the right side than the left |
| The most common tumor seen with Meig's syndrome is the fibroma |
| Ovarian Vein Thrombosis most commonly occurs in C-section deliveries |