Cross-Sectional Imaging of the Uterus and Ovaries

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Radiology Review Course
Seattle, WA
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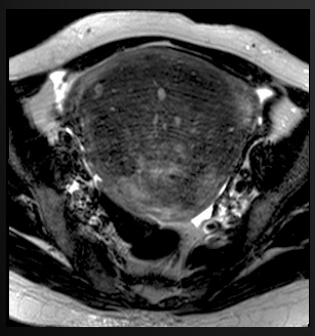
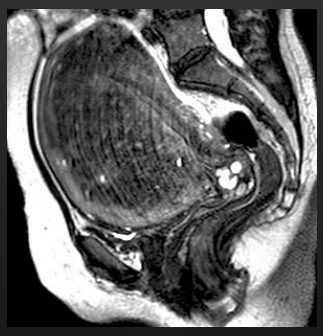
Why MR?

- Problematic adnexal masses
- Congenital anomalies
- Uterine cancer staging
- Benign disease - uterus
  - Adenomyosis, endometriosis
  - Fibroids
- Lower GU tract cysts

Case 1

Case 1

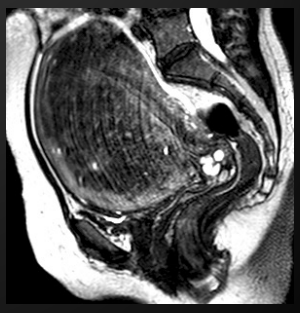

T2


T2


T1

Which is true for this diagnosis:

A. Thickened junctional zone is a sensitive finding
B. T2 dark signal in this entity is related to associated fibroids
C. T2-bright microcysts are a highly specific finding
D. Junctional zone thickness is unrelated to menstrual cycle



Dx: Adenomysosis

- Intrauterine ectopic endometrial tissue
- Histopathology:
  - Endometrial cells > 2.5mm from endometrial/myometrial interface
  - Reactive myometrial hypertrophy

Types of Adenomyosis

- Diffuse
- Focal
- Adenomyoma

Demographics

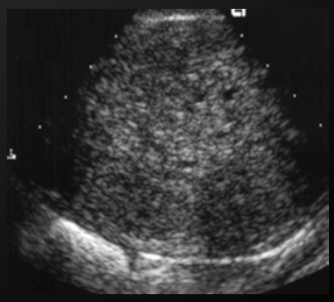
- Premenopausal women
- Risk factors
  - Multiparity
  - prior endouterine procedures
- Prevalence 30%
- Assoc: fibroids, endometriosis

Clinical

- Often asymptomatic; menorrhagia, pain
- Clinical dx challenging
- Treatment
  - D & C, hysterectomy, embolization

Imaging Diagnosis

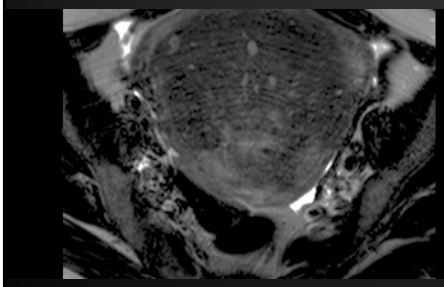
- HSG: nonspecific
  - Single or multiple cavities
- US: normal can exclude
  - poor definition of canal
  - posterior wall thickening
  - myometrial cysts
  - *ddx w fibroids



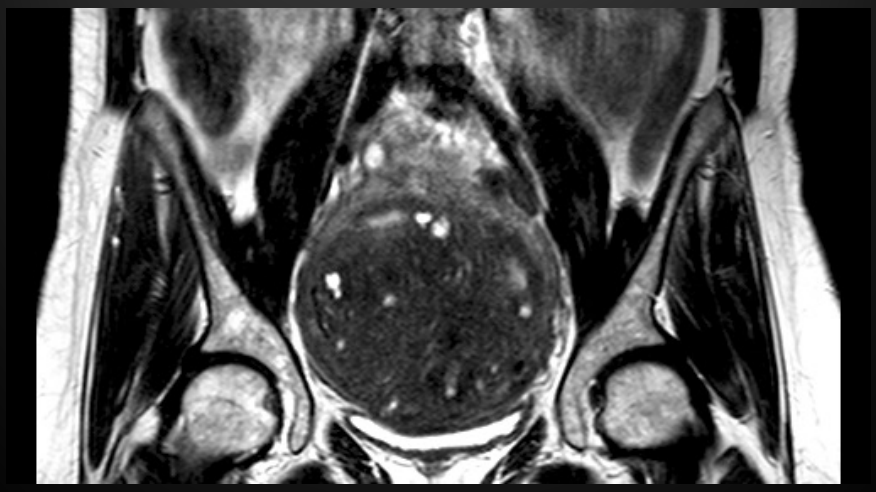
MR findings

- Direct signs
  - Microcysts
  - Adenomyoma
- Indirect signs
  - JZ thickening
  - Ill-defined JZ

MR Direct Sign: Microcysts



MR Direct Sign: Adenomyoma



Adenomyoma	Fibroid
Microcysts	None
None	Large peripheral vessels
Ill-defined	Well-demarcated
Elliptical along long axis	Round
Rare	Common

Indirect signs

- Thickened junctional zone
- Several others not as well studied

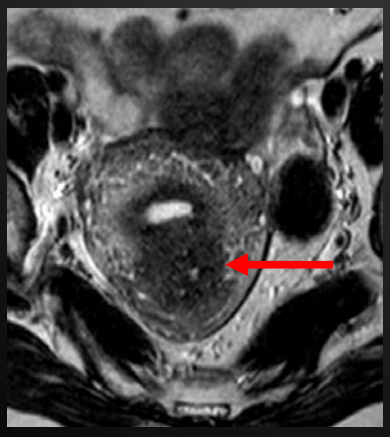
Indirect Sign: Thickened JZ

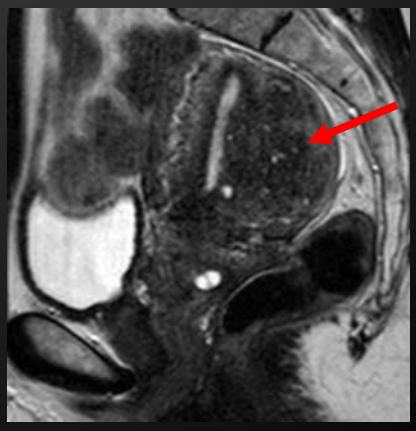
- Scan in secretory phase
- Normal 5-8mm
- Abnormal > 12mm
  - 96% specific, only 63% sensitive

Overall Performance of MR

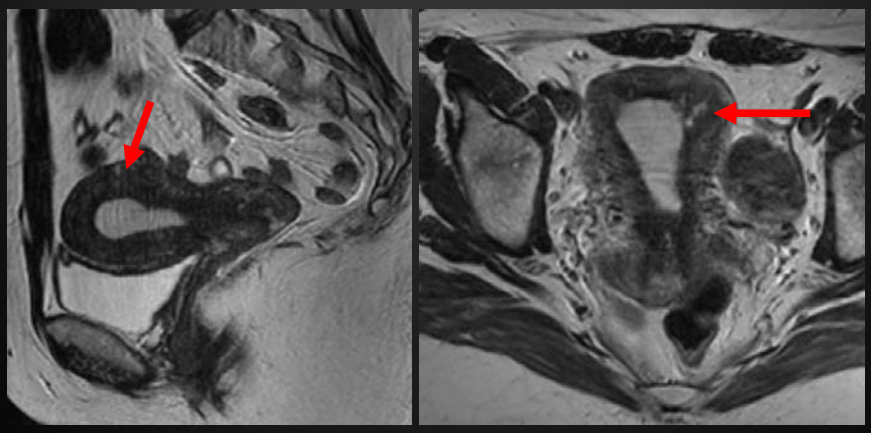
- Sens 70-86%
- Spec 86-93%
- Accuracy 88%

Companion Case 1





Companion Case 2



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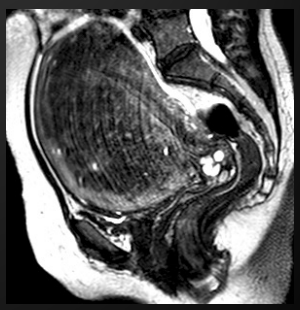
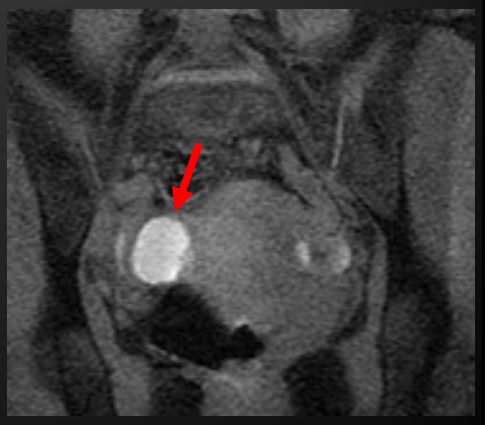


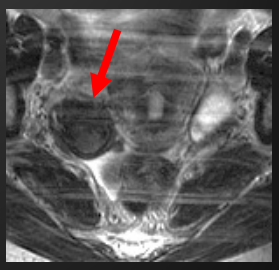
Case 2

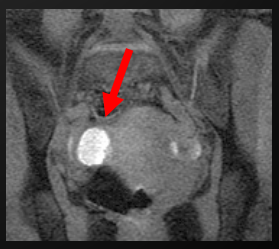
Case 2



Which is true for this diagnosis:

A. MRI is the reference standard for diagnosis
B. Most symptoms are caused by superficial disease
C. T2 shading refers to layering of blood products, protein, and viscous fluid in a cyst
D. Hematosalpinx in a nonpregnant patient is relatively specific for this disease





Dx: Endometrioma

Endometriosis

- Functional glands and stroma outside uterus
- Overall prevalence 5-10%
- Uncertain pathogenesis – retrograde menstruation

Clinical

- Infertility
- Pain

Gross Pathology – 3 types

- Superficial disease
- Ovarian
- Deep (solid infiltrating)
  - > 5mm below serosal surface

MR – Superficial Disease

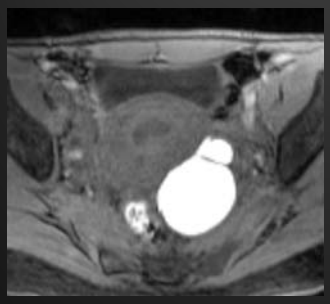
- Usually not visible

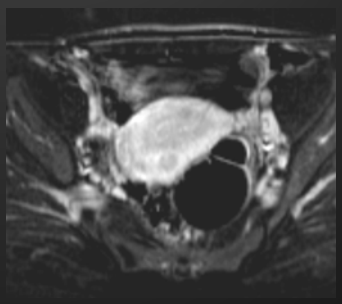
MR – Ovarian Disease/Endometrioma

- Multiple T1 bright lesions +/- T2 shading
  - mod sens, highly spec
- Single T1 bright lesion
  - T2 shading: sens, not spec
  - T2 dark spots: specific, not sensitive

Endometrioma

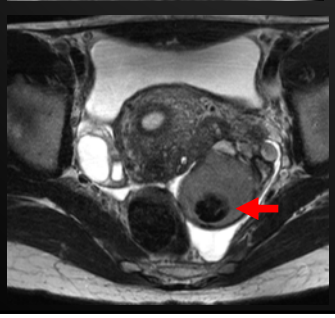
T1 FS





Subtraction
(T1 post-pre)

T2

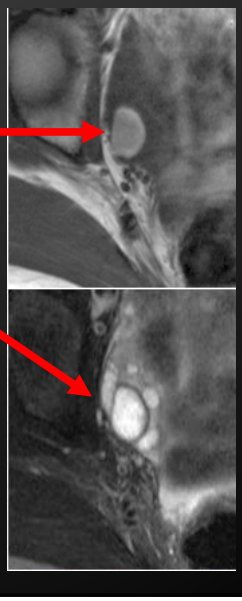


Malignant Transformation

- < 2% (clear cell, endometrioid)
- MR signs
  - **enhancing nodule
  - growth
  - loss of T2 shading

DDx: hemorrhagic cyst

- Rarely multiple
- Not as T1 bright
- Less T2 shading
- No T2 dark spots
- Resolves



T1

T2

DDx: mature cystic teratoma

T1 T1 FS

MR: Deep Infiltrating Disease

- Solid fibrotic masses, easy to miss
- T2 dark w/ T2 bright foci
- Common locations
  - Uterosacral ligament
  - Ant rectosigmoid
  - Bladder

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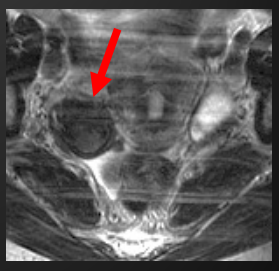
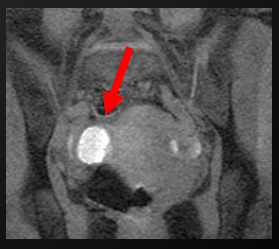
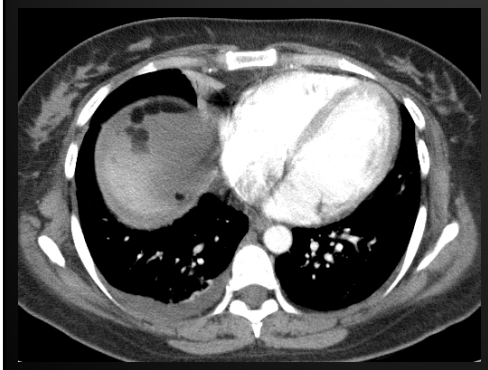
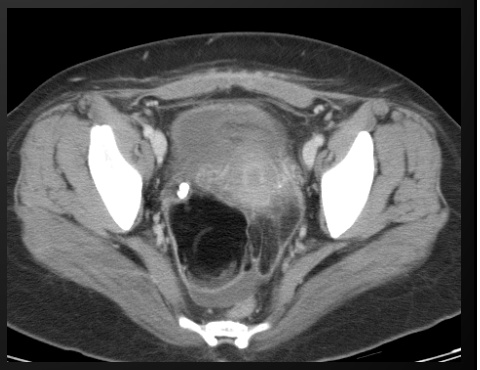




Case 3

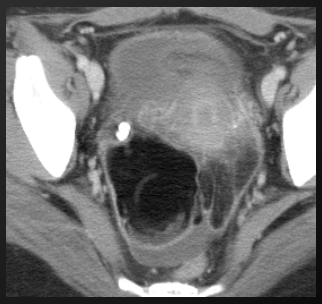
Case 3





Which is true for this diagnosis:

A. The Rokitansky nodule is a sign of malignant degeneration
B. Rupture is the most common complication
C. T1 bright appearance of these lesions can be differentiated from hemorrhage by STIR
D. Malignant degeneration is rare



Dx: Mature Cystic Teratoma

- Younger age group
- Very common…
  - 20% all adult ovarian masses
  - 50% all pediatric adnexal mass
  - Most common adnexal mass removed at surgery

Pathology

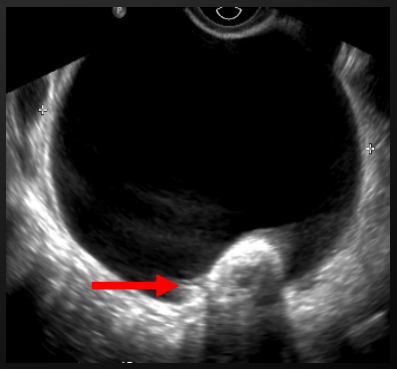
- Contains > 1/3 germ cell elements
- Sebum-filled unilocular cyst
- Rokitansky protuberance
- Bilateral 10-15%

Complications

- Torsion: most common (15%)
- Rupture: <1%, granulomatous peritonitis
- Malignant degeneration: <1%, squamous

US findings

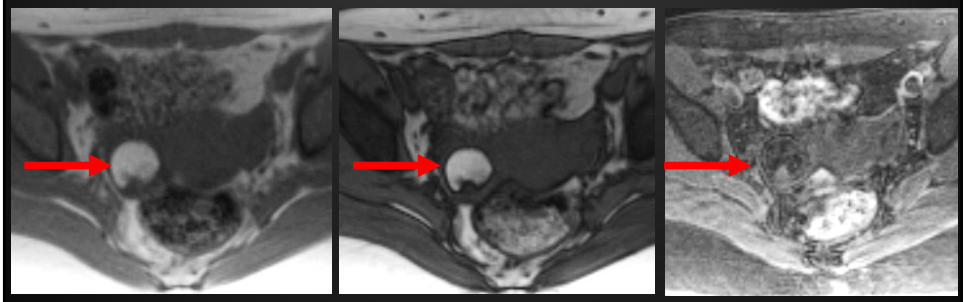
- Cystic lesion with Rokitansky nodule
- Diffusely or partially echogenic mass
- Pitfalls…



CT/MR

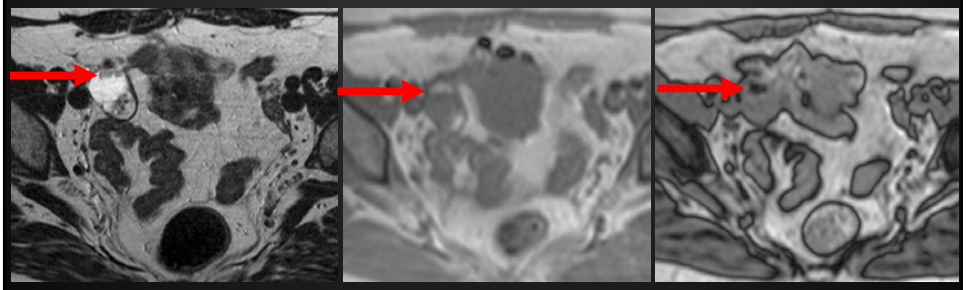
- CT
  - Cyst with fat diagnostic
  - Ca++ nonspecific
- MR
  - T1 bright
  - T2 variable, usu follows fat
  - STIR vs freq-selective FS
  - Tiny amount of fat – chemical shift

Mature Cystic Teratoma



T1 IP T1 OP T1 FS

Mature Cystic Teratoma



T2 T1 IP T1 OP

T2

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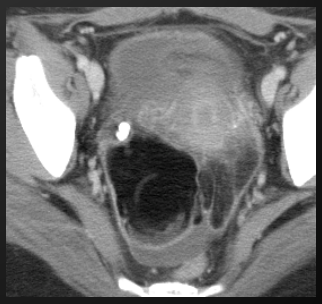


Why are adnexal masses indeterminate at US?

- Too large
- Site of origin?
- Indeterminate features: solid-cystic, solid
  - most are common benign lesions

Why MR?

- Accuracy: MR> Doppler US (.91 vs .78)
- Bayesian analysis - ovarian mass with indeterminate gray scale US followed by subsequent imaging
  - Pre MR prob → post Gd-MR prob malignancy
    - premenopausal 25% → 80%
    - postmenopausal 63% → 95%

Benign vs Malignant - Simplified

- Pathognomonic lesions
- Benign features
- Malignant features

Pathognomonic

- Endometrioma
- Simple cyst
- Mature cystic teratoma
- Hemorrhagic cyst

Benign Features

- Absence of solid tissue
- No wall enhancement
- Solid tissue
  - homogeneously T2 very dark
  - hypo on DWI
  - little to no enhancement

Malignant Features

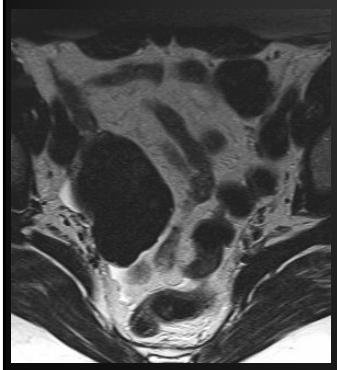
- Solid tissue (weak)
- Gd
  - None/minimal - benign
  - Moderate – indeterminate
  - Marked – high prob
- Implants – definite

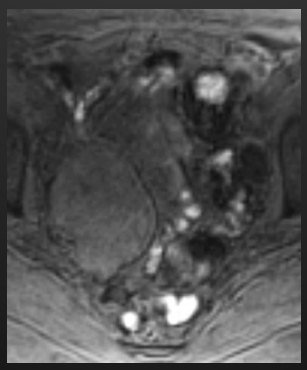
Bottom Line

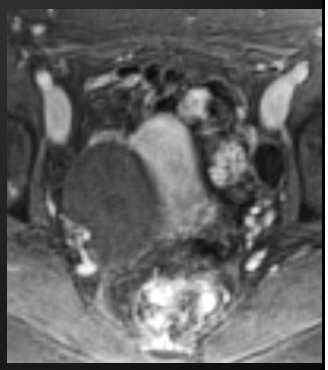
- No solid tissue or wall enhancement = benign
- Solid tissue = r/o malignant *unless*
  - T2 very dark
  - no to minimal enhancement

Case 4

Case 4

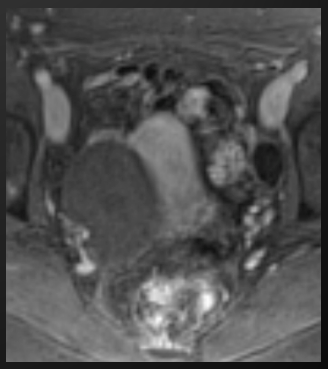

T2


pre-con


post-Gd

Which is false regarding this diagnosis?

A. These are usually malignant lesions
B. These can be hormonally active
C. These are the most common solid primary ovarian tumors in asymptomatic women
D. They can be associated with pleural effusions and ascites



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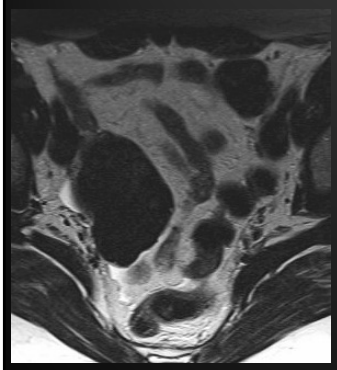

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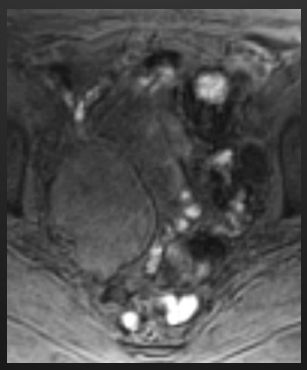

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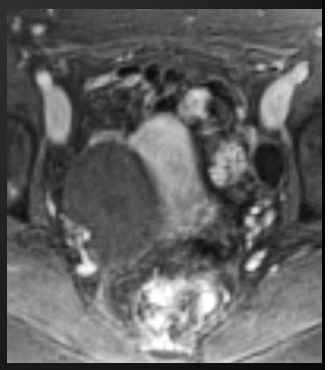

post-Gd

Fibroma, Fibrothecoma, Thecoma

- Spectrum of benign sex-cord stromal tumors
- Fibroma most common, bilateral 10%
- Malignant <1%
- Meigs' syndrome
  - Ascites and (R) pleural effusion
  - Most often a/w fibroma
- MR: T2 very dark, minimal enhancement

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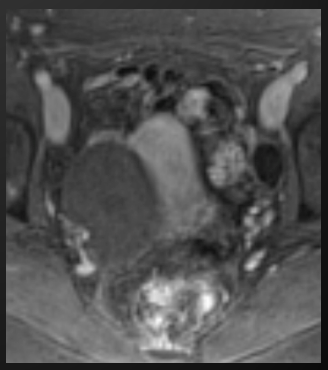

Case 5

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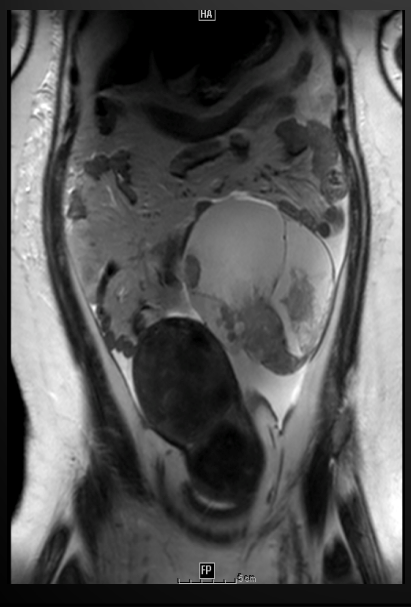
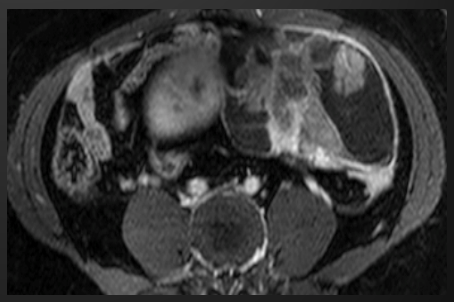
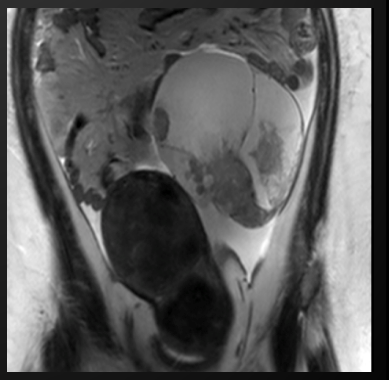




Which is true of ovarian malignancy:

A. Ovarian epithelial neoplasms do not actually arise from native ovarian tissue
B. Mucinous epithelial neoplasms are the most common primary ovarian malignancy
C. Serous lesions are rarely bilateral
D. OCPs increase the risk of ovarian cancer



Primary Ovarian Malignancy

- Epithelial 90%
- Rest are germ cell and stromal

Epithelial CA origin - ? ovary

- Serous - fallopian tube
- Mucinous – endocervical or GI
- Clear cell and endometrioid – endometrium
- Brenner – transitional cell

New theory – extraovarian origin

- Serous – fimbrial CA →ovary
- Endometrioid/clear cell – retrograde menstruation
- Mucinous/Brenner – paraovarian epithelial rests

Ovarian cancer – risk factors

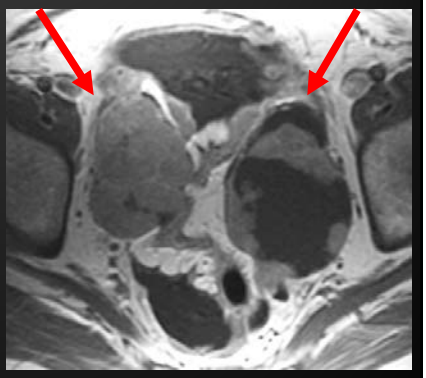
Decreased risk	Increased risk
multiparity	family hx
lactation	nulliparity
OCP	endometriosis
tubal ligation	

Ovarian Malignancy Prophylaxis

- Traditional: BSO
  - but: increase in all cause mortality and CAD
- Alternative: post-reproductive salpingectomy with ovarian conservation

Serous

- Most common ovarian CA
- 60% benign, 25% malignant
- 85% bilateral

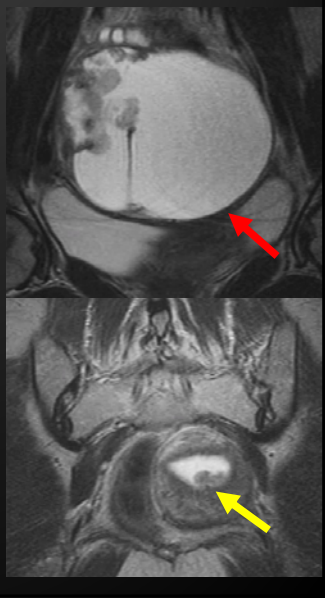


Mucinous

- >90% benign, unilateral
- DDx metastatic mucinous lesions

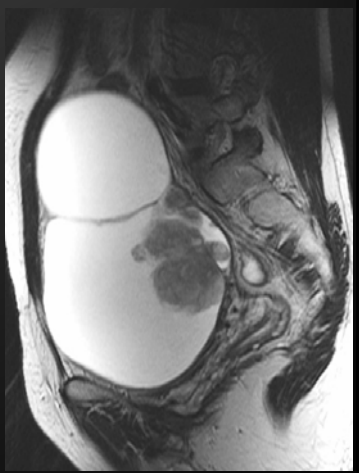
Endometrioid

- 10-20% of ovarian ca
- Best prognosis
- Associations
  - Endometrial CA – 15-20%
  - HNPCC
  - Endometriosis



Clear Cell

- 5% of ovarian carcinomas
- Strongest a/w endometriosis
- Highly aggressive



Brenner (Transitional Cell) Tumor

- Rarely malignant
- Large unilateral solid or complex mass - T2 dark solid components
- Assoc with another ovarian tumor 30%, often mucinous

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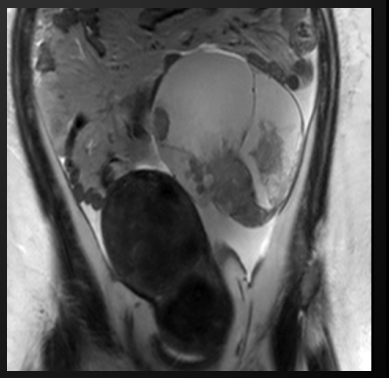

Case 6

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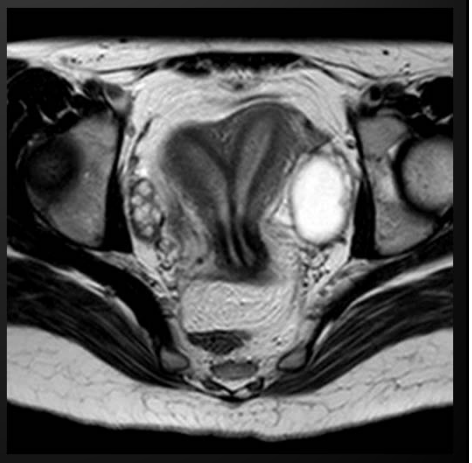
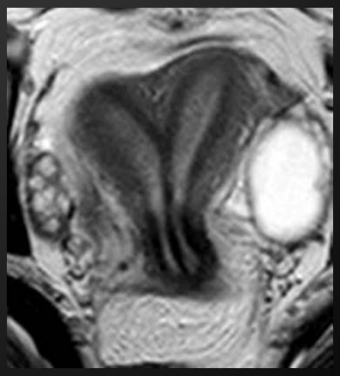


Which is true regarding this anomaly?

A. It is the most common congenital uterine anomaly
B. It is due to failure of normal fusion of the Mullerian ducts
C. It is associated with difficulty in conceiving
D. Surgical treatment is not particularly effective in reducing miscarriage rates



Dx: Septate Uterus

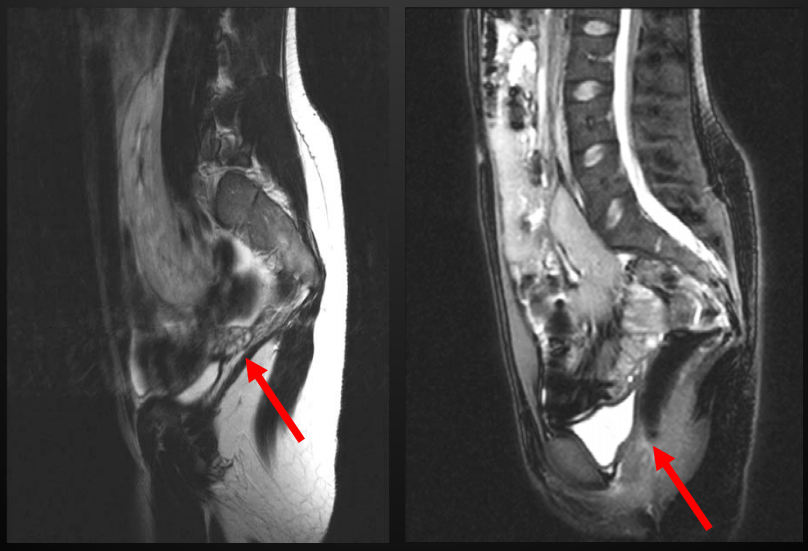
Congenital Uterine Anomalies

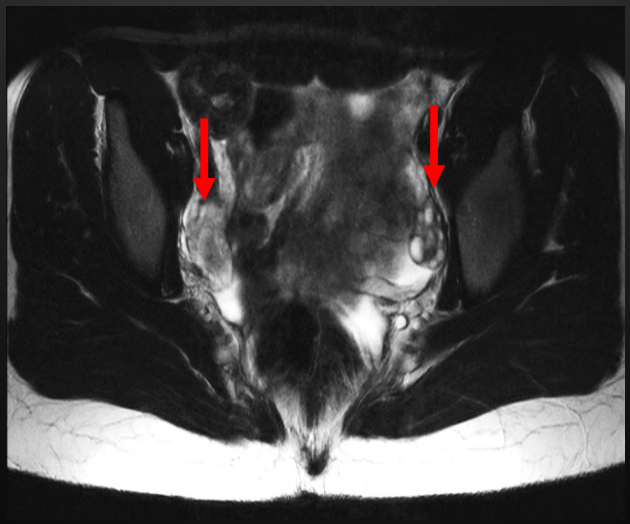
- Common: 4-7%
- Traditional classification based on AFS, push for new classification with less limitations in Europe – CONUTA (CONgenital Uterine Anomalies)

Embryology

- Mullerian ducts fuse to form uterus, tubes, and upper 2/3 vagina
- Three steps/points of failure in this process
  - Formation
  - Fusion
  - Resorption uterovaginal septum

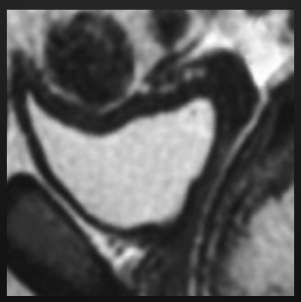
Failure of Formation: Agenesis





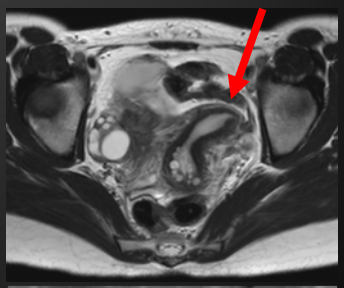
Mayer-Rokitansky-Kuster-Hauser Syndrome

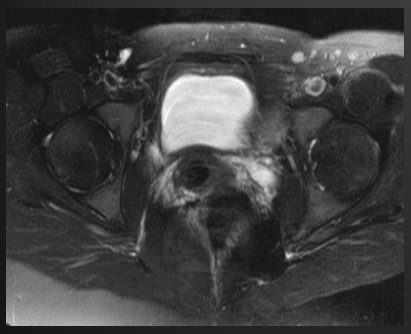
- 1/5000
- 2nd most common cause primary amenorrhea
- Assoc with renal anomalies, Klippel-Feil

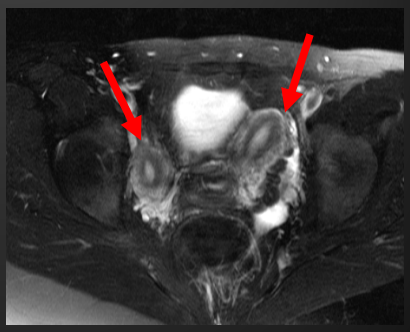


Failure of Formation: Unicornuate

- 20% of uterine anomalies
- "banana-shaped" horn and rudimentary horn
- 40% assoc renal anomalies ipsilateral to rudimentary horn
- Treat only if rudimentary horn w/ functioning endometrium
  - ruptured pregnancy, obstruction, pain

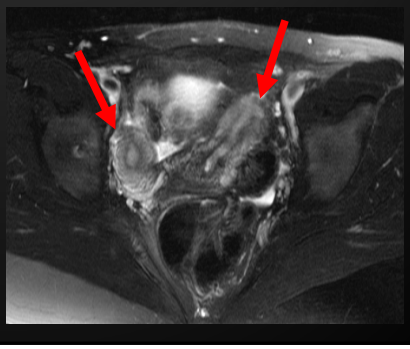






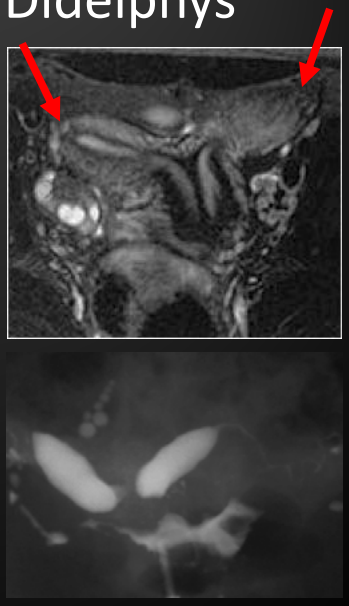
Left: noncommunicating cavitary (functioning)

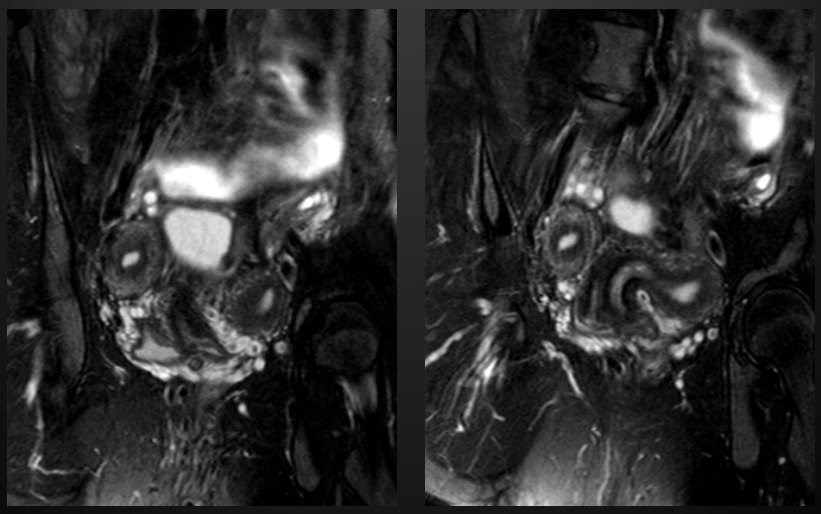
Right: rudimentary horn



Failure of Fusion: Didelphys

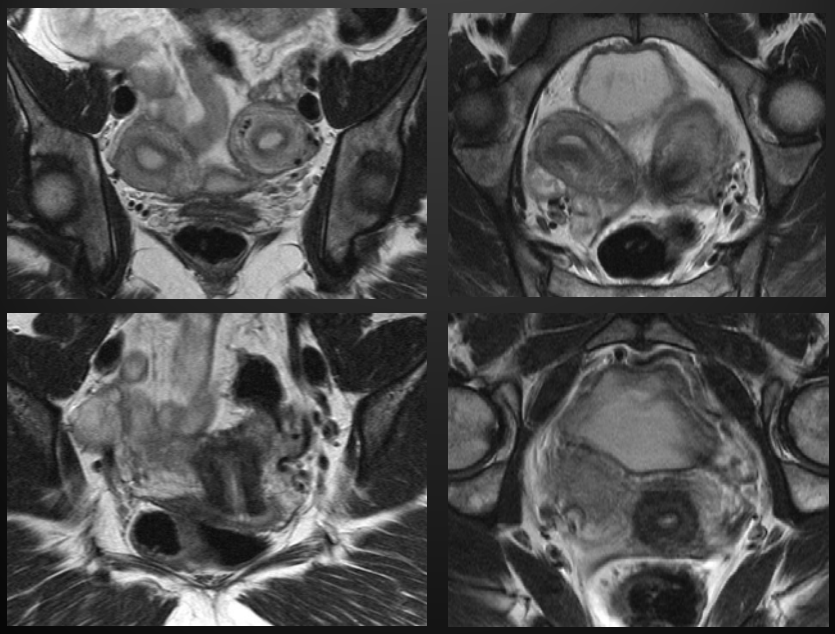
- Complete failure – 2 uteri, cvx
- Vaginal septum – 75%
- Often asymptomatic
- MR diagnosis:
  - Widely divergent uterine horns and cervices
  - Fundal depression >1cm
  - Intercornual distance >4cm





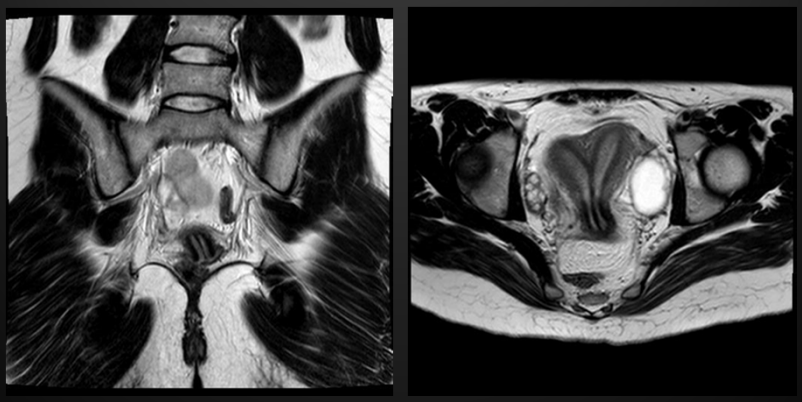
Failure of Fusion: Bicornuate

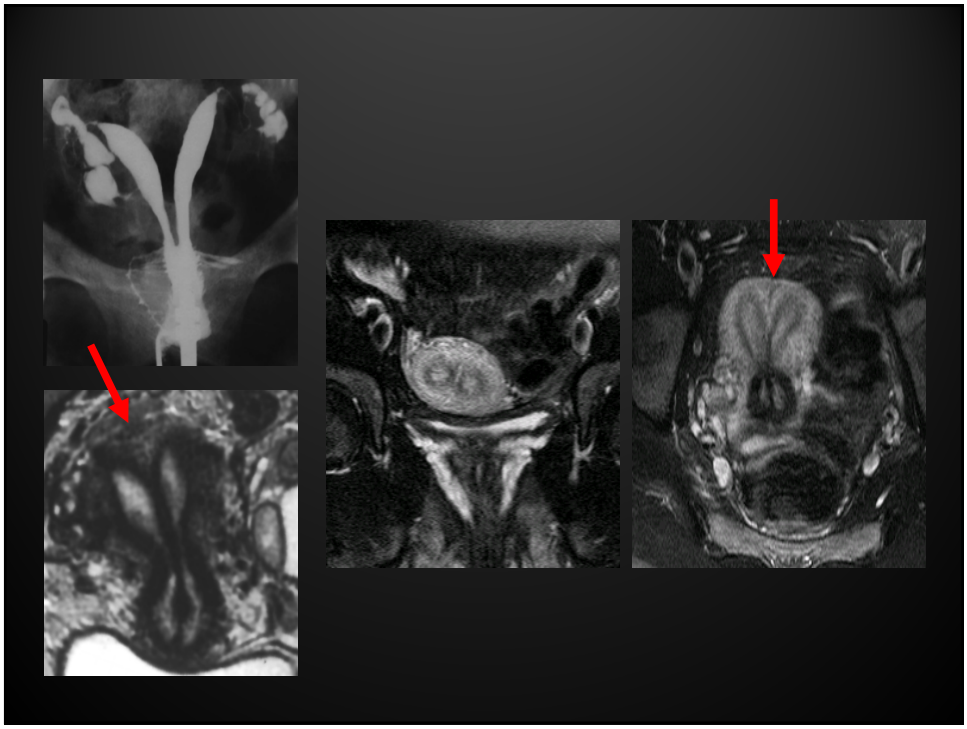
- Partial nonfusion
- Bicollis: to ext os
- Unicollis: to int os
- No tx → ddx septate
- Imaging similar to didelphys



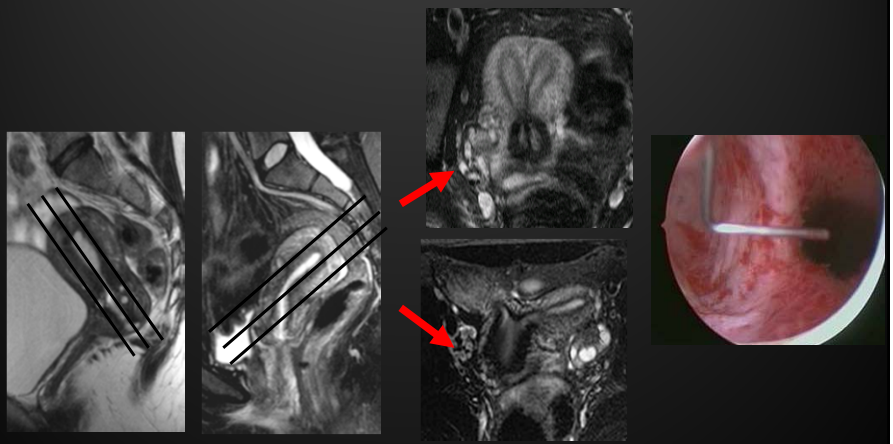
Failure of Resorption: Septate

- Most common 50%
- Septum fibrous or fibromuscular
- High rate of preg loss, resection is very effective





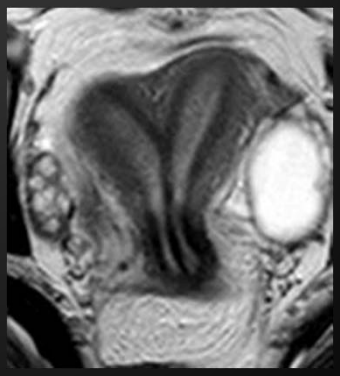
Bicornuate vs. Septate



Important distinction
Must use oblique coronal sequence

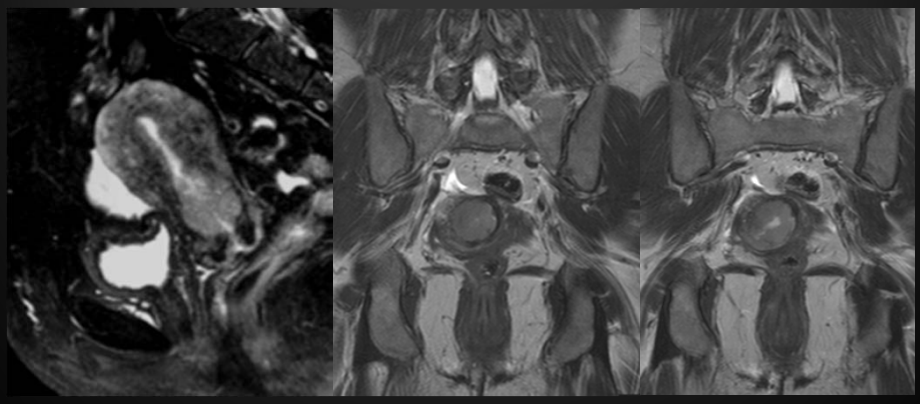
Which is true regarding this anomaly?

A. It is the most common congenital uterine anomaly
B. It is due to failure of normal fusion of the Mullerian ducts
C. It is associated with difficulty in conceiving
D. Surgical treatment is not particularly effective in reducing miscarriage rates



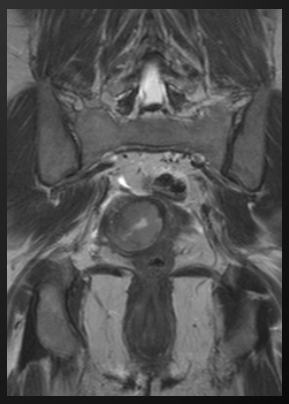
Case 7

Case 7



Which is true of this diagnosis:

A. Intact fibromuscular stromal ring has a 100% negative predictive value for parametrial invasion
B. This is the 2nd most common gynecologic malignancy in the world
C. Adenocarcinoma is the most common cell type
D. Hydronephrosis implies stage IIB



Dx: Cervical CA stage IIB

Cervical Cancer

- Most common gyn and 2nd most female common cancer worldwide (#3 gyn in US)
- FIGO staging is clinical, not surgical/path
- Accuracy MR vs clinical staging:
  - tumor size 93% vs 60%
  - parametrial invasion 93% vs 40%

Revised FIGO

- I – within cervix
- II
  - IIA – upper 2/3 vagina
  - IIB – parametrial invasion
- III
  - IIIA – lower 1/3 vagina
  - IIIB – pelvic sidewall
- IV
  - Adjacent organs (inc bladder/rectum)
  - Distant organs

Revised FIGO

- I – within cervix
- II
  - IIA – upper 2/3 vagina

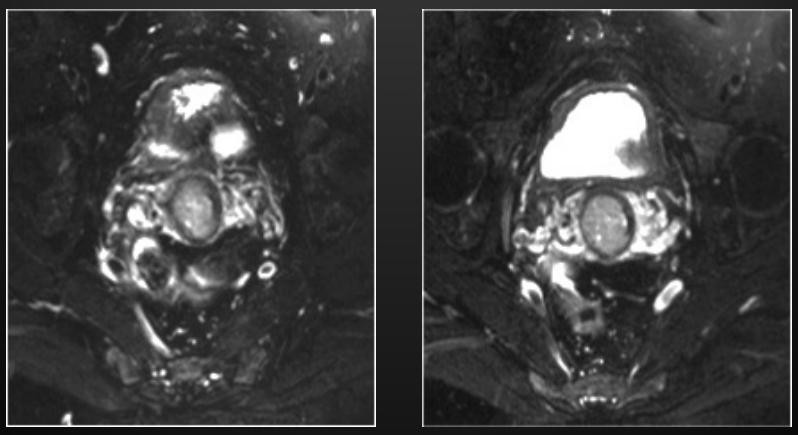
Surgery (< 4 cm) vs Chemorad (> 4cm)

  - IIB – parametrial invasion
- III
  - IIIA – lower 1/3 vagina
  - IIIB – pelvic sidewall

Chemorad

- IV
  - Adjacent organs (inc bladder/rectum)
  - Distant organs

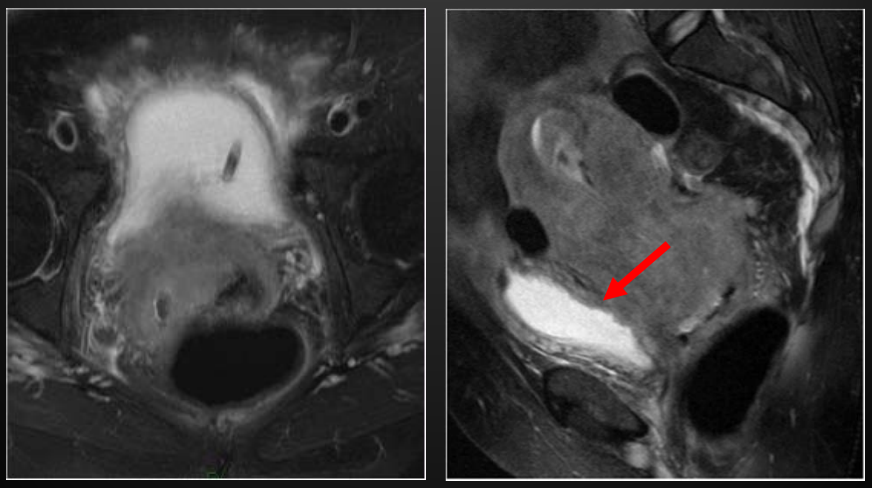
Cervical cancer - stage I



Cervical cancer - stage IIA

Cervical cancer - stage IIB

Cervical cancer - stage IVa



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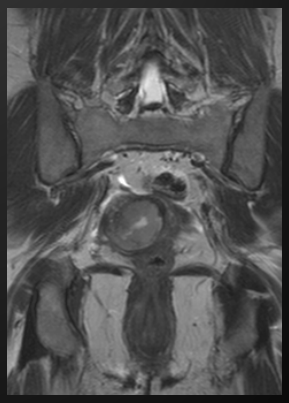
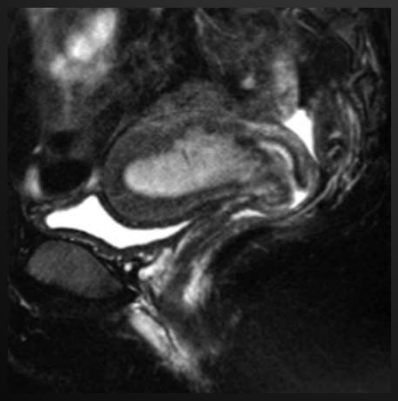
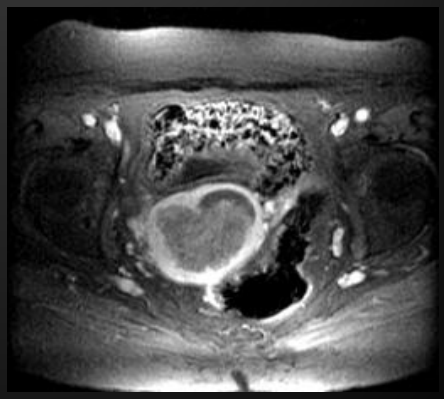


Case 8

Case 8



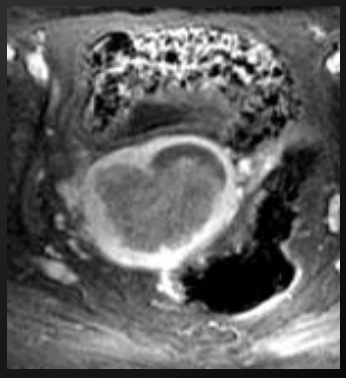
Patient A



Patient B

Which is true for this diagnosis?

A. Staging is done by imaging, not surgery
B. Invasion of the bladder muscularis propria but not the mucosa is considered stage IV disease
C. Serous papillary and clear cell variants are the most common and spread like ovarian cancer
D. Most cases are in post-menopausal women



Dx: Endometrial cancer stage IB

Demographics

- most common gynecologic malignancy in US
- peri to post menopausal
- major types
  - endometrioid – vast majority
  - aggressive types
    - clear cell, serous papillary

Clinical

- No good screening test but 90% → early abnormal bleeding:
  - Endometrial atrophy 60-80%
  - Endometrial cancer 10%
  - HRT 20%
  - Polyps/hyperplasia 10%

Revised FIGO staging

- I – uterus only
  - A: endo/myo invasion <50%
  - B: myo invasion >50%
- II – cervical stroma
- III – local/regional spread
- IV – bladder/bowel, distant

Revised FIGO staging

- I – uterus only
  - A: endo/myo invasion <50%
  - B: myo invasion >50%

TAH/BSO

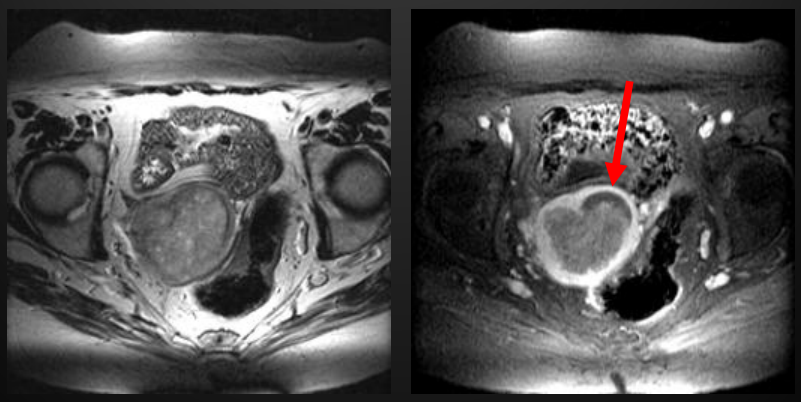
+/- LND, +/- RT

- II – cervical stroma
- III – local/regional spread
- IV – bladder/bowel, distant

LND, CHEMO, +/- RT

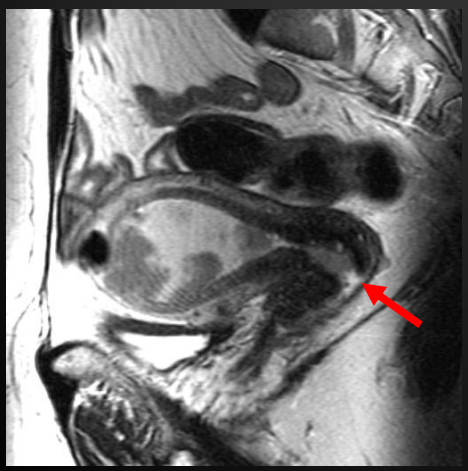
Endometrial cancer – stage IA

Endometrial cancer – stage IB



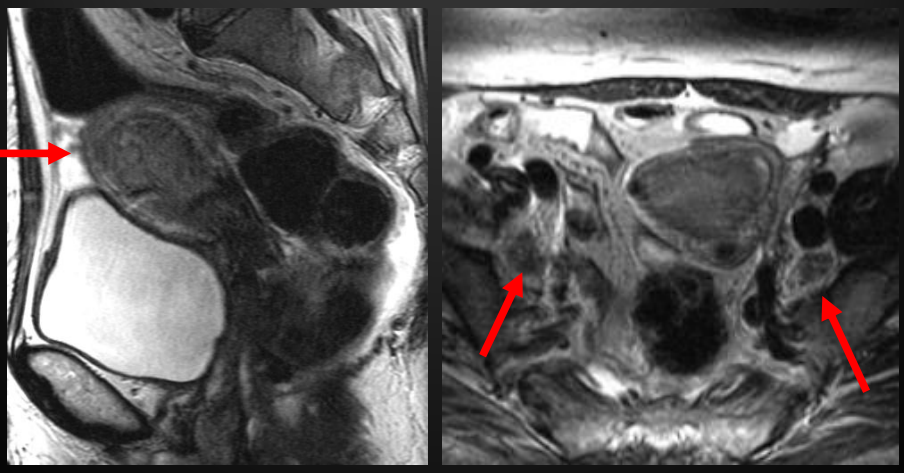
Cervical involvement

Stage I



Stage II

Endometrial cancer – stage IIIC



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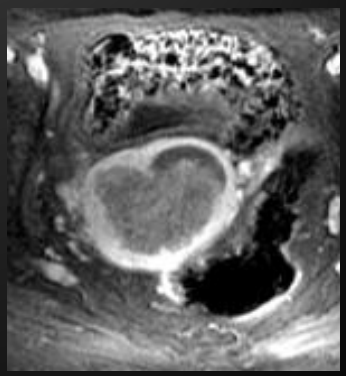

Thank you

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- **T. Dubinsky MD**
- **S. Kim MD**

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