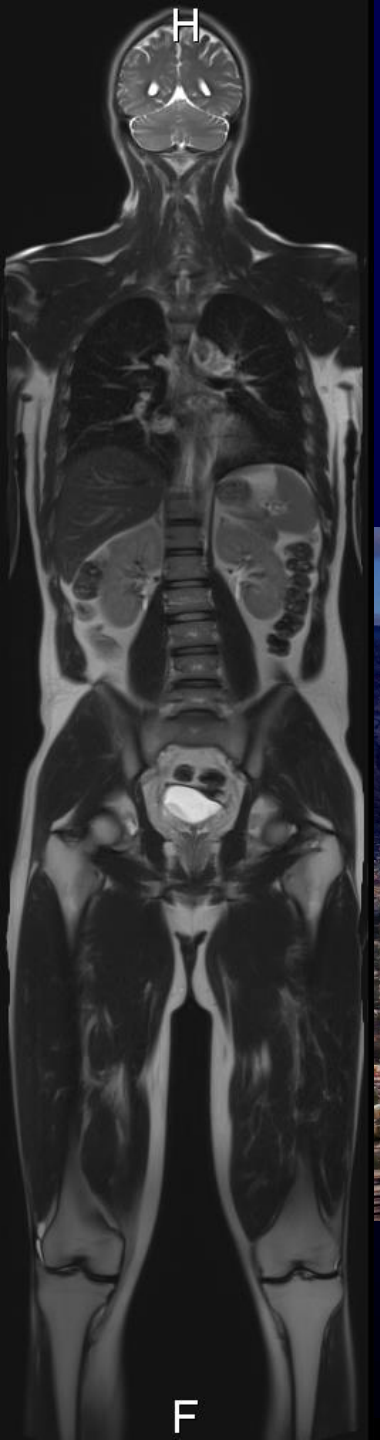
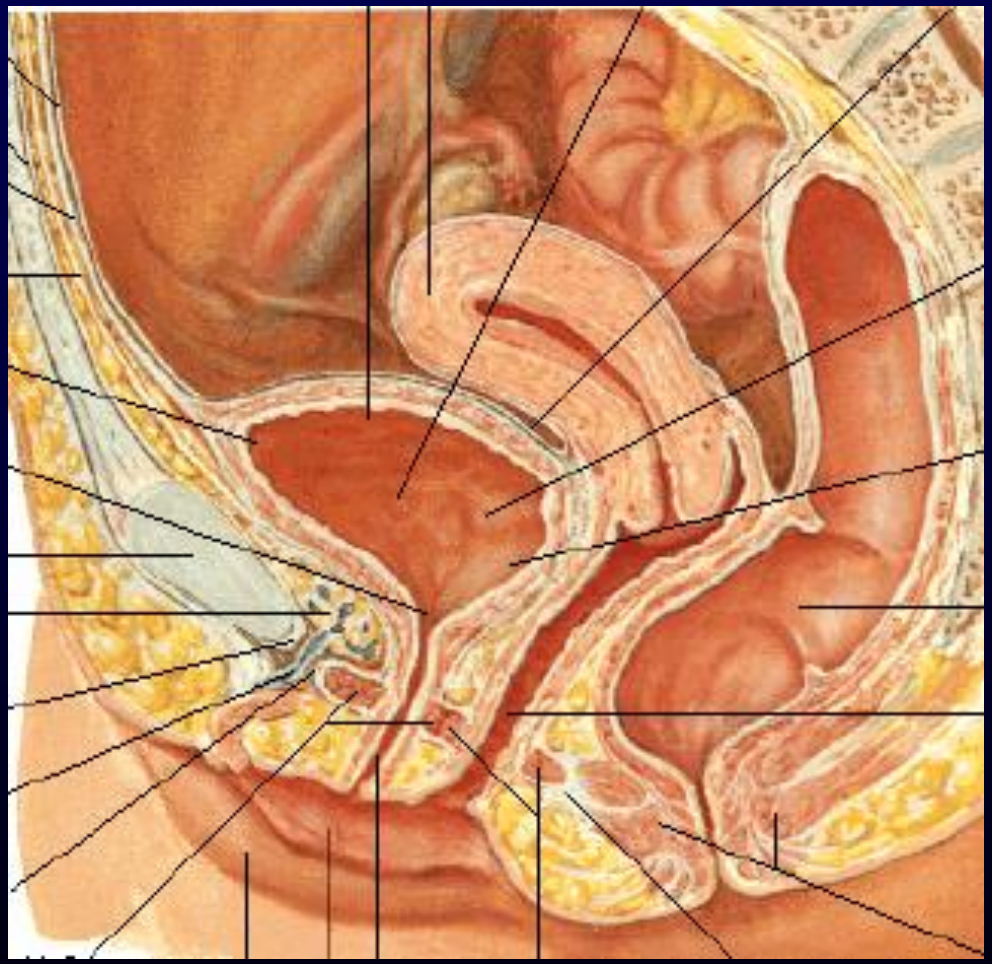
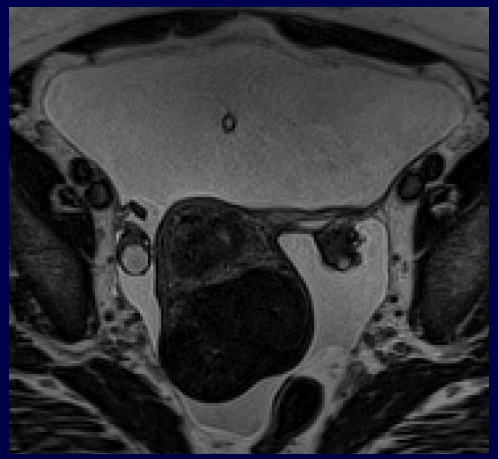


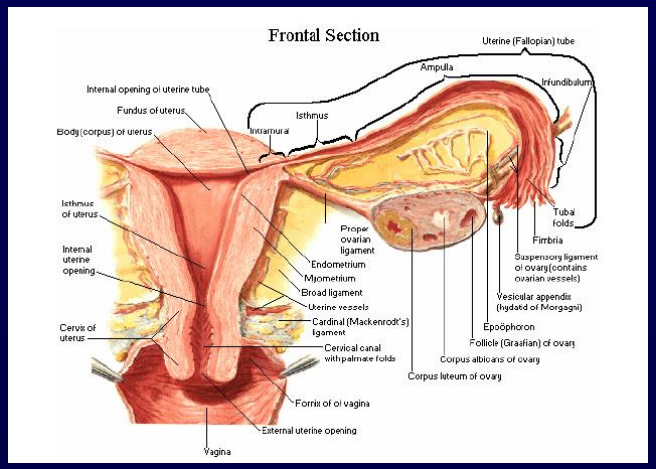
THE UNIVERSITY OF ARIZONA

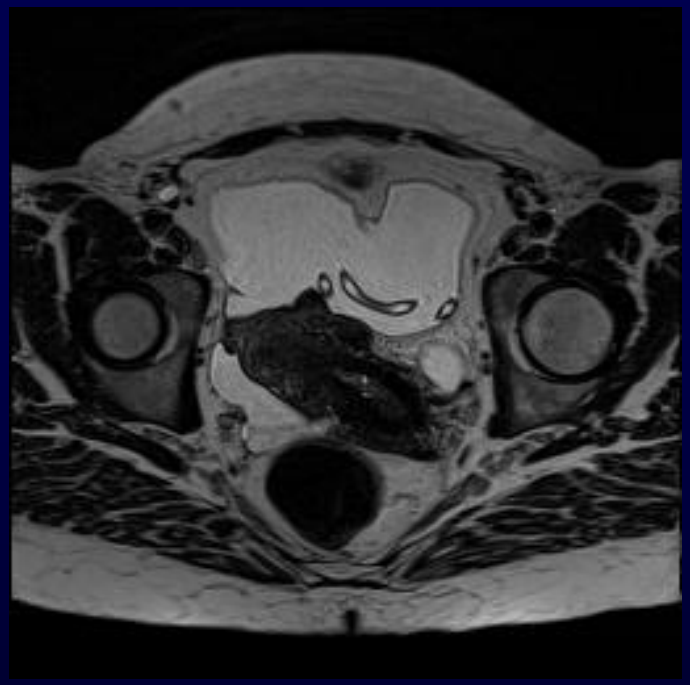
MRI- Female Pelvis

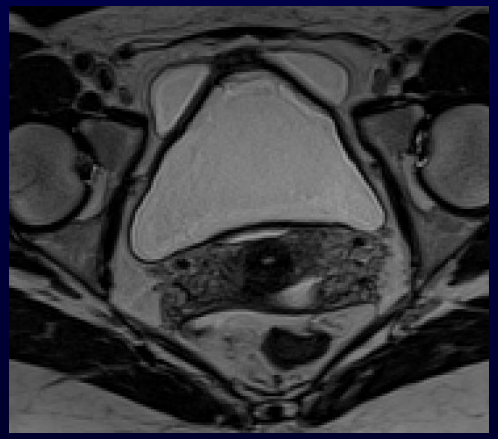
Normal anatomy

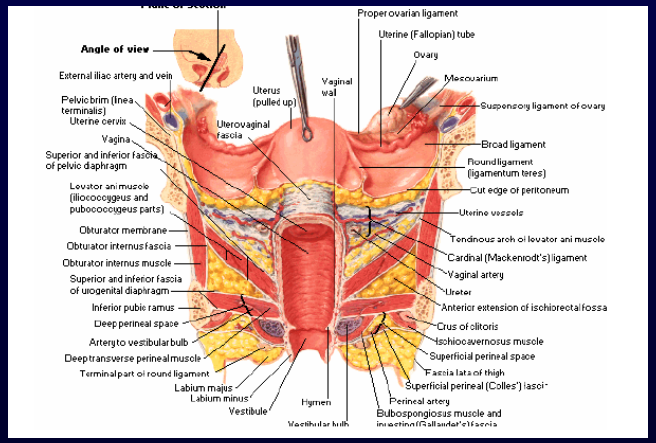


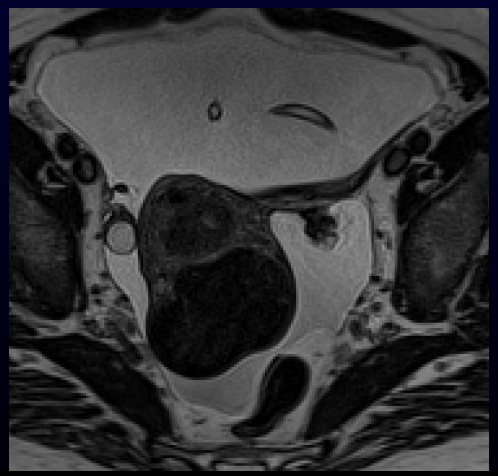


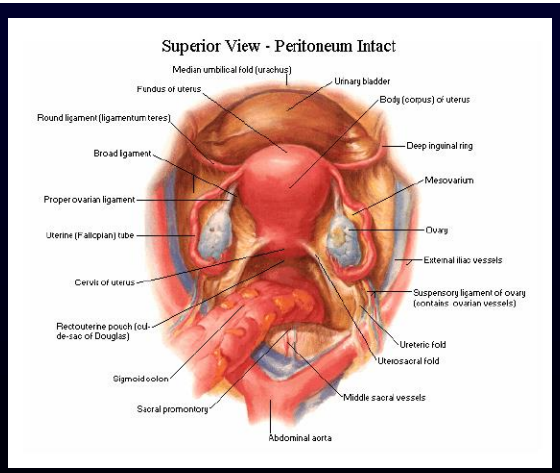

Frontal Section
Uterine (Fallopian) tube
Ampulla
Infundibulum
Internal opening of uterine tube
Fundus of uterus
Isthmus
Body (corpus) of uterus
Intramural
Isthmus of uterus
Tubal folds
Fimbria
Proper ovarian ligament
Internal uterine opening
Endometrium
Suspensory ligament of ovary (contains ovarian vessels)
Myometrium
Broad ligament
Vesicular appendix (hydatid of Morgagni)
Uterine vessels
Epoöphoron
Cervix of uterus
Cardinal (Mackenrodt's) ligament
Follicle (Graafian) of ovary
Cervical canal with palmate folds
Corpus albicans of ovary
Corpus luteum of ovary
Fornix of of vagina
External uterine opening
Vagina

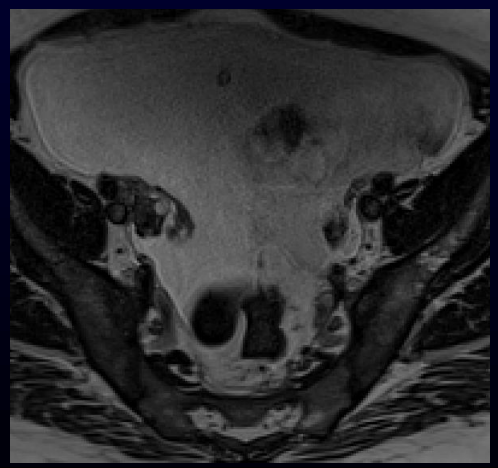





Angle of view
Proper ovarian ligament
Uterine (Fallopian) tube
Ovary
External iliac artery and vein
Mesovarium
Vaginal wall
Uterus (pulled up)
Pelvic brim (linea terminalis)
Suspensory ligament of ovary
Uterine cervix
Uterovaginal fascia
Vagina
Broad ligament
Superior and inferior fascia of pelvic diaphragm
Round ligament (ligamentum teres)
Levator ani muscle (iliococcygeus and pubococcygeus parts)
Cut edge of peritoneum
Uterine vessels
Obturator membrane
Tendinous arch of levator ani muscle
Obturator internus fascia
Cardinal (Mackenrodt's) ligament
Obturator internus muscle
Vaginal artery
Superior and inferior fascia of urogenital diaphragm
Ureter
Inferior pubic ramus
Anterior extension of ischiorectal fossa
Deep perineal space
Crus of clitoris
Artery to vestibular bulb
Ischiocavernosus muscle
Deep transverse perineal muscle
Superficial perineal space
Terminal part of round ligament
Fascia lata of thigh
Labium majus
Superficial perineal (Colles') fascia
Labium minus
Hymen
Perineal artery
Vestibule
Bulbospongiosus muscle and investing (Gallaudet's) fascia
Vestibular bulb




Superior View - Peritoneum Intact
Median umbilical fold (urachus)
Urinary bladder
Fundus of uterus
Body (corpus) of uterus
Round ligament (ligamentum teres)
Deep inguinal ring
Broad ligament
Mesovarium
Proper ovarian ligament
Ovary
Uterine (Fallopian) tube
External iliac vessels
Cervix of uterus
Suspensory ligament of ovary (contains ovarian vessels)
Rectouterine pouch (cul-de-sac of Douglas)
Ureteric fold
Uterosacral fold
Sigmoid colon
Middle sacral vessels
Sacral promontory
Abdominal aorta



Congenital uterine anomalies

- Sequelae of developmental abnormalities of the Müllerian duct system
- Wide variety of clinical presentations
  - Difficult to diagnosis clinically
- Actual incidence and prevalence not definitively known
  - range 0.1-4% for general population
  - up to 10% in patients with recurrent pregnancy loss

Congenital uterine anomalies

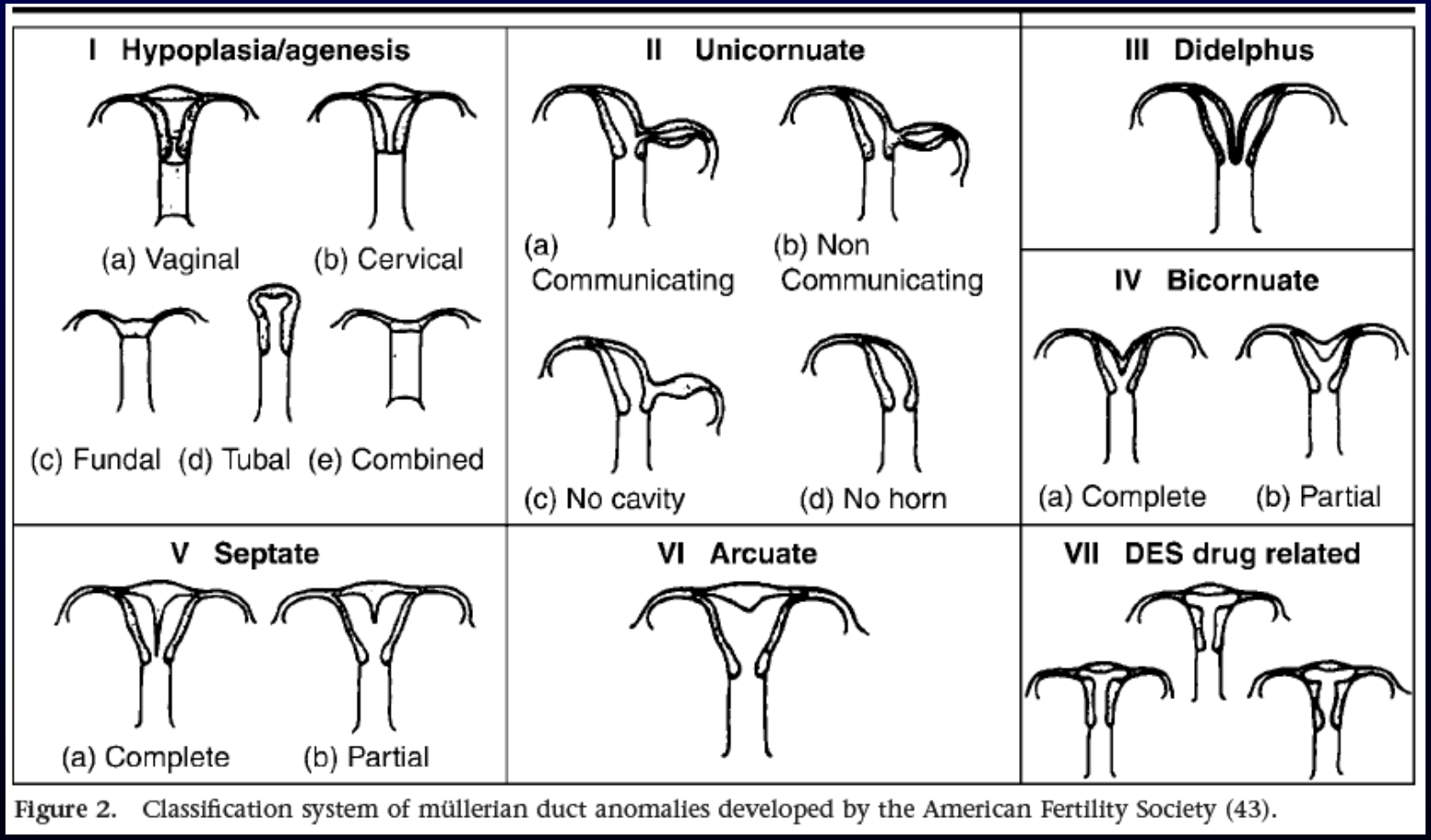
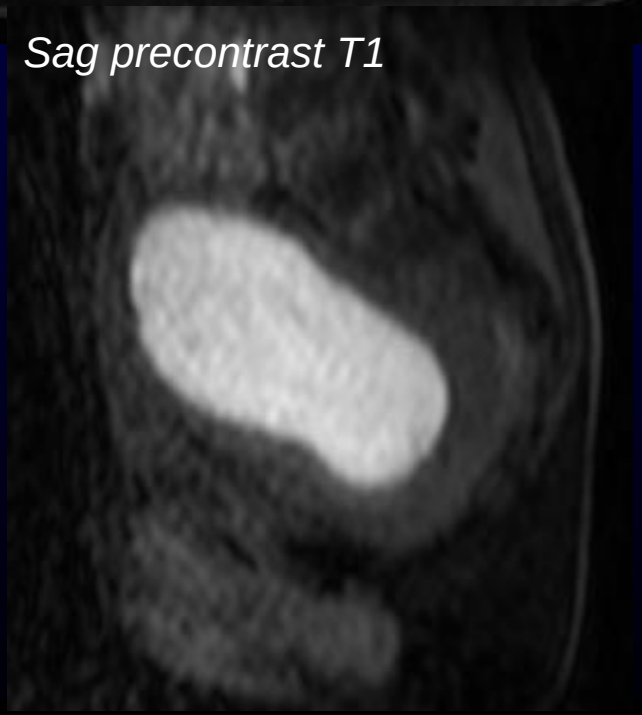


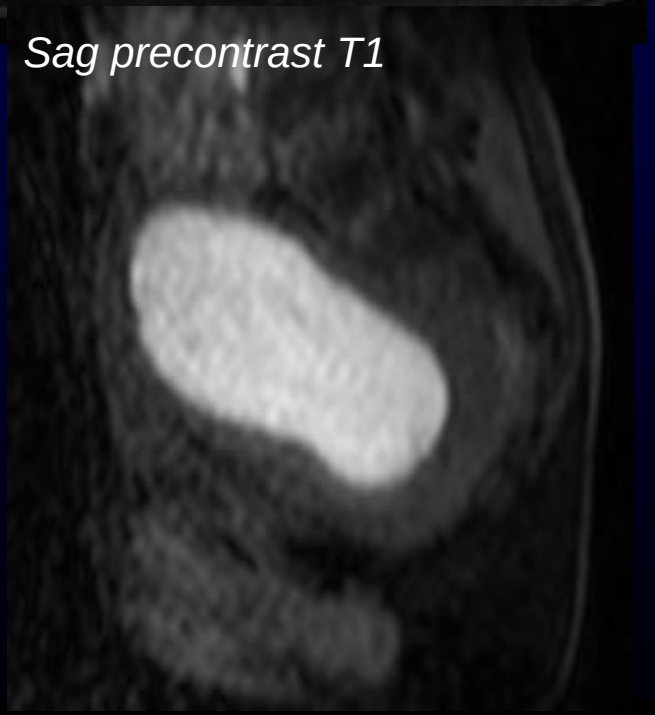
Figure 2. Classification system of müllerian duct anomalies developed by the American Fertility Society (43).

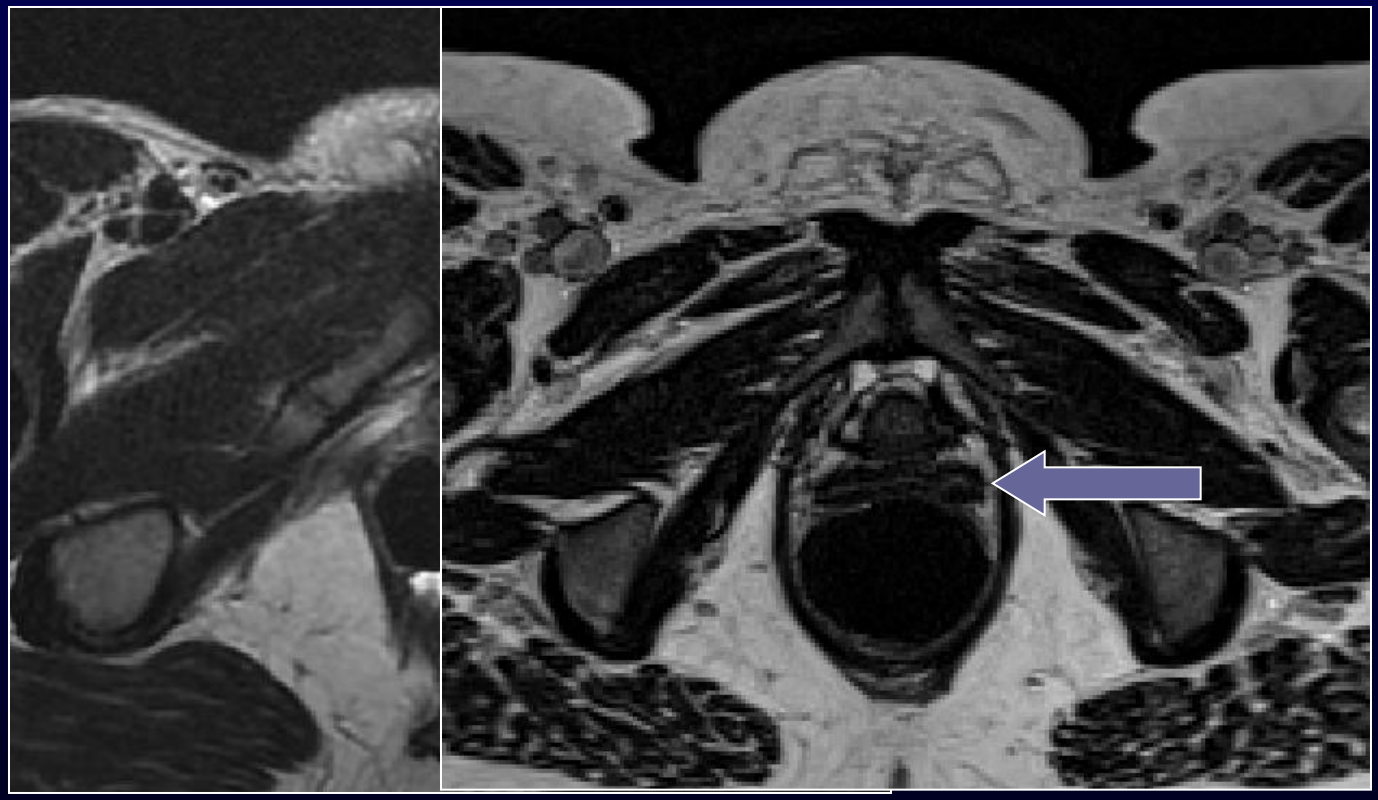
Troiano RN, McCarthy SM. *Mullerian Duct Anomalies: Imaging and Clinical Issues*. Radiology, October 2004

13 yo F, primary amenorrhea



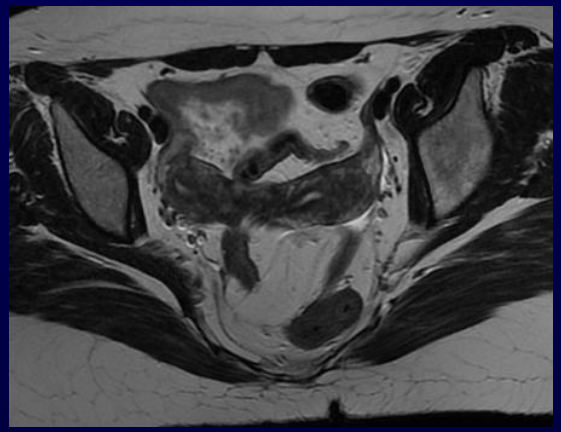
Cervical agenesis; uterus torsed

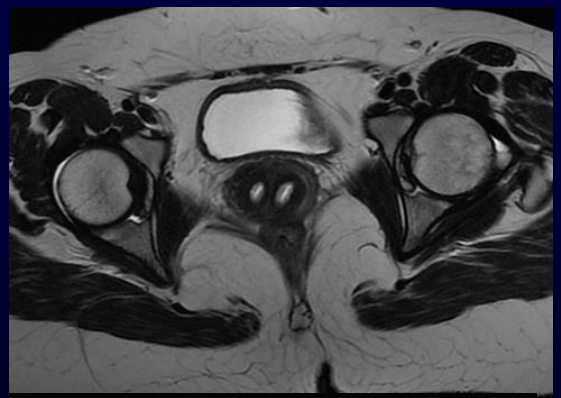


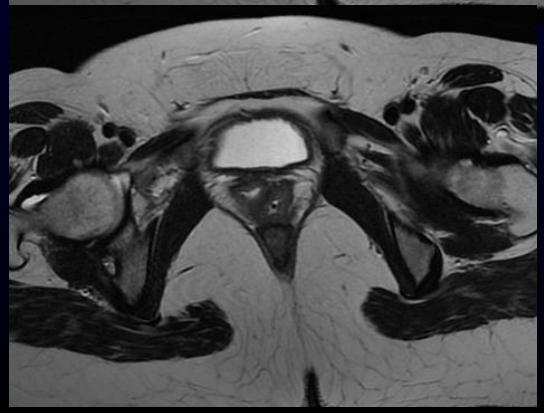


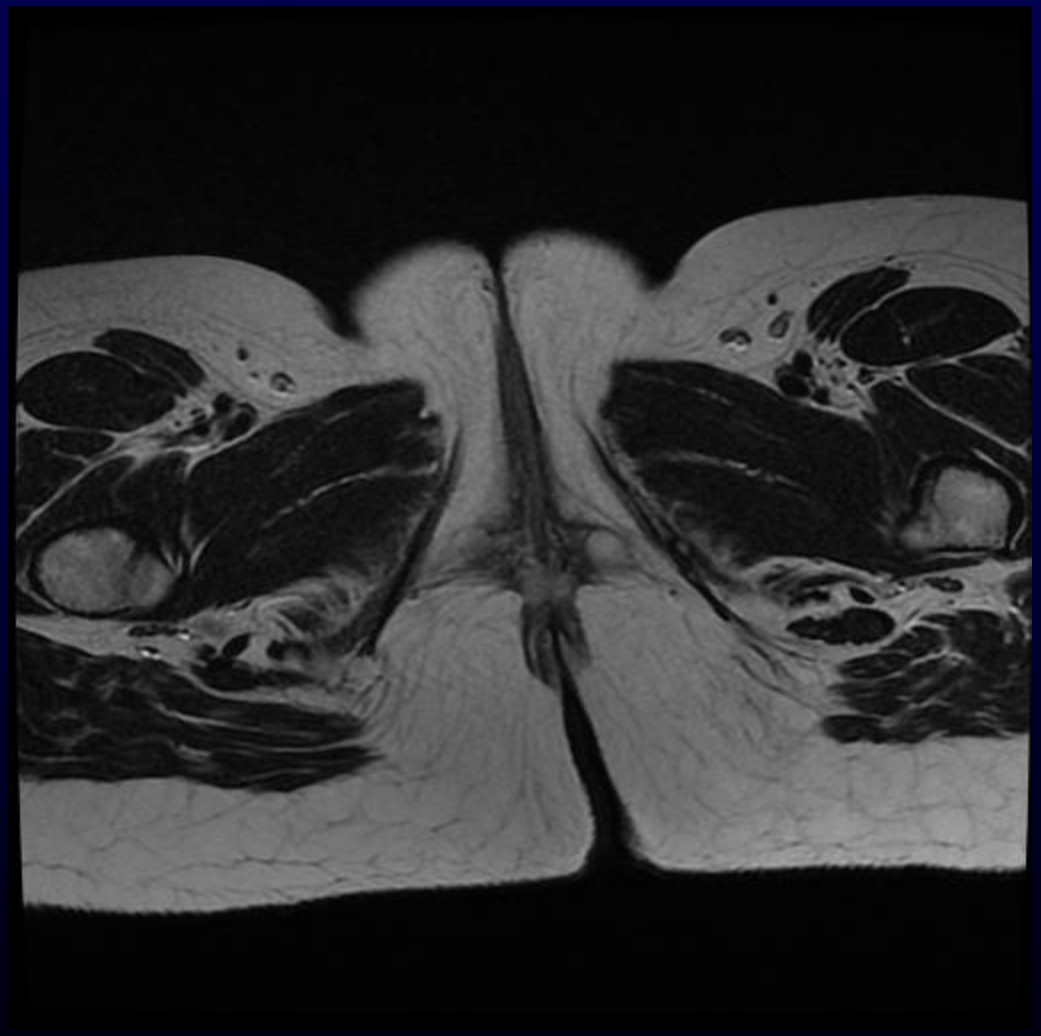
22 yo F, uterus and vaginal agenesis

25 yo F, uterine didelphyis

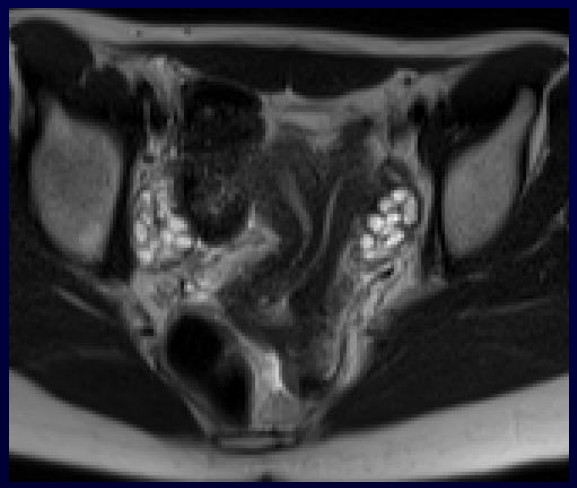


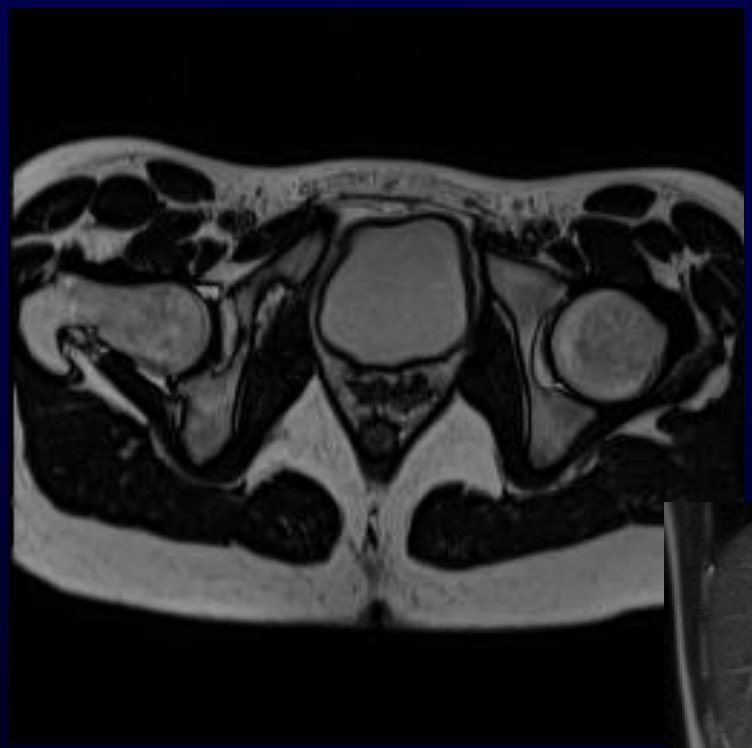


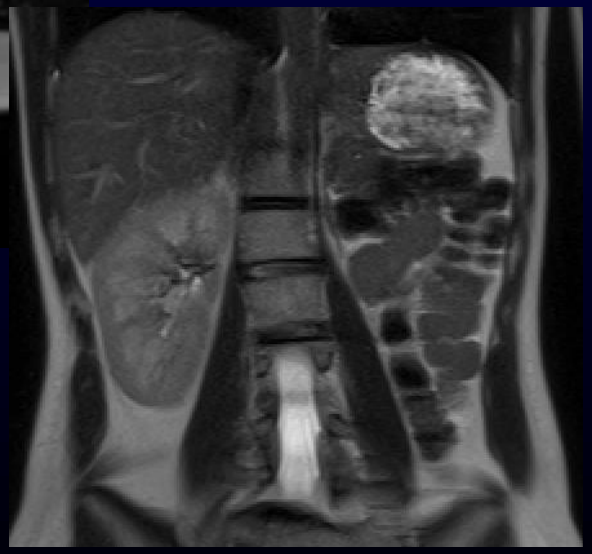


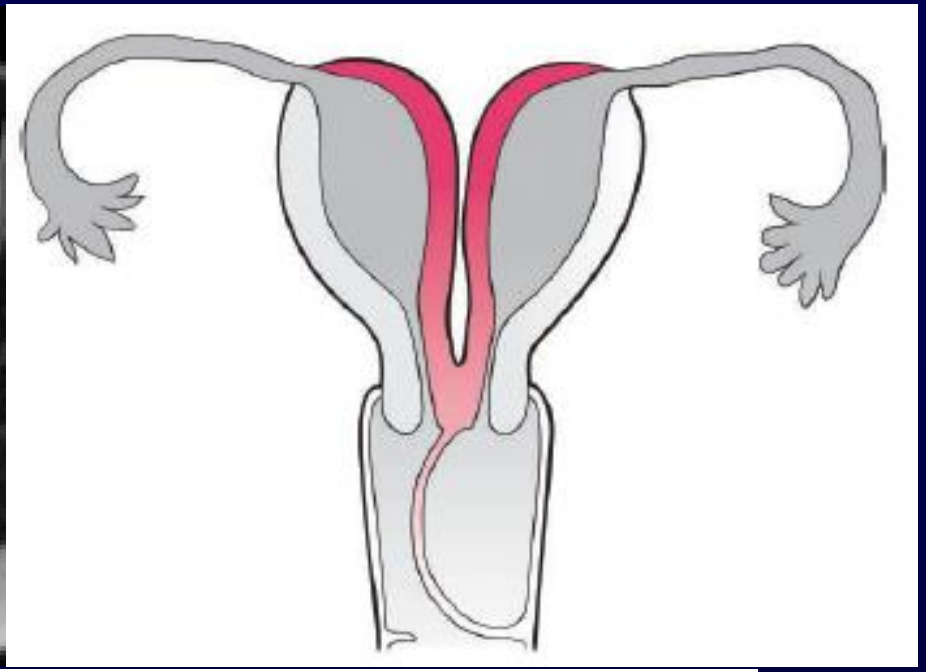


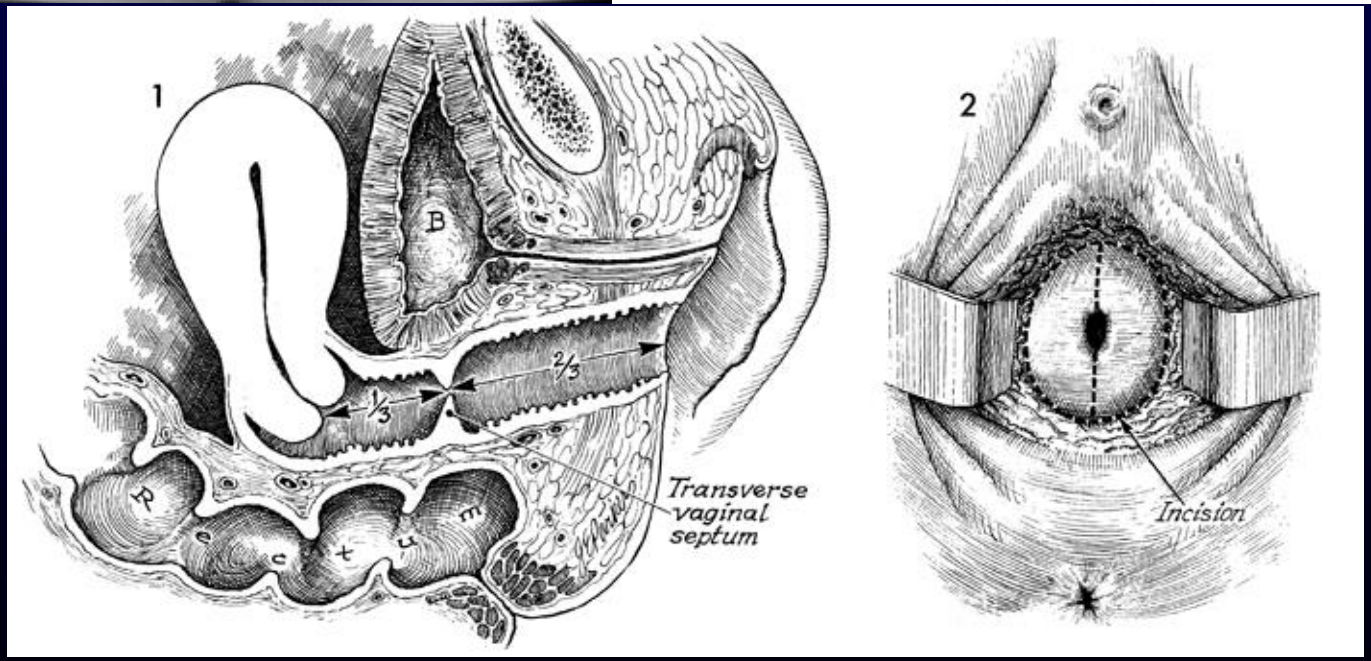
17 yo F, didelphyis- obstructed horn











Junqueira BL, Allen LM, Spitzer RF, Lucco KL, Babyn PS, Doria AS. Mullerian duct anomalies and mimics in children and adolescents: correlative intraoperative assessment with clinical imaging. Radiographics 2009 Jul-Aug;29(4):1085-103.

http://www.atlasofpelvicsurgery.com/

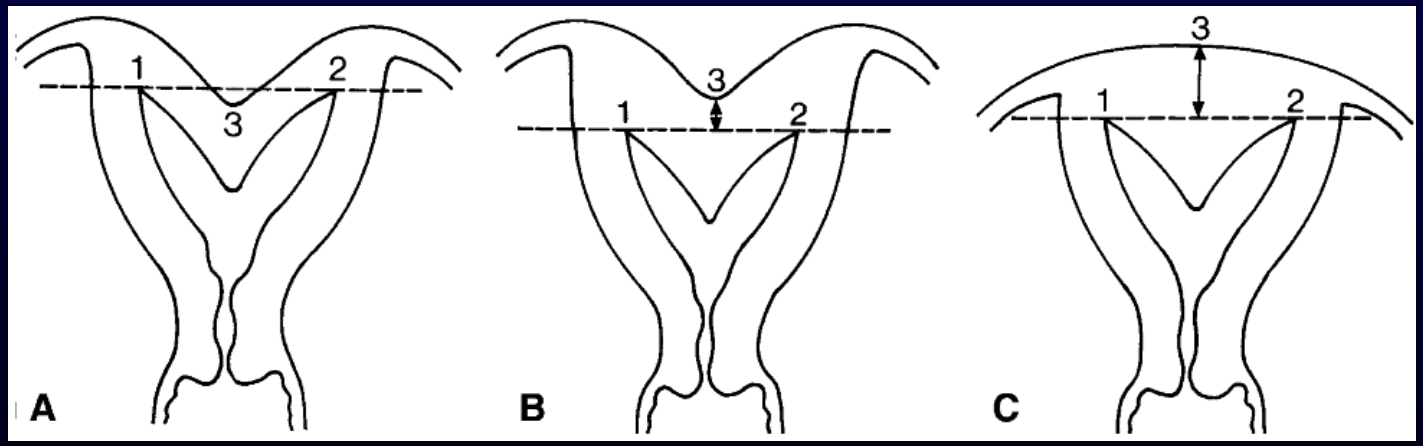
Septate vs bicornuate

- Typically defined by depth of indentation of the fundal contour
  - Bicornuate: > 1.0 cm indentation
  - Septate: < 1.0 cm indentation

- Arbitrary designation based on subjective assessment by gynecologists at laparoscopy

Septate vs bicornuate

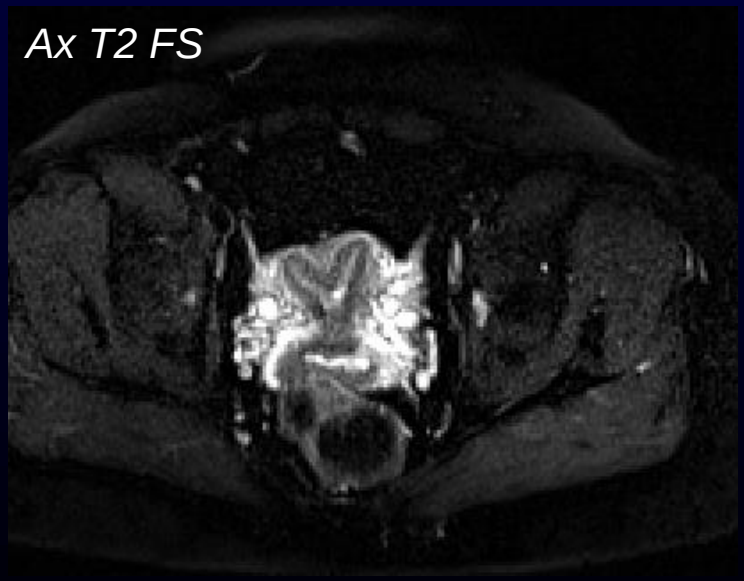
- *US literature*: measurement of fundal indentation relative to straight line between tubal ostia



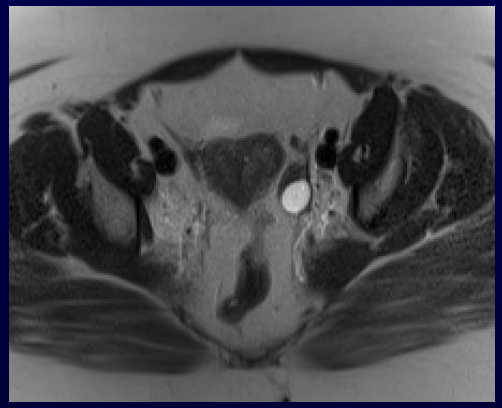
Troiano RN, McCarthy SM. *Mullerian Duct Anomalies: Imaging and Clinical Issues*. Radiology, October 2004

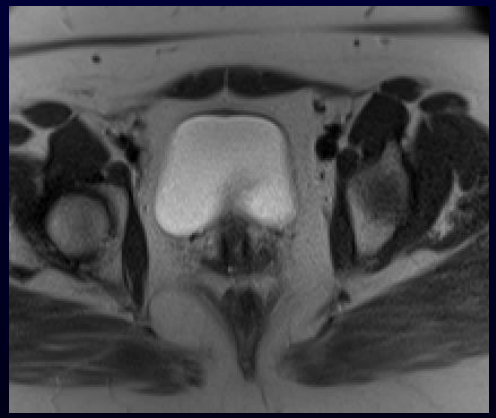
Fedele L, Ferrazzi E, Dorta M, Vercellini P, Candiani GB. Ultrasonography in the differential diagnosis of "double" uteri. Fertil Steril 1988 Aug;50(2):361-4.

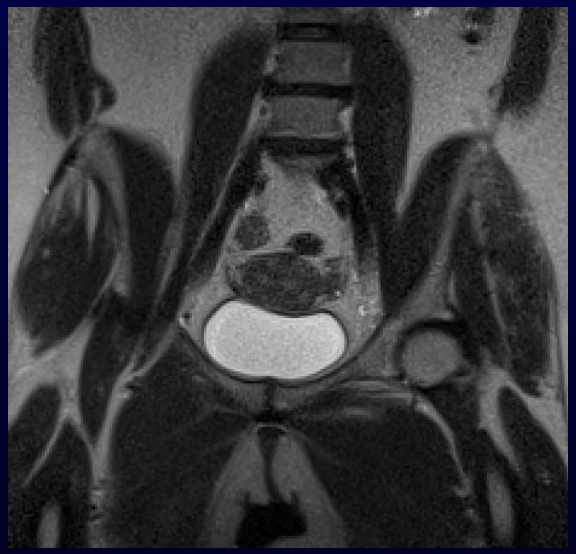
33 yo F, septate uterus

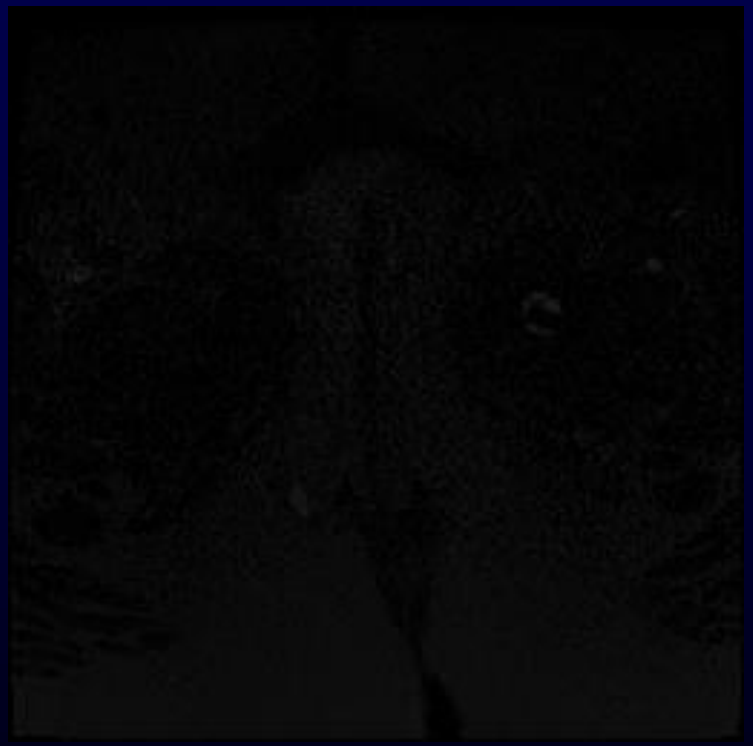


Septate uterus

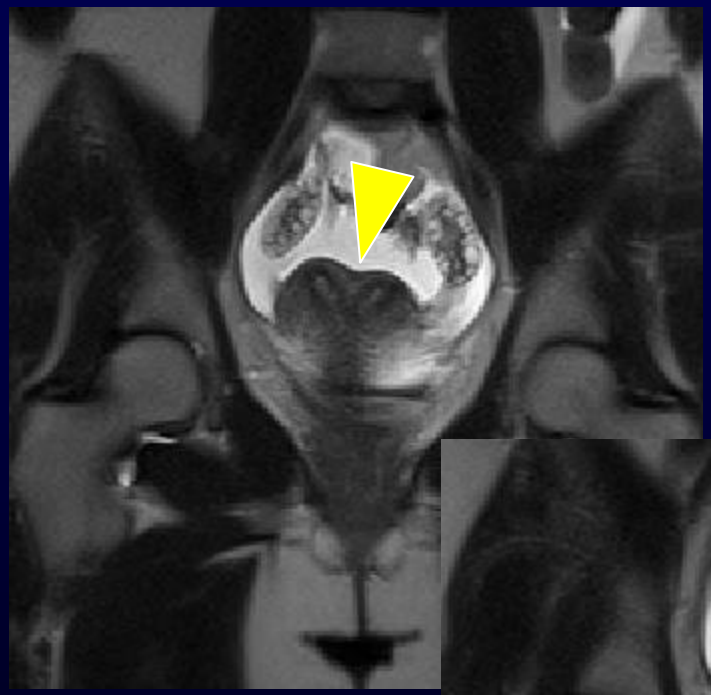


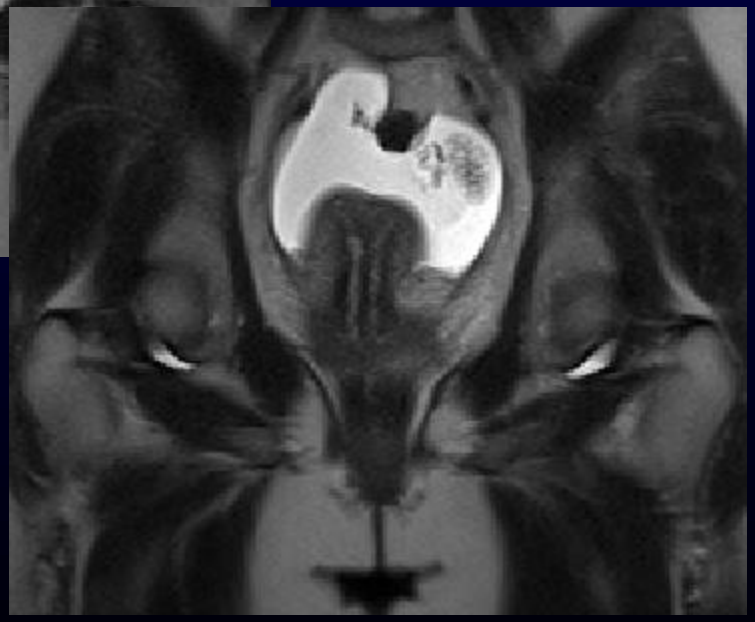


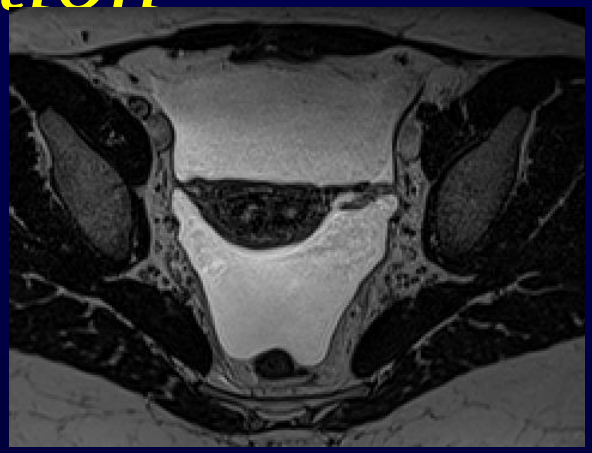


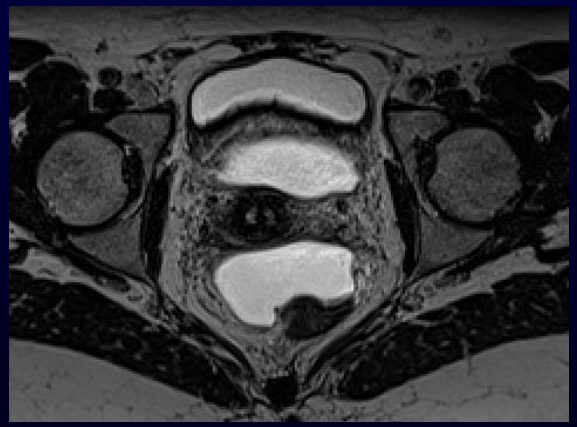


23 yo F, uterine septum (complete) with bicornuate configuration

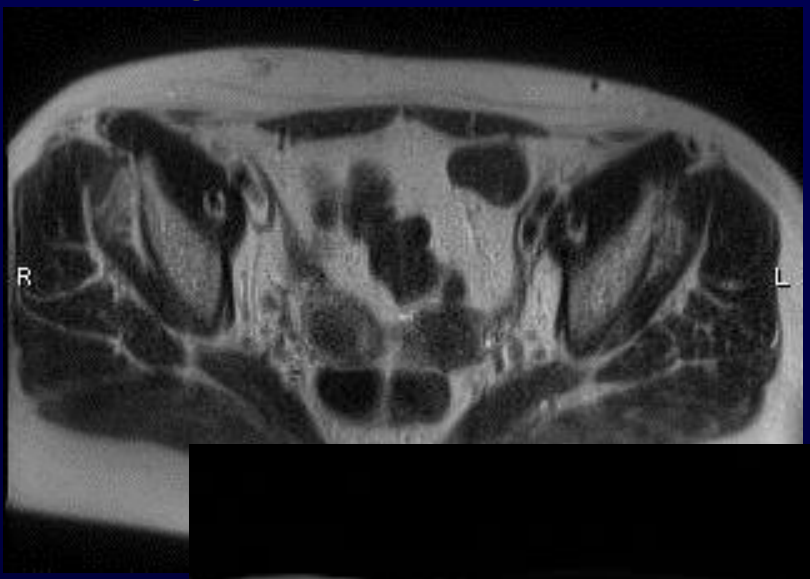


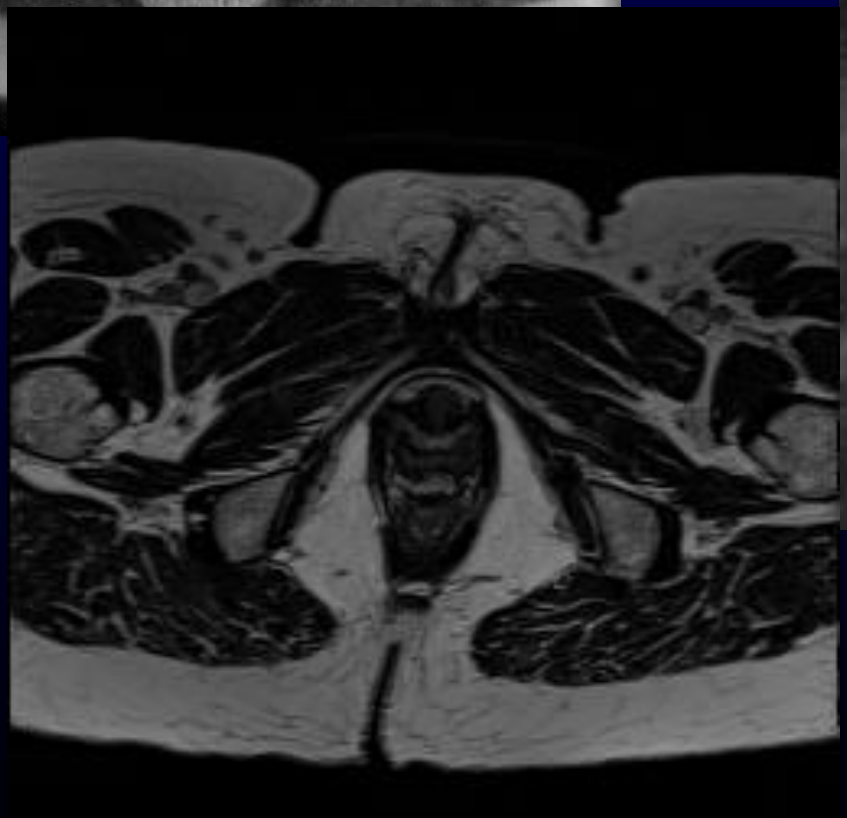


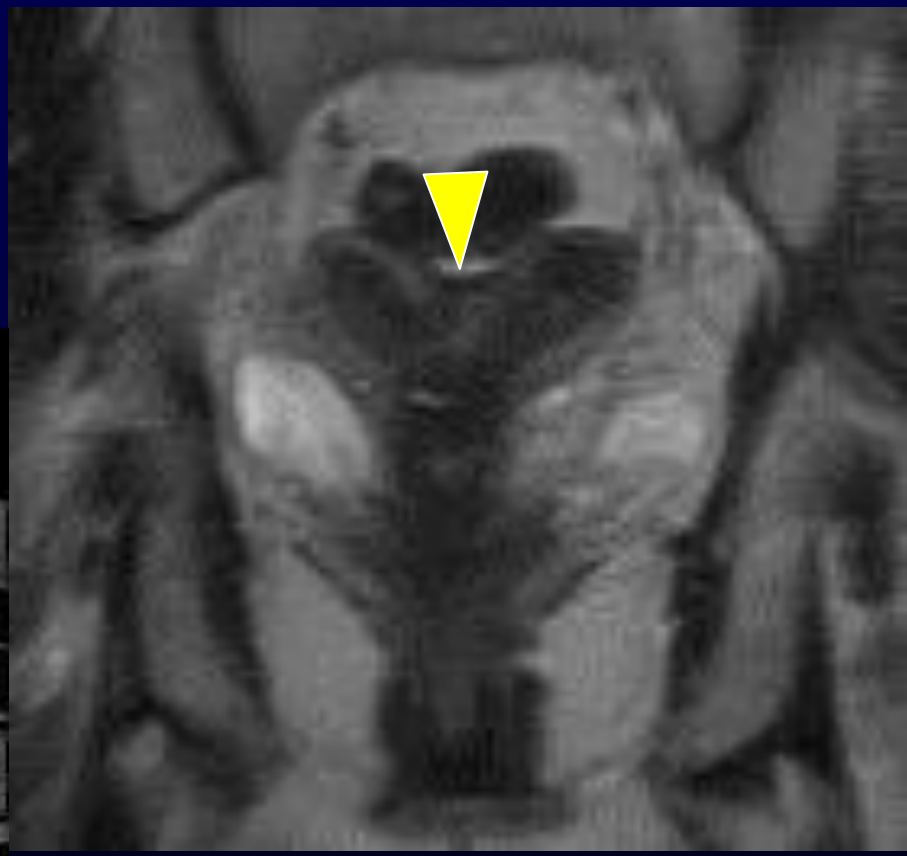




52 yo F, bicornuate uterus





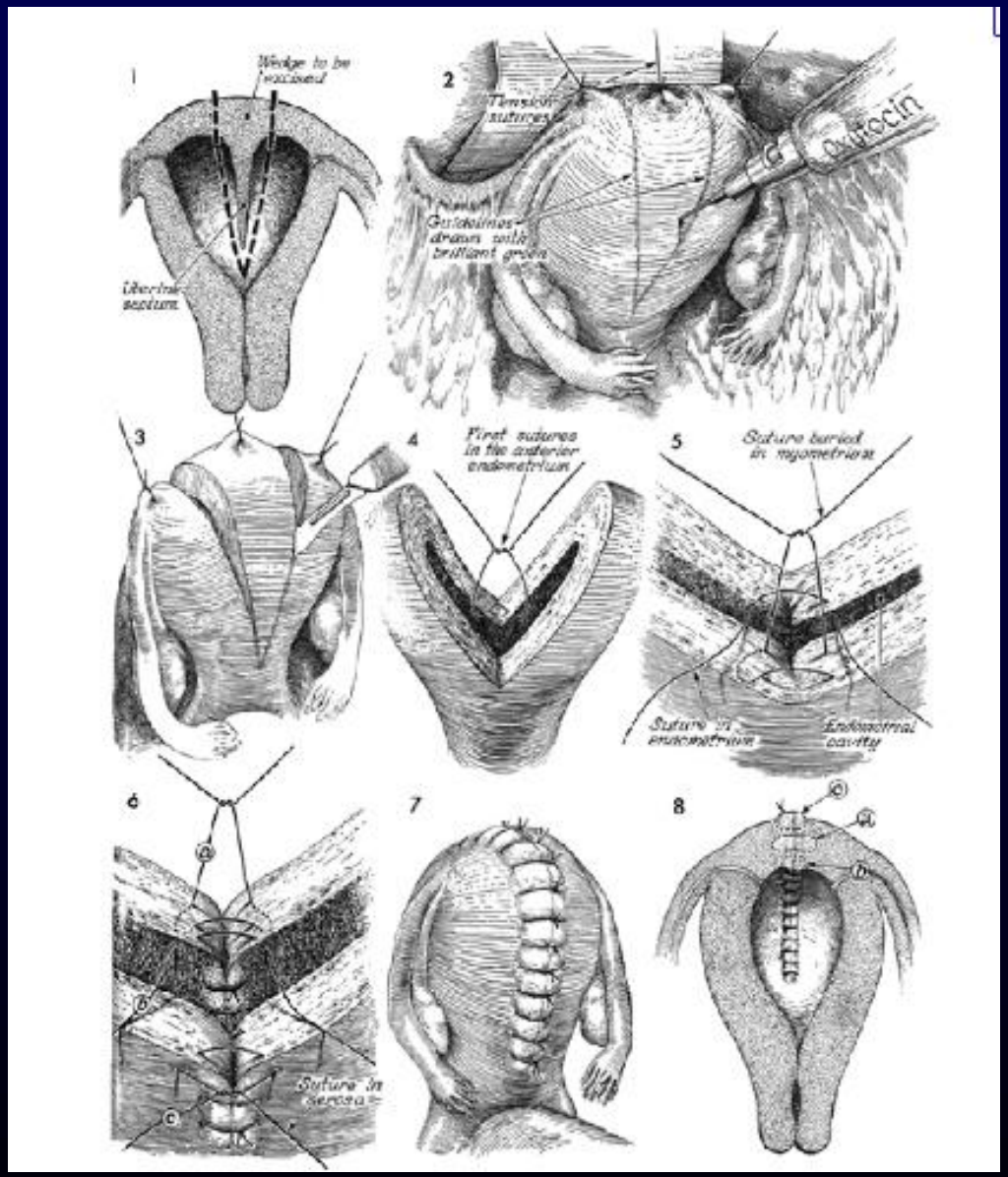


Surgical therapies

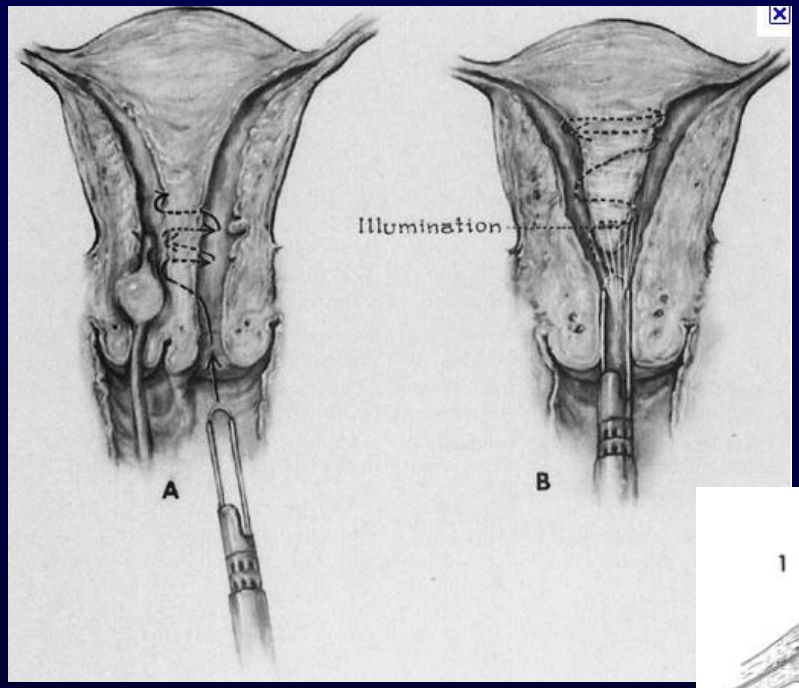
- Metroplasty

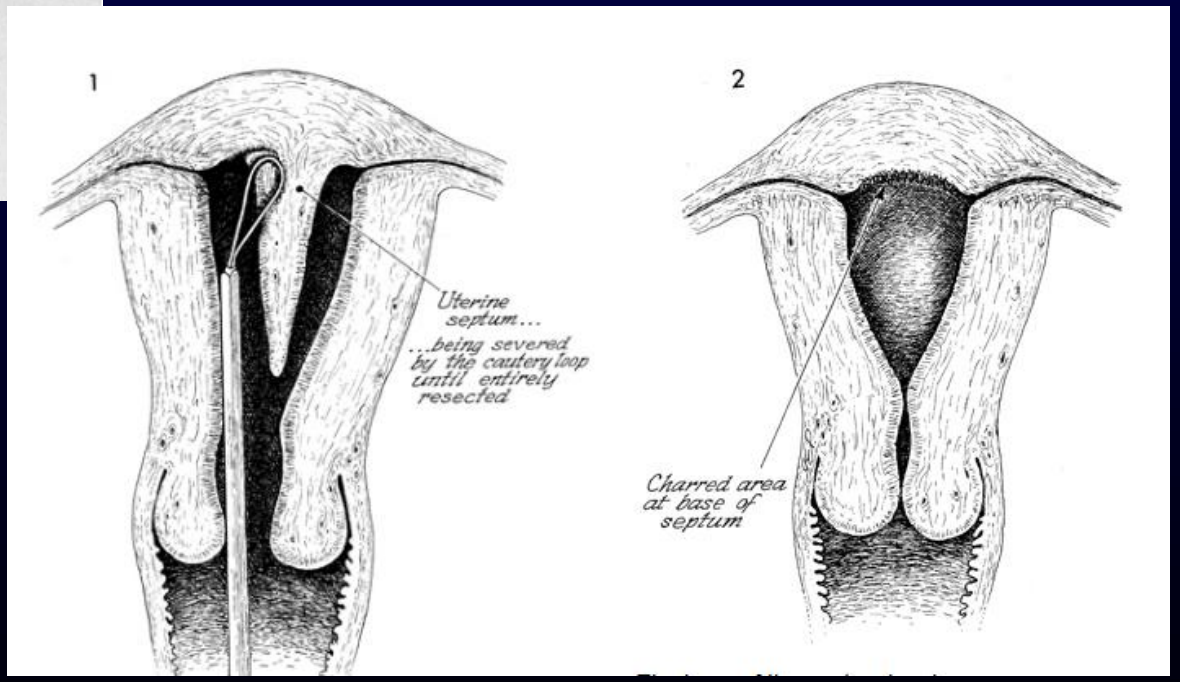
- Hysteroscopic resection of septum

Metroplasty

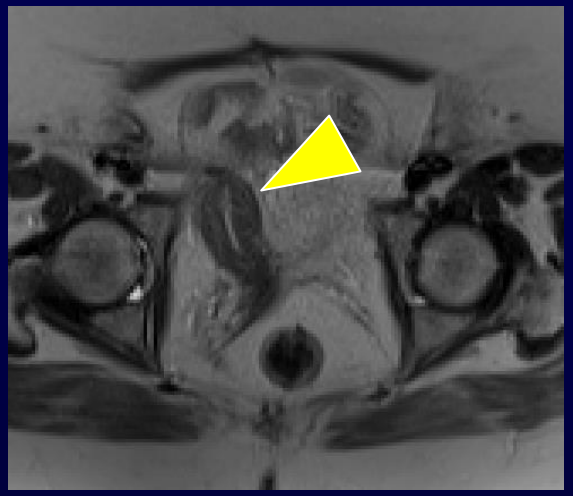


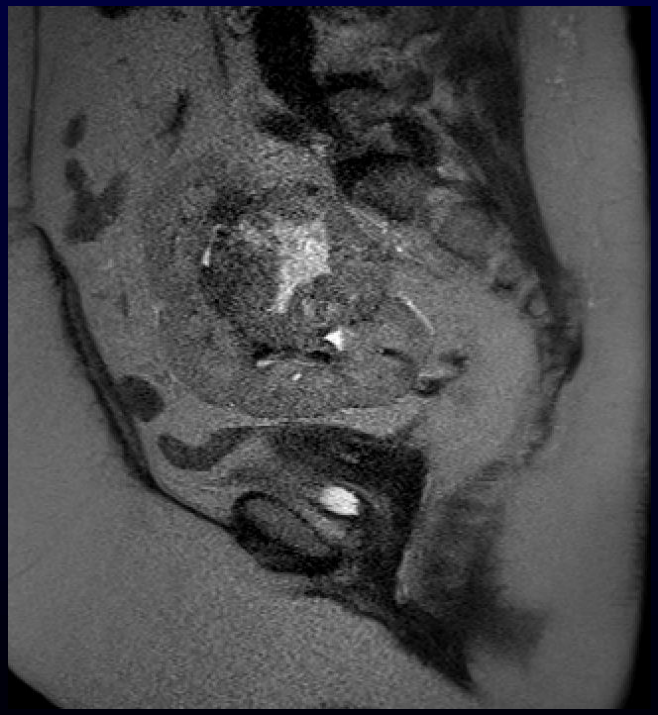
Septoplasty

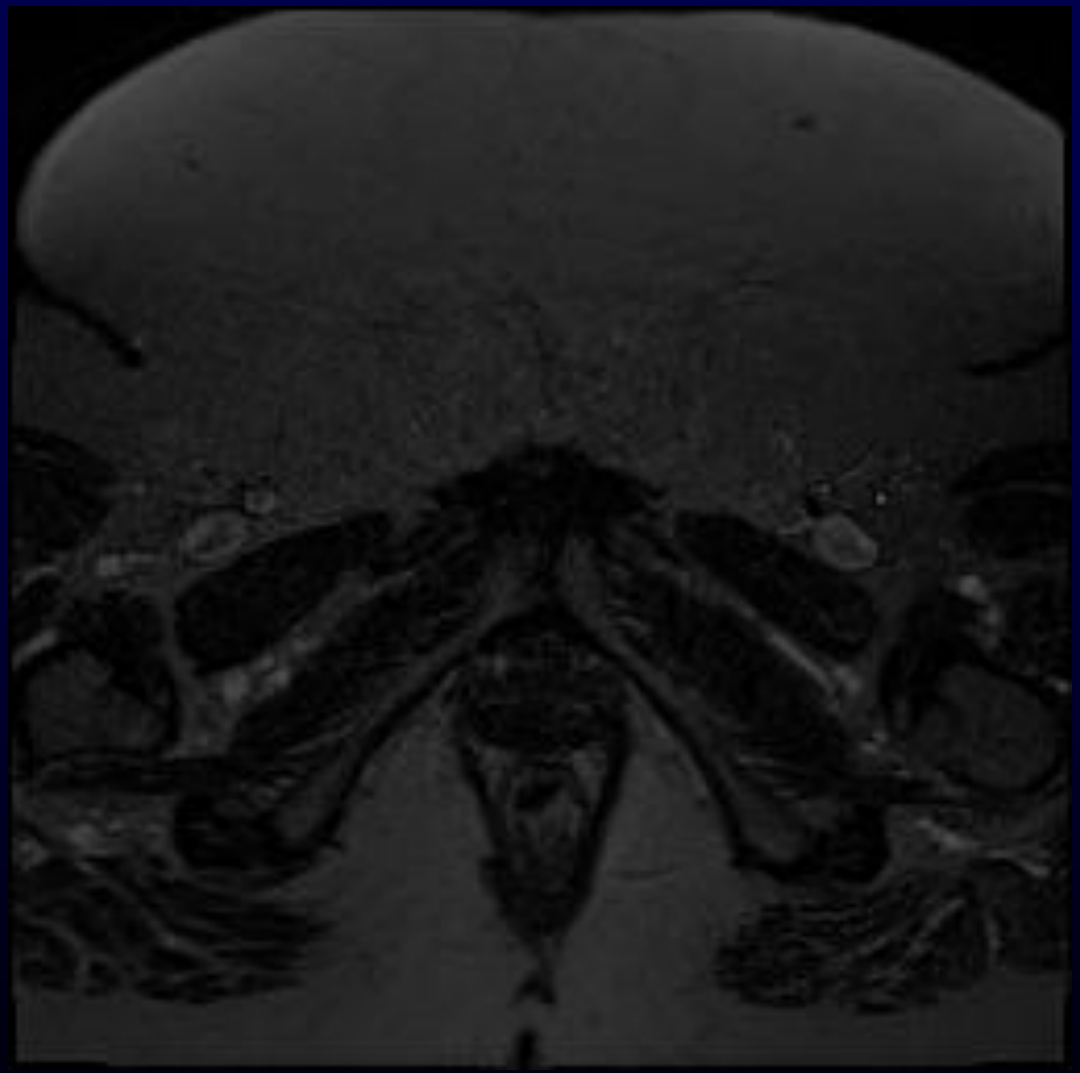




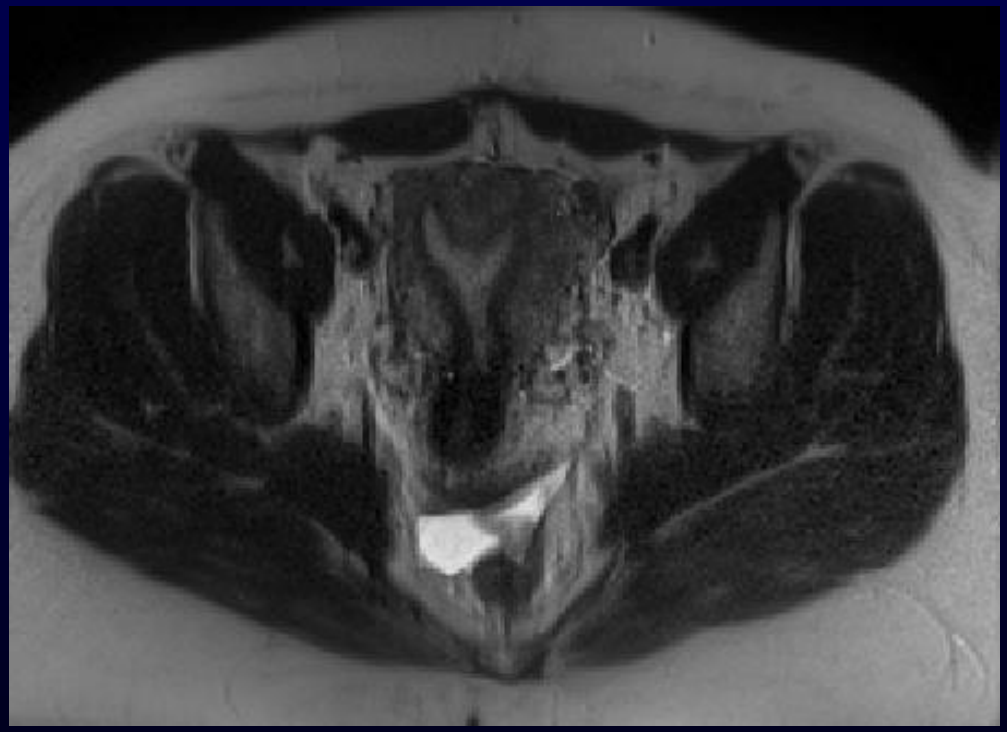
62 yo F, unicornuate uterus

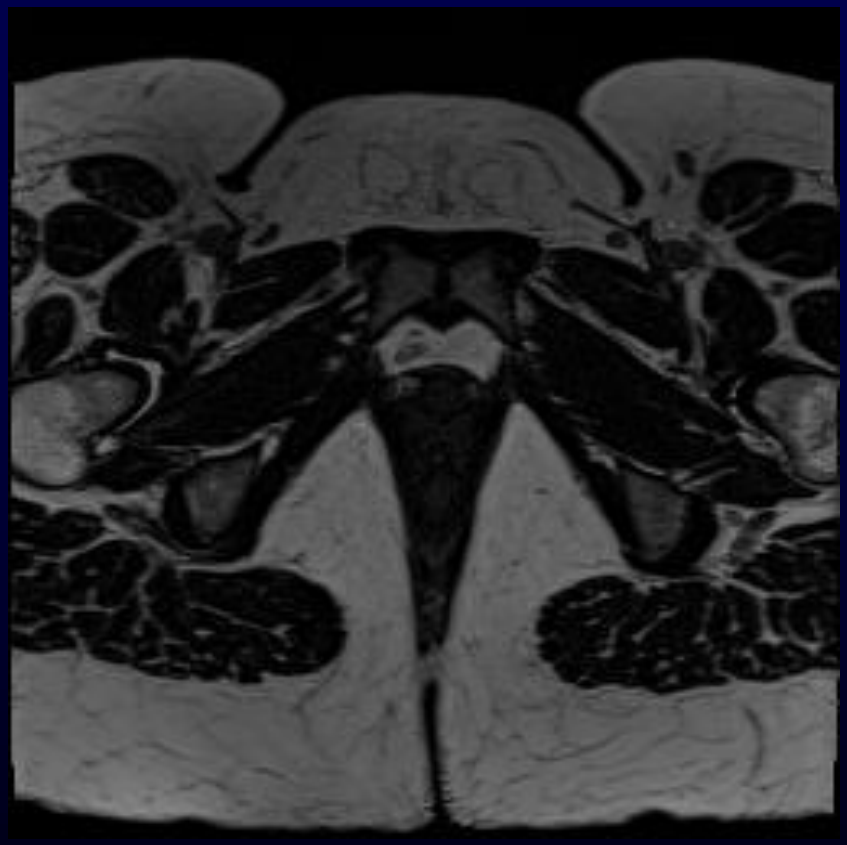






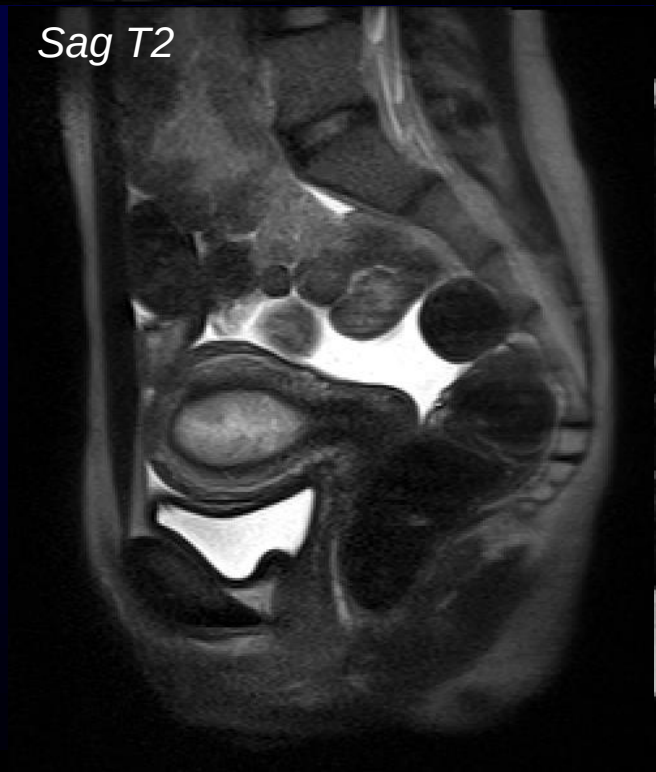
41 yo F, arcuate uterus





Endometrium- normal

Endometrium- menstrual changes

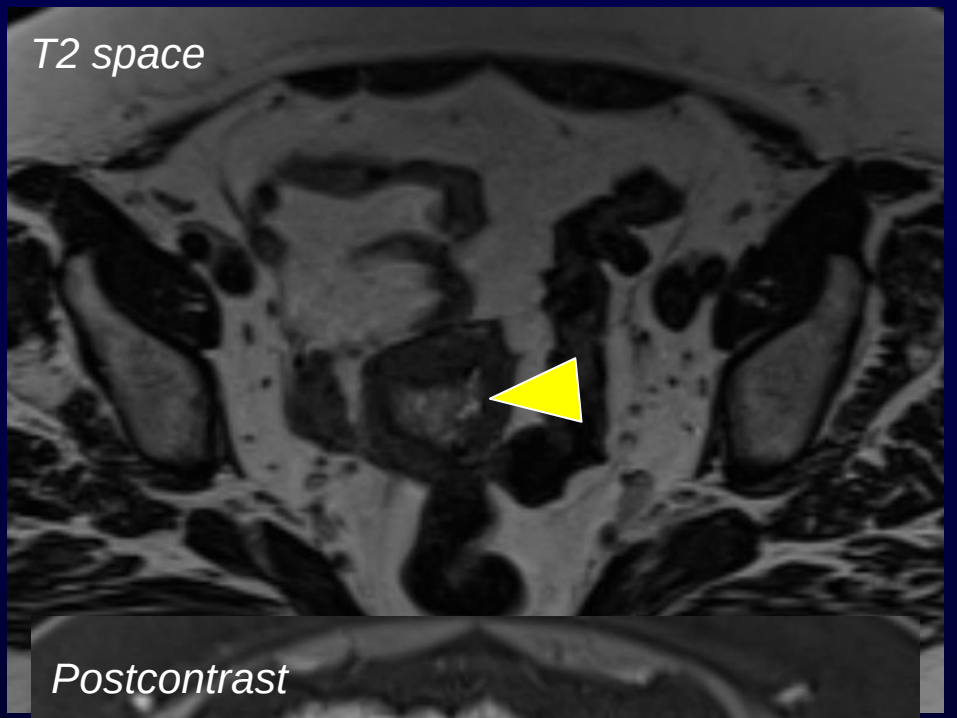


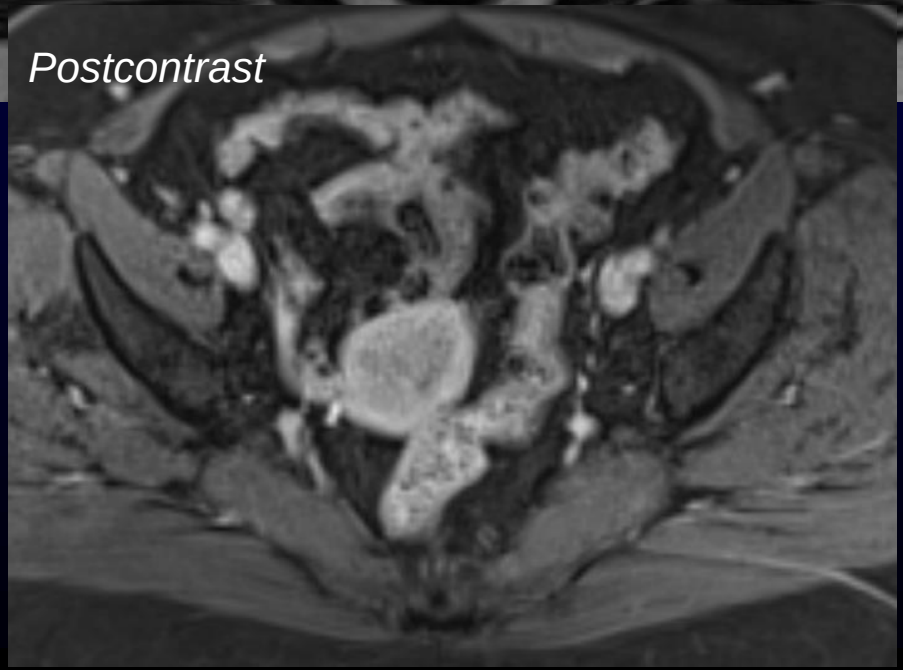
Endometrial polyps

- Focal protrusion of the endometrium
  - Composed of benign endometrial glands and stroma
    - Unresponsive to progesterone stimulation
  - Frequent cystic change of endometrial glands in polyp
- **MRI**
  - Cystic change within the polyp
  - Central fibrous core (low signal T2W images)
  - +/- stalk of connection with endometrium

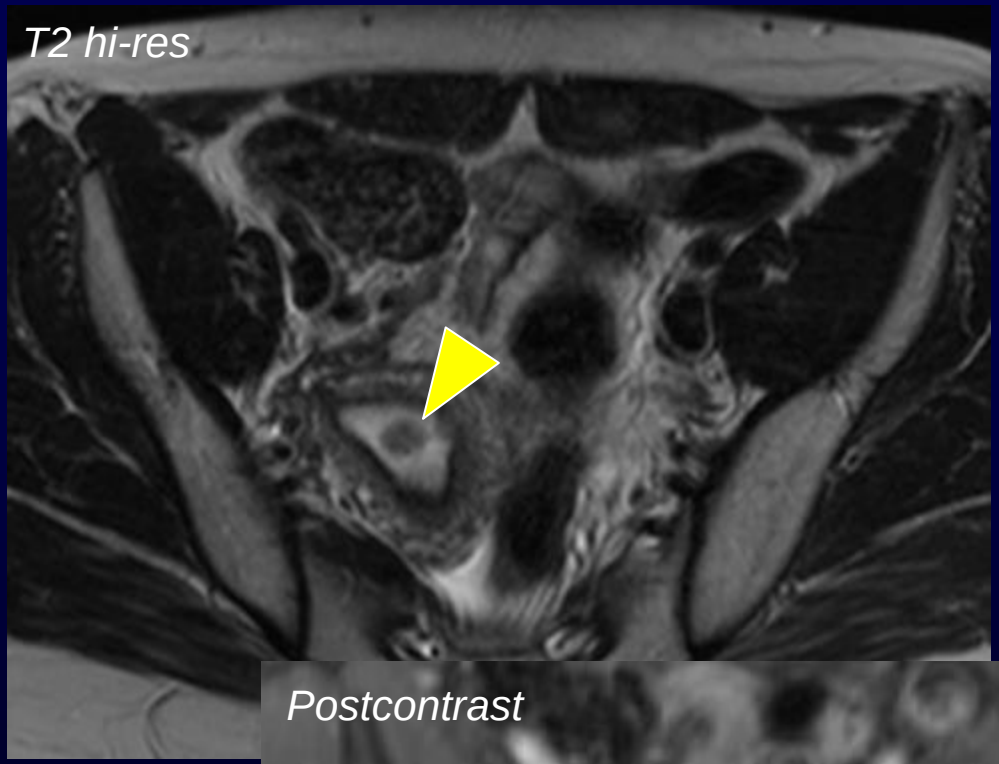
Grasel RP, Outwater EK, Siegelman ES, Capuzzi D, Parker L, Hussain SM. Endometrial polyps: MR imaging features and distinction from endometrial carcinoma. Radiology 2000 Jan;214(1):47-52.

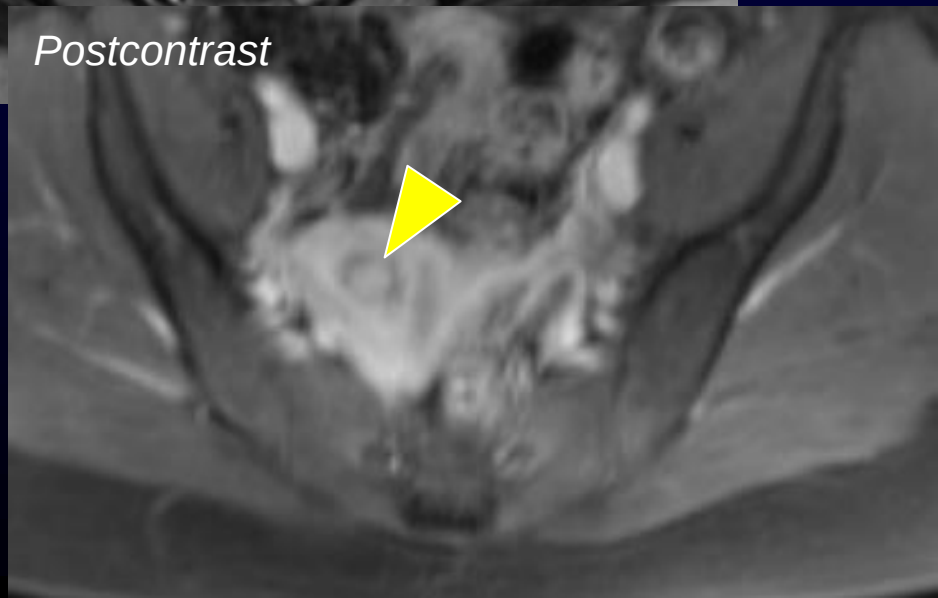
61 yo F, endometrial polyp





30 yo F, endometrial polyp





Endometrial cancer

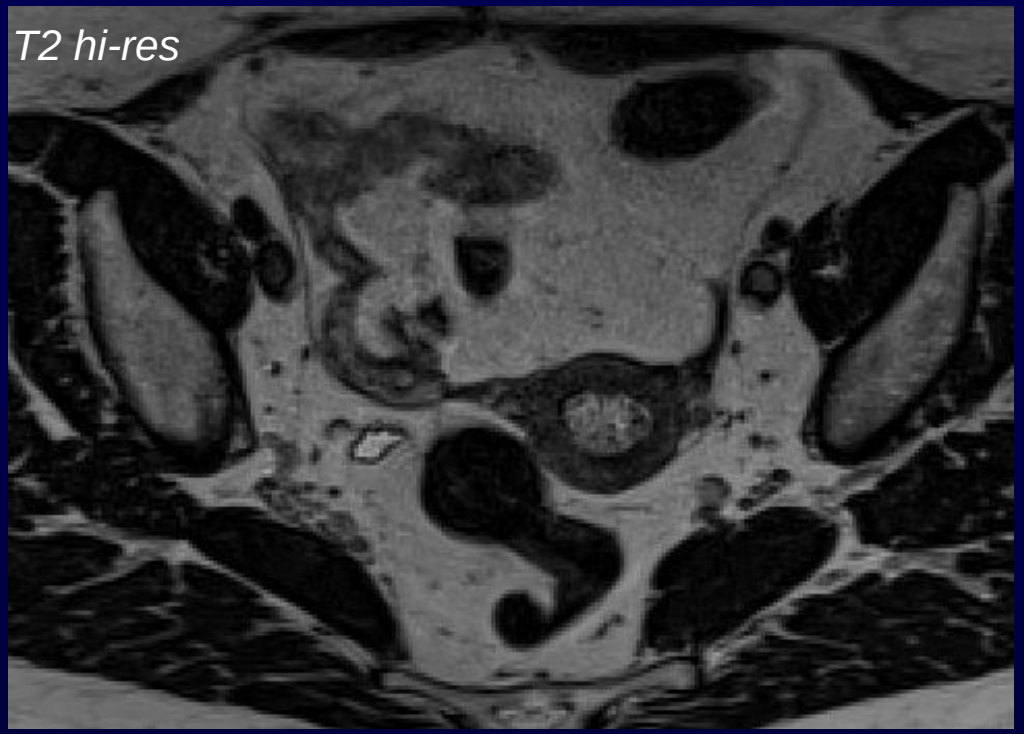
- Most common malignancy of the female genital system
  - Risk factors: estrogen stimulation
- **Pathology:** tumor composed of malignant glandular cells
  - Multiple subtypes: endometroid (most common), clear cell, adenosquamous, papillary serous

Staging

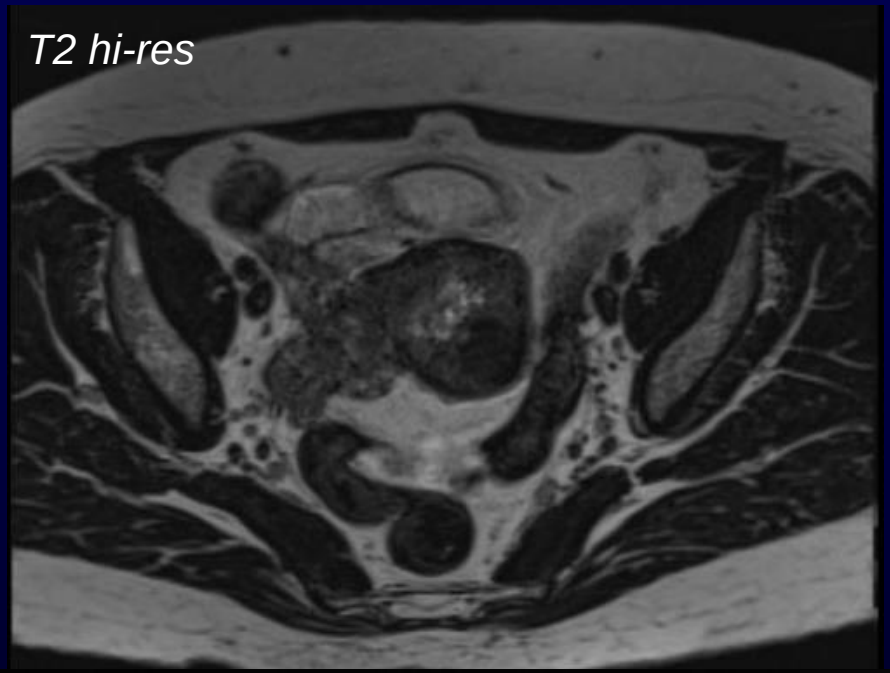
- FIGO staging system revised in 2010
  - IA: Tumor confined to uterus, ≤ 50% myometrial invasion
  - IB: Tumor confined to uterus, ≥ 50% myometrial invasion
  - II: Cervical stromal invasion, not beyond uterus
  - IIIA: Tumor invades serosa or adnexa
  - IIIB: Vaginal/parametrial involvement
  - IIIC1: Pelvic nodal involvement
  - IIIC2: Para-aortic nodal involvement
  - IVA: Tumor invasion into bladder/bowel mucosa
  - IVB: Distant metastases (including abdominal/inguinal lymph nodes)

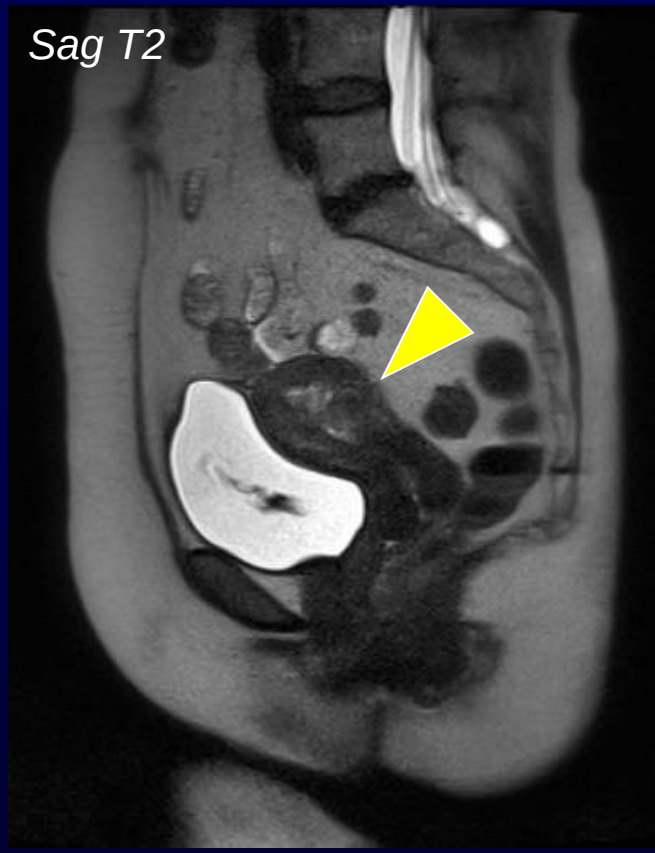
http://info.cancerresearchuk.org/cancerstats/types/uterus/symptomsandtreatment/

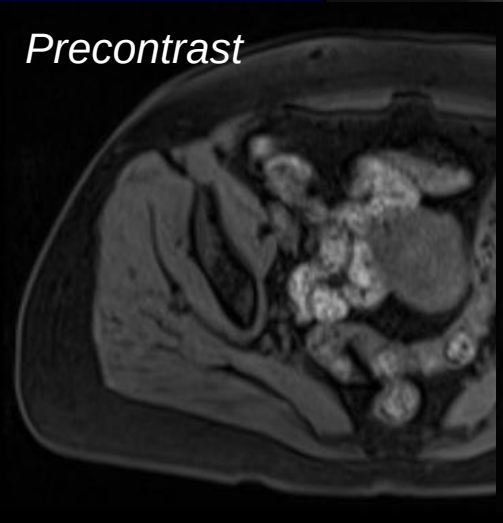
FIGO 1A

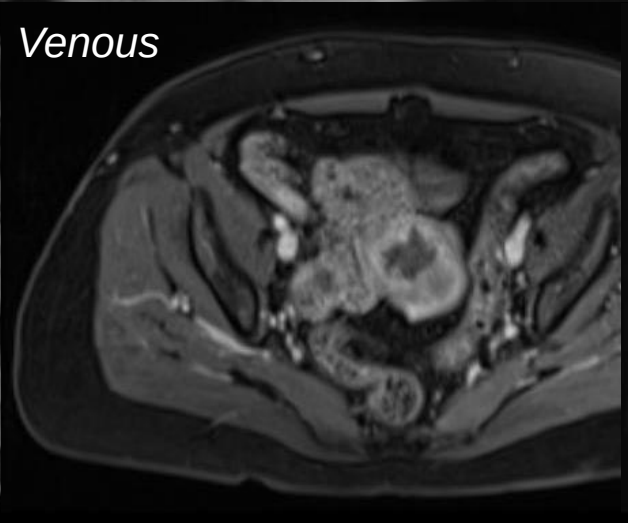


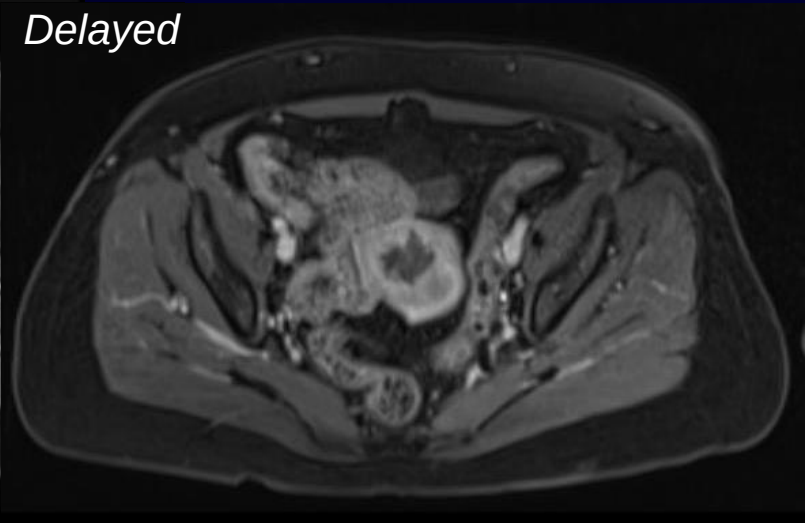
FIGO 1B











FIGO 2


Sag T2

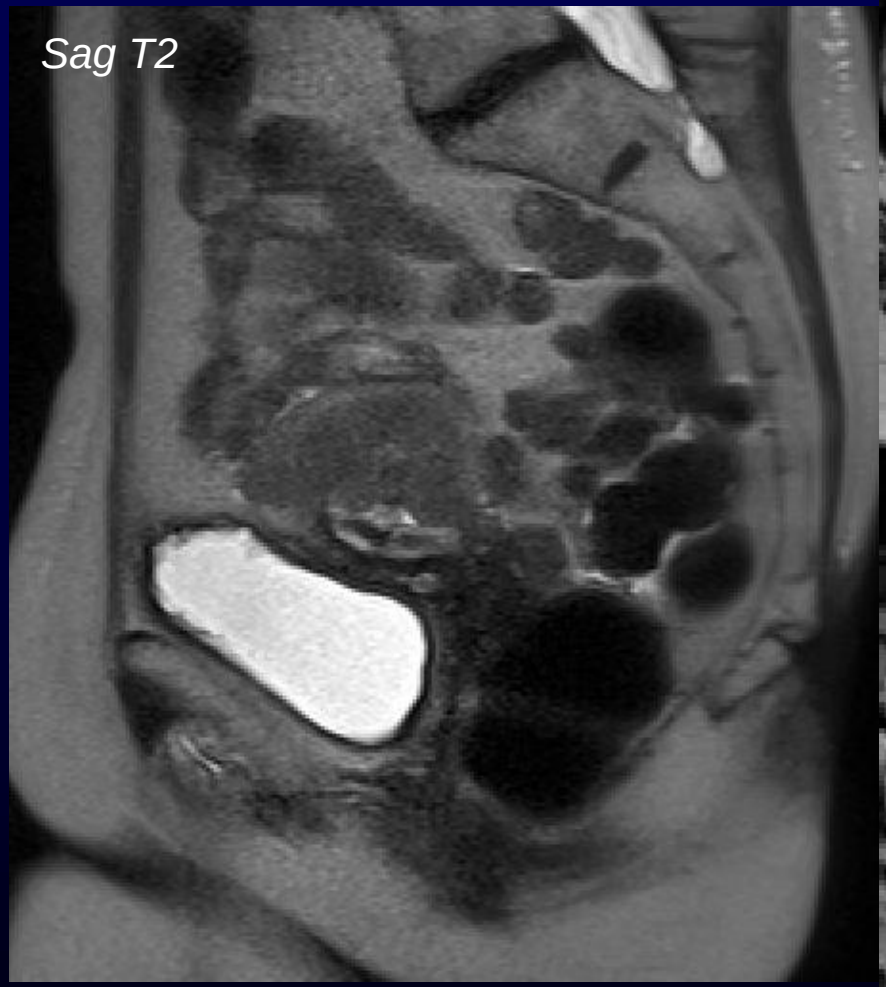

Sag T2


T2 hi-res
A
R
L
P

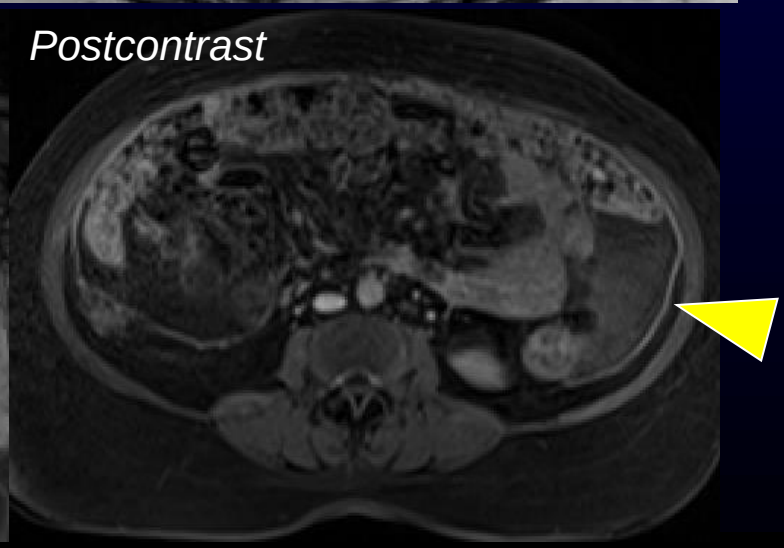

Postcontrast
A
R
P


Postcontrast
A
R
L
P

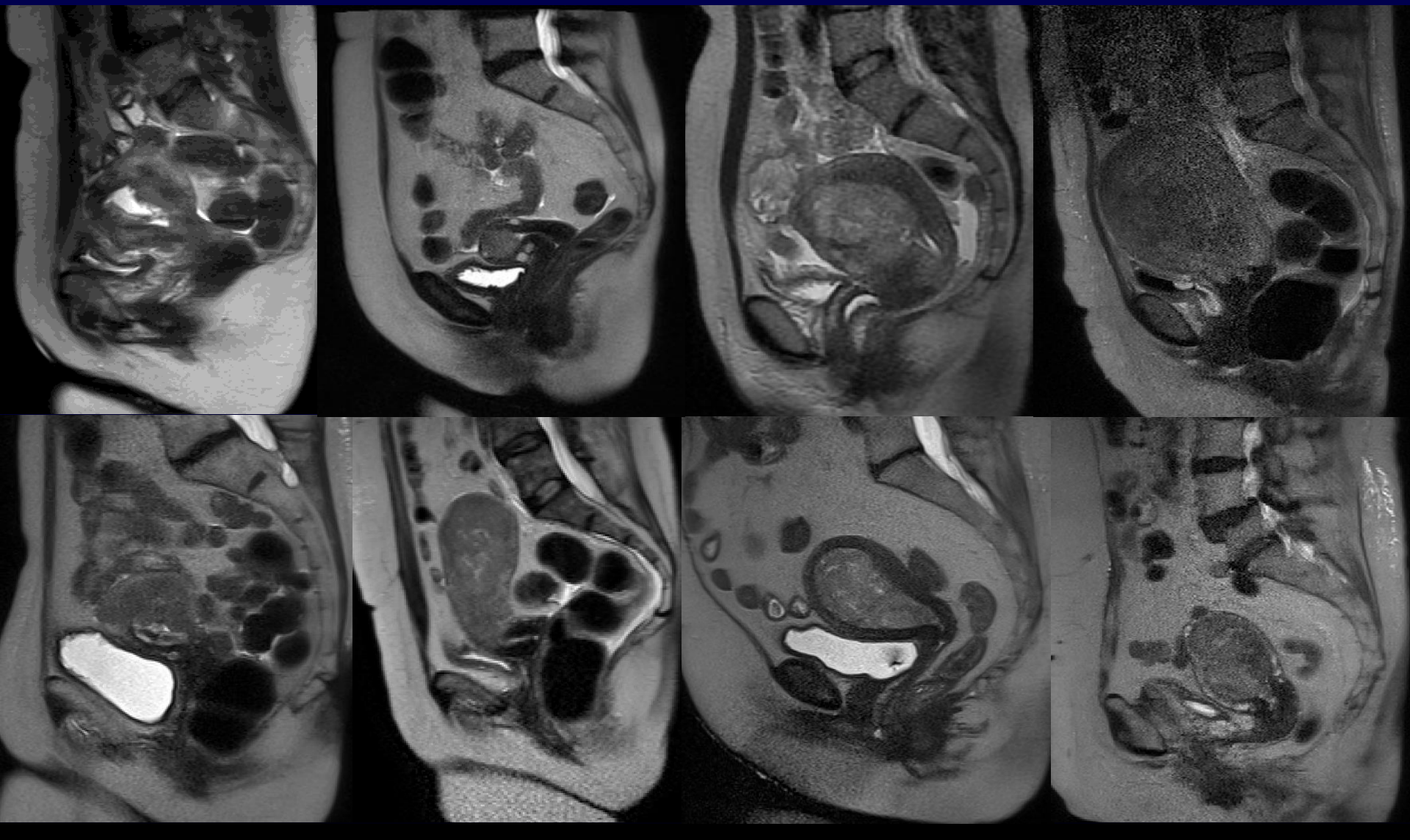
FIGO 3



Endometrial carcinoma (serous papillary)- metastatic

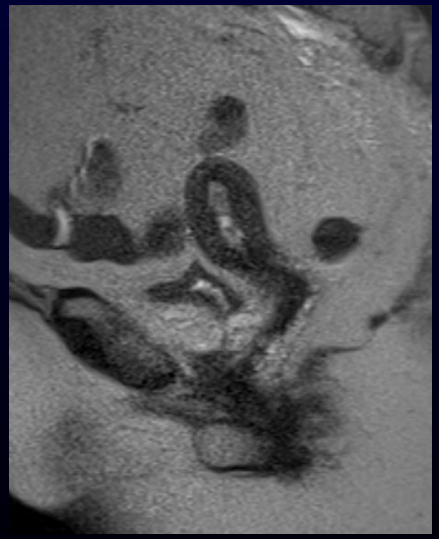


Endometrial carcinoma



Endometrial polyps versus cancer

Endometrial carcinoma



Endometrial polyp

Endometrial polyps versus cancer

- Controversies in potential for malignant change
  - 8.5% polyps associated with endometrial carcinoma
  - Factors associated with coexistent carcinoma:
    - Symptomology (uterine bleeding)
    - Age (postmenopausal)

Ben-Arie A, Goldchmit C, Laviv Y, et al. The malignant potential of endometrial polyps. Eur J Obstet Gynecol Reprod Biol 2004 Aug 10;115(2):206-10.

Perri T, Rahimi K, Ramanakumar AV, et al. Are endometrial polyps true cancer precursors? Am J Obstet Gynecol Sep;203(3):232 e1-6.

Ferrazzi E, Zupi E, Leone FP, et al. How often are endometrial polyps malignant in asymptomatic postmenopausal women? A multicenter study. Am J Obstet Gynecol 2009 Mar;200(3):235 e1-6.

Uterine leiomyoma

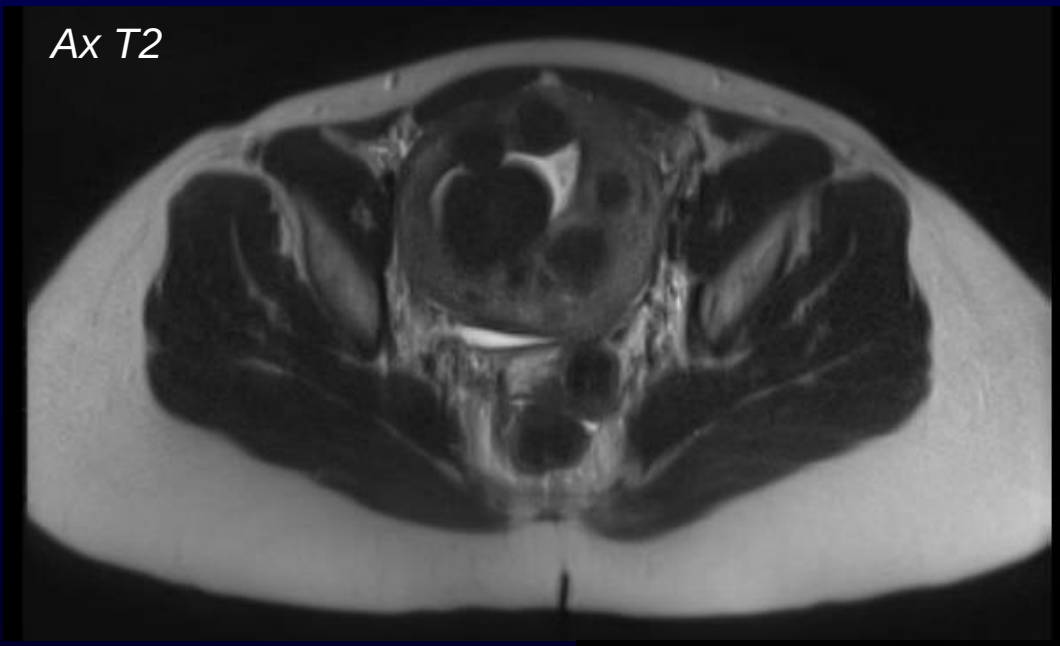
- Benign tumor of the uterus
  - Extremely common cause of pelvic symptoms
    - Pain, abnormal bleeding

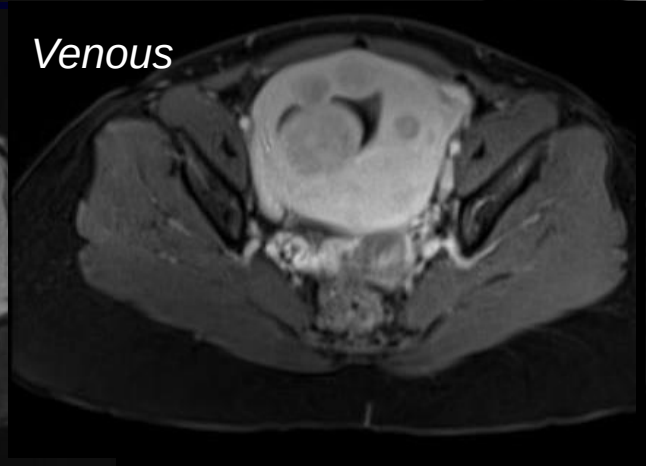
- **Pathology:**
  - Smooth muscle tumors interlaced with connective tissue

Uterine leiomyoma- Imaging

- Ultrasound frequently used
  - Poorly defined
  - Difficulty in distinguising fibroids from adenomyosis
- MRI provides optimal evaluation, especially for pre-procedure planning
  - Well-circumscribed uterine lesions
  - T2 hypointense
    - Reflective of muscular component
  - Variable vascularity

41 yo F, fibroids

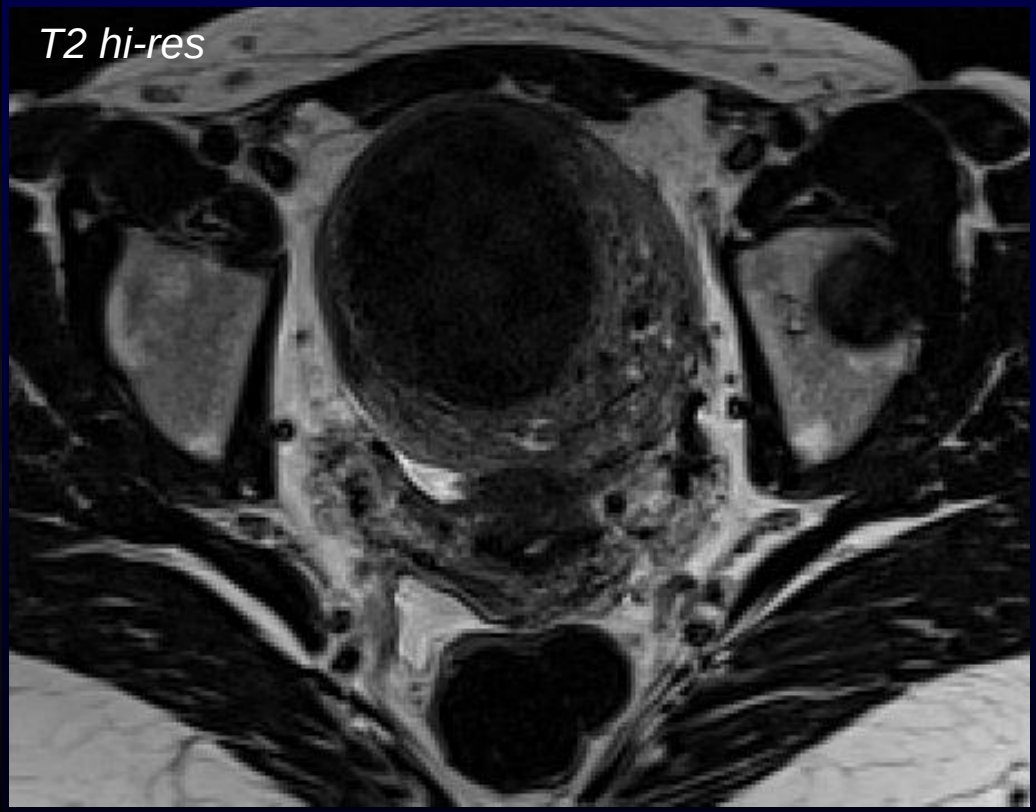




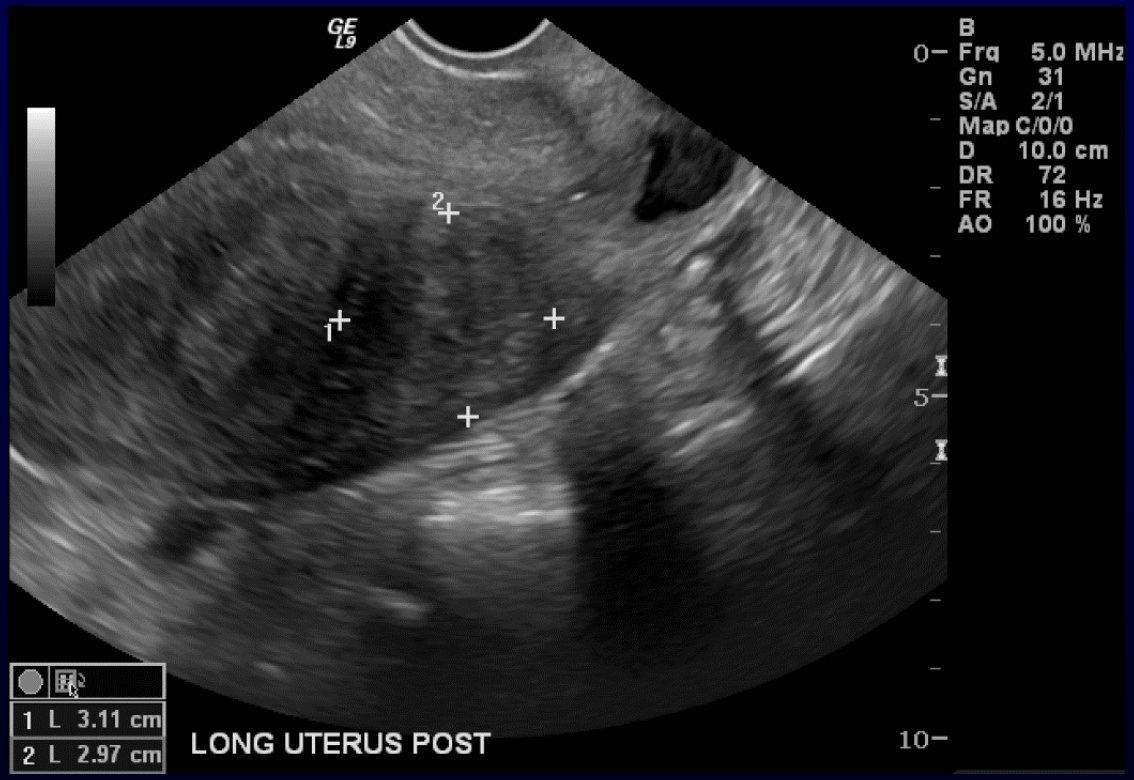
Fibroid embolization

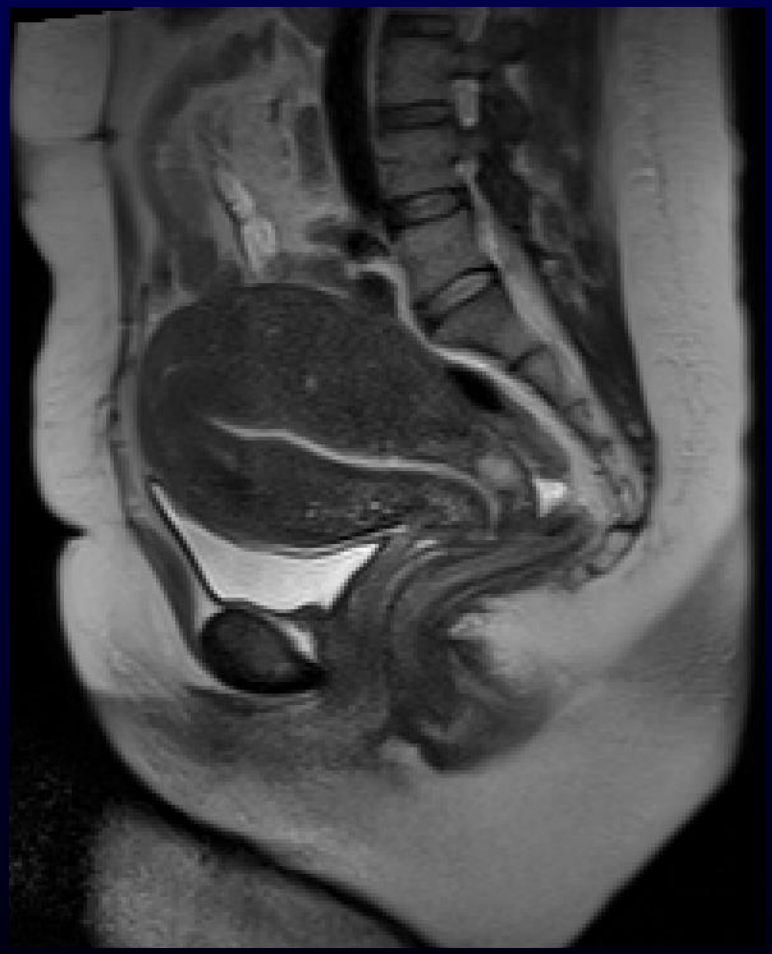
- Effective method of controlling symptoms of uterine fibroids
- **UAE vs myomectomy**
  - Razavi et al (*AJR 2003*) found UAE better at pain and bleeding control, while myomectomy perhaps better at relieving symptoms of mass effect
  - Mara et al (*Cardiovasc Interven Radiol 2008*)- randomized trial, found UAE to have shorter hospital stay and recovery, similar outcomes
- Long term fibroid symptom relief with UAE
  - 13-15% ultimately go to hysterectomy
    - Popovic M, Berzaczy D, Puchner S, Zadina A, Lammer J, Bucek RA. Long-term quality of life assessment among patients undergoing uterine fibroid embolization. AJR Am J Roentgenol 2009 Jul;193(1):267-71.
    - Bucek RA, Puchner S, Lammer J. Mid- and long-term quality-of-life assessment in patients undergoing uterine fibroid embolization. AJR Am J Roentgenol 2006 Mar;186(3):877-82.

40 yo F, fibroids and adenomyosis

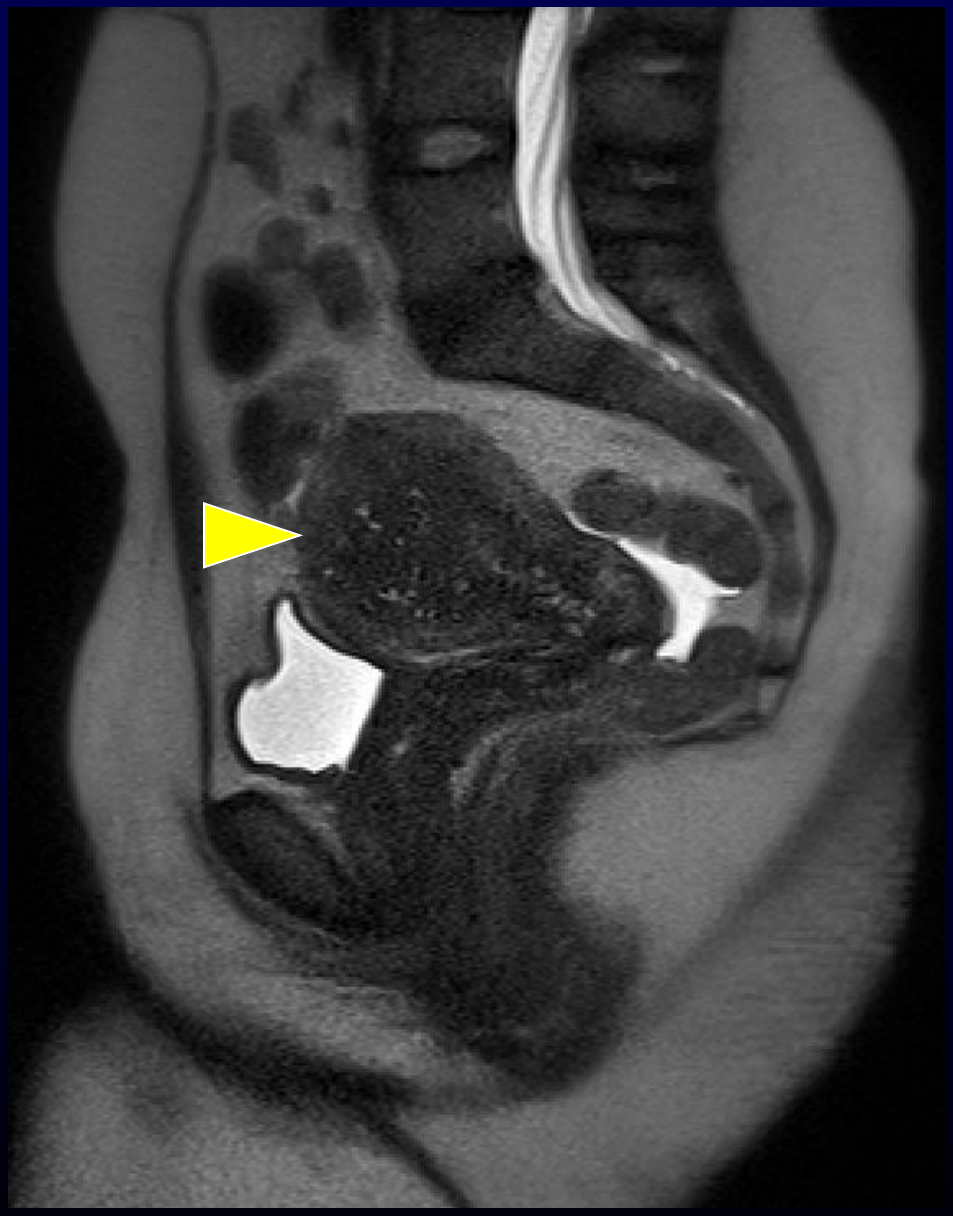


Adenomyosis- US and MRI

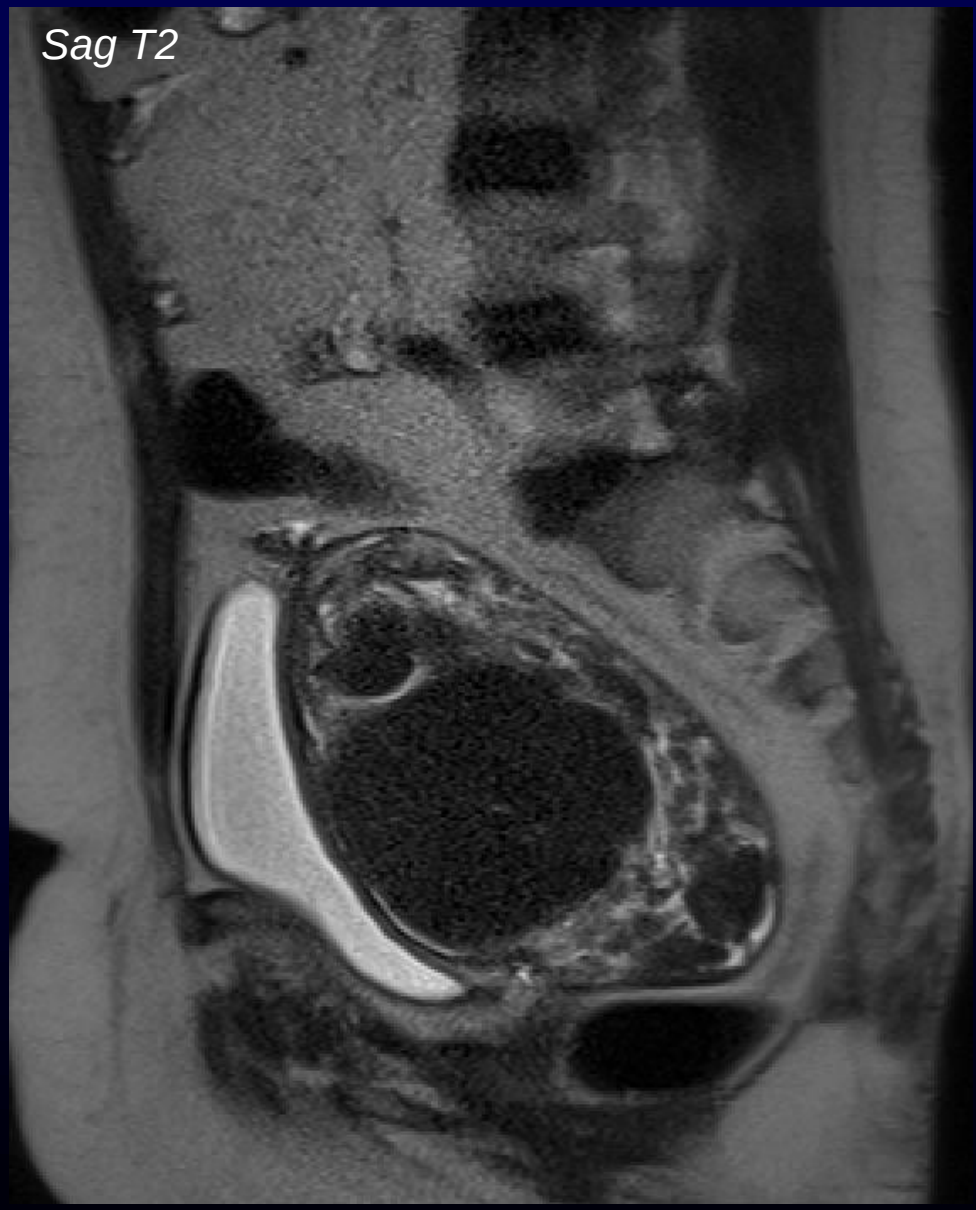




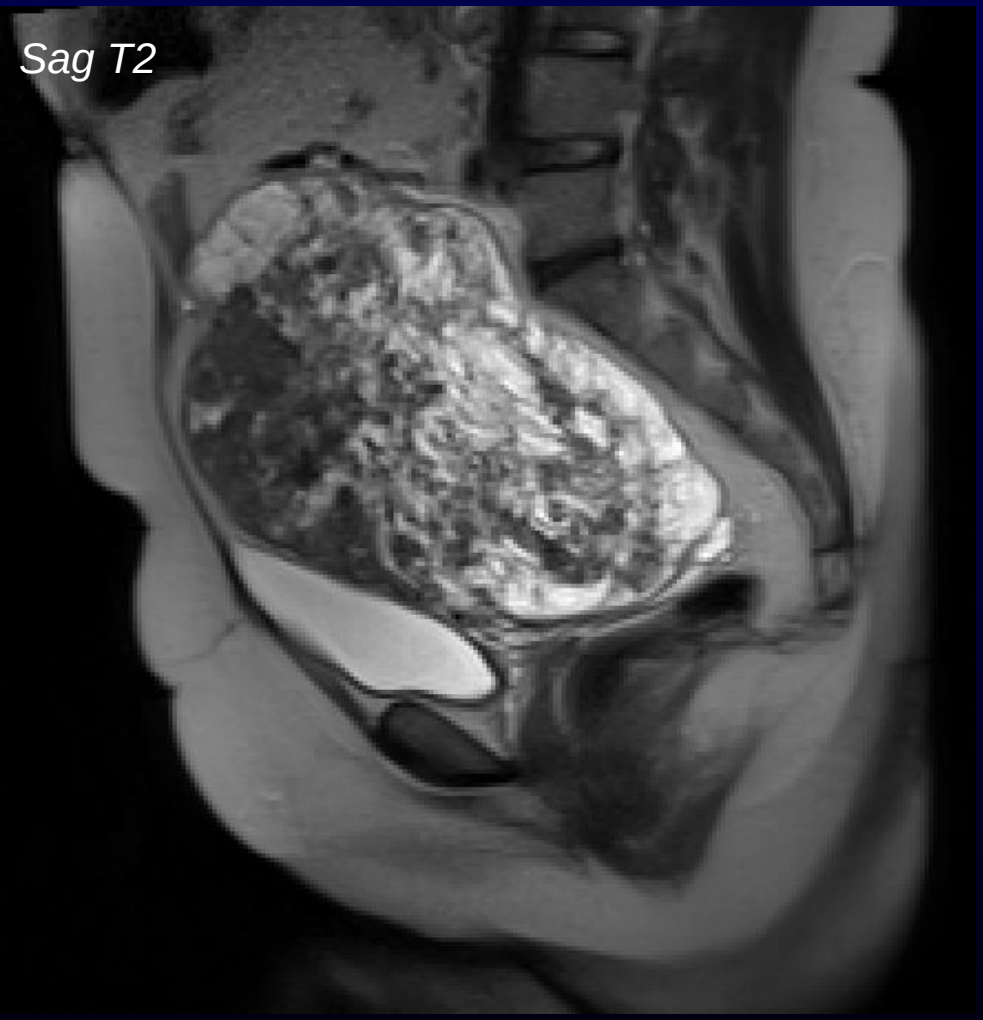
37 yo F, focal adenomyosis

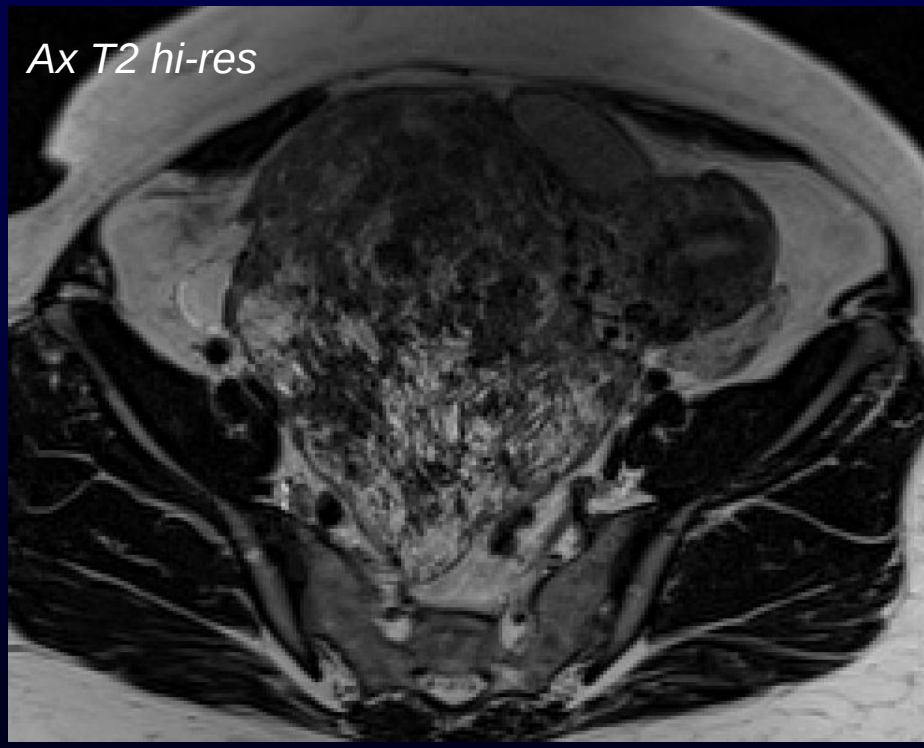


72 yo F, degenerating fibroid

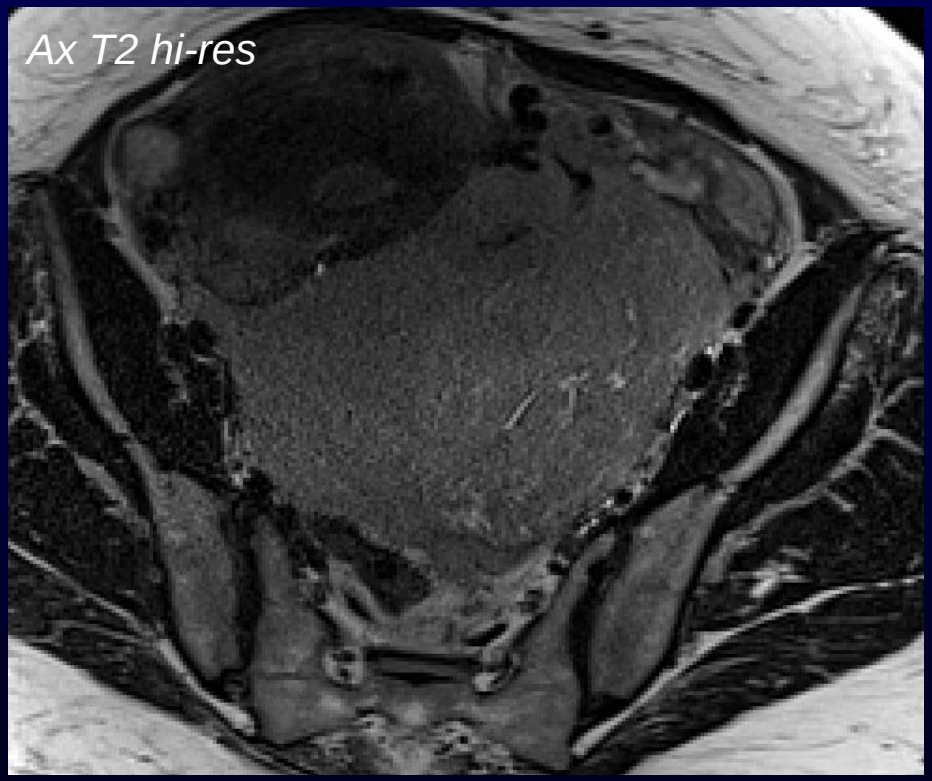


37 yo F, degenerating fibroid

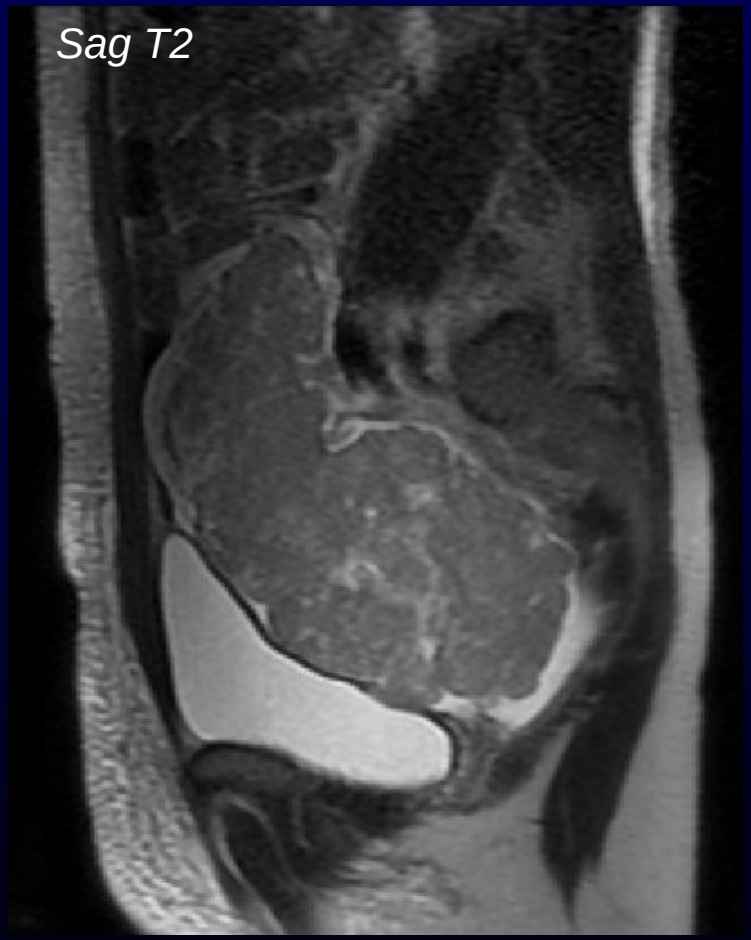


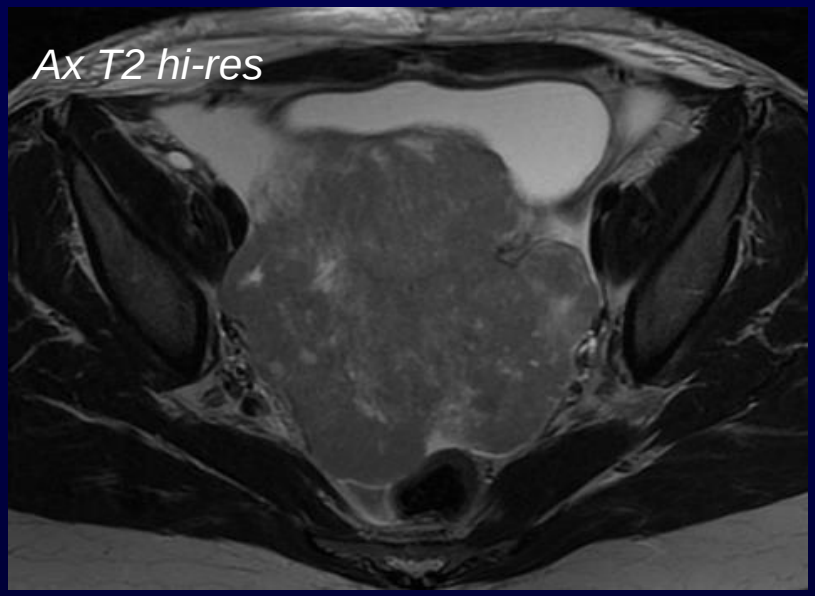


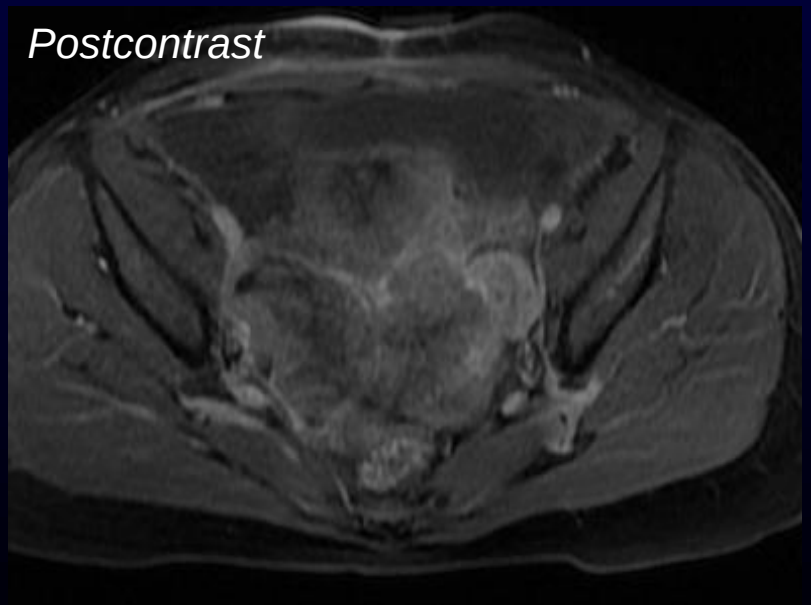
44 yo F, leiomyosarcoma



44 yo F, recurrent leiomyosarcoma







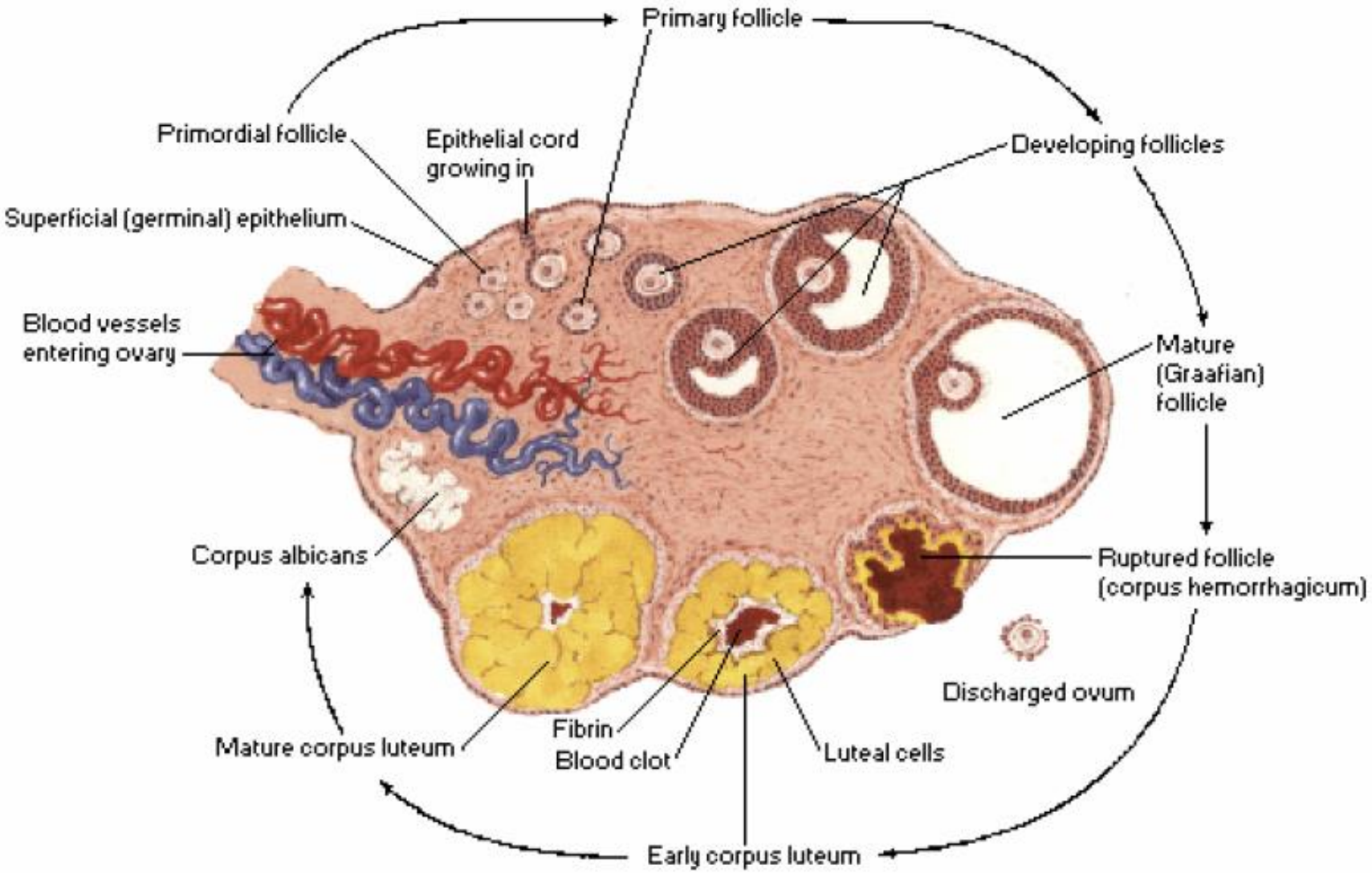
Ovarian Neoplasms

- Main differential
  - Surgical vs. non-surgical

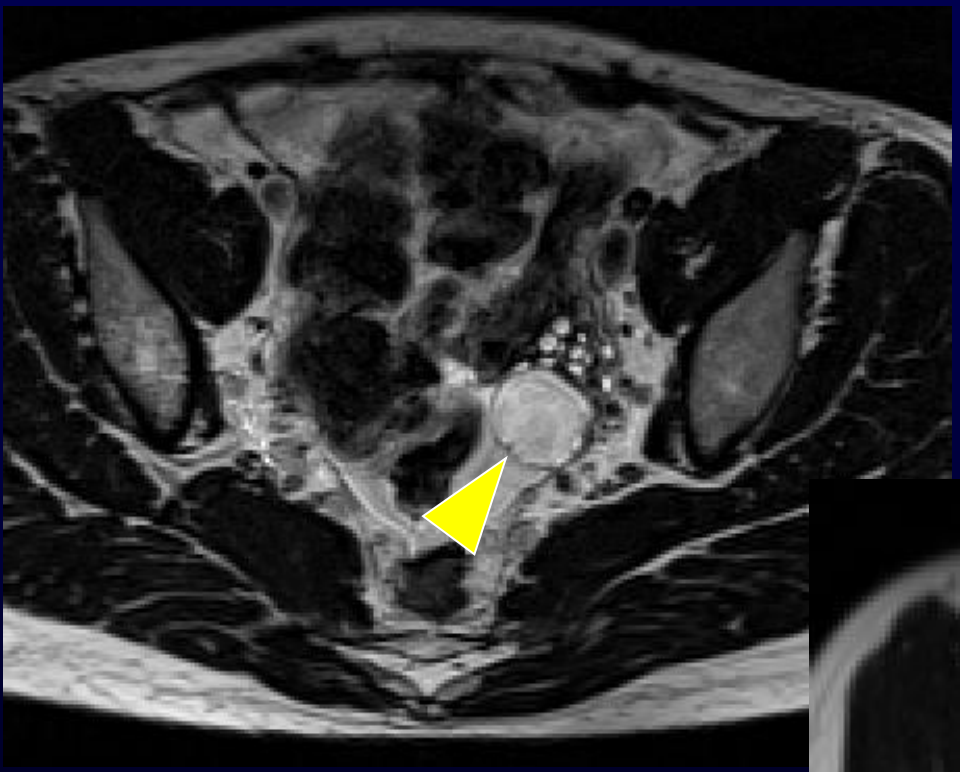
- Questions:
  - *Neoplastic* septations?
    - Cystic neoplasm versus functional cyst
  - Enhancing elements?
    - surgical; carcinoma is primary consideration

Ovarian lesions- non-tumor

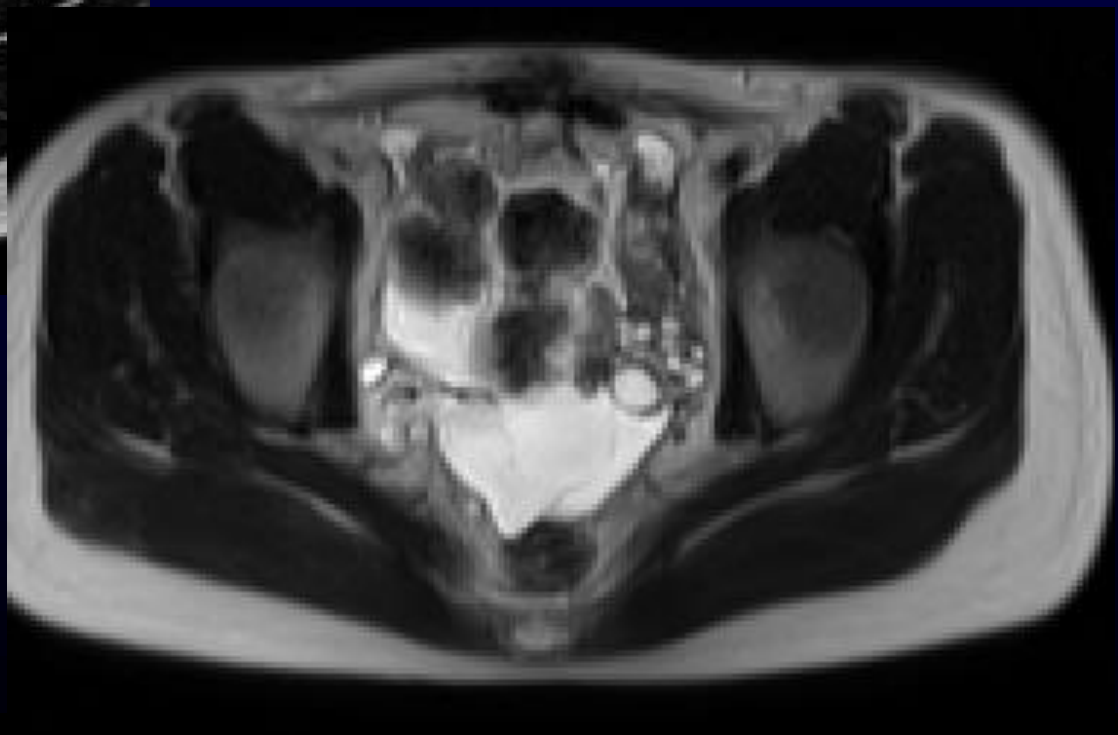
- Ovarian follicles/PCOD/corpus luteum
- Hemorrhagic cysts
- Endometriomas
- Pelvic inclusion cyst


Primary follicle
Primordial follicle
Epithelial cord growing in
Developing follicles
Superficial (germinal) epithelium
Blood vessels entering ovary
Mature (Graafian) follicle
Corpus albicans
Ruptured follicle (corpus hemorrhagicum)
Discharged ovum
Fibrin
Blood clot
Mature corpus luteum
Luteal cells
Early corpus luteum

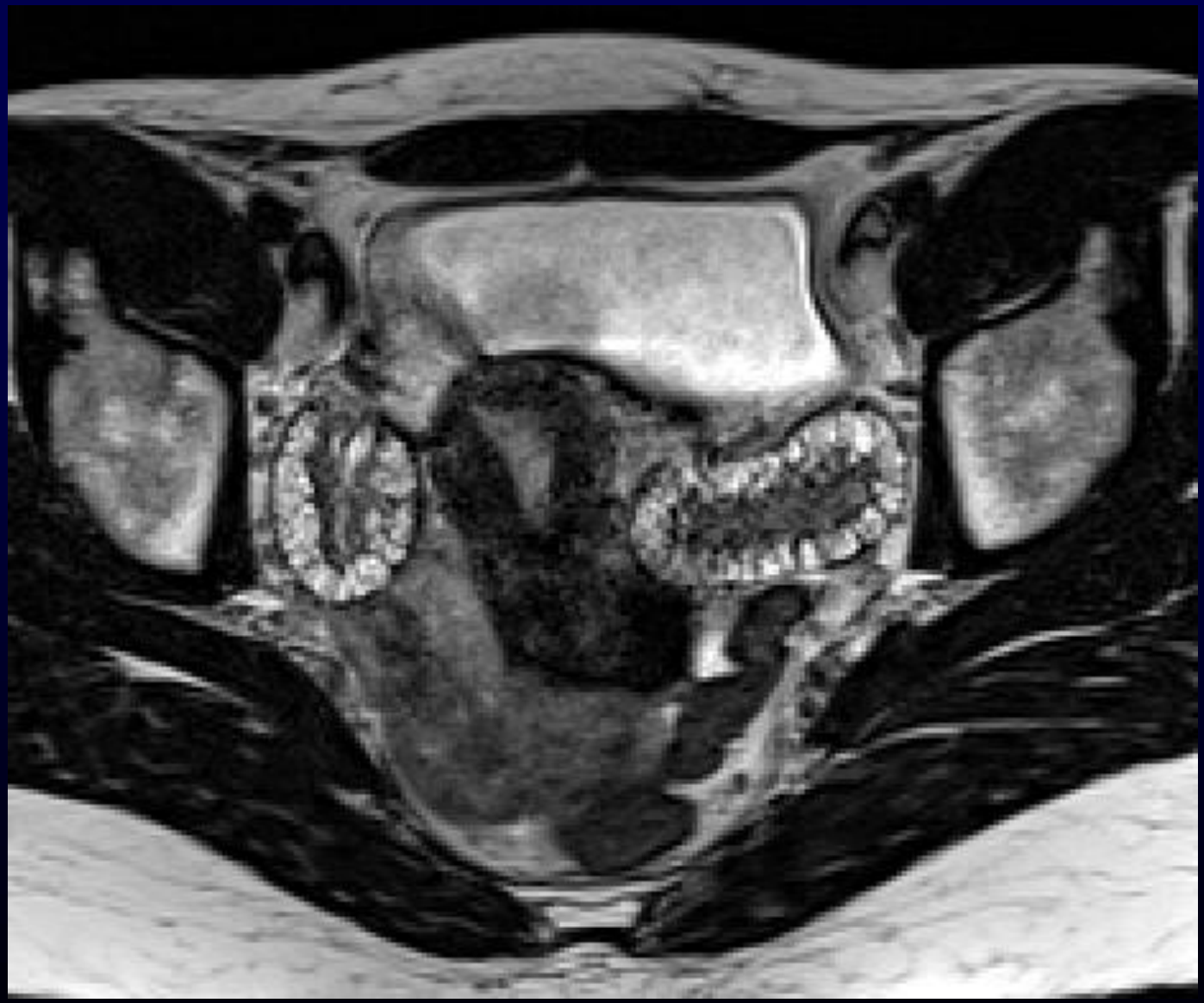
22 yo F, functional cyst



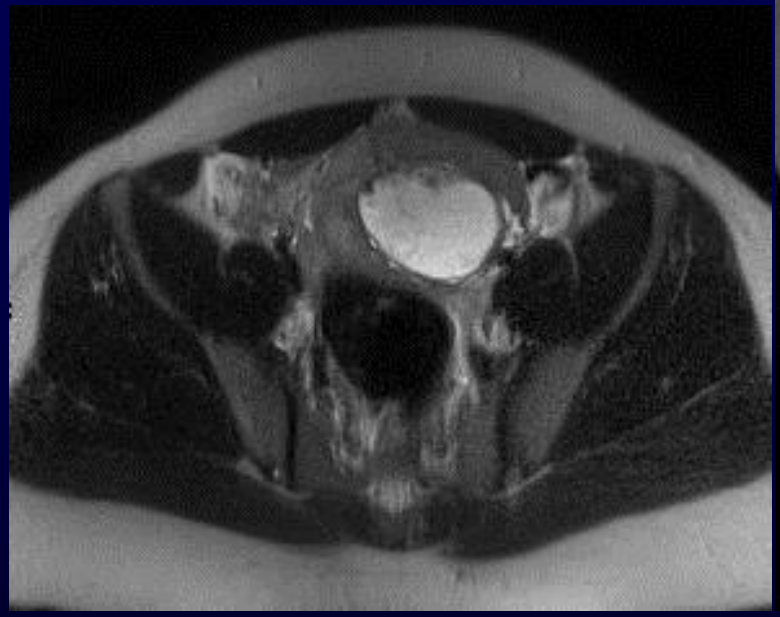
3 months later

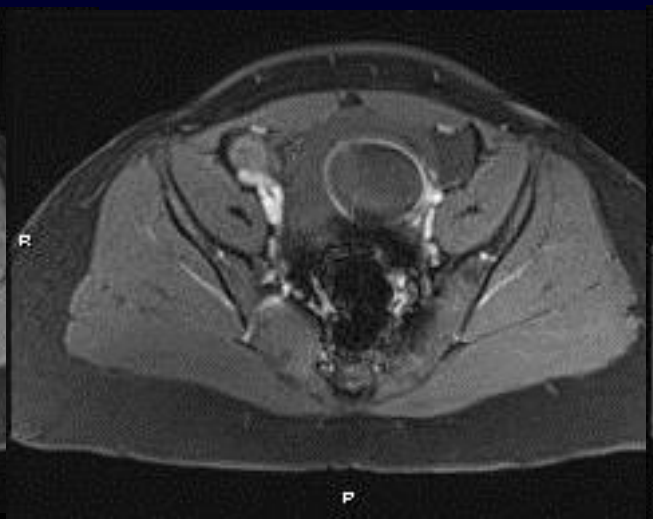


Polycystic ovarian syndrome



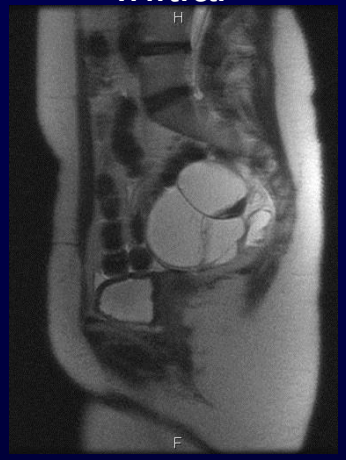
32 yo F, hemorrhagic ovarian cyst

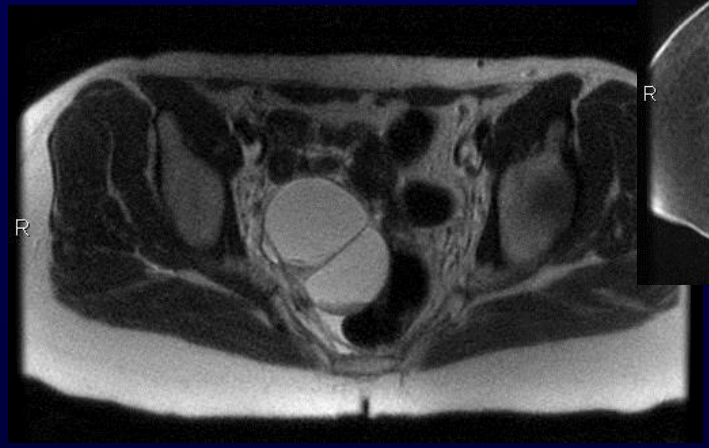


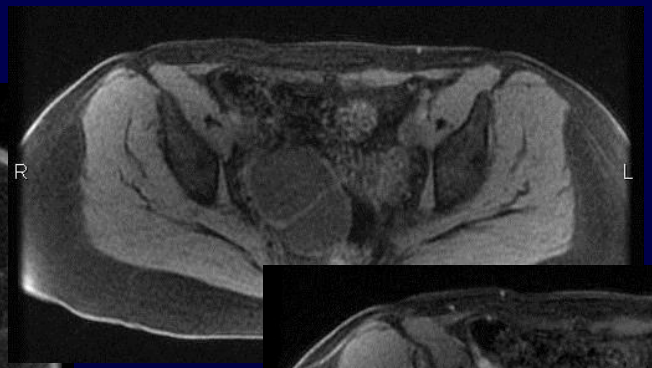


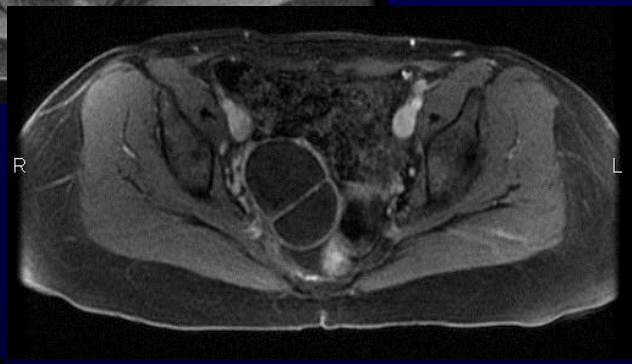
43 yo F, hemorrhagic cyst

Initial

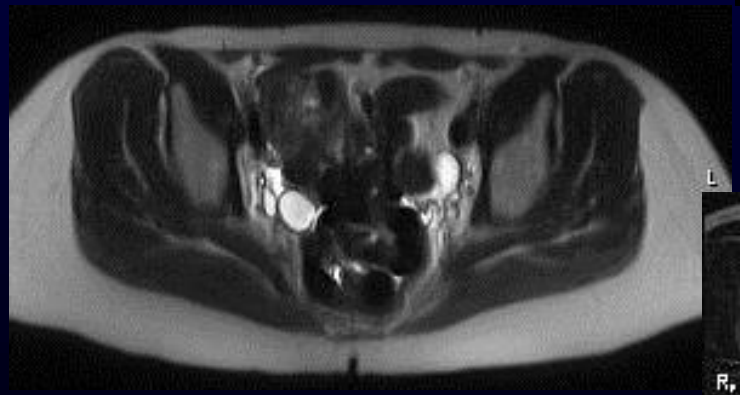




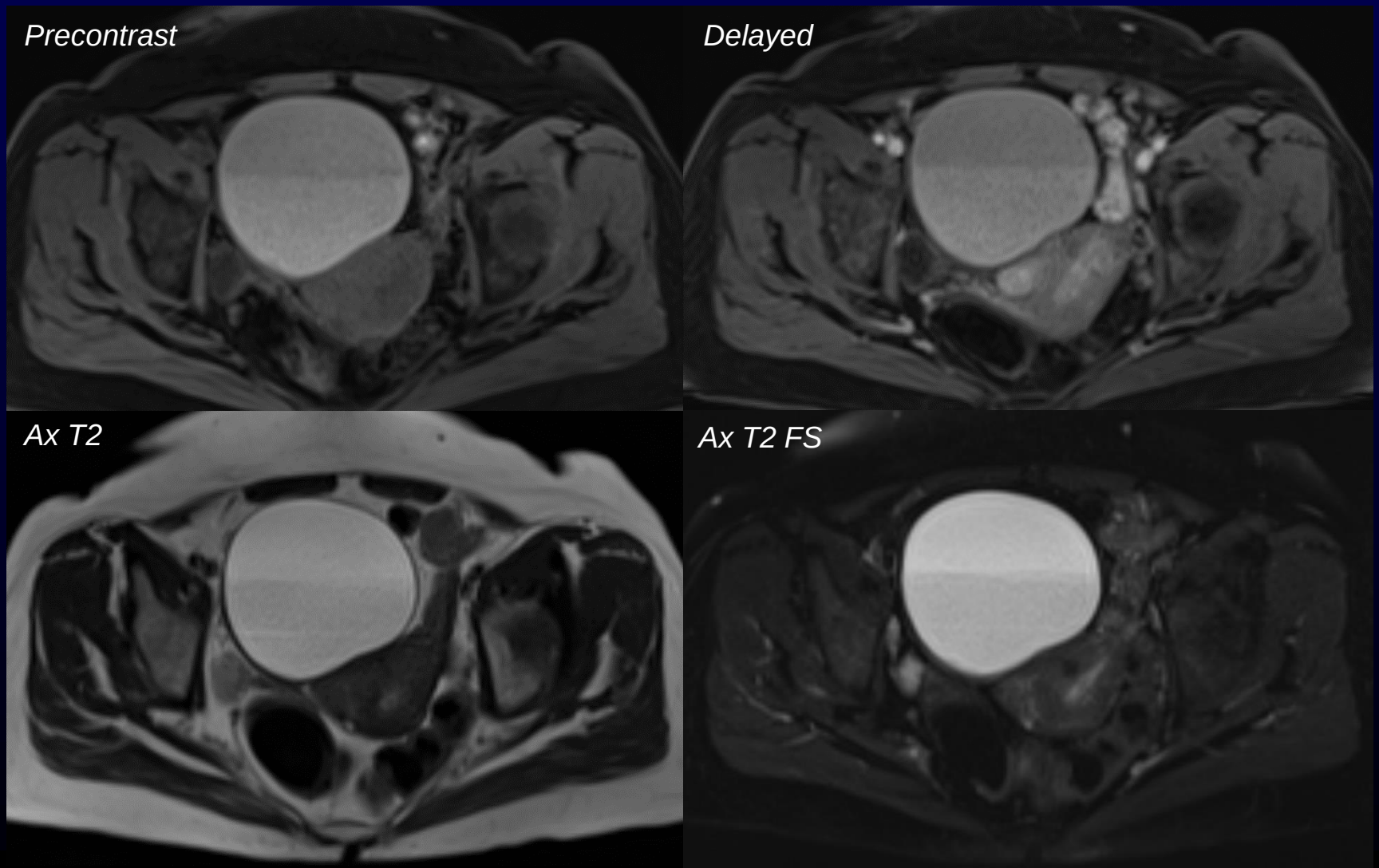




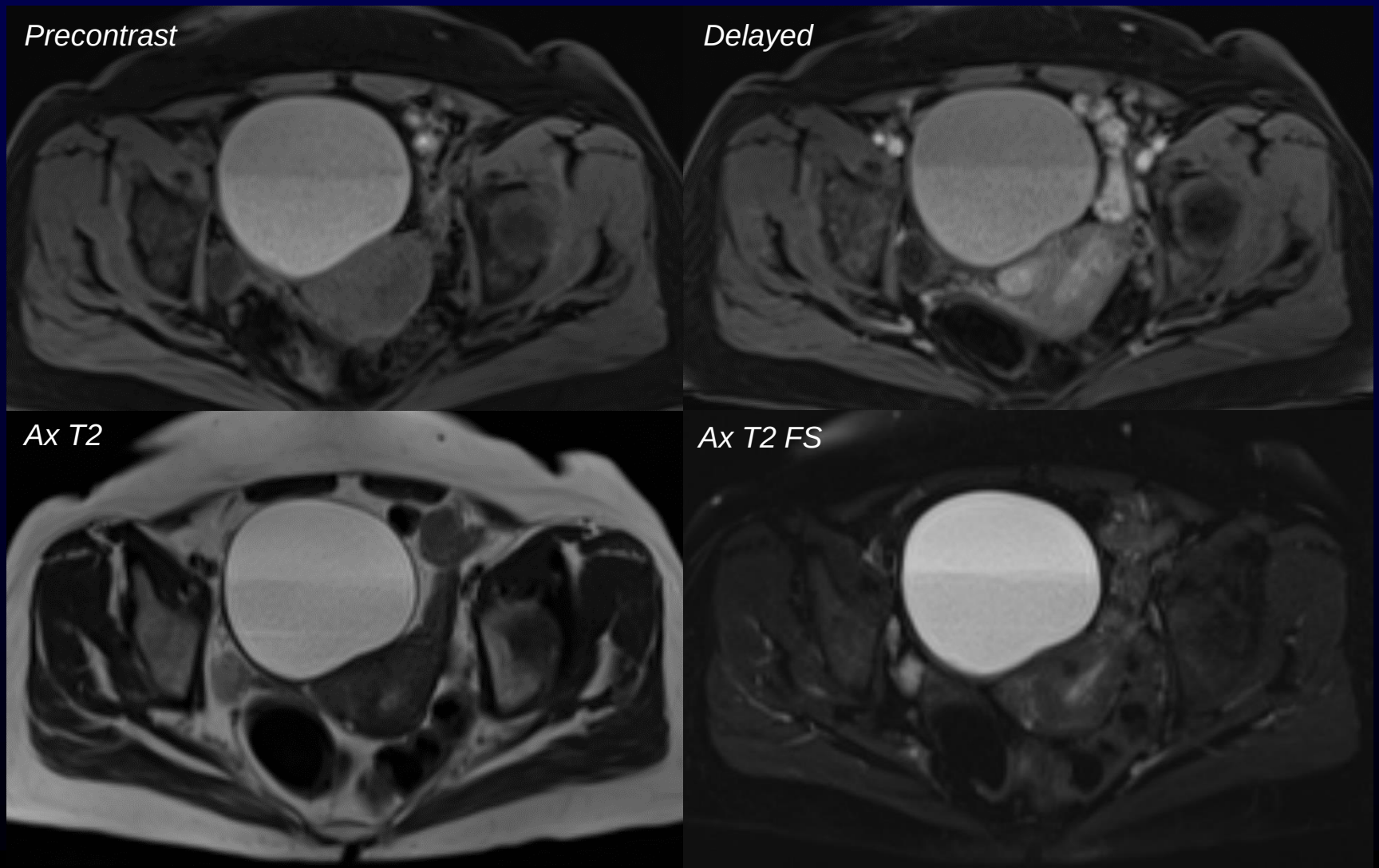
3 mo FU



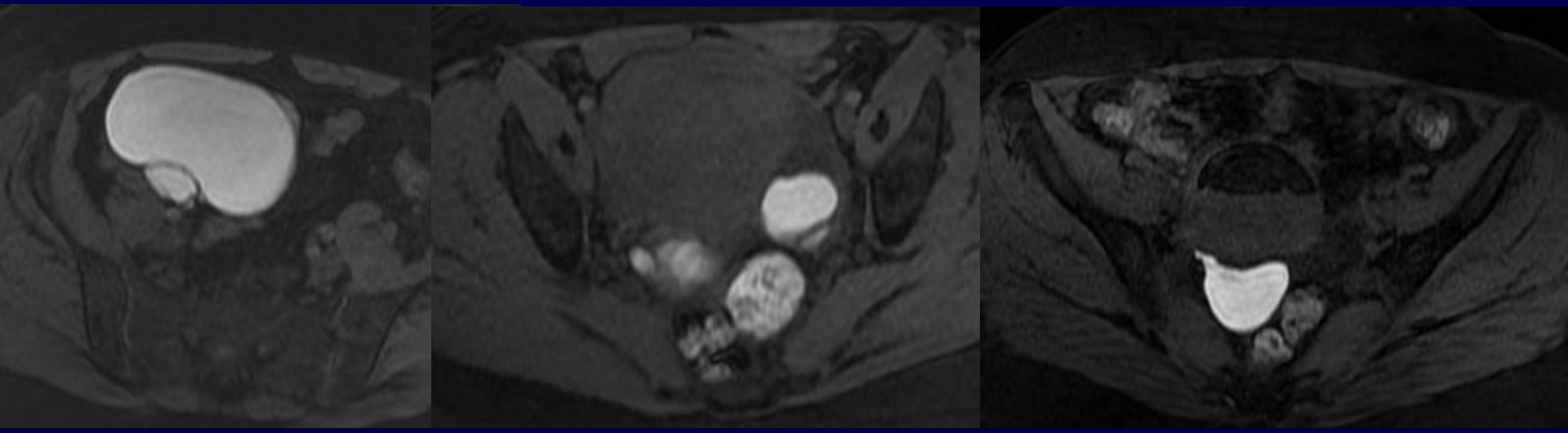
54 yo F, ovarian lesion



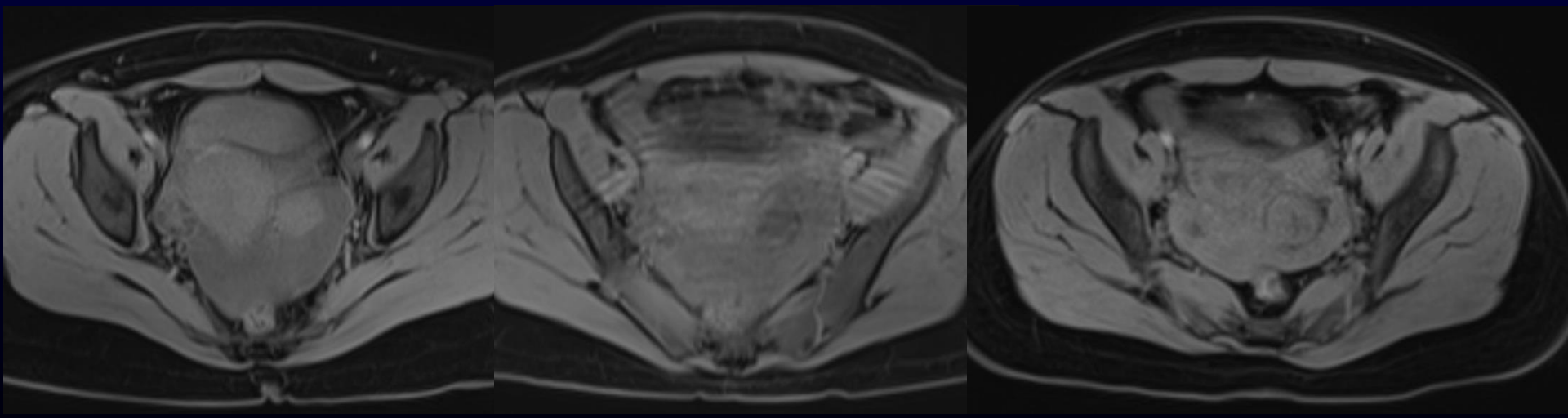
Endometrioma



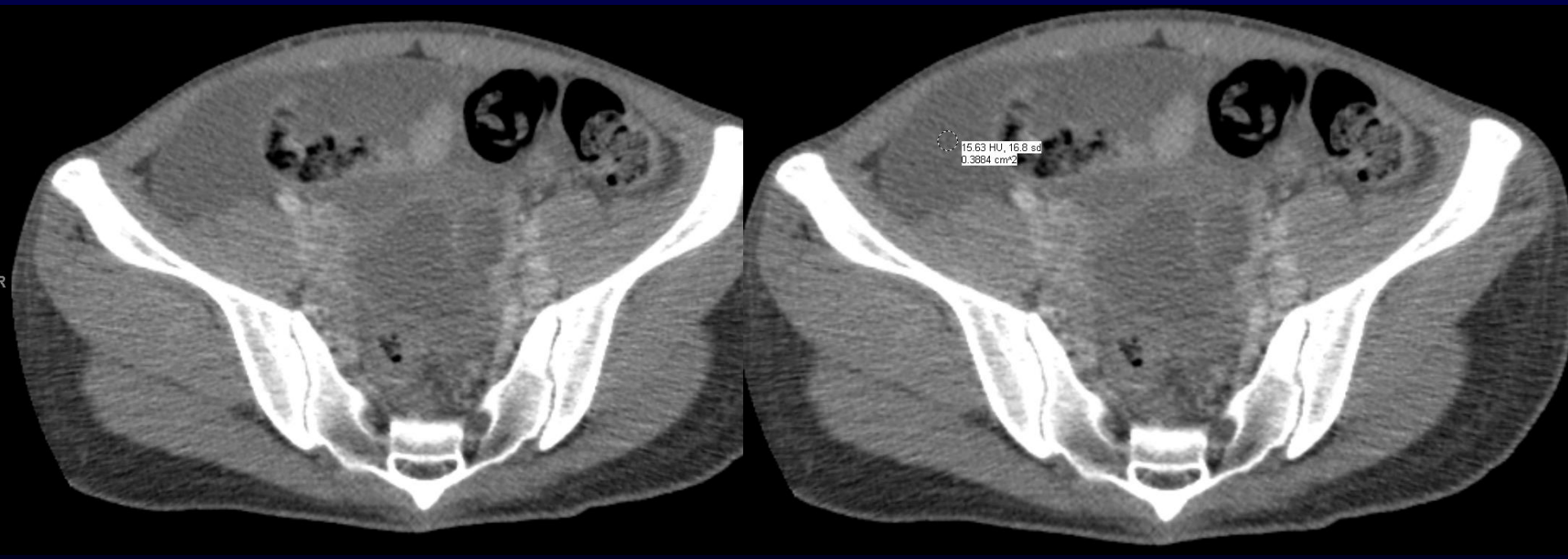
Endometriomas



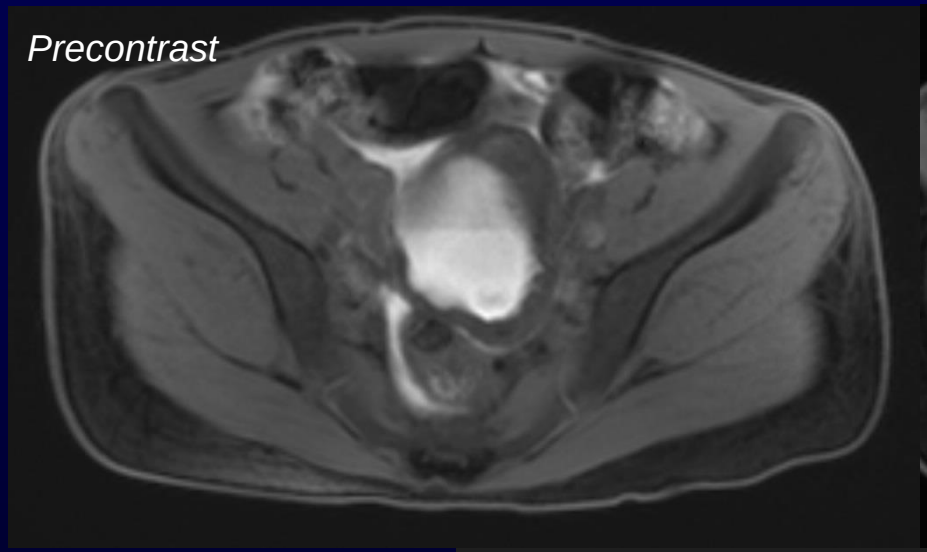
Hemorrhagic cyst (ruptured)

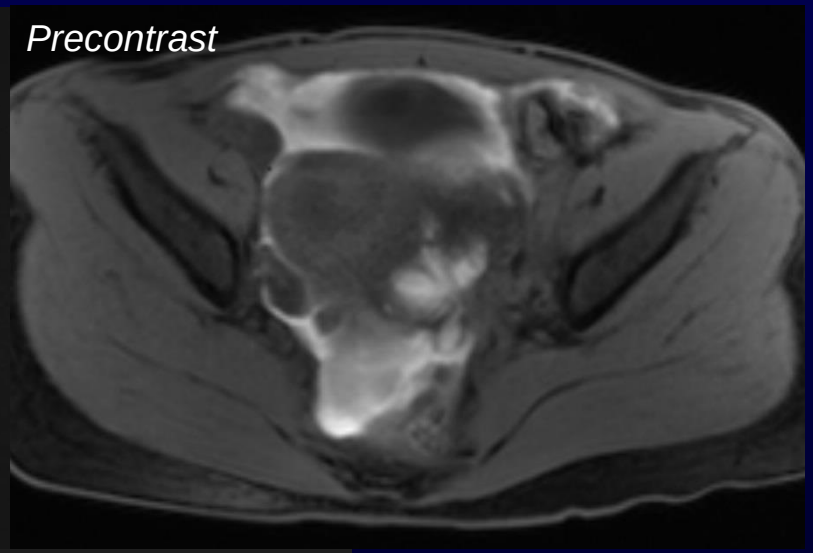


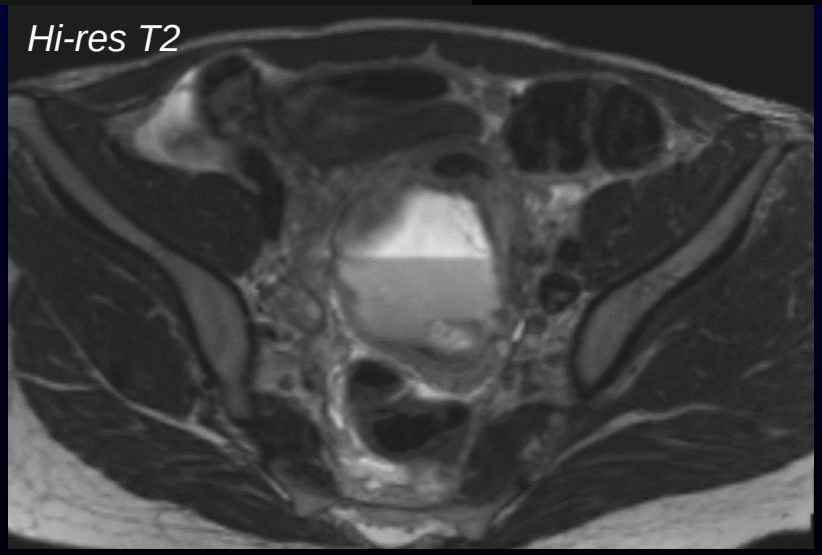
37 yo F, abdominopelvic pain



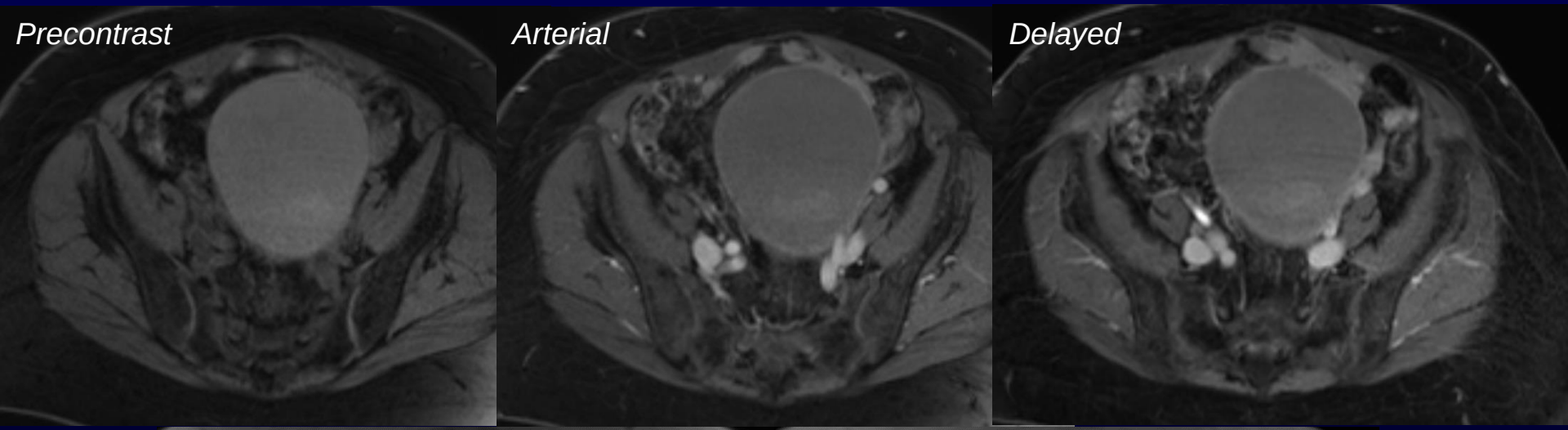
Ruptured endometrioma

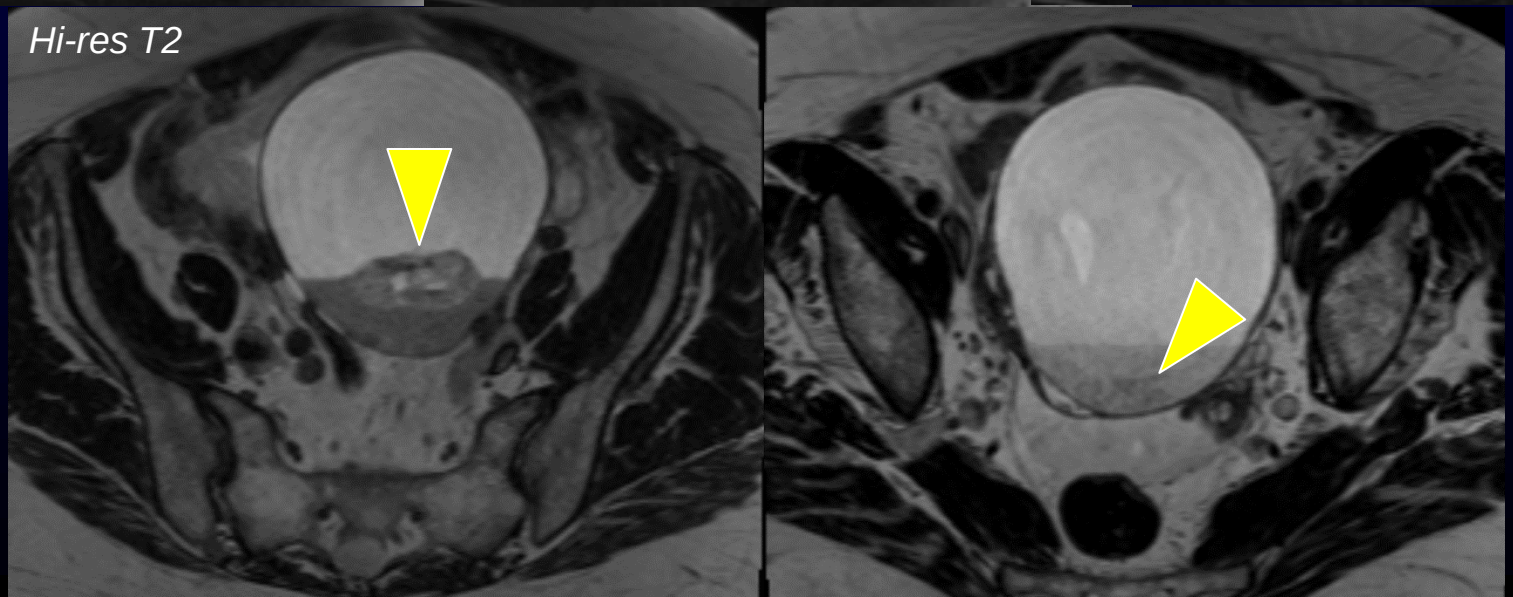




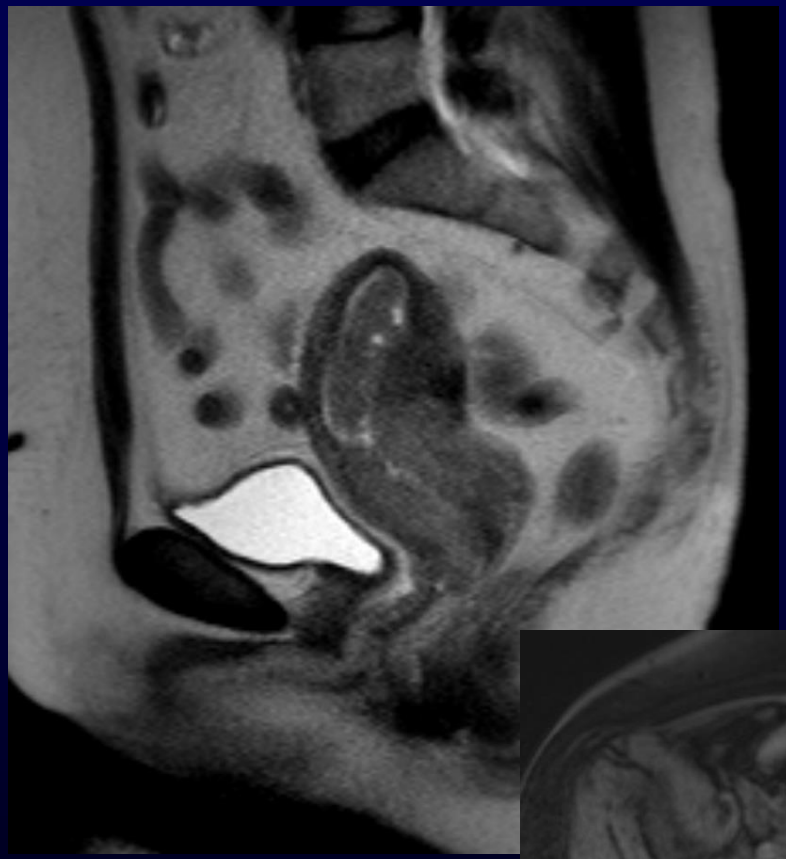


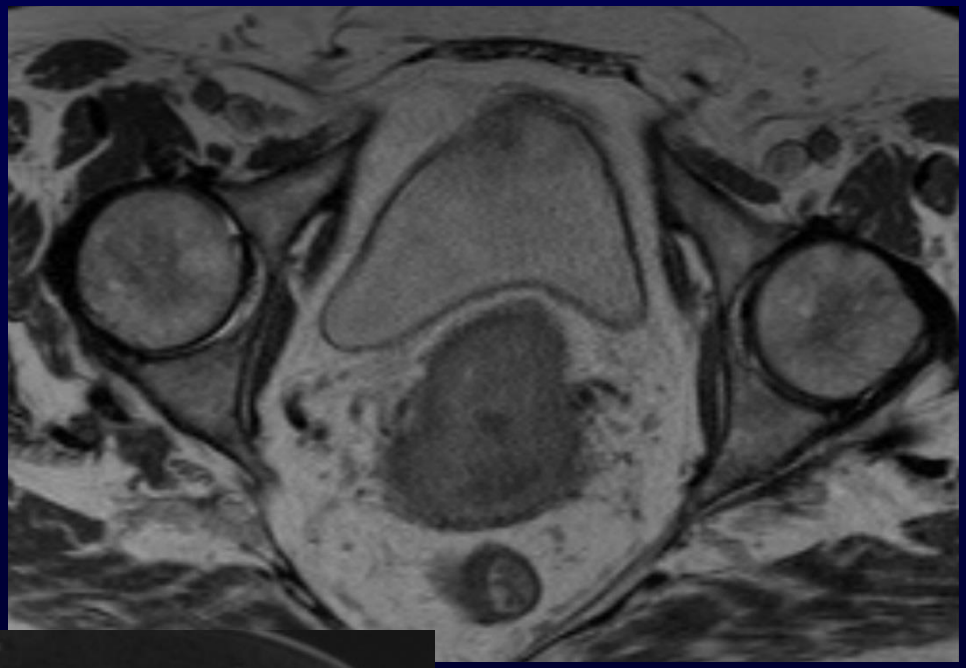
Clear cell CA in endometrioma

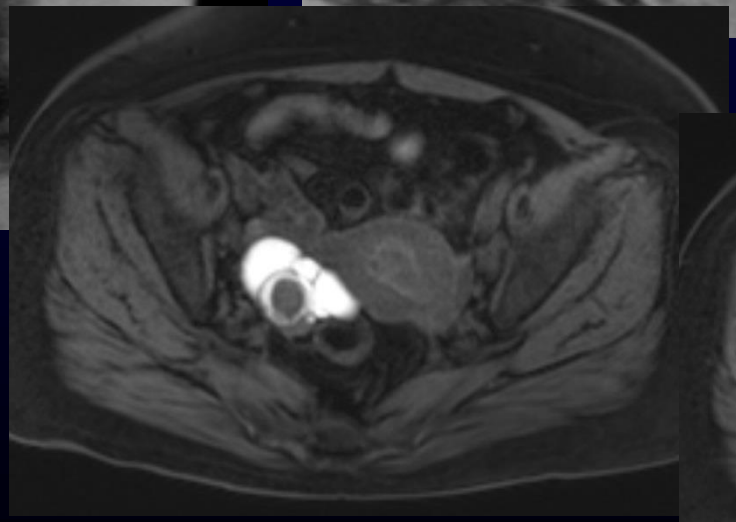


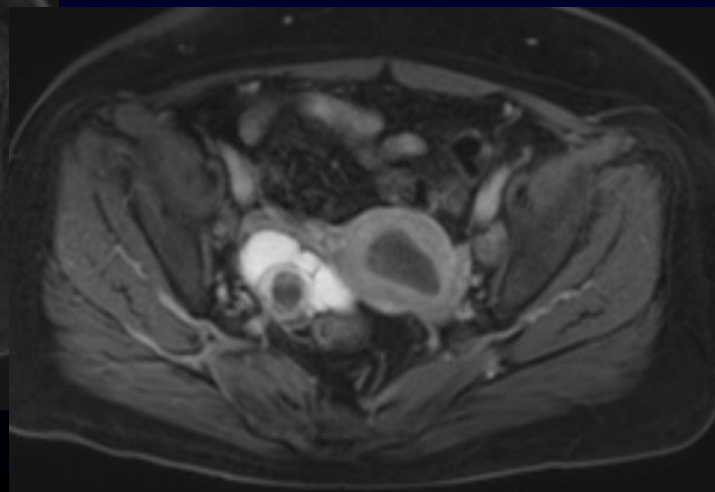


51 yo F, bleeding

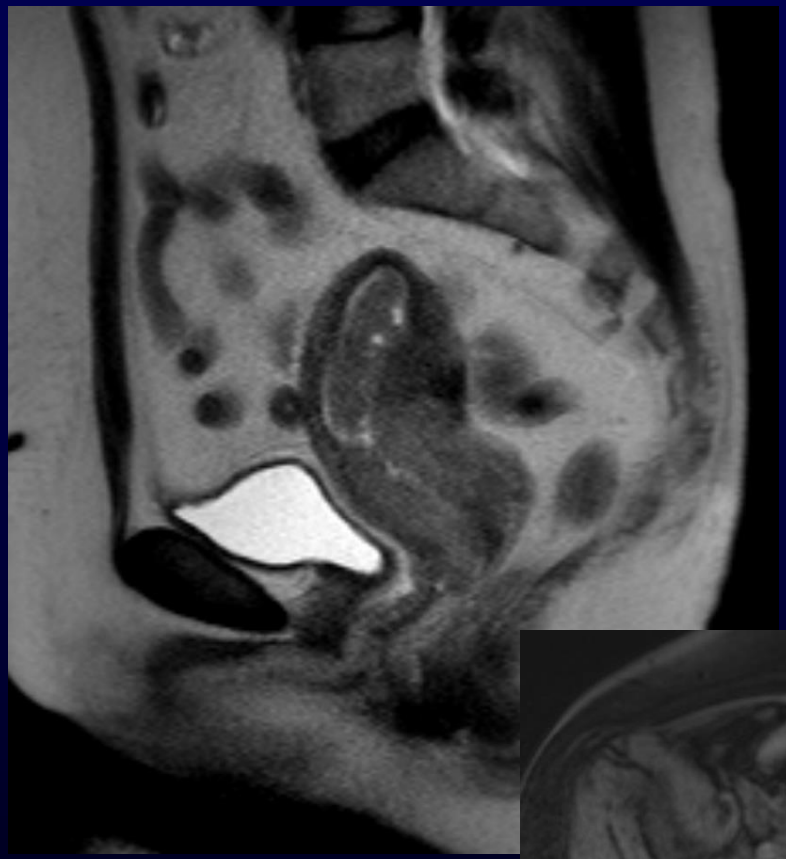


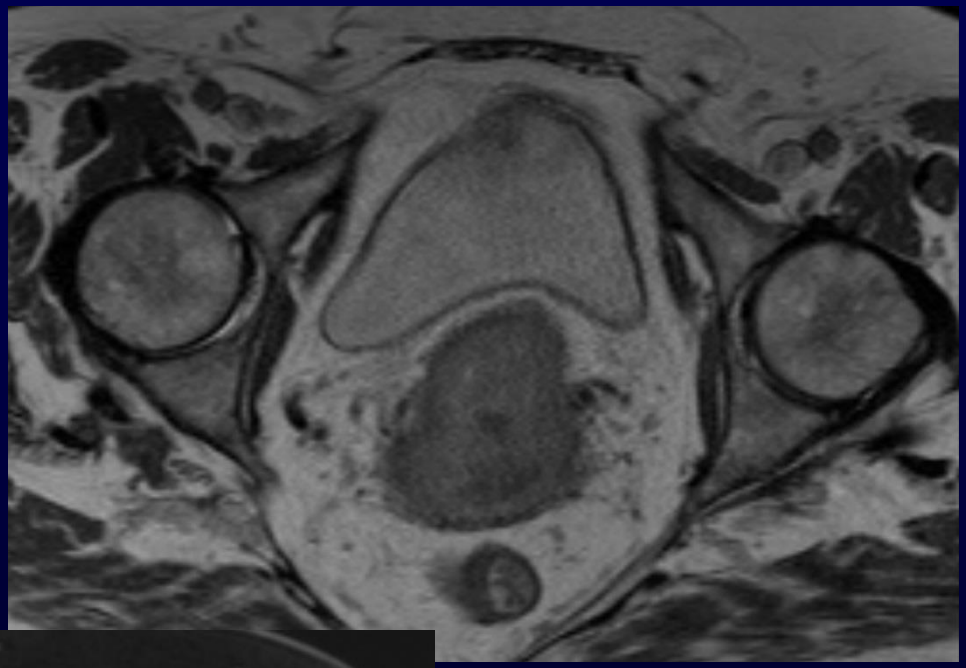


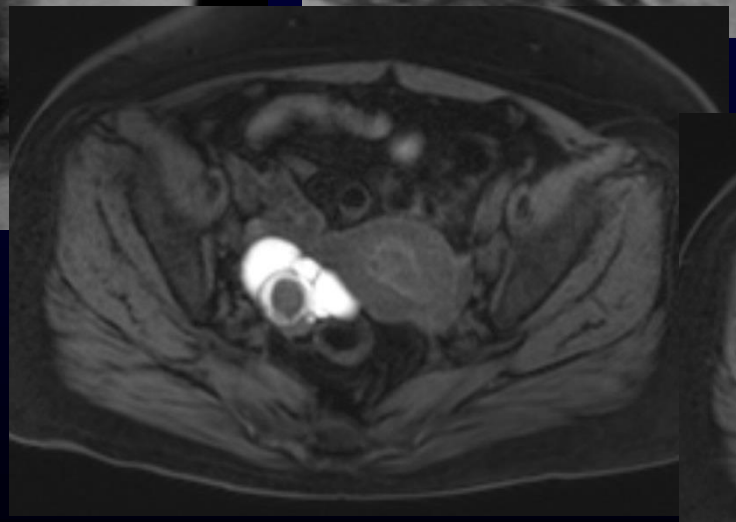


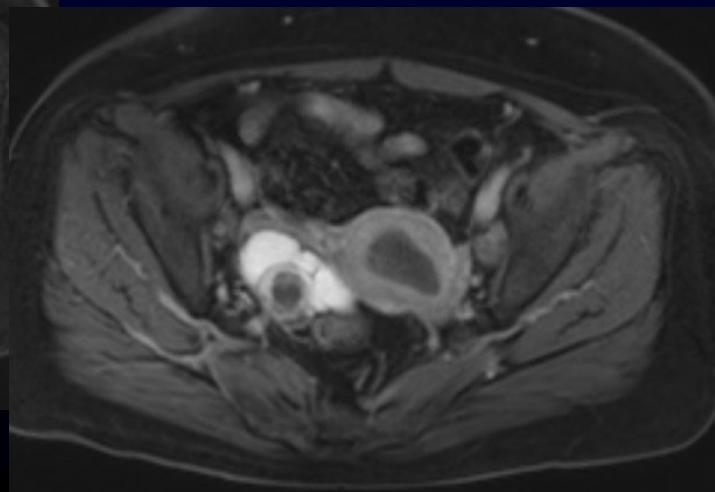


51 yo F cervical cancer

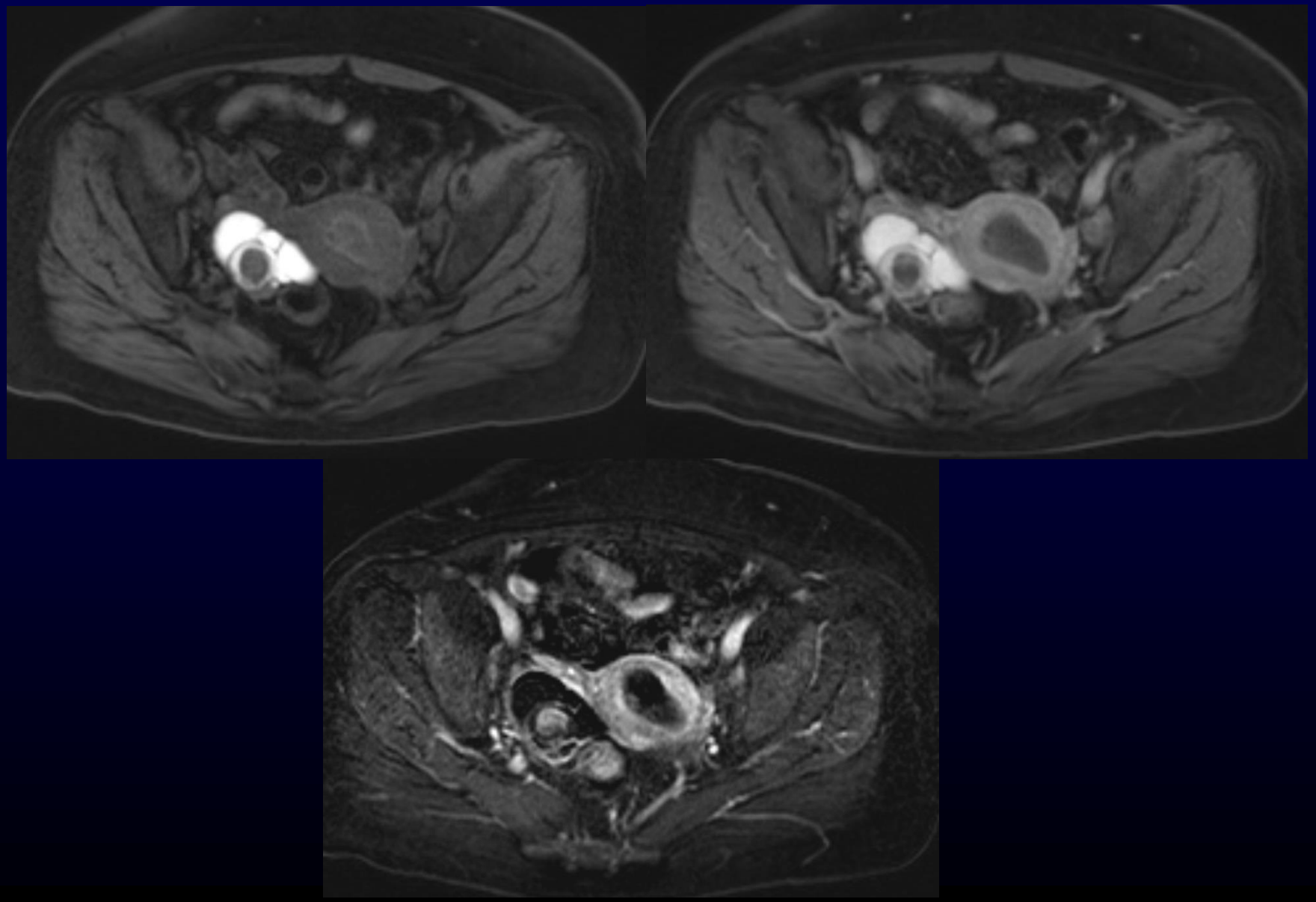




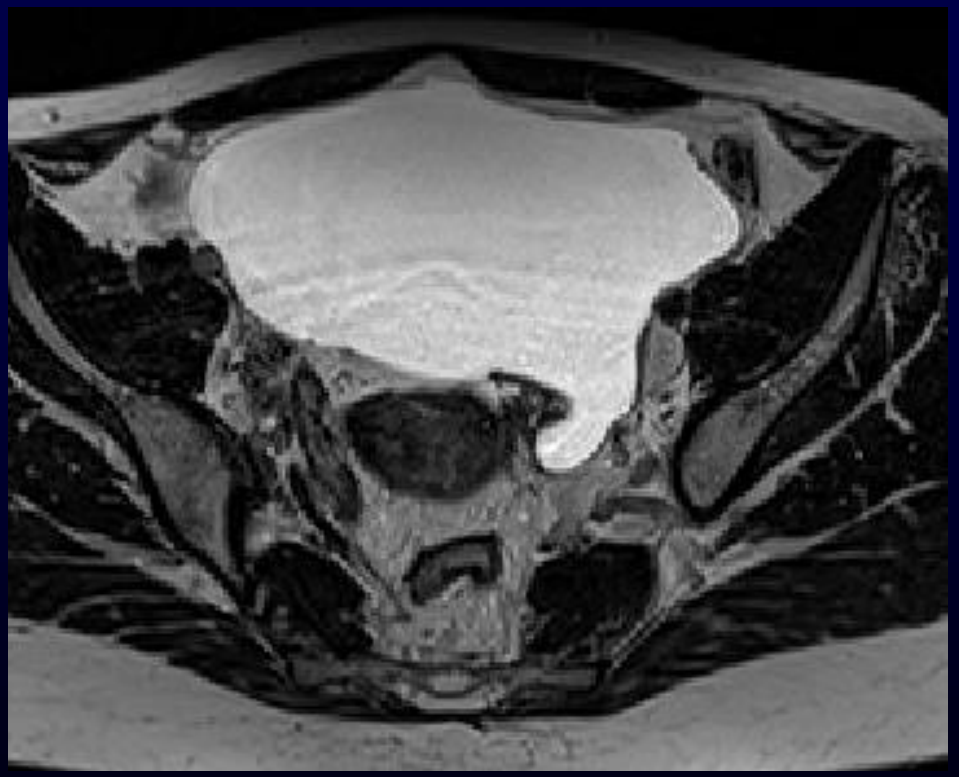




51 yo F right adnexal met in endometrioma



44 yo F, pelvic inclusion cyst



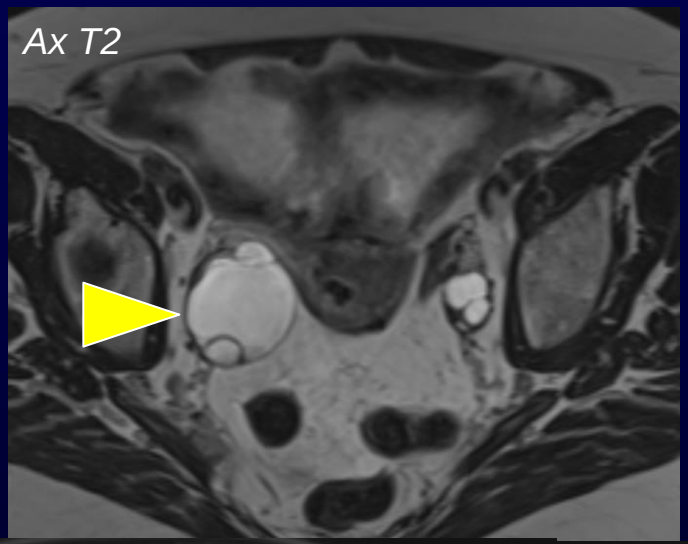
Ovarian Masses - tumor

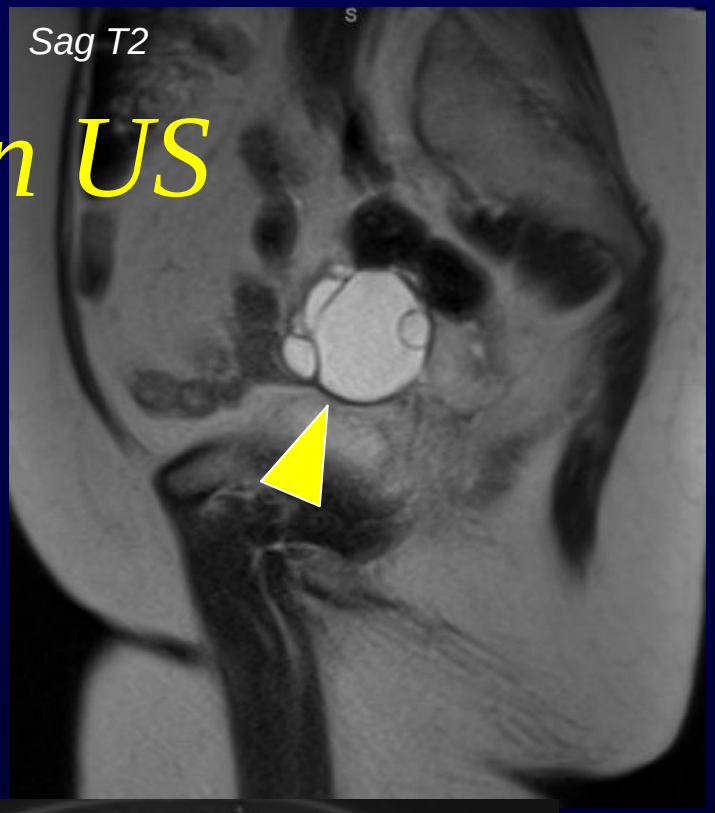
- Epithelial (65%)
  - Serous/Mucinous/Endometriod/Clear Cell/Brenner
- Germ Cell (25%)
  - Dermoid (younger)/ Malignant transformation (older) / Dysgerminoma*/Embryonal*/Chorio*/Mixed*
    - *solid/young/~fat/~calcium/AFP/HCG
- Stromal (5%)
  - Thecoma (estrogen)/Fibroma (Meigs)/Granulosa Cell Tumor (estrogen +hemorrhage-complex)/Sertoli/Leydig Cell Tumors
- Gonadoblastoma (5%)

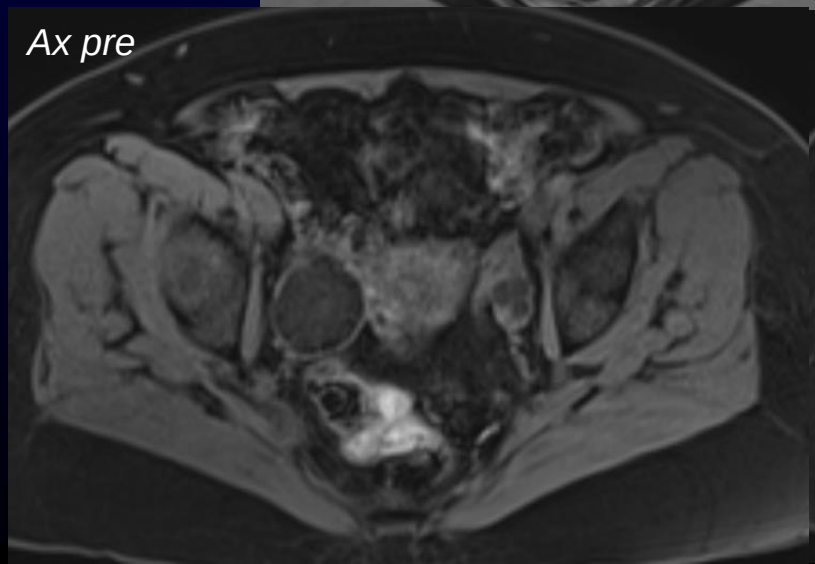
Surface epithelial tumors

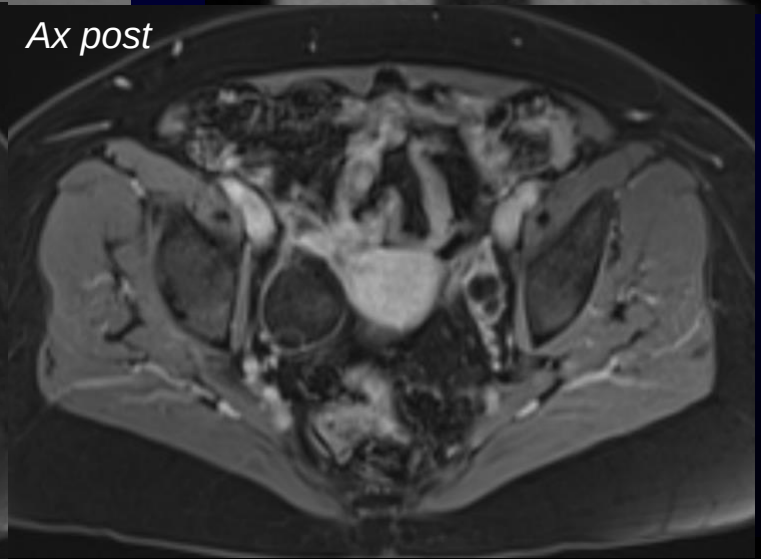
- Typically cystic
  - Neoplastic septations
- Solid elements = Surgical
  - Borderline tumor versus carcinoma

73 yo F, ovarian cyst on US

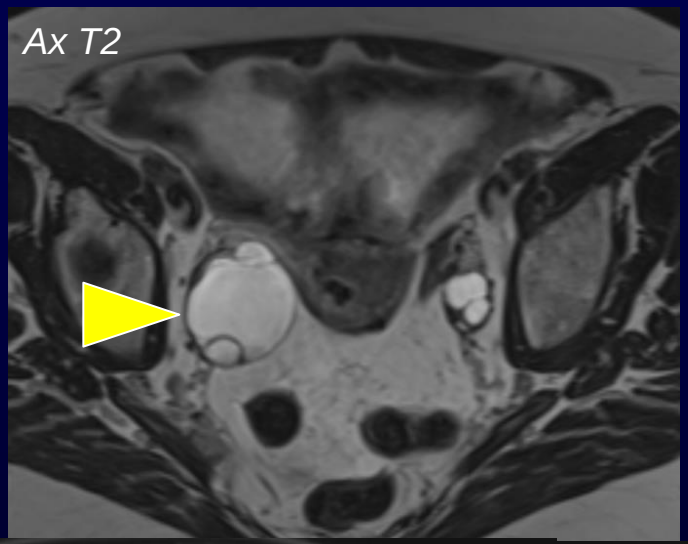


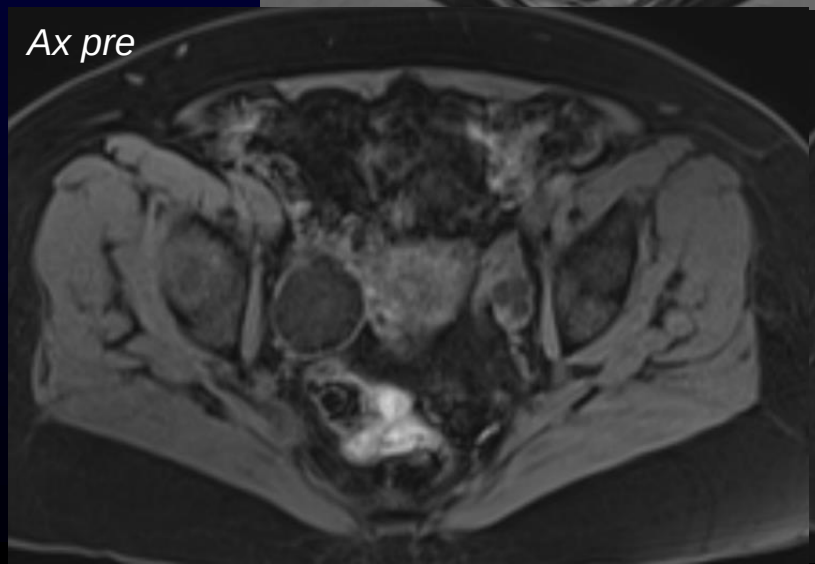


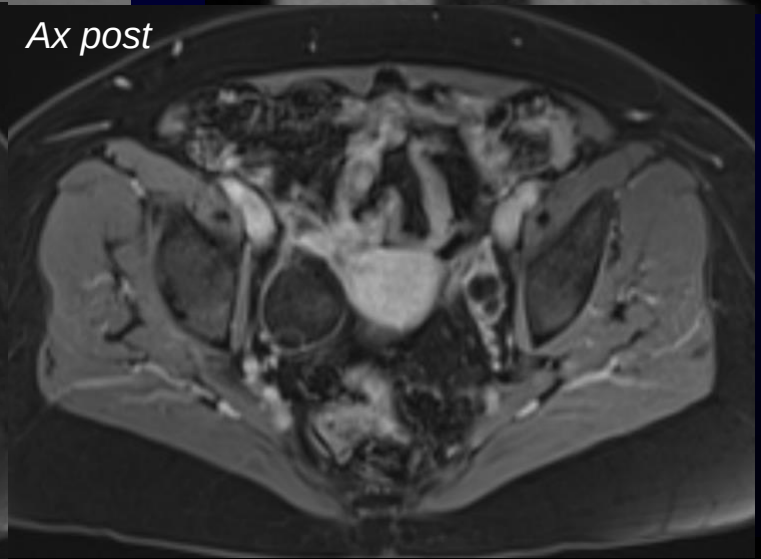




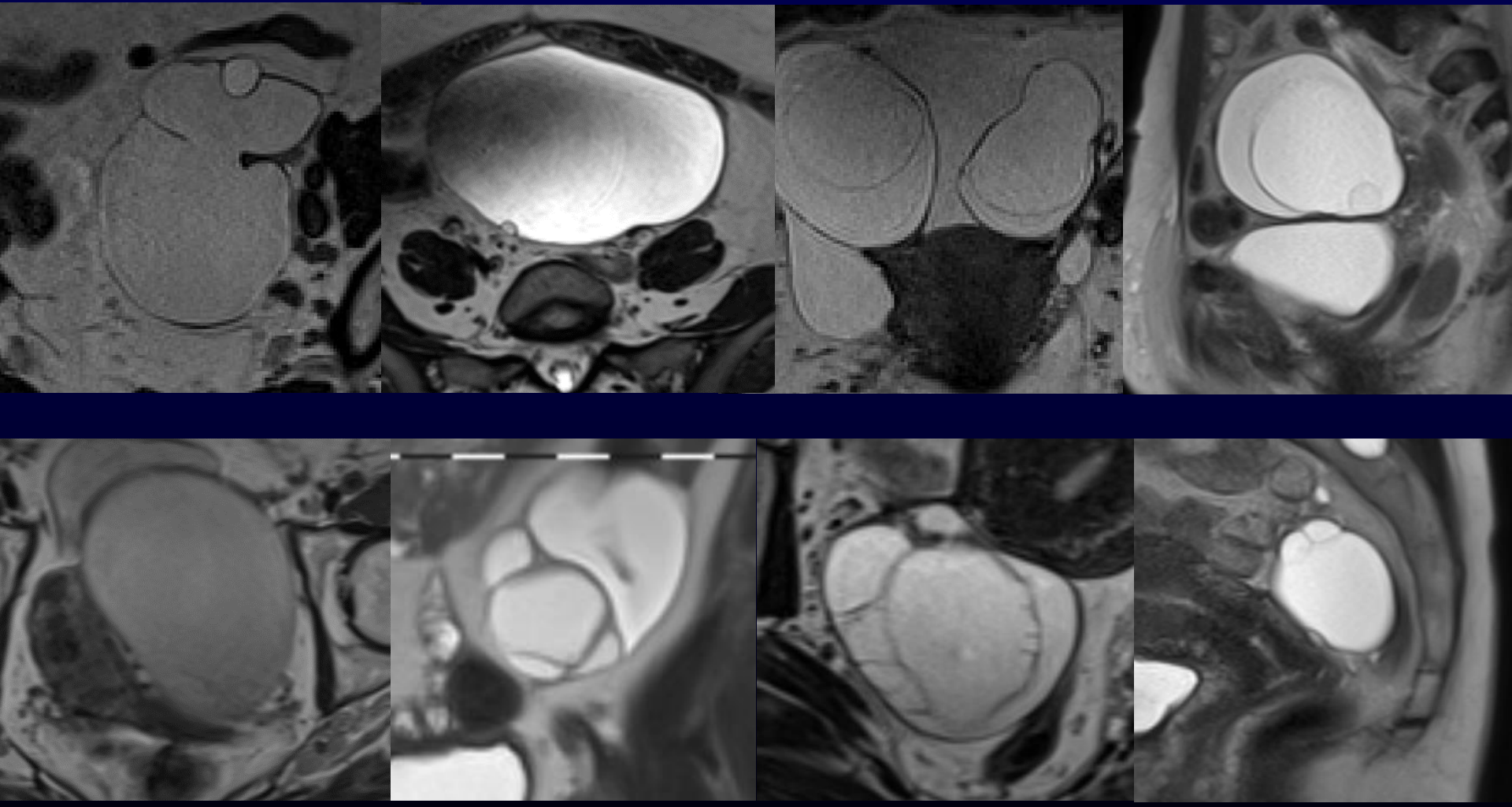
Serous cystadenoma



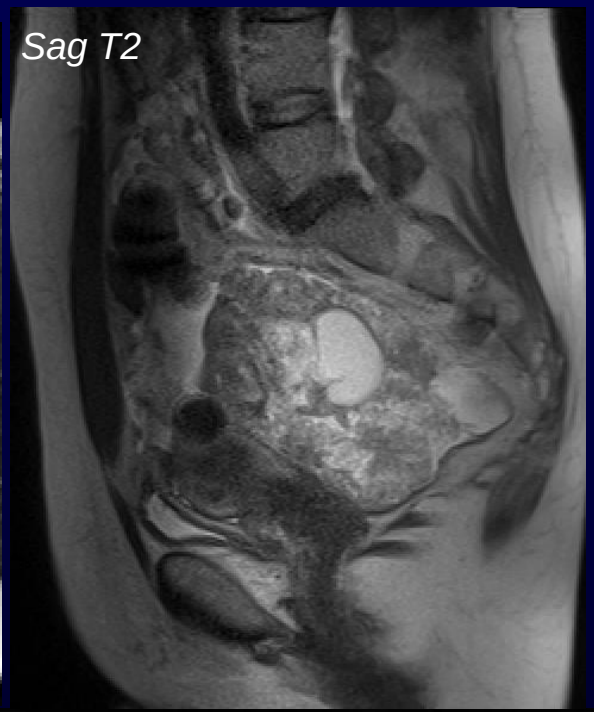


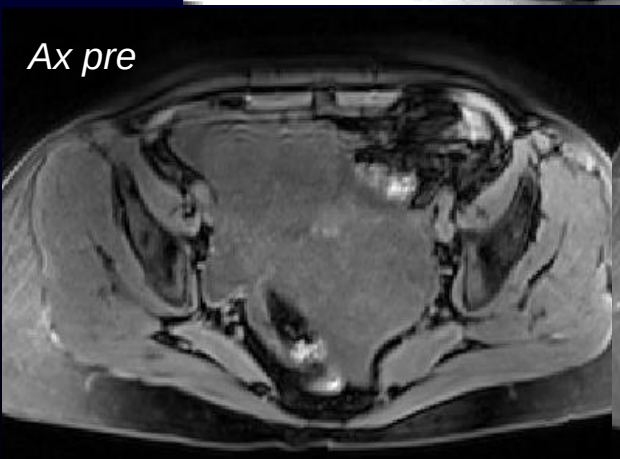


Serous cystadenomas

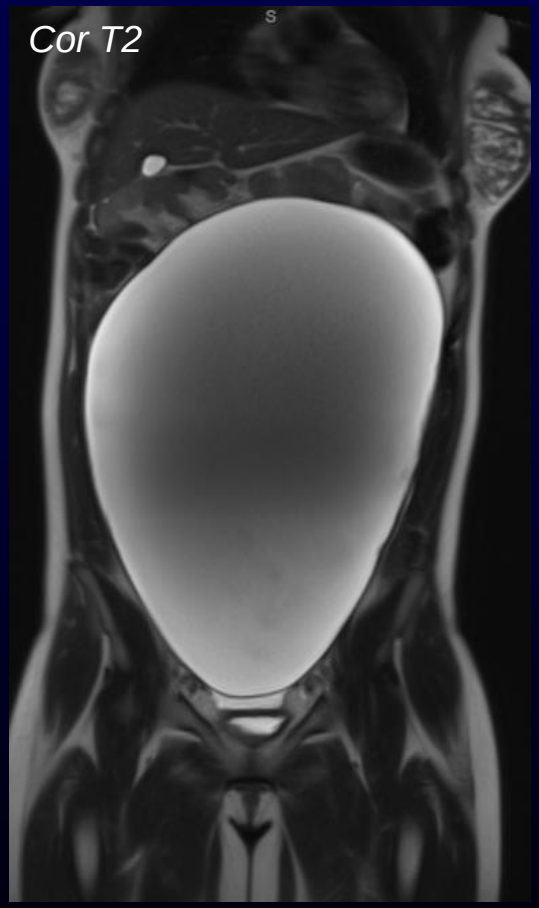


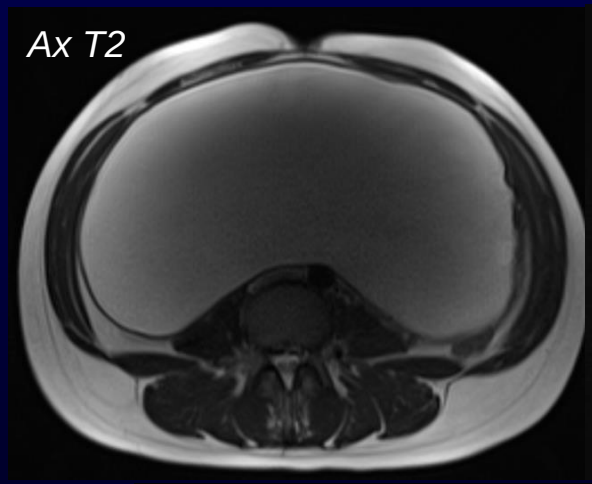
58 yo F, serous papillary carcinoma

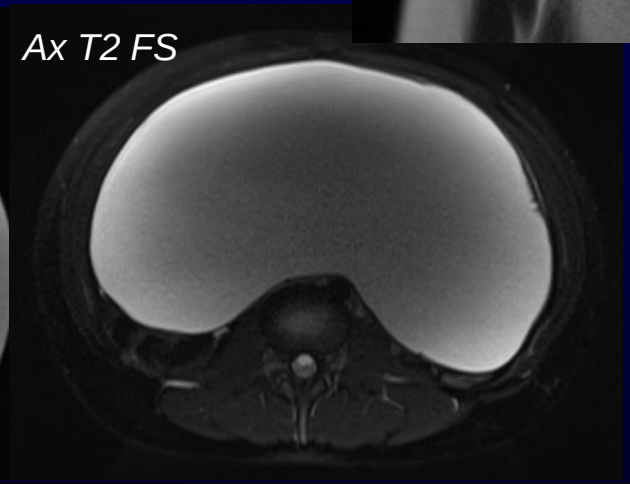


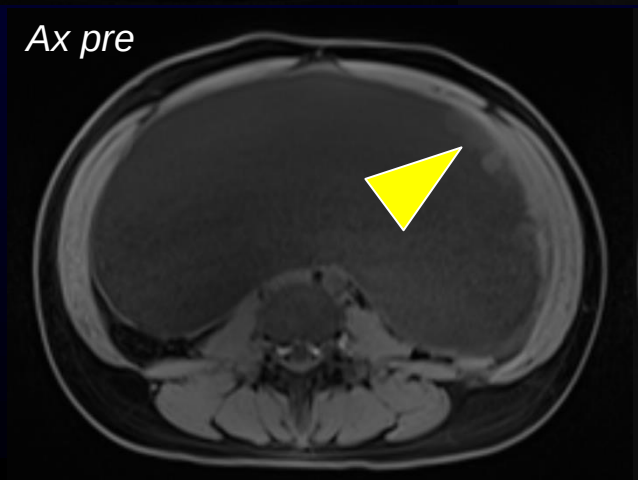


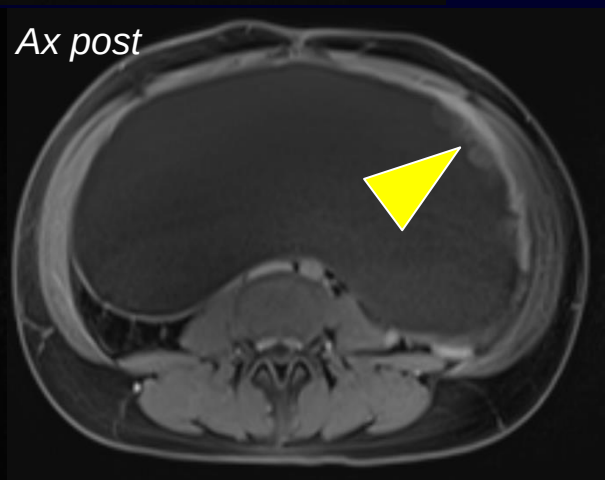
Serous cystadenoma (borderline)



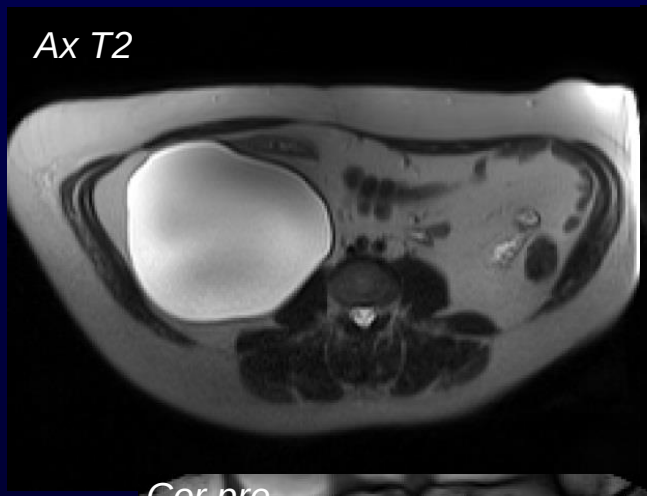


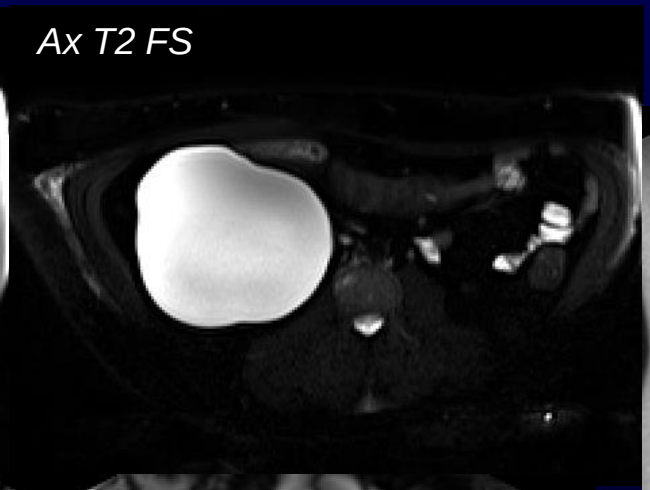


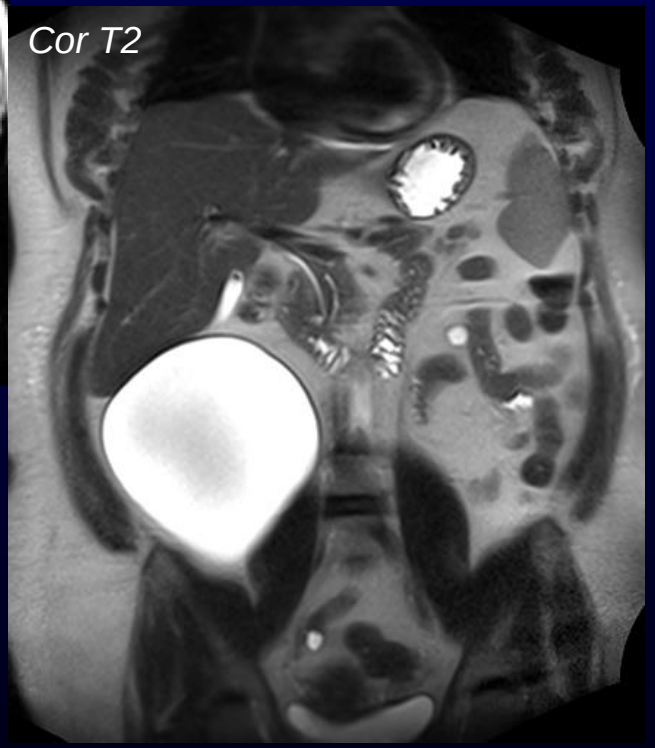


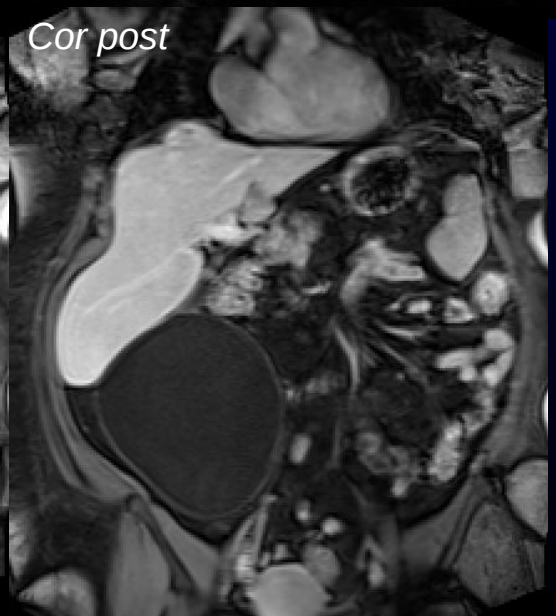


46 yo F, ovarian serous cystadenoma, retroperitoneal

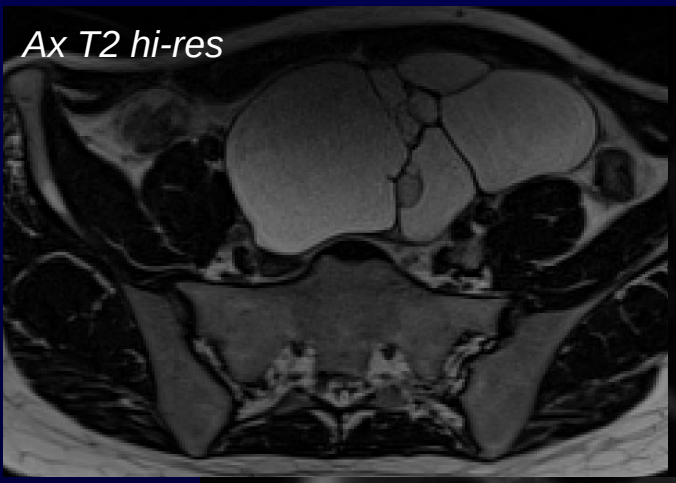






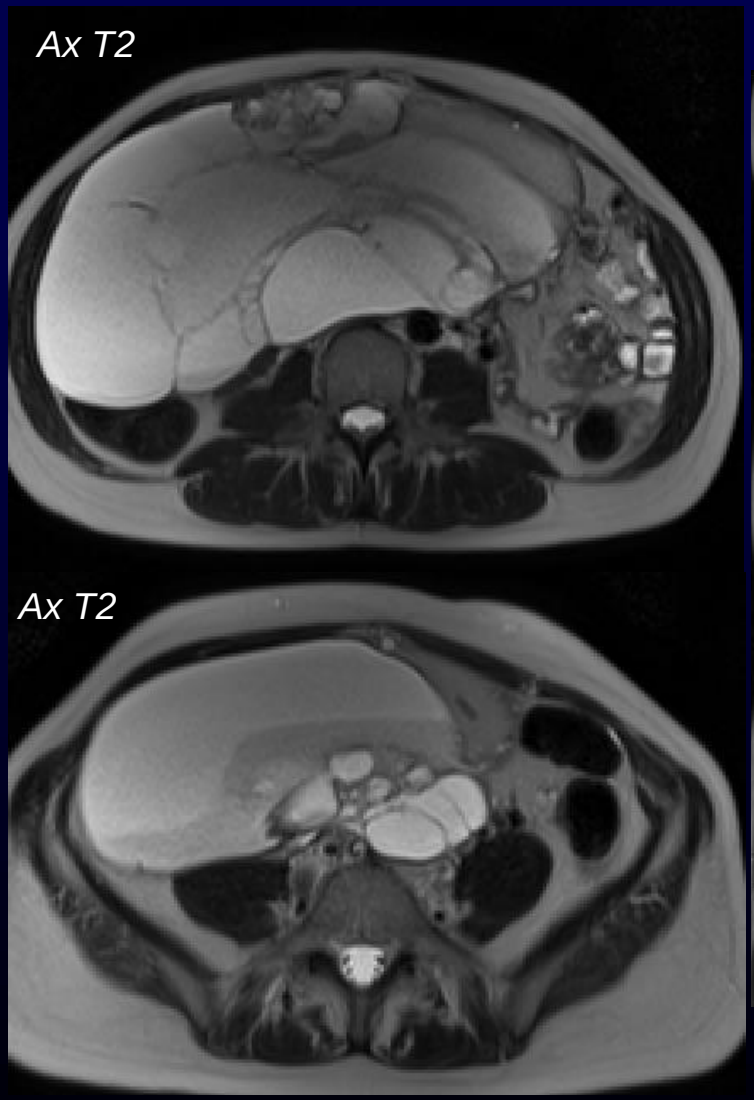


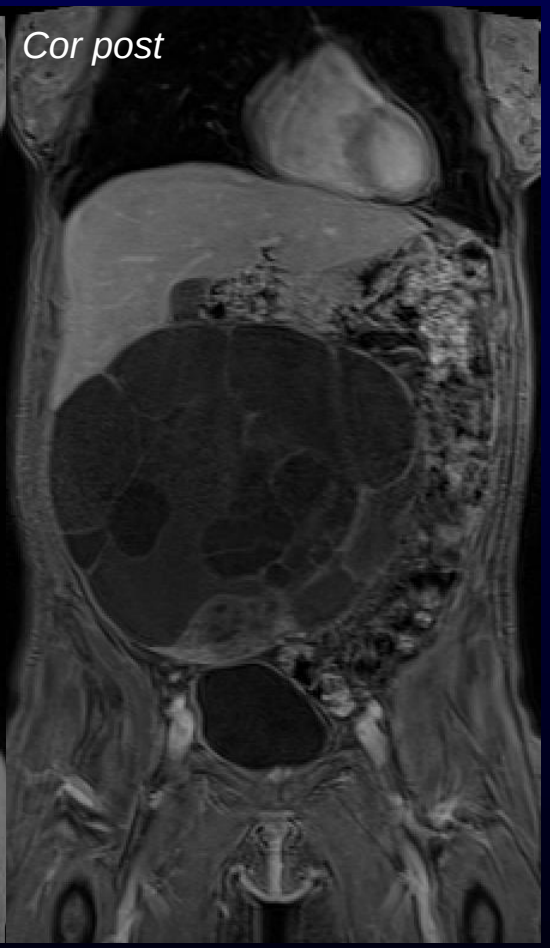
33 yo F, mucinous cystadenoma



29 yo F, mucinous cystadenoma

33 yo F, mucinous cystadenoma-borderline

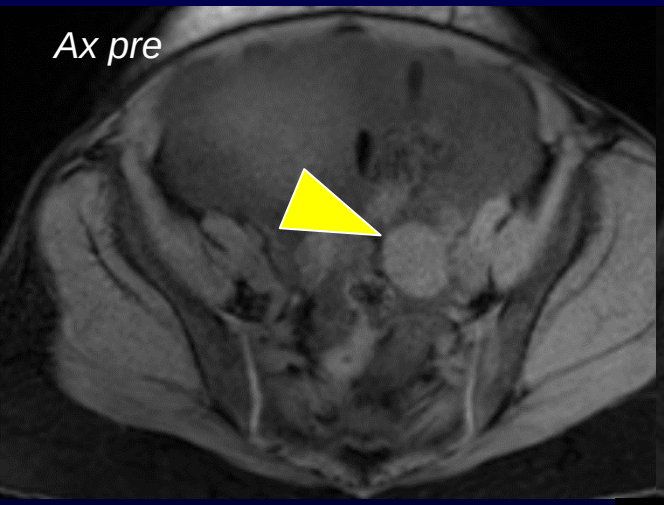


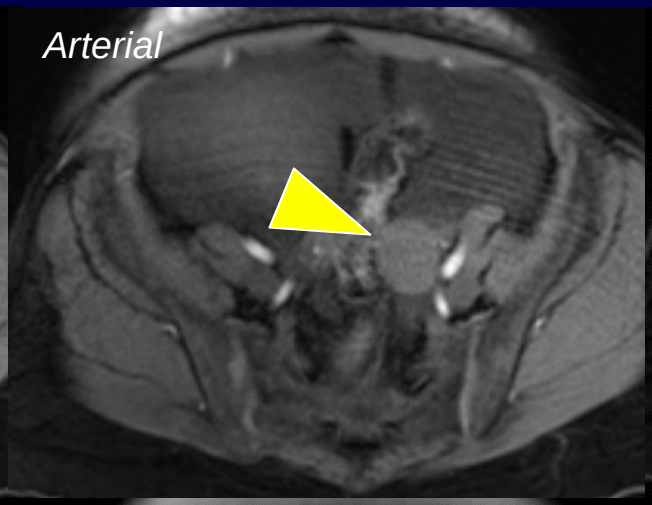


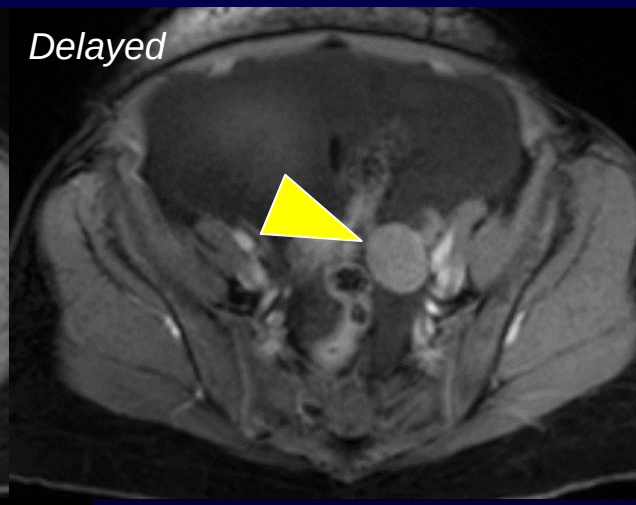
Sex cord stromal tumors

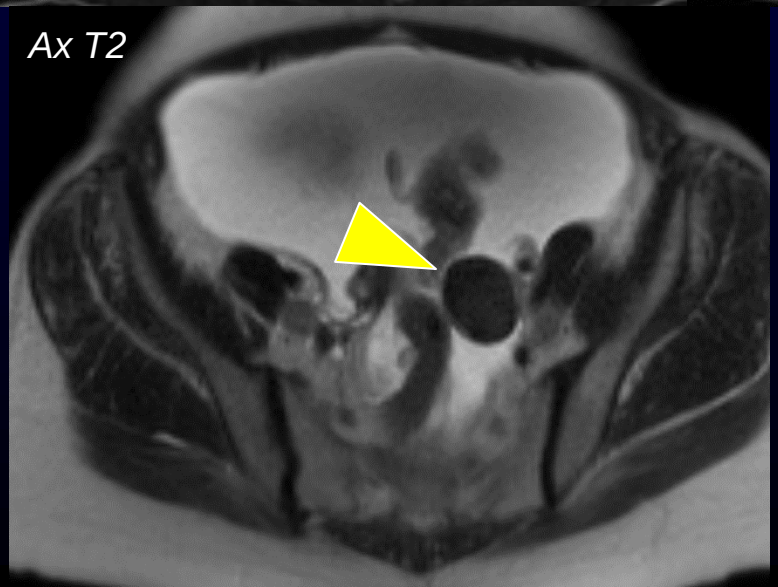
- Tumors in this category composed of cells that resemble:
  - Female/male endocrine apparatus
    - Granulosa cells, theca cells, sertoli/leydig
  - Other stromal elements (fibroblasts)
- Overlap!
- Hormonally active

40 yo F, ovarian fibroma

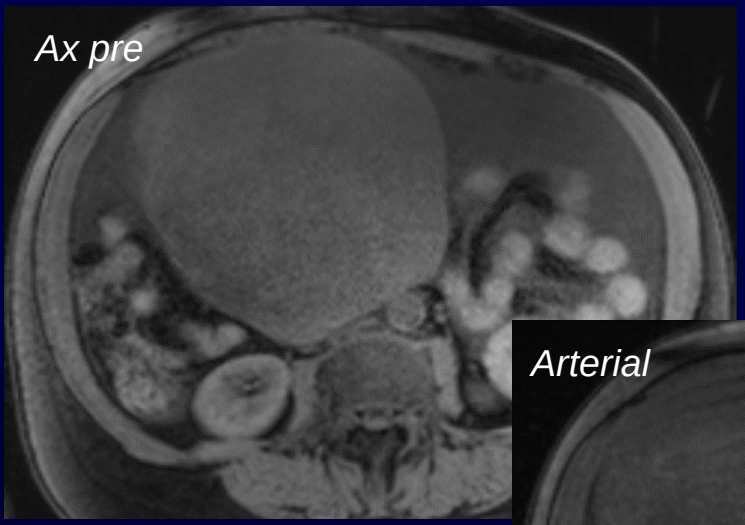


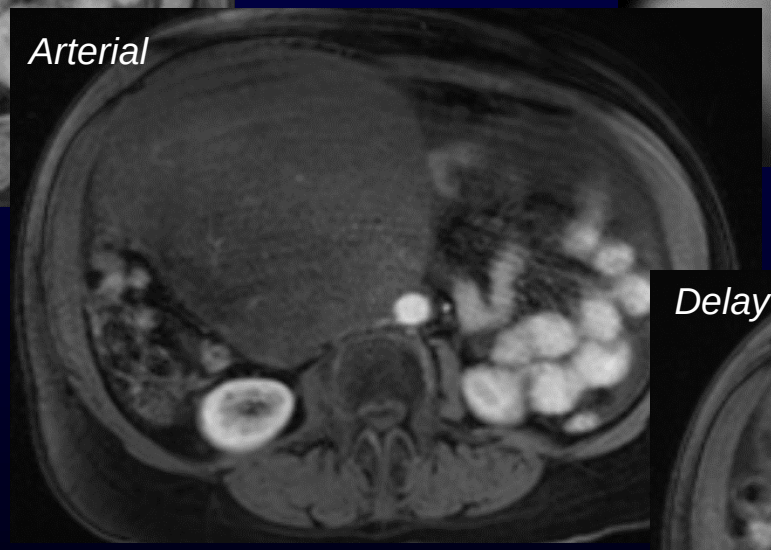


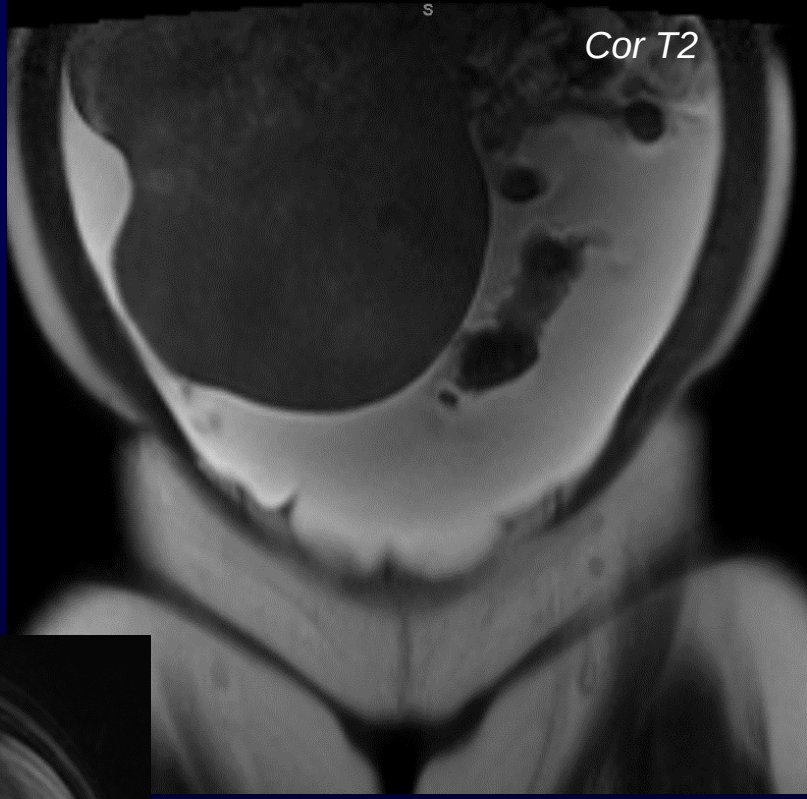




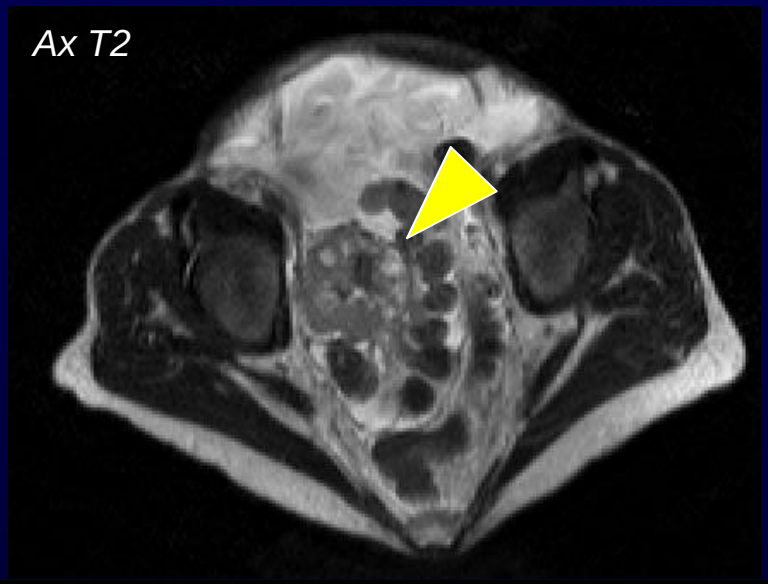
61 yo F, fibroma

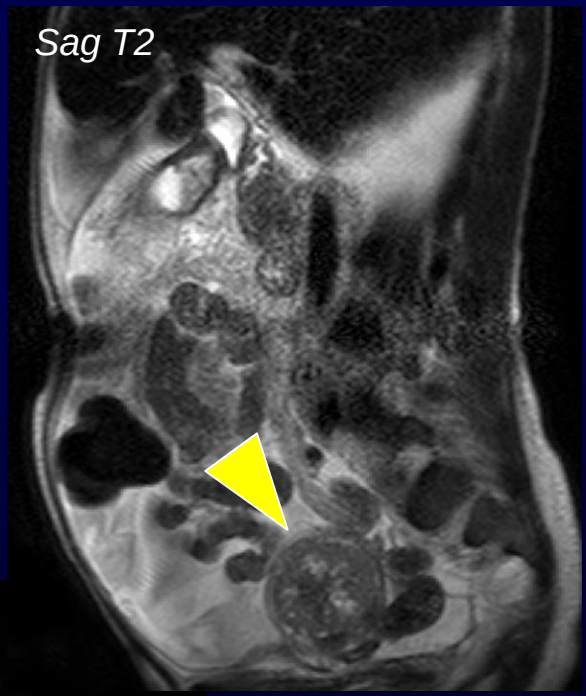


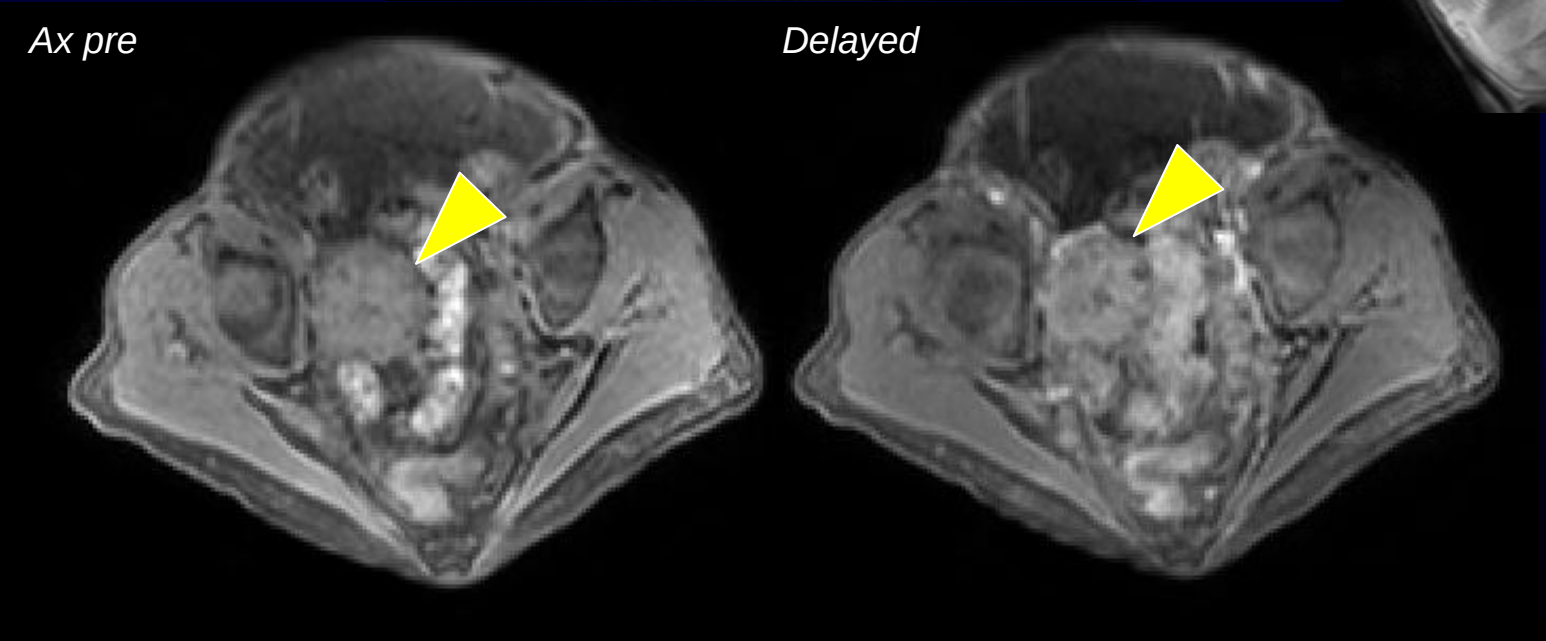




27 yo F, granulosa cell tumor





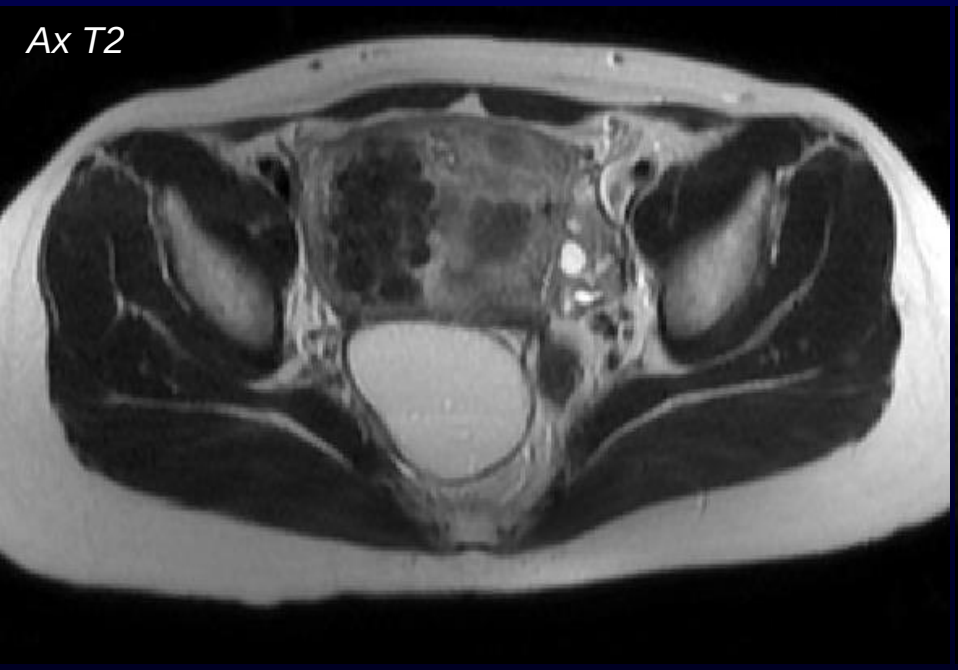


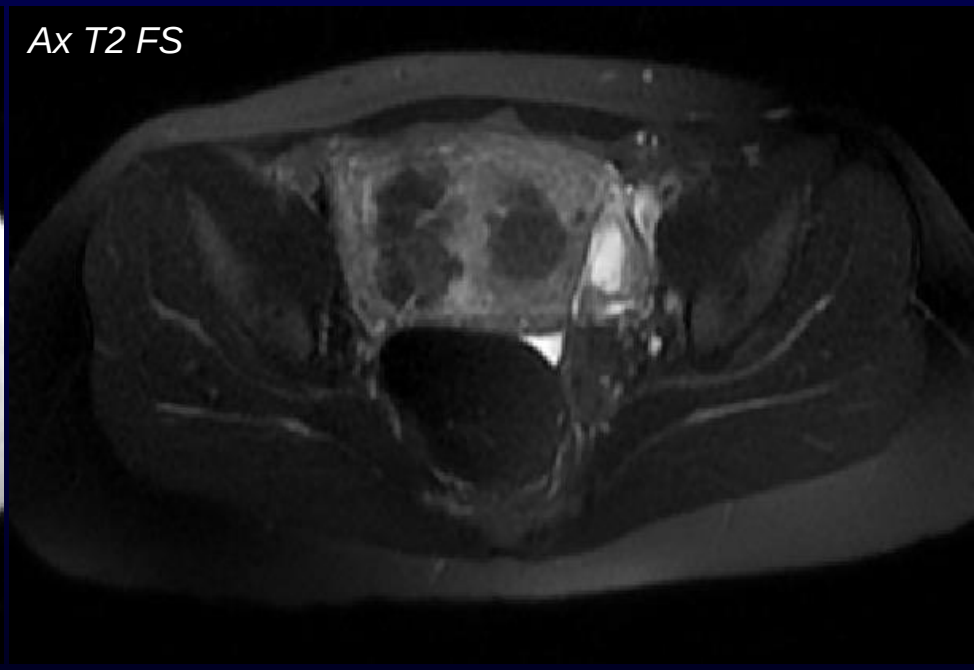
Germ cell tumors

- Except for dermoids, these are typically aggressive tumors
  - Frequently mixed type

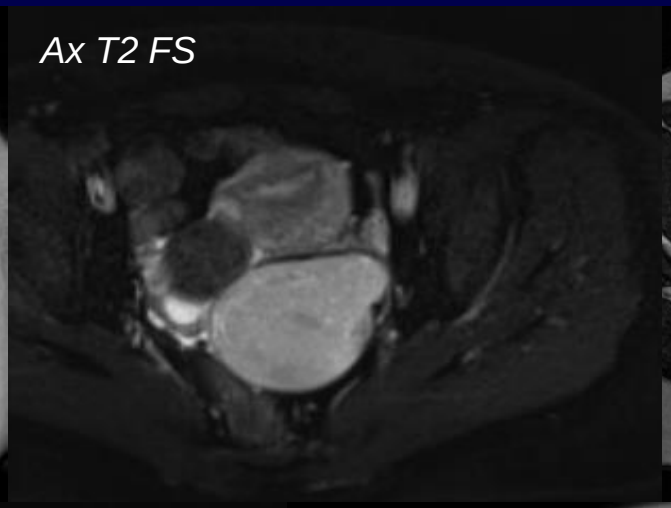
- Tumor subtypes: Dysgerminoma, embryonal carcinoma, endodermal sinus tumor, choriocarcinoma

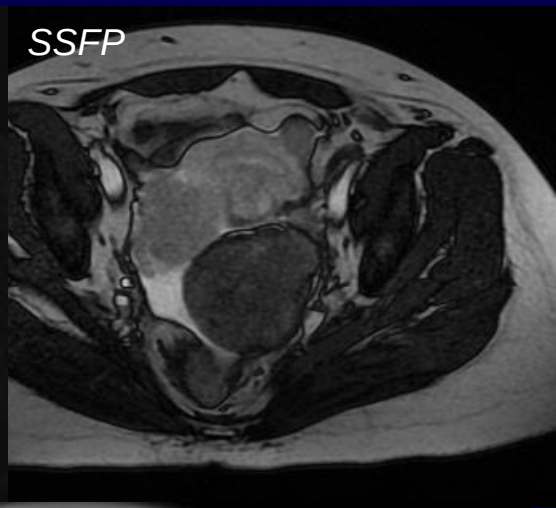
42 yo F, dermoid

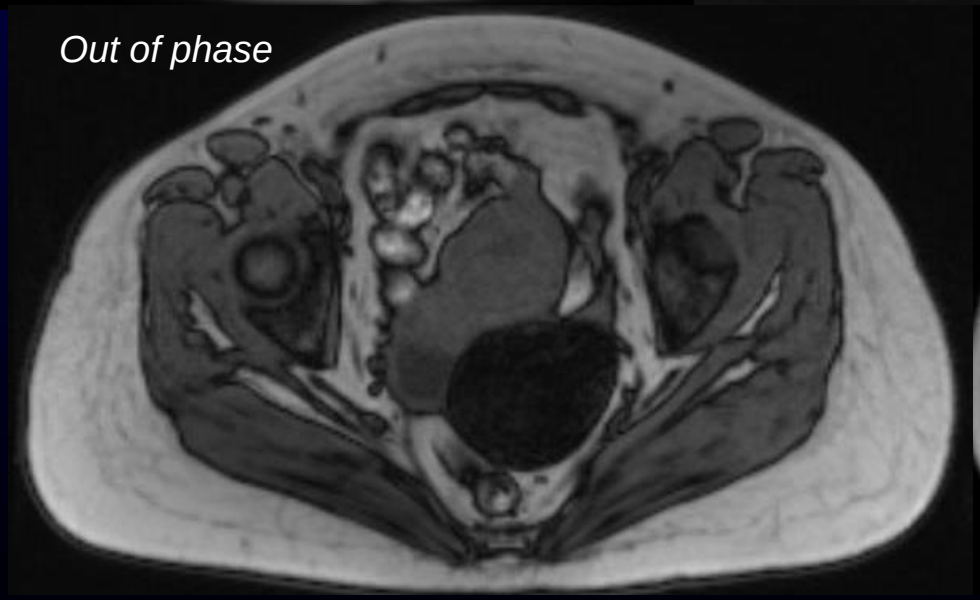




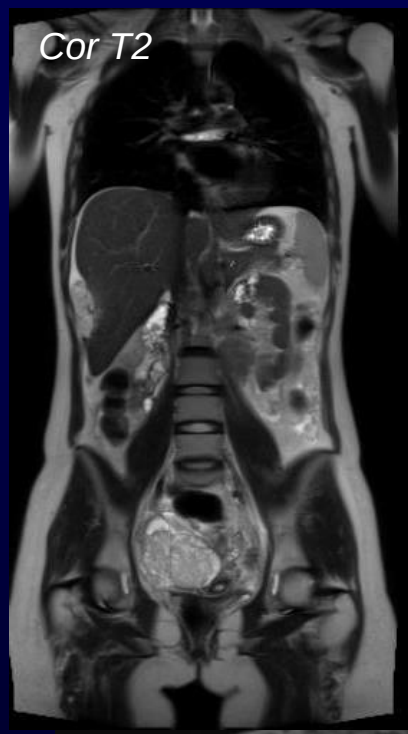
Dermoid: In and Out-of-Phase

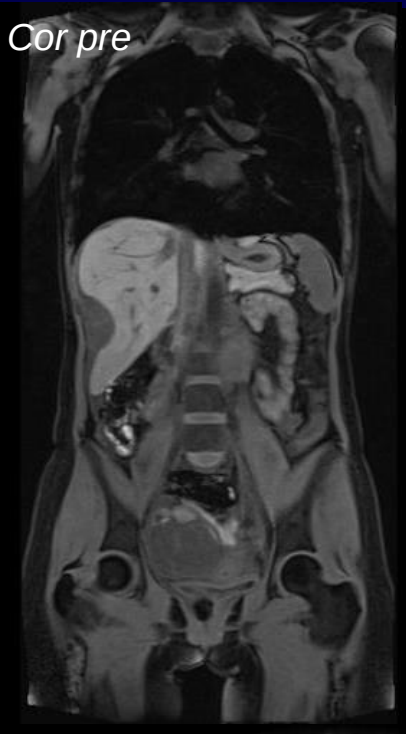


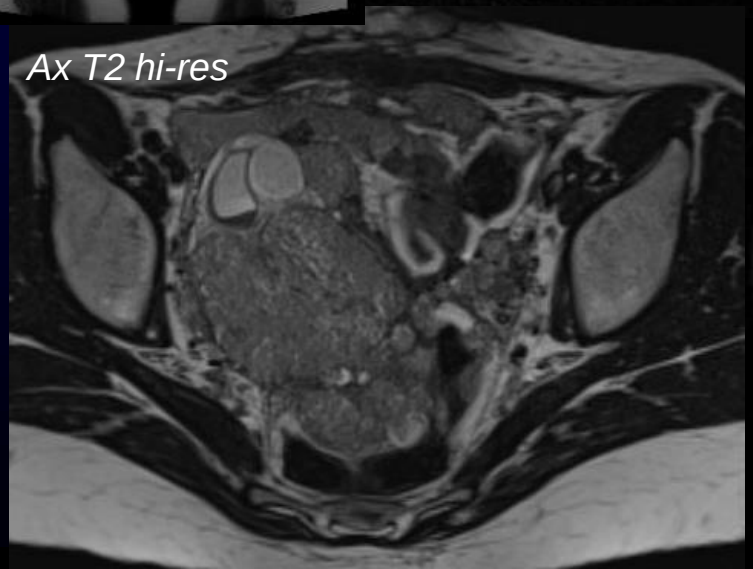


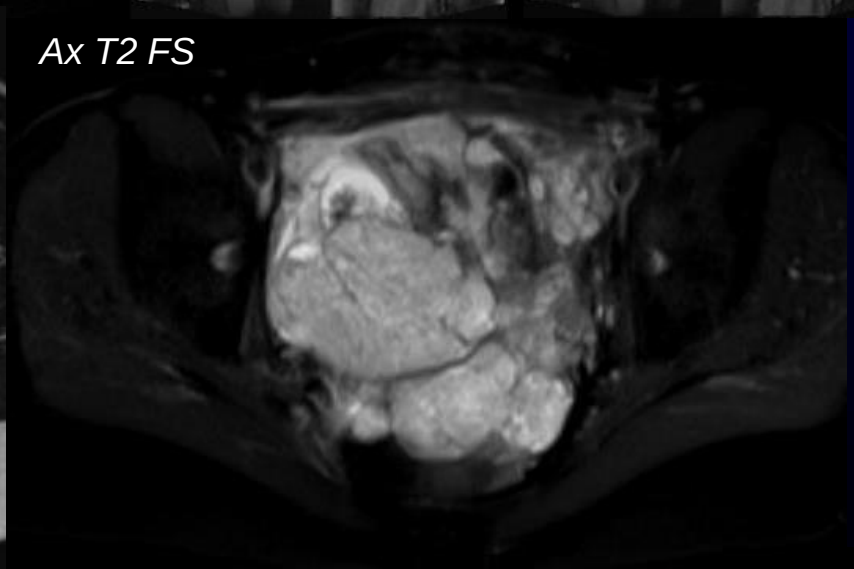


24 yo F, metastatic embryonal cell CA

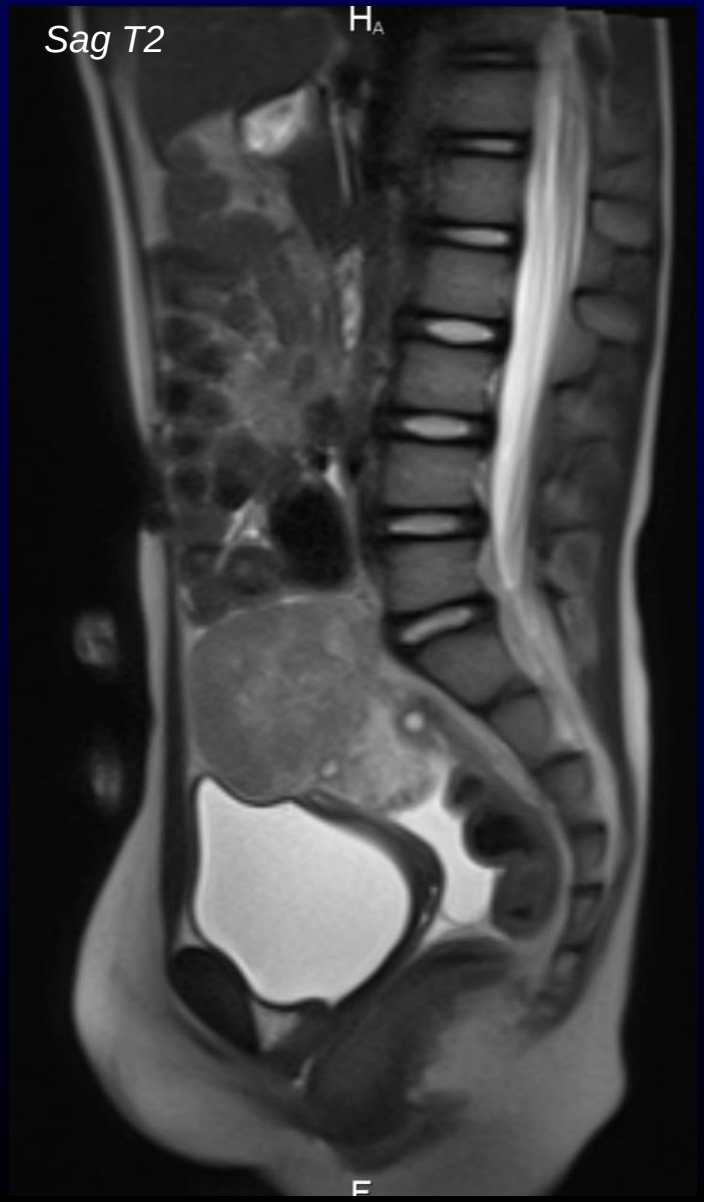


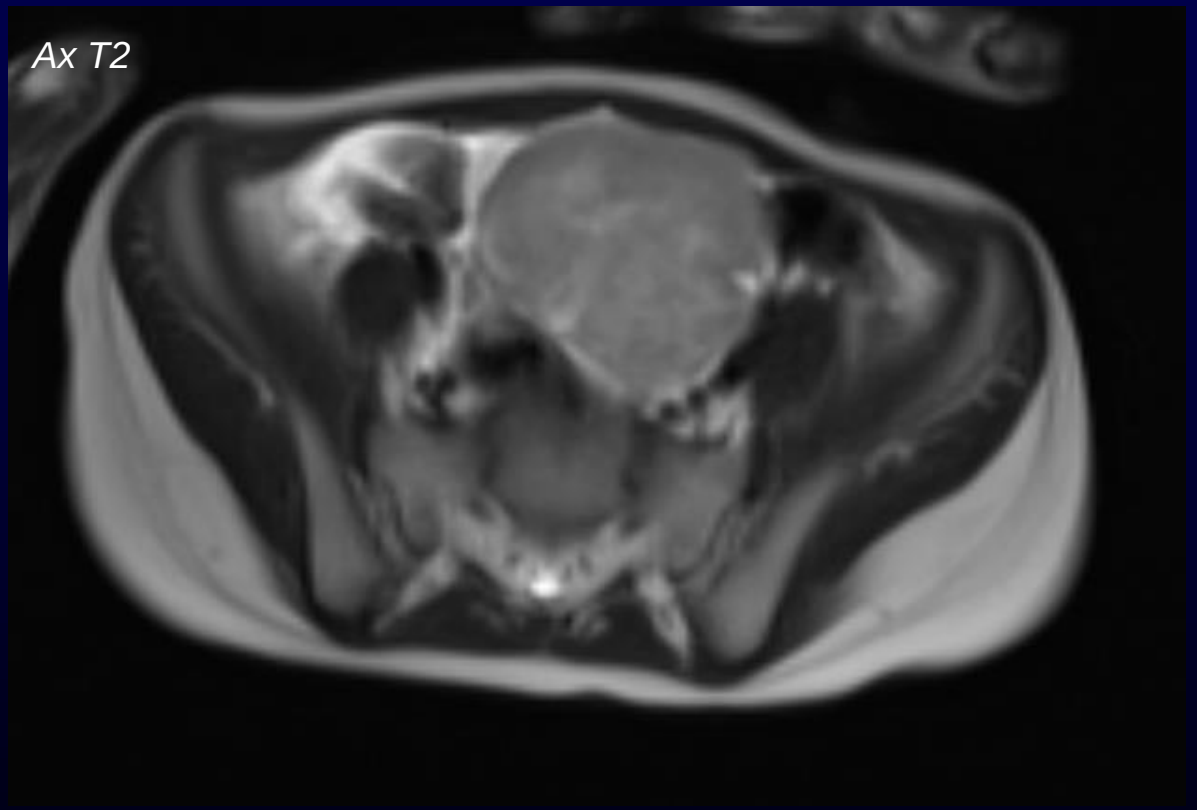






4 yo F, dysgerminoma, torsed ovary





Summary

- MRI provides most detailed analysis of congential uterine anomalies, which may be mixed and complex
- Distinction between endometrial CA and polyp is mostly straightforward, though there may be overlap of imaging features
- Ovarian tumors are typically best assessed with MRI, especially regarding diagnostic specificity