Beyond the Fetus:
Pearls and Pitfalls of Benign Pathology in the Pregnant Patient

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Some disease entities are exclusive to pregnancy while other common conditions can be exacerbated by pregnancy.

The clinical diagnosis of intra-abdominal pathology in a pregnant patient may be confounded by maternal physiologic and anatomic changes.

Timely and accurate diagnosis of intra-abdominal pathology in pregnant patients is paramount as an inaccurate or delay in diagnosis can threaten both the mother and the fetus.
Radiologic diagnosis in a pregnant patient may require an altered imaging algorithm.
Imaging the Pregnant Patient: 
Ultrasound

- **Preferred modality** for imaging pregnant patients given availability, cost effectiveness, and lack of ionizing radiation.
- Helpful in diagnosing obstetric and gynecological pathology.
- Limited evaluation of bowel, pancreas, ureters and mesentery.
- Quality of exam is highly **operator dependent**.
- In the **late third trimester**, the enlarged gravid uterus can make ultrasound **technically challenging** to image maternal structures.
Lack of ionizing radiation makes MRI an excellent imaging modality for evaluating pregnant patients.

Use of MRI during pregnancy may vary based on availability and institutional experience.

MRI particularly helpful in diagnosing acute appendicitis which is the most common cause of acute abdominal pain in the pregnant patient.
To date, no study has shown deleterious effects to a fetus by MR imaging.

The ACR approves MR imaging of the fetus in any trimester but continues to reinforce the need to assess risk versus benefit on a case by case basis.

Radiofrequency energy used in MR imaging is deposited in the fetus and amniotic fluid in the form of heat, however, predicted fetal temperature rises are below expected teratogenic levels.

The amount of energy deposited in a patient from radiofrequency energy used in MR is termed specific absorption.

Studies have shown that the mother, not the fetus, has a higher specific absorption rate in MR imaging.

Gadolinium contrast agents are contraindicated in pregnant patients

Gadolinium crosses the placenta and is excreted by the fetal kidneys into the amniotic fluid where it remains throughout the pregnancy.
When necessary, **CT should not be delayed** for fear of exposing the fetus to ionizing radiation.

Single use CT has been demonstrated to improve fetal and maternal outcomes when used judiciously in a pregnant patient with acute abdominal pain.

No single diagnostic imaging study results in radiation exposure that would threaten the developing fetus.
Distinguishing Physiology from Benign Pathology

**Physiology**
- Physiologic hydronephrosis
- Uterine enlargement
- Myometrial contractions
- Changes in ovarian size
- Pelvic vascular engorgement

**Pathology**
- Obstructive hydronephrosis
- Adnexal masses
- Ovarian torsion
- Massive ovarian edema
- Venous thromboembolism
- Endometriosis and adenomyosis
- Leiomyomas
Physiologic Pregnancy Related Changes

- A number of laboratory and anatomic changes occur in the pelvis of a pregnant woman.

- These changes may be secondary to physical enlargement of pelvic organs and/or hormonal changes during pregnancy.

- Anatomic and laboratory changes may confound clinicians evaluating pregnant patients with abdominal or pelvic pain.
Physiologic Pregnancy Related Changes

- **Important physiologic changes** that occur in pregnant females include:
  - Loss of elasticity of the abdominal wall musculature which may prevent guarding in the setting of peritonitis
  - Physiologic elevation of white blood cells (6,000-16,000)
  - Physiologic hydronephrosis
  - Marked enlargement of the uterus
  - Myometrial contractions
  - Changes in ovarian size
  - Engorgement of pelvic vasculature
Physiologic Hydronephrosis

• Physiologic hydronephrosis is a common occurrence during pregnancy, occurring in up to 90% of pregnant patients.

• Causes include:
  • Progesterone and gonadotropin induced *ureteral smooth muscle relaxation*
  • *Extrinsic compression* of the ureters between the growing uterus and iliopsoas muscle

• Predominantly occurs on the *right side* (80-90%)

**PITFALL: Obstructive hydronephrosis**

• Flank pain is the most common non-obstetric cause of hospitalization during pregnancy.
• Commonly caused by urinary tract calculi
**Physiologic Hydronephrosis versus Obstructive Hydronephrosis**

**Physiologic Hydronephrosis**
- Usually asymptomatic
- No associated renal enlargement or perinephric fluid
- Gradual and smooth tapering of the mid to distal ureter at the level of the sacral promontory

**Obstructive Hydronephrosis**
- Often associated with localized flank pain
- Perinephric fluid
- Abrupt change in caliber
- Visible calculus appears as a low signal intensity filling defect on MRI
The Normal Ovary During Pregnancy

- The ovary **slightly enlarges during the 1st trimester** of pregnancy.
  - Intra-ovarian corpus luteum generates progesterone and estrogen and is responsible for maintaining hormone levels during the 1st trimester.
  - Average ovarian volume during pregnancy is 11.1 cm³ (versus 9.4 cm³ in non-pregnant patients).
- The ovaries are **more difficult to identify during the 2nd and 3rd trimester**, primarily for two reasons:
  - They are displaced from their normal location by the gravid uterus.
  - Ovarian volume is decreased as their functional role in pregnancy maintaining hormone production is shifted to the placenta and the corpus luteum regresses.
Adnexal Masses in the Pregnant Patient

- Adnexal masses are present in approximately 2% of all pregnancies.
- Most are incidentally discovered during routine 1st trimester ultrasound.
- An adnexal mass may become symptomatic if:
  - Mass is compressed or exerts mass effect on an adjacent organ, more likely to occur as the gravid uterus enlarges
  - Complicated by hemorrhage or torsion
- The majority are benign cysts (corpus luteum, theca lutein, hemorrhagic and endometriotic cysts).
- Approximately 1-8% of adnexal masses found during pregnancy are malignant.
- Ultrasound is the preferred modality for evaluating adnexal masses in the pregnant patient, however MRI is a useful problem solving adjunct.

Surgical excision is preferentially performed in the 2nd trimester
- Surveillance is often selected in the 1st trimester due to possibility of spontaneous resolution
- Resection in the 3rd trimester is technically challenging due to marked uterine enlargement
Subsequent MRI evaluation demonstrates bilateral:

- T2 variable intensity cysts, "stain glass" pattern.
- T2 isointense nodules
- Regions of T1 hyperintensity representing proteinaceous material

US: Solid and cystic bilateral ovarian lesions which demonstrates vascular nodules.

Pathologic diagnosis: Bilateral borderline serous tumors
Adnexal Masses in the Pregnant Patient

PITFALL: Corpus Luteum Cyst
Most common adnexal “mass” in pregnancy and may be a cause of pelvic pain, particularly when associated with hemorrhage

• US:
  - Fluid filled 1-3 cm structure with echogenic crenulated walls and a hypervascular rim
  - Hemorrhage appears as fibrinous strands within the fluid filled lumen with associated retracting clot, septations and wall irregularity.

• MRI:
  - T2 hyperintense intraovarian structure with a thick crenulated wall that enhances on post gadolinium imaging.
  - Hemorrhagic corpus luteum will demonstrate variable T1 and T2 intensity depending on the age of hemorrhage
PITFALL: Decidualized Endometrioma

Hormonal influences of pregnancy may cause endometriomas to undergo decidual reaction consisting of increased vascularity and the development of solid nodules and papillary excrescences; findings which mimic ovarian neoplasms.

US:
Solid, smoothly lobulated nodules with internal vascularity within endometrioma

MRI:
Nodules with marked similarity in T2 signal intensity and morphology to decidualized endometrium in uterus
Ovarian Torsion

- Increased incidence during pregnancy occurring in up to 1 out of 800 gestations.

- Risk factors for ovarian torsion in pregnancy include:
  - Presence of an adnexal mass
  - Growing uterus and ligamentous laxity.

- Most commonly occurs during the 1\textsuperscript{st} and 2\textsuperscript{nd} trimesters

**US:** Enlarged and edematous ovary with peripheral follicles

**MRI:** Enlarged T2 hyperintense ovary with peripheral follicles; thickened/twisted vascular pedicle and fallopian tube
Ovarian Torsion Mimics

**PITFALL: Massive Ovarian Edema**
- Rare entity resulting in marked unilateral ovarian enlargement secondary to intermittent torsion. May be mistaken for a solid ovarian neoplasm.
- Proper recognition facilitates conservative management and ovarian preservation.

**US:**
- Asymmetric ovarian enlargement with echogenic or heterogeneous stroma and peripherally displaced follicles.
- May be indistinguishable from ovarian torsion except for its chronicity.

**MRI:**
- Marked ovarian stromal T2 hyperintensity
- Teardrop configuration reflecting a chronically compressed or torsed ovarian pedicle.

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US image showing ovarian enlargement and follicles.

MRI images showing T2 hyperintensity and teardrop configuration.
Ovarian Torsion Mimics

PITFALL: Ovarian Neoplasm

- Solid ovarian mass resulting in ovarian enlargement.
- *Note:* the only solid ovarian tumor that is T2 hyperintense is sclerosing stromal tumor of the ovary.

Endovaginal ultrasound shows an *enlarged left ovary* with an *ill-defined intra-ovarian mass* that contains small cystic areas that simulate follicles. Axial T2 weighted fast spin-echo MR of the same patient shows an *enlarged left ovary* with increased T2 signal intensity.
Physiologic Uterine Contractions

- Transient focal regions of myometrial thickening which can persist for several minutes, although disappear on subsequent images.

- May artificially appear to lengthen cervical measurement on US.

- On MRI, appear as focal area of T2 hypointensity.

**PITFALL:** Adenomyosis or Leiomyoma

- Myometrial contractions may mimic adenomyosis or a leiomyoma.
- Physiologic contractions of pregnancy should be transient unlike adenomyosis or leiomyomas which will persist through the entire exam.
Leiomyomas

• Clinical Considerations
  • It is common for leiomyomas to grow during pregnancy secondary to rising estrogen levels.
  • As a leiomyoma grows during pregnancy, it may outgrow its blood supply resulting in **cystic degeneration**, **infarction** or hemorrhagic necrosis, so called “**red degeneration**.”

Pre (left) and post (right) gadolinium T1 images demonstrate intrinsic T1 hyperintensity representing hemorrhage, without significant contrast enhancement.
Decidualized Adenomyosis

- Proliferation of ectopic endometrial stromal cells within the uterus in response to the elevated levels of progesterone that occur during pregnancy.

- US Imaging Characteristics:
  - Multiple echogenic foci or small cysts in a subendometrial location that may be associated with shadowing.
  - Increased number and degree of surrounding echogenicity during pregnancy.

32 year old female with known adenomyosis now 6 weeks pregnant.

A. Baseline pelvic ultrasound (non-gravid). B. Pelvic ultrasound in the same patient obtained at 4 weeks gestational age.
Round Ligament Varices

- The round ligament extends from the lateral uterus to the labium majus and contains veins, arteries, lymphatic vessels, and nerves.

- Increased blood volume and hormone-related venous dilation, and compression of the pelvic veins by the gravid uterus may result in round ligament varices.

Imaging Characteristics

- Ultrasound is the preferred modality for diagnosis
- Dilated tubular structures with flow on Doppler imaging

PITFALL: Inguinal Hernia

- Inguinal hernias occur in approximately 1-3000 pregnancies
- Similar presentation with swelling in the inguinal region that may worsen with increased abdominal pressure.
- Patients with round ligament varices have undergone unnecessary surgery after being misdiagnosed with inguinal hernias.
Incarcerated Uterus

- Rare and potentially devastating complication in which a retroverted or retroflexed gravid uterus fails to physiologically reduce and becomes trapped between the sacral promontory and pubic symphysis.

- Incidence ~1 in 3000 pregnancies

- Imaging Findings
  - Anteriorly and superiorly displaced cervix compresses the urinary bladder, which appears distended and elongated.
  - Uterine fundus located deep within the posterior pelvis, below the sacral promontory.

- Management: Manuel reduction of the incarcerated uterus.

Clinical Pearl: Patients with an incarcerated uterus present repeatedly with urinary symptoms of retention or incontinence.

Severely retroverted and retroflexed uterus with the fundus deep within the pelvis below the sacral promontory, posterior and inferior to the elongated and superiorly displaced cervix. The bladder appears elongated.
32 year old female at 26 weeks gestation with urinary retention

Initial diagnosis was thought to be an incarcerated uterus. However, after multiple failed attempts at manual reduction, the correct diagnosis of a cervical pregnancy was made after MR evaluation.

**PITFALL: Cervical Pregnancy**

**US**
- Hypoechoic structure with central echogenicity resembling a cervix is actually the urethra.
- What was thought was the uterine fundus in the deep pelvis was actually a low lying pregnancy.

**MR**
- The uterine fundus is in the expected location.
- Low lying gestational sac with fetus represent a cervical pregnancy.
Many benign entities are incidentally discovered during the routine obstetrical ultrasound.

These benign entities may be unique to the pregnant patient or represent well-known diseases that have an atypical appearance due to the effects of hormones during pregnancy.

While many of the benign entities described above are mimics of malignancy, they have a few key imaging characteristics that enable an accurate diagnosis.

Familiarization with these imaging characteristics is important to prevent misdiagnosis and avoid unnecessary surgical intervention.
References


