An Ultrasound Review of PELVIC PATHOLOGY

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Pathology to be covered

• Uterus
• Cervix
• Ovary
• Adnexa
• Appendicitis
• Interesting Cases
Pathology not covered

• Pelvic pathology related to pregnancy, congenital or childhood abnormalities or normal variants
• Pelvic pathology related to non gynecological problems
• Limited review of normal anatomy
Myometrial Pathology

- Leiomyoma
- Lipoleiomyoma
- Leiomyosarcoma
- Adenomyosis
- Arteriovenous Malformations
Leiomyomas (Fibroids)

- Most common uterine neoplasm seen in up to 30% of women over 30
- More often seen in Afro-Americans
- Usually multiple
- Often asymptomatic but may present with pain/uterine bleeding
- Composed of spindle shaped muscle cells and fibrous connective tissue
• Estrogen dependent and may increase in size in anovulatory cycles, during pregnancy, with Tamoxifen and in post menopausal woman on hormone replacement.

• Most stabilize or decrease in size after menopause
• Location
  • Intramural
  • Submucosal
  • Subserosal

• Appearance
  • Enlarged heterogenic uterus
  • Hypoechoic/heterogenic lesion
  • Acoustic attenuation
  • Focal calcifications/ calcified rim
  • Degeneration/necrosis
Intramural Fibroid

Confined to myometrium
Submucosal Fibroid

Projecting into the endometrial cavity
Submucosal Fibroid
Subserosal fibroid

Projecting from the peritoneal surface
Pedunculated Fibroid
Enlarged diffuse leiomyomatous
Fibroid with acoustic attenuation
Calcified fibroid
Calcified fibroids on plain films
Degenerating Fibroid
Lipoleiomyomas

• Very rare benign tumors
• Consist of variable amounts of lipocytes, smooth muscle and/or fibrous tissues
• Appears as echogenic, attenuating mass with no flow on color Doppler
• Usually asymptomatic and do not require surgical removal
Lipoleiomyoma
Leiomyosarcomas

• Very rare malignancy which accounts for less than 2% of uterine cancers
• It may arise from a preexisting leiomyoma
• Frequently asymptomatic; uterine bleeding may occur
• Has the ultrasound appearance of a rapidly growing or degenerating leiomyoma with local invasion or distant metastases
Leiomyosarcoma
CT of a leiomyosarcoma
Adenomyosis

- The presence of endometrial glands and stroma within the myometrium
- Diffuse form characterized by an enlarged uterus with a diffusely heterogenic myometrium
- Nodular form compose of nodules (adenomyomomas)
- May present with pelvic pain, dysmenorrhea or menorrhagia
• Asymmetrically thickened myometrium
• Subendometrial cysts, echogenic linear striations or echogenic nodules
• Ill defined endometrial border
Adenomyosis

Echogenic nodule
Subendometrial cysts with indistinct endometrium
MRI of Adenomyosis
Focal thickening of myometrial junction zone
Uterine Arteriovenous Malformations

- Consist of a vascular plexus of arteries and veins with no intervening capillaries
- Rare lesions seen in the myometrium and occasionally in the endometrium
- Most are acquired secondary to trauma, surgery or gestational trophoblastic neoplasms
• Greyscale images may be nonspecific or may show multiple serpiginous, anechoic structures
• Color Doppler shows abundant blood flow in the AVM
• Spectral Doppler shows high velocity low-resistance arterial flow with high velocity venous flow
Multiple serpiginous anechoic structures
AVM in Cesarean scar
Endometrial Appearance

- Normal premenopausal phases
  - Early proliferative
  - Mid cycle secretory
  - Late secretory
- Post menopausal
  - Endometrial atrophy
  - Endometrial hyperplasia
Early proliferative
5-7mm on transvaginal ultrasound
Midcycle secretory
Up to 11 mm on transvaginal ultrasound
Late secretory
7-16mm on transvaginal ultrasound
Post menopausal endometrium
Endometrium should be $\leq 4$mm on transvaginal ultrasound
Reasons for post menopausal bleeding

- Endometrial atrophy
- Endometrial hyperplasia
- Endometrial polyps
- Endometrial carcinoma
Postmenopausal atrophy
If < 4mm, postmenopausal bleeding is usually attributed to atrophy
May see small amount of fluid or cystic changes
Endometrial Hyperplasia

- Diffuse but may not involve the entire endometrium
- Histologically may +/- cellular atypia
- (25% with atypia progress to cancer)
- Need Bx to determine
- Develops from unopposed estrogen stimulation - hormone replacement, persistent anovulatory cycles, PCO, obesity, estrogen producing ovarian cancers
Diffuse
Diffusely thickened and echogenic
Tamoxifen Therapy

Has estrogenic effect on postmenopausal women-causes endometrial thickening and cystic changes-Increased risk of polyps/Ca
Endometrial Polyps

• Localized overgrowths of endometrial tissue covered by endothelium
• 20% of polyps are multiple
• Malignant degeneration is uncommon
• May be diffuse, focal, pedunculated, stalked or contain cysts
• Best evaluated with sonohysterography
Echogenic polyp
Echogenic polyp

Color Doppler shows vascular flow
Small single polyp
Multiple polyps
Cystic changes in Endometrial Polyp
**Sonohysterography**

Helps determine if endometrial lesion is polyp or submucosal fibroid.
Endometrial Carcinoma

- Most common gynecologic malignancy occurring in 3% of women
- 75-80% of this cancer occurs in postmenopausal woman
- Accounts for less than 1.5% of cancer deaths in women because >75% of endometrial cancers are confined to the uterus.
Subtypes of endometrial cancer

- Type I (80%)
  - Well differentiated with slow progression seen in woman 55-65
  - PTEN gene mutation in 30-80%
  - Arises in setting of hyperplasia/elevated estrogen

- Type II (20%)
  - Less differentiated and spreads early
  - in woman 65-75
  - P53 mutation in up to 50%
  - Arises in setting of endometrial atrophy
Appearance of endometrial cancer

May resemble hyperplasia/polyps with uniformed thickened echogenic endometrium

More commonly the endometrium is heterogenic with poorly defined borders
Fluid filled endometrium with an irregular vasculized wall, polypoid lesions and ascitis
Endometritis

- Endometrium may appear thickened, irregular and may or may not contain fluid
- Gas may be seen in the endometrial canal
- May occur postpartum, following surgery or with PID
Thickened heterogenic endometrium
Secondary to PID
Poorly defined endometrium with gas
Following myomectomy for leiomyoma
Endometrial Adhesions

- Endometrium may appear normal on transabdominal and transvaginal US
- Best seen in secretory phase when the endometrium is more hyperechoic
- Sonohysterography demonstrates adhesions as bridging bands of tissue that distort the endometrial cavity
Transvaginal

Bright hyperechoic scar tissue in the endometrial canal
Sonohysterogram
Demonstrates synechiae also known as Asherman’s syndrome
INTRAUTERINE ADHESIONS

ADHESION ON HSG

ADHESION AT HYSTEROSCOPY
Hydro/Hematometrocolpos

- Accumulation of secretions and/or blood in the uterus and/or vagina with the location depending on the amount of obstruction.
- When congenital due to imperforate hymen, vaginal septum, atresia, rudimentary uterine horn
- When acquired due to endometrial or cervical tumors or postradiation fibrosis
Hydrometacolpos
Secondary to imperforate hymen
Hematometrocolpos
Secondary to cervical tumor
Intrauterine Contraceptive Devices

• Appear as echogenic linear structures in the endometrial cavity in the body of the uterus

• Should see acoustic shadowing and two parallel echoes representing the anterior and posterior surfaces of the IUCD
3D US image
IUCD correctly positioned in the fundus and body of the endometrial canal
Malpositioned IUCD
IUCD in endocervical canal
IUCD in the posterior wall of the uterus
Cervical Lesions

- Nabothian cysts
- Cervical polyps
- Cervical leiomyomas
- Cervical carcinoma
Nabothian cysts
Common finding
Measure few mm to 4 cm
May have internal echoes from hemorrhage or infection
Cervical Polyps

Hyperechoic lesion with vascular flow
Frequent cause of vaginal bleeding
Cervical Leiomyoma

Pedunculated fibroids can prolapse into vagina
Can be obstructive at childbirth
Cervical Carcinoma
May resemble a cervical Fibroid
Usually diagnosed clinically
Benign Ovarian Cysts

- Functional Cysts
  - Follicular
  - Corpus Luteal
- Hemorrhagic Cysts
- Theca-luteal Cysts
- Postmenopausal Cysts
- Endometriomas
Normal ovarian follicles

-during the proliferative phase
Dominant follicle on Day 10 which can reach 2-2.5 cm at time of ovulation
Follicular cyst
Result of mature follicle failing to ovulate or involute; Cyst must be > than 2.5 cm; usually regress on own
Corpus Luteal Cyst

Result from failure of absorption or from excess bleeding into the corpus luteum
Have thicker walls with crenulated appearance
Hemorrhagic cysts

• Internal hemorrhage from granulose cells lining functional or corpus luteal cysts

• Appearance depends on age and amount of hemorrhage ranging from hyperechoic with posterior acoustic enhancement to reticular pattern with internal echoes to fluid-fluid line

• No flow seen within cyst on Doppler
Acute hemorrhagic cyst

Echogenic free fluid in pelvis indicates a leaking or ruptured cyst – woman with these cysts complain of pelvic pain.
Hemorrhagic Cysts
Septations with internal echoes and no flow
Theca-luteal cysts

- Largest of functional cysts
- Associated with high levels of HCG
- Seen in gestational trophoblastic disease and ovarian hyperstimulation syndrome with infertility drug therapy
- These cysts are bilateral, multilocular and very large
Theca-luteal cysts

Cysts may hemorrhage, rupture or undergo torsion
Ovarian Hyperstimulation Syndrome

- Complication of ovulation induction
- Mild form associated with lower abdominal pain, up to 5 cm ovaries, mild ascitis nausea
- Severe form associated with severe abdominal pain and distention, 10cm or larger ovaries with multiple cysts, ascitis, pleural effusions, low BP, oliguria and electrolyte imbalance
Postmenopausal Cysts

• Unilocular <7cm in diameter and without septations or solid components can be followed by US
• <3cm simple cysts seen in 15% of postmenopausal woman
• May disappear or change in size
Ovarian Remnant Cysts

• Small simple to larger complex cysts can infrequently arise from a small amount of residual ovarian tissue following a bilateral oophorectomy

• Usually the remnant of ovarian tissue is secondary to a surgery complicated by adhesions, endometriosis, PID or tumor
Followup of Ovarian cysts in Premenopausal Women

- **Simple Cysts**
  1. <3cm=Normal finding
  2. 3-5 cm=Certainly benign, No F/U
  3. 5-7 cm= Likely benign; yearly F/U
  4. >7 cm=further evaluation with MRI or surgery

- **Hemorrhagic Cysts**
  1. < 5 cm= Describe; No F/U
  2. >5 cm=F/U in 6-12 weeks
Followup of Ovarian Cysts in Post menopausal Women

- Simple Cysts
  1. <1cm = inconsequential; No F/U
  2. 1-7cm = Yearly F/U
  3. >7cm = Further evaluate with MRI or surgery

- Hemorrhagic Cysts
  - Perimenopausal = F/U US in 6-12 wks
  - Postmenopausal = Abnormal; Surgery
Endometriomas

- Localized form of endometriosis
- Well defined uni/multilocular cystic mass with diffuse low level internal echoes usually found in the ovary; often bilateral
- May have marginal echogenic nodules or fluid-fluid level
- Show little change over time with no pain or chronic menstrual pain
- Endometriomas > 9 cm show <1% malignant transformation
- Cause decrease ovarian function and fertility
Polycystic Ovarian Disease

- PCOD is an endocrine disorder which causes elevated LH and depressed FSH levels which results in hypersecretion of androgens and chronic anovulation.
- Common cause of infertility and early pregnancy loss
- Increased risk for Type 2 DM, CAD, CVA, HTN and Hyperlipidemia
- Spectrum ranges from thin menstruating woman to obese, hirsute amenorrheic females (Stein-Leventhal syndrome)
PCOD Appearance

• Threshold ovarian volume > 10cm
• There are 12 or more follicles measuring 2-9mm in diameter
• Need to have only one ovary meet either of the criteria to establish the presence of polycystic ovaries
• Increased echogenicity of ovarian stroma
Ovarian Torsion

• Partial or complete rotation of the ovarian pedicle on its axis which compromises the lymphatic and venous drainage causing edema leading to loss of arterial perfusion and infarction

• May occur in normal ovaries or with an ovarian mass

More common in childhood/reproductive years with increased risk during pregnancy
Ultrasound Findings

- Enlarged ovary with multiple cortical follicles
- Sparse or lack of flow in the ovary on Color Doppler
- Free fluid often present
Nonshadowing Echogenic Ovarian Foci (EOF)

- EOF in otherwise normal ovaries are caused by a specular reflection from walls of tiny unresolved benign cysts
- Can be peripheral, central or diffuse
- Average size = 1.8 mm
- Benign and require no further imaging followup
Psammomatous Calcification
Ovarian Neoplasms

- Surface epithelial-stromal: 65-75%
- Germ cell: 15-20%
- Sex cord-stromal: 5-10%
- Metastatic: 5-10%
Surface epithelial-stromal Tumors

• Account for 65-75% of ovarian malignancies
• Five categories
• 1. Serous cystadenoma/carcinoma
• 2. Mucinous cystadenoma/carcinoma
• 3. Endometrioid carcinoma
• 4. Clear cell carcinoma
• 5. Transitional cell carcinoma
Serous Cystadenomas

- Account for 20-25% of all benign ovarian neoplasms
- Peak incidence in woman age 30-50
- 20% bilateral
- Large thin walled unilocular cystic mass
- May contain septations or mural nodules
Serous Cystadenocarcinomas

- Account for 40-50% of all malignant ovarian neoplasms
- Most often seen in peri /post menopausal women
- 50% are bilateral
- Very large multilocular cystic mass with multiple papillary projections arising from the walls and septae
- May contain echogenic solid material
Mucinous cystadenomas

- Account for 20-25% of all benign ovarian neoplasms
- Peak incidence in women 20-50
- 5% are bilateral
- 15-30cm cystic masses with multiple thin septae and low level echoes caused by mucoid material
Mucinous cystadenocarcinomas

- Account for 5-10% of primary ovarian neoplasms
- Most often seen in woman 40-70
- 15-20% are bilateral
- Appearance is similar to mucinous cystadenoma but with septal nodularity
- Can see pseudomyxoma peritonei secondary to intraperitoneal spread
Germ Cell Tumors

- Derived from the primitive cells of the embryonic gonad

- Three categories of germ cell tumors
  - 1. Teratoma
    - Dermoid
    - Immature
  - 2. Dysgermininoma
  - 3. Yolk sac tumor
Dermoids

- Account for 95% of germ cell tumors
- AKA a mature cystic teratoma
- Occur in women of child bearing age
- Usually unilocular, few are multilocular and 15% are bilateral
- Compose of ectoderm, mesoderm and endoderm
- Up to 60% contain Ca+
- Presence of fluid fat level is diagnostic
Tip of the Iceberg sign
Echogenic mass of hair and secum which obscures the posterior wall of the lesion
Fat fluid level
Dermoid mesh

Hair fibers in cystic portion
Sex cord-stromal Tumors

• Derived from the sex cords of the embryonic gonad and/or the ovarian stroma
• Three categories
  • 1. Granulosa cell tumor
  • 2. Sertoli-Leydig cell tumor
  • 3. Thecoma and fibroma
Thecoma and Fibroma Tumors

- Arise from the ovarian stroma and contain thecal and fibrous tissue
- On US appear as a hypoechoic mass with marked posterior attenuation of the sound beam
Metastatic Tumors

• Three categories
• 1. Genital primary - Uterus
• 2. Extrageneric primary
  • Stomach
  • Colon
  • Breast
• 3. Lymphoma
Krukenberg Tumor
Metastasis from the colon
Extraovarian Lesions

- Hydrosalpinx
- Pyosalpinx/Tubo-ovarian Abcess
- Endometriosis
- Carcinoma
- Peritoneal inclusion cysts
- Para-ovarian cysts
Hydrosalpinx
Distally blocked fallopian tube filled with serous or clear fluid; 2 to infection/endometriosis
Pyosalpinx
Low level internal echoes in dilated fluid filled tube
Tubo-ovarian Abscess
Enlarged complex cystic multiloculated mass
Tubo-ovarian Abscess
May have irregular margins and scattered internal echoes
Endometrial implants

Diffuse endometriosis presents as minute implants on the pelvis organs and their ligaments
Peritoneal Inclusion Cyst
Occur primarily in premenopausal women with hx of previous surgery, PID, trauma or endometriosis
**Peritoneal inclusion cyst**

Ovary is entrapped in fluid
Paraovarian Cysts

- Cystic dilatation in the vestiges of the Wolffian or Mullerian ducts in the broad ligament
- These cysts are separate from the ovary and fallopian tubes
- Nonfunctional in nature
- Can measure from 1-8 cm in size
Acute Appendicitis

• Secondary to obstruction of the appendiceal lumen.
• Presents as a blind ending, aperistaltic and noncompressible tubular structure arising from the cecum
• => 7mm in diameter
• Advanced cases may perforate and cause an abscess
Interesting cases
HX: 28 year old female with pelvic and RLQ pain
DX: Acute appendicitis and 6 week IUP
HX: 16 yr old amenorheic female
Dx: Amenorrhegic female successfully tx with hormones

• Hormone imbalance may be at the level of the pituitary/hypothalamus or be related to gonadal end organ failure
Hx: 48 yr old female with excessive uterine bleeding

- Hx of IDDM, LUE DVT tx with Xerelto
- Heavy menstrual bleeding which started 9 days ago
- Hgb=5
Dx: DUB secondary to med

- Pelvic exam revealed no cervical or vaginal mass
- Tx with Provera and blood transfusion
Hx: 29 yr old female with acute onset of LLQ pain
Dx: Torsed mucinous cystadenoma of the left ovary
Hx: 50 yr old female with RLQ pain
Dx: Mucinous adenoma of the appendix/ left ovarian cystadenoma