POST PARTUM UTERUS IMAGING OF COMPLICATIONS

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Disclosures

- None
Objectives

- Normal post partum uterus
- Post-partum hemorrhage
  - Uterine Atony
  - Retained products of conception (RPOC)
  - Sub-involution trophoblastic tissue
- Infection
- Gestational Trophoblast Disease (GTD)
- Unusual Cases
Post partum period includes after

- Spontaneous vaginal delivery or C-section
- Termination of pregnancy
- Early Pregnancy Loss (EPL)
Post-Partum Uterus: Imaging

- Ultrasound 1\textsuperscript{st} line imaging followed by CT or MRI as most appropriate
Post-Partum Uterus : Normal

- Endometrial cavity
  - 2 – 2.5cm sagittal AP (1 week PP)
  - Heterogeneous containing gas (20%), debris (24%)
- Return to baseline over 6-8 wks
  - May delayed in setting RPOC or infection
  - Time < well-defined post TA or EPL

Van Schoubroeck et al. Prospective evaluation of blood flow in the myometrium and uterine arteries in the puerperium. UOG 2004;23(4):378-81
Post Partum Uterus

Differential Diagnosis Thickened Endometrium
Differential Diagnosis Thickened Endometrium

Differential diagnosis

- Normal < 2-2.5cm
  - 20% foci gas, 24% debris
- Blood clots
- RPOC
- Subinvolution trophoblastic tissue
- Endometritis – (Myometritis)
- Gestational trophoblast disease (GTD)
### Differential Diagnosis

<table>
<thead>
<tr>
<th>Differential diagnosis</th>
<th>Stratify by</th>
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<tbody>
<tr>
<td>Normal &lt; 2-2.5cm</td>
<td>Vascularity</td>
</tr>
<tr>
<td>▪ 20% foci gas, 24% debris</td>
<td>□ Timing post partum</td>
</tr>
<tr>
<td>Blood clots</td>
<td>□ Symptoms</td>
</tr>
<tr>
<td>▪ RPOC</td>
<td>▪ Bleeding, infection, pain</td>
</tr>
<tr>
<td>Subinvolution trophoblastic tissue</td>
<td>□ bHcg status</td>
</tr>
<tr>
<td>Endometritis – (Myometritis)</td>
<td></td>
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<tr>
<td>Gestational trophoblast disease (GTD)</td>
<td></td>
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</table>
Stratify: Vascularity

- Consider if confined to endometrium (RPOC) or extends into myometrium (subinvolution trophoblastic tissue or GTD)

Van Schoubroeck et al. Prospective evaluation of blood flow in the myometrium and uterine arteries in the puerperium. UOG 2004;23(4):378-81
Stratify: Post-Partum Uterus & βhCG
Thickened endometrial cavity

<table>
<thead>
<tr>
<th>βhCG Negative</th>
<th>Consider blood clots, non-viable RPOC</th>
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<tbody>
<tr>
<td>βhCG Low to Negative</td>
<td>Consider RPOC</td>
</tr>
<tr>
<td>βhCG High or non-declining</td>
<td>Consider GTD</td>
</tr>
</tbody>
</table>
Retained Products of Conception (RPOC)

- RPOC implies incomplete uterine evacuation
- 2nd commonest etiology PPH after uterine atony

Risk Increased in setting:
- Late pregnancy termination or loss
- Uterine atony
- Placental attachment disorders, succenturiate lobe

Ultrasound can readily exclude retained products when the endometrial cavity is thin (< 2 mm), or contains a small amount of fluid.
- An echogenic intracavitary mass suggestive of RPOC but can be misleading in as many as 1/3 cases
- Calcification favor RPOC
Retained Products of Conception (RPOC)

- Diagnosis unequivocal: Fetal parts or placenta
- Suspicious: Endometrial mass +/- vascularity
  - Absent CDS not exclude RPOC
    - Non-viable or necrotic tissue
    - Natural history of non-vascularized RPOC uncertain but believe majority pass spontaneously
- Specific diagnosis histological proof chorionic vllii

*van den Bosch et al Occurrence and outcome of residual trophoblastic tissue JUM. 2008;27(3):357-61.*
Retained Products of Conception (RPOC)

Stratify: Bleeding
Post-Partum Hemorrhage (PPH)

- Early (< 24 hours) vs Delayed (> 24 hours)
  - > 500 ml
  - 1-2% all deliveries
  - Leading cause maternal mortality
  - Clinical diagnosis
Post-Partum Hemorrhage (PPH)

- Etiology
  - Commonest is uterine atony (early PPH)
  - RPOC 2nd commonest etiology
  - Also increased risk:
    - Post C-sections (1/3 deliveries are Csect USA)
    - > rate & variety PPH and infections
    - Late terminations or pregnancy loss
    - Placental attachment disorders

PPH: Uterine Atony

- Commonest etiology early PPH
  - Clinical diagnosis - suboptimal uterine contraction
  - Risk factors:
    - Overdistension uterus (polyhydramnios, multips)
    - Uterine relaxants like magnesium sulphate
    - Abnormal placentation with adherent placenta.

- If uterotonic agents ineffective consider non-permanent embolic agents to gain control over PPH in short-term
Post-Partum Uterus & Vascularity
Enhanced Myometrial Vascularity (EMV)

- Typically at implantation/placenta site
- Due subinvolution trophoblast tissue
- Can extend subendometrial into myometrium (full depth)
  - Low resistance, dilated, turbulent BV

- EMV without bleeding - presumed transient
- EMV with bleeding & RPOC - consider D&C
- EMV without RPOC – ?
- Natural history resolve spontaneously ~ 6 - 12 weeks PP but may take up to 6 months
Post-Partum Uterus & Vascularity Enhanced Myometrial Vascularity (EMV)

- Low resistance, dilated, turbulent BV typically at implantation/placenta site believed due subinvolution trophoblast tissue
- Can extend subendometrial into myometrium (EMV)
- EMV but no bleeding - presumed transient
- EMV with bleeding & RPOC - remove RPOC
- EMV without RPOC – ?
- Natural history resolve spontaneously ~ 6 - 12 weeks PP but may take up to 6 months
Case: What’s Your Diagnosis?

What is the next step? Why?

Now what?

Adjusted color gain appropriate to see area of maximum flow
PSV 100 cm per sec
Post-Partum Uterus & Vascularity

Spectrum RPOC to Uterine “non-AVMs”

- Hypervascular turbulent flow inner 1/3 myometrium
  - PSV > 0.83 cm/sec higher probability significant PPH
  - PSV < 0.39 likely safe

- “Uterine non-AVMs” group with high PSV
  - No early venous drainage or vascular nidus at angiography but > risk catastrophic hemorrhage PP
  - Need appropriate CDS settings to minimize aliasing so ID these high PSV vessels

Post partum Uterus & Role CDS

- Role CDS in suspected RPOC
  - Confirm vascularity, location

- Risk stratification
  - Triage group with higher risk significant PP bleeding

Management
Spectrum RPOC to Uterine “non-AVMs”

- Conservative or expectant in majority
- Medical (Misoprostol or methotrexate)
- Surgical Options
  - **D&C**
    - US guidance used for D&C resection or hysteroscopic resection of focal tissue.
  - **Uterine Artery Embolization or Ligation**
    - Good option in unstable or unreliable patient with concerning PPH and/or US evidence of “high PSV” with no endometrial mass
    - Unsure risk post UAE infertility
  - **Hysterectomy** (unstable-emergent)

_Timmerman et al. Color Doppler imaging is a valuable tool for the diagnosis and management of uterine vascular malformations. UOG 2003;21(6):570-7._
Case Diagnosis: Uterine “Non-AVM”

- Counseling that in a high risk group for PPH
- Chose undergo UAE
Case Diagnosis: Uterine “Non-AVM”

Pre Embolization

Adjusted color gain appropriate ID

What is the next step? Why?

Sag

Now what?

Trans

Pre Embolization

Post UAE

Trans
Case
Indication: Rule out RPOC

- Delivered 22 wk triplets due PROM & PTL
- 7 weeks PP with a βhCG 4
Findings: Distended endometrial cavity (2.4 cm) with marked internal vascularity with velocities reaching up to 100 cm/sec.

Opinion: Findings may correspond to retained product of conception associated with placenta increta extending almost to the serosal surface of the uterus. Gestational trophoblastic disease at this point cannot be excluded. Correlation with beta hCG level and D & C is recommended, after which further close followup would be advised to assess evolution.
#2 Ultrasound Report: 9 weeks PP
Still bleeding

US demonstrates passage of avascular material into lower uterine segment/cervix
So – End of Case?

- The original ultrasound report generated a request for MRI with clinical history: Complex mass in uterus invading to level of serosa. Help characterize **accreta vs AVM vs choriocarcinoma**
Diagnosis: RPOC with “non-AVM” in high risk triage group in association with subinvolution trophoblast tissue (EMV)
Management: Uterine Non-AVMs

- Stable reliable patient & PSV < 30 cm/sec low risk
  - Expectant 3-6 months regress
  - Medical – misoprostyl (uterotonic); methotrexate

- Unstable, unreliable, fail conservative & PSV > 90 cm/sec
  - Consider D&C (hysteroscopic or US guided)
  - Consider uterine artery embolization (UAE)
    - Unknown risk infertility, felt to be low
Case: Persistent extensive bleeding
High PSV 100 cm/sec
Case: Extensive PPH required transfusions

US Guidance of D&C to ensure all tissue removed
Post C-section: Bleeding

**Bladder Flap Hematoma**

- Extraperitoneal collection blood
  - < 2cm generally resolve
  - > 5 cm increased risk dehiscence

- Can extend into vesicouterine space (anterior to LUS/bladder) then may track into broad ligament and even extra-peritoneal
Post C-section: Bleeding

**Subfascial Hematoma** – next commonest extraperitoneal

- Related to injury epigastric blood vessels
- Accumulate prevesical space between rectus and bladder
- Large potential space
- May co-exist with bladder flap hematoma
Post C-section: Bleeding

Paravaginal Hematoma

- **Infralevator perivaginal space**
  - Easy to ID as extend to vulva, perineum, ischiorectal fossa thus may diagnosis on inspection

- **Supralevator** may dissect thru paravaginal fascia and broad ligaments
Post C-section: Bleeding

- If suspect active bleeding or extravasation then CTA (CT-angiography)
  - Confirm extravasation, ID BV/site
  - Define extent

- Angiography useful in hemodynamically unstable or candidates for UAE
Case: PPH (delivery 8 weeks ago)

- Emergent C-section @ 32 weeks due placental abruption
  - Adherent placenta was removed in bits
  - PPH required 3 units pRBCs
  - Hemoglobin 8.1 at discharge

- Returns 8 weeks PP due persistent bleeding (Hb only 8.4)
Case: What’s Your Diagnosis?

History: PP 8 weeks, persistent bleeding, underwent emergent C-section with PPH requiring transfusion
Diagnosis: Large bladder flap hematoma with dehiscent gap
- Note expansion LUS/cervical canal, bulging uterine contour
Case: What’s Your Diagnosis?

History: PP 8 weeks, persistent bleeding, underwent emergent C-section with PPH requiring transfusion
Management Options: Bladder Flap Hematoma & Dehiscence

- Avoid D&C due high risk uterine perforation
- Late for surgical approximation (8 wks PP)
- Plan
  - Stable, let uterus heal, reassess anatomy with MRI
  - Unstable UAE or emergency hysterectomy
  - Concurrent reliable contraception.
Case: Pain Post Termination Pregnancy

- D&E earlier that day for 16 week pregnancy
  - 16 weeks post laminaria tent dilation
  - Experience severe abdominal pain – procedure stopped

- Presented to ER
Case: What’s your Diagnosis?
Pain post D&E (16 wks)
Case: What’s your Diagnosis?
Pain post D&E (16 wks)

Uterine Rupture: Surgical repair 1.5 cm tear lower uterine segment
Case: Pain post D&E (16 wks)

Diagnosis: Uterine Rupture
Dehiscence & Rupture

- Risk factors
  - **Prior C-section**
  - Bladder flap hematoma > 5cm
  - Endometritis
  - Terminations – late – D&E
  - PAD (Placental adherence disorder)
  - GTD

- Delayed dehiscence may be related to inadequate treatment PP endometritis or infected RPOC
PP/Post C-section: Rupture-Dehiscence

- Rare but high morbidity/mortality
  - Partial implies intact serosa vs complete tear extend thru serosa
  - Tends to occur in relatively avascular LUS

- Classic signs include severe pain, PPH, hypovolemic shock

- Treat vary antibiotics to surgical repair
- Concurrent counsel risk future pregnancy and interim use contraceptives
PP/Post C-section: Dehiscence

- Thus careful US evaluation for uterine wall integrity indicated if bladder flap hematoma > 2cm
- US, CT, MR all valuable to assess for discontinuity serosal and/or myometrial layers and blood tracking
  - US appear normal, subtle thin, frank disruption with extrusion fetal parts beyond endometrium or bowel loops into myometrium
  - CT defect enhancement myometrium but phlegmon/defect may appear similar unless frank disruption.
  - MR superior demonstrate transmural defect, non-enhancing myometrium of connection endometrial cavity to serosal surface, lack apposition endometrium & serosa at incision site
Infection in PP state or Puerperal Sepsis

- 1-5% vaginal deliveries vs 5-30% C-sections
- Endometritis commonest cause PP fevers
  - Typically empiric antibiotics without imaging
- Small % myometrial involvement
  - > risk in obese, post Csection, RPOC
  - Rare uterus rupture - infection & necrosis
- US findings generally non-specific
- MRI most sensitive distinguish phlegmon/abscess from true dehiscence
Case: What’s Your Diagnosis?

History: Fevers and foul smelling discharge post C-section

Uterus TAS

Gas tracking into myometrium

Localized perforation (Echogenic inflamed fat)
Box suture - Myometrial Necrosis -- Infection
CT & MRI

Locule gas adjacent to myometrium consistent with localized perforation and anterior myometrial thinning.

T1W MR post gadolinium Demonstrate defect anterior myometrium.
Treatment

- Fulminant endomymometritis with localized perforation

- Treated with simple foley cathether for drainage with retention balloon inflated in vagina & Antibiotics
Puerperal Sepsis

- Septic pelvic thrombophlebitis espec ovarian vein thrombosis increased PP
  - Hypercoagulable state
  - Promotion venous stasis enlarged gravid uterus
  - Rising incidence C-sections
- Challenge to ID on US
- Role for MRA without Gadolinium techniques
Painless PPH: Gestational Trophoblast Disease

- ~ 0.5-1/1000 pregnancies (USA)
- Abnormal growth of trophoblast cells.
- **Partial molar**: US multiple cystic placental changes, often segmental, may gestational sac or fetal parts.
- **Complete molar**: > symptomatic with PPH, hyperemesis, occasional hyperthyroidism
  - Cystic mass enlarging uterus but **no fetal parts**
  - 50% elevated hCG, with levels rising above 100,000
  - Theca lutein cysts more common due higher hCG levels
Partial Mole: Twin 11 weeks

- **Bhcg 113 529**
- Presentation spotting

Finding:
- Mass
- 2 YS
- 1 fetus 5mm no ECA
Gestational Trophoblast Disease – Complete Mole

- Echogenic mass multiple small cysts filling uterine cavity
- No fetus or gestational sac
- Vascular – high velocity-low impedance
Gestational Trophoblast Disease: Malignant

- 5-8% of GTD undergo malignant transformation
  - 16-20% complete mole vs 0.5% partial mole

- Choriocarcinoma occurs on background
  - 50% molar pregnancy
  - 25% post TA
  - 25% post normal pregnancy

- Typically within 6 months PP

- Chemosensitive (Mtx), surgical evacuation

- Recurrence risk is 1-2% in subsequent pregnancy
Gestational Trophoblast Disease
GTN - Malignant

- FIGO standard diagnosis:
  1. hCG level plateau plus or minus 10% of baseline recorded in 4 measurements over a 3-week duration (days 1, 7, 14, 21)
  2. hCG ≥ 10% rise in 3 consecutive measurements recorded over a 2 week duration (days 1, 7, 14)
  3. Persistence of detectable hCG for more than 6 months after molar evacuation.
GTN Malignant
Placental SiteTrophoblastic Tumor (PSTT)

- Rarest form GTD (1-2%)
  - Neoplastic proliferation intermediate trophoblast cells
  - role in implantation

- Thus minimal or no hCG elevation (delay diagnosis)

- Increase serum hPL (human placental lactogen)
  - Histology stain human placental lactogen, b1-glycoprotein

- Follow any type pregnancy

- Slow growing, locally invasive, late metastases

- Primary treatment surgical
  - Relative resistant to chemotherapy
Case: What’s Your Diagnosis?
Presents 6 weeks post-partum

Images courtesy Dr. Teresita Angtuaco
Uterine Inversion

- Uncommon but important cause PP pain
- Attribute excess traction UC in fundal placenta
- 1/30,000

- Easy to miss on US
  - Uterus projects into vagina thus in sagittal the transducer abuts cervix rather than fundus
  - If complete the uterus will protrude thru cervix.
Knowledge of the early and late complications of bleeding and pain in the postpartum period can improve patient care by narrowing or specifying a diagnosis.

Prompt diagnosis may be life-saving.

Role of CDS in RPOC can be diagnostic and may potentially stratify patients into low and high risk categories for potential significant PPH.
Thank you

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Delayed Caesarean Complications

- Endometriosis at scar site – may be delayed by years
  - Incidence 0.03-1.5% (rare) but still most common extragenital endometriosis
  - Presentation is variable, may be cyclical
  - Appearance is variable
    - Tend solid masses with not well-defined borders, heterogenous

- Placental adherence disorder

- C-section scar implantation
AIP : Abnormally Invasive Placenta

- Other terms include placenta accrete, PAD/placenta adherence disorder, MAP (morbidly adherent placenta)…….
- Consider c-section scar pregnancy as AIP, even on spectrum

- Recommended signs to evaluate on ultrasound:
  - Loss retroplacental clear zone
  - Placental lacunae (numerous, large/irregular, may turbulent flow)
  - Bladder wall interruption
  - Placental bulge defined as deviation uterine serosa, typically into bladder+/- or focal exophytic mass
  - Uterovesial hypervascularity with bridging vessels which may originate from lacunae
  - Parametrial involvement

Pro Forma for ultrasound reporting in suspected abnormally invasive placenta (AIP): an international consensus
UOG: Volume 47, Issue 3, March 2016, Pages: 276-278
Placenta Adherence Disorder
Delayed PP Complication post C-section

- Sensitivity US vary from 30-90% literature whereas MR typical sensitivity specificity but gen not change management
- Recommend dedicated evaluation placenta and LUS at time fetal anatomy study in any patient with prior history repeated C-section or placenta previa
- US features:
  - Multiple placental lacunae, thinned/distorted myometrium with loss retroplacenta clear zone, irreg bladder-placenta interface
    - Hypoechoic foci are abnormal BV clusters < well-defined borders than venous lakes, may turbulent flow on CDS
    - “Swiss cheese” or “moth-eaten” appearance.
- MR features
  - Buging of the placenta, dark intraplacental bands on T2W, heterogeneous appearance

Placenta Adherence Disorder
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- MR features
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Case: Elective C-section
History: Macrosomia, PET

- Severe PPH require return OR
- Emergency hysterectomy
  - Cardiac arrest due hypovolemia (10 min)
  - Acute renal failure requiring dialysis
CT Findings:
- Subcapsular hepatic hematoma
- Liver CE patchy
- HV, PV attenuated
- Hemoperitoneum

Diagnosis:
- Hepatic infarctions & rupture
- May secondary to combination cardiac arrest and HELLP syndrome
Question 1: The uterus should return to baseline pre-pregnancy appearance after delivery by?

- A. 2-4 weeks
- B. 4-6 weeks
- C. 6-8 weeks
- D. 8-10 weeks
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- A. 2-4 weeks
- B. 4-6 weeks
- C. 6-8 weeks
- D. 8-10 weeks

**Solution to Question 1:**

- The uterus will gradually return to the size and appearance of the non-pregnant uterus by 6-8 weeks postpartum. **Option D is the best response.**

Question 2. The most common type of post caesarian section hematoma is which of the following?

- A. Subfascial hematoma.
- B. Bladder flap hematoma.
- C. Paravaginal hematoma
- D. Broad ligament hematoma.
Question 2. The most common type of post caesarian section hematoma is which of the following?

- A. Subfascial hematoma.
- B. Bladder flap hematoma.
- C. Paravaginal hematoma
- D. Broad ligament hematoma.

**Solution to Question 2:**

The two most common post caesarian section hematomas are the bladder flap hematoma, followed by subfascial hematoma and then by paravaginal hematomas. The bladder flap hematoma may extend into the broad ligament. The typical size of a bladder flap hematoma is approximately 2cm or less. When the hematoma is larger than 5 cm there is concern for the occasional occurrence of uterine dehiscence or even rarer rupture. **Option B is the best response.**

Question 3: Subinvolution of the placenta refers to which of the following?

- A. Retained products of conception, specifically placental tissue.
- B. Areas of hypervascularity and turbulent flow in the myomerium.
- C. Areas of placental tissue in the myometrium.
- D. Placenta accreta or placental attachment disorder.
Question 3: Subinvolution of the placenta refers to which of the following?

- A. Retained products of conception, specifically placental tissue.
- B. Areas of hypervascularity and turbulent flow in the myometrium.
- C. Areas of placental tissue in the myometrium.
- D. Placenta accreta or placental attachment disorder.

Solution to question 3:
Areas of hypervascularity and turbulent flow in the myometrium, in particular the inner one-third, are not uncommon and are believed to represent subinvolution of the placenta in the postpartum patient, in the sense that there are persistent enlarged spiral arteries with low resistance and often turbulent flow patterns. These can be in association with retained products of conception or persist despite complete evacuation of products of conception. There is no actual placental tissue in the myometrium, unless there is associated placenta accreta. **Option B is the best response.**

Question 4: Which is the most common form of malignant gestational trophoblastic disease?

- A. Complete molar pregnancy.
- B. Partial molar pregnancy.
- C. Choriocarcinoma.
- D. Placental site trophoblast tumor.
Question 4: Which is the most common form of malignant gestational trophoblastic disease?

- A. Complete molar pregnancy.
- B. Partial molar pregnancy.
- C. Choriocarcinoma.
- D. Placental site trophoblast tumor.

Solution to question 4

Although molar and partial molar pregnancies are part of the spectrum of gestational trophoblast disease they are not malignant. Placental site trophoblast tumor is an uncommon form of gestational trophoblast neoplasia with choriocarcinoma accounting for the majority of gestational trophoblast malignancies. **Option C is the best response.**

Question 5: In the United States what percentage of women undergo Caesarian section?

- A. 10%
- B. 15%
- C. 30%
- D. 50%
Question 5: In the United States what percentage of women undergo Caesarian section?

- A. 10%
- B. 15%
- C. 30%
- D. 50%

Solution to Question 5:
Up to one-third of birth in the United States are performed by caesarean section. Caesarean section is associated with an increased rate and variety of postpartum complications thus it is important for the clinician and imager to be aware of their incidence and variety of presentation or appearance on imaging. **Option C is the best response.**

Placental Adherence Disorder
Placenta Accreta