A Tale of Two Ovaries: Cross-Sectional Imaging Spectrum of Ovarian Emergencies

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Disclaimer: We do not have any conflict of interest or financial gain to disclose
Introduction

• Several emergent conditions are known to affect the ovaries from the newborn to the post menopausal period
• Some of the pathologies can affect both the ovaries with a potential threat to fertility in the reproductive age group
• Clinical/ laboratory evaluation alone may not be sufficient to diagnose many of these conditions
• Some of these have atypical presentations
• Identifying the pathology may be challenging on ultrasound alone. Cross sectional imaging is very important for timely diagnosis and prevention of complications

In this exhibit, we discuss the characteristic cross sectional imaging findings & differential diagnosis of the spectrum of the ovarian emergencies in the non pregnant patients
Learning Objectives

1. To discuss cross sectional imaging of ovarian emergencies

2. To study the role of imaging and intervention in the diagnosis and management of these conditions

3. To highlight the usefulness of imaging in evaluating the rare systemic manifestations such as Anti-NMDA encephalitis, thyrotoxicosis, pulmonary embolism, congestive heart failure and other conditions which are associated with specific ovarian disorders

Increased awareness of such entities will contribute to optimized care of patients
Introduction

• Acute pelvic pain related to the gynecological tract is a common presentation in the emergency department
• It might be difficult to localize the origin of pain
• Various imaging modalities play an important role in steering the management of the patient
• Appropriate and prompt surgical intervention is needed in many patients of life threatening ovarian emergencies
• In some cases, timely management is required for preserving the fertility in reproductive age group
• Initial step in management is to rule out pregnancy
Role of Cross-Sectional Imaging Modalities

- Ultrasound is the first line of modality in a patient presenting with pelvic pain
- Computed tomography (CT) is not routinely employed to diagnose the acute pelvic pathologies
- However, gastrointestinal and genitourinary pathologies clinically mimic ovarian emergencies
- In such cases, patient undergo CT scan and pelvic pathologies are incidentally found
- Awareness of imaging characteristics of the emergent ovarian pathologies will help the radiologists to make the accurate diagnosis
Role of Cross-Sectional Imaging Modalities

• CT has increased sensitivity to detect wall thickness, evaluate fat planes and mesenteric stranding
• CT also has an added advantage to diagnose rupture, characterize the content of the free/loculated fluid and diagnose associated findings like metastases
• MRI is used for characterizing features that are unclear on ultrasound and CT and is particularly helpful in identifying the site of origin of large pelvic masses
Role of Cross-Sectional Imaging Modalities

- 18 F-FDG PET/CT is sensitive and specific to diagnose recurrence
- MRI is also reliable in detecting local invasion
- Proton MR spectroscopy may identify the presence of mucinous material containing N-acetyl mucinous compounds, and can provide helpful information in distinguishing mucinous and non-mucinous ovarian tumors
- MRI has been increasingly used in Pediatric patients to avoid radiation
An Overview of Ovarian Emergencies

**Ovarian Torsion**
- Torsion of an otherwise normal ovary
- Torsion of ovarian teratoma
- Torsion of ovarian cysts and cystic neoplasms
- Massive ovarian edema

**Rupture**
- Ruptured ovarian cyst with hemoperitoneum
- Ruptured ovarian teratoma with hemorrhage and chemical peritonitis

**Miscellaneous:**
- Tuboovarian abscess
- Gonadal AVM
- Ovarian vein thrombosis
- Ovarian hyperstimulation
- Anti NMDA receptor antibody encephalitis

**Oncologic emergencies**
- Small bowel obstruction due to peritoneal carcinomatosis
- Hydronephrosis due to mass effect
Ovarian Torsion

- By definition, an adnexal torsion is the rotation of at least one turn of the ovaries around tubo-ovarian ligament and the infundibulopelvic ligament
- Pelvic pain may be intermittent and may be misleading
- Prompt diagnosis of torsion is critical to preserve the ovary
- In adults, usually associated with concurrent ovarian cyst or mass (frequently mature cystic teratoma-30% cases of the torsion)

Torsion of an Otherwise Normal Ovary

A and B- Axial CT with IV contrast showing midline pelvic mass pushing uterus (white arrow) anteriorly and has multiple small hypodense enlarged follicles (orange arrows).

C- Sagittal MRI T2 weighted image showed large midline mass with characteristic multiple follicles (orange arrow)

D- Coronal MRI T2 weighted image showed the relation of the mass with the uterus in this 13 year old otherwise normal patient.

Teaching Point: CT and MRI findings include an enlarged ovary, uterine deviation to the affected side, smooth wall thickening of the twisted adnexal cystic mass or fallopian tube, peripheral cystic structures almost of equal size and ascites. Usually happens secondary to excessive mobility of the adnexa due to long fallopian tube and mobile ovary. In children, it can occur in absence of ovarian disease.
Patient 2: E- Axial CT showed Torsion of Ovarian Teratoma with areas of infarction (white arrow) and hemorrhagic necrosis (red arrow).

Patient 1: Axial (A, B, C) and coronal (D) contrast enhanced CT images in a young adolescent female presenting with severe pelvic pain demonstrate a torsed left ovarian teratoma (red arrow) which is seen to lie in the right hemipelvis with associated mild fat stranding and fluid (blue arrows). Increased adjacent vascular congestion (white arrow) is also noted. An uncomplicated right ovarian teratoma (yellow arrows) is seen in the pelvis posteriorly. Diagnosis: Torsion of the left ovarian teratoma.
A and B- Axial CT demonstrating a huge cystic mass (orange arrow) in the midline located anterior to the uterus (red arrow)
C- Sagittal reformat showed free fluid adjacent to the mass (white arrow)
D- Coronal reformat showed congestion of the vasculature

Teaching point: Abnormal location of the ovarian mass in the relation to the uterus, free fluid and vascular congestion are consistent with ovarian torsion secondary to the cystic mass as the lead point in a proper clinical setting.
Axial MRI T1 weighted (A), T2 weighted (B), and post-contrast T1 weighted (C) images show enlarged right ovary (white arrows) with tiny peripheral follicles (red arrows) and increased vascularity at the periphery (orange arrow) of the right ovary (star). Normal left ovary in D (Blue arrow).
Hemorrhagic ovarian cysts can mimic a variety of solid and mixed solid-cystic masses depending on the time of the onset of the hemorrhage on USG and can be also mistaken for a solid/cystic neoplasm.

Larger cysts can spontaneously rupture and cause hemoperitoneum, which is a surgical emergency.

MRI is used to solve the problem if bleeding neoplasm cannot be ruled out on CT.

Teaching Point: Common pitfall in diagnosing high attenuation areas in the hemorrhagic cysts is non-attainment of the non-contrast study which leaves no comparison to compare after the contrast injection. Delayed phase should be obtained in cases of suspected cyst rupture. Pooling of contrast-enhanced blood within the pelvis is pathognomonic of rupture.
29 year old woman with past history of ectopic pregnancy now presented with acute left quadrant pain. Negative B HCG.

**A, B and C** - Axial CT with oral and IV contrast showing heterogenous contents with hyperdense areas suggesting blood products suggesting ruptured ovarian cyst (*orange arrows*)

Left gonadal AVM as a result of prior ectopic pregnancy (*red arrows*) a dilated left ovarian vein (*yellow arrows*)

Right ovary shows an active corpus luteal cyst (*green arrow*)
Ruptured Ovarian Teratoma with Hemorrhage and Chemical Peritonitis

- Mature cystic teratomas are the most common ovarian tumors -20% in the adult population, 50% in the Peds population
- The most common complication is torsion
- Rupture and chemical peritonitis happens in 0.5% of the cases
- Another complications include malignant degeneration and infection
- Rupture can happen spontaneously or during the surgery
A, B and C - Axial CT with IV contrast in this 32 year old woman presenting with the right groin pain showing a predominantly cystic mass with fat density in the pelvis consistent with an ovarian dermoid/teratoma (red arrows). Right lower abdominal wall fluid and fat (green arrows) and free fluid (yellow arrows). There are inflammatory changes throughout the mesentery (blue arrows).

Proposed theories for the cause of the rupture are torsion with infarction, direct trauma or prolonged pressure from pregnancy or delivery, infection of the dermoid contents, malignant change, internal pressure from rapid growth of the cyst. Complications include chemical/granulomatous peritonitis.

Teaching Point: Distorted shape, heterogeneous fluid in the pelvis, discontinuity of the capsule, mesenteric stranding and perihepatic fatty deposits are the features which can be appreciated on USG/CT or MRI. These modalities are complimentary to each other for establishing the diagnosis. CT is more to establish the prompt diagnosis of the chronic complications like chronic peritonitis, mesenteric inflammations and bowel obstruction.
**Teaching point:** Approximately 18% of the females with ovarian cancer have bowel obstruction, which is usually pre-terminal event. Bowel can be invaded directly. Bowel obstruction can be secondary to peritoneal carcinomatosis. Mucinous pathology is associated with higher incidence of obstruction at the time of the diagnosis.

*Gynecol Oncol. 2013 April ; 129(1): 107–112*
By definition, peritoneal carcinomatosis is disseminated metastases in the peritoneum from the cancer which has not originated in the peritoneum.

Imaging characteristics include free or loculated fluid, mesenteric invasion, omental involvement.

Omental caking is very characteristic soft tissue deposits separating the bowel loops away from the abdominal wall.

Mesenteric involvement can be in the form of nodules/masses, thickening of the stomach wall and abnormal fixation of the bowel.

Teaching Point: The differential diagnoses of PC is Pesdomyxoma Peritoneii, peritoneal lymphomatosis, TB, Peritoneal mesothelioma, diffuse peritoneal leiomyomatosis and splenoses.
A, and B- Pretreatment Axial CT with IV contrast in this 57 year old woman showing showing multiple peritoneal nodular mets (red arrows). Omental mets (green arrows) and free fluid (yellow arrows) are seen.

C- Post-treatment Axial CT showing minimal residual free fluid(yellow arrows) and calcified treated nodular peritoneal mets( red arrows).

D and E Axial CT with IV contrast in this 63 year old postmenopausal woman showing showed bilateral ovarian masses (red arrows). Omental caking (green arrows) and free fluid (yellow arrows) are seen.
Peritoneal Metastases-Ovarian Cancer with Perforation and Loculated Ascites

A, B - Axial CT with contrast showing Loculated ascites (red arrow). In addition, there is bowel obstruction with multiple dilated bowel loops (yellow arrow). There are small air pockets in the adjacent mesentery suggestive of bowel perforation (Orange arrow).

Teaching Point: Obstruction due to adhesions have better prognosis and survival. All other obstructions have bad outcome irrespective of the intense management.

Gynecol Oncol. 2013 April ; 129(1): 107–112
Endometroid Carcinoma of the Ovary Complicated with Acute Hemorrhage

**A** - Axial T2 image showed heterogeneous mass in the left adnexa

**B** - Axial T1 weighted showed hyper intense blood products

**C** - Axial post contrast T1 showed solid enhancing area

**D** - Coronal T2 weighted image showed mass effect over the uterus which is pushed to the right.

Teaching Point: Endometroid carcinoma is a rare epithelial ovarian tumor. 8-15% ovarian cancers have Endometroid component. These are highly invasive tumors. Grade 1 are bilateral. Associated with endometrial cancer in 20-30% of the cases.
Lack of treatment or under-treatment of the pyosalpinx may lead to TOA formation.

Complications: Ectopic pregnancy & infertility

USG: Complex solid and cystic mass with internal septa and mural irregularity

Ovaries not separately identified in most of the cases

Contrast-enhanced CT/MR:
- Adnexal mass with enhancing walls and septations
- Fluid-debris level
- Internal air is rare, which is however pathognomonic for abscesses in the other parts of body
Tubo-Ovarian Abscess

A, B, C - USG & Doppler: complex right adnexal lesion (*) replacing right ovary with hyperemia & decreased RI.

Axial CT pelvis: D, E, & F reveal complex cystic mass with tubular component representing TOA (red arrows) with peripheral enhancement and presacral fat stranding (green arrow) in this patient of tubo-ovarian abscess.

Teaching Point: Fitz-Hugh–Curtis syndrome is one of the complications from PID. Other complications include serositis and bowel obstruction.

AJR: 174, March 2000
Ovarian Hyperstimulation Syndrome (OHSS)

Axial CT with contrast showing multiple enlarged follicles in both the ovaries (yellow arrows) with free fluid in the pelvis (red arrow) in a patient who is on the ovarian stimulating drugs

- OHSS is an iatrogenic potentially lethal condition complicated secondary to ovarian hyperstimulation in patients of infertility
- Typically presents during the luteal phase of the menstrual cycle or early pregnancy
- Both USG and CT findings include- peripherally located corpora lutea cysts, producing the “spoke wheel” appearance

Teaching Point: Pregnant patients with OHSS have a higher risk of ovarian torsion

*RadioGraphics 2008; 28:1355–1368*
Meig’s Syndrome

- Associated with solid ovarian tumors-sex cord-stromal tumours
- Subtypes include- Fibromas, thecomas and fibrothecomas
- Mostly are incidentally detected
- Classically associated with pleural effusions and ascites
- MRI characteristics depend upon the amount of the fibrous tissue and the lipid content
- The fibrous contents are hypointense on both T1 and T2 weighted images without significant enhancement
Meig’s syndrome

A, B, C - Axial CT with contrast showing solid right ovarian tumor (blue arrow). In addition, there is a large amount free fluid in the abdomen and pelvis (red arrows) and a right pleural effusion (orange arrow).

Teaching Point: Post ovarian resection the ascites and pleural effusion resolve. Less than 1% of the fibromas degenerate into fibrosarcoma. Rarely, Meig’s syndrome is associated with elevated CA125, creating management challenges.
Figures A, B, C axial CT abdomen with contrast: 34 year old female after recent C section for the twin pregnancy showing bilateral dilated, thrombosed ovarian veins (red arrows). Thrombus on the right side is extending into the IVC (orange arrows) and on the left just inferior to the left renal vein. Figure D: Coronal reformat showing the bilateral ovarian thrombosis, IVC thrombus and the patent left renal vein (green arrow)

Teaching Point: Ovarian vein thrombosis is a rare but a serious complication in immediate post partum period. The proposed causes include intrapartum trauma, uterine infection, peripartum hypercoagulability, and stasis of blood within dilated ovarian veins. Most of the patients would be symptomatic. Clinical challenge is in the asymptomatic patients who have undergone hysterectomy and there is a delay in obtaining the imaging.
Endometriosis/Chocolate cysts

• By definition, endometriosis is presence of the endometrial tissue outside the uterus
• 5-10% of the women are diagnosed with this condition every year
• Chocolate cysts can rarely rupture resulting in chemical peritonitis
• The endometriomas are typically larger than the functional cysts - 7cm average diameter versus 3.5 cm respectively
• Endometriomas are commonly bilateral

Teaching Point: T2 shading is not specific for the chocolate cysts. T2 shading occurs due to different protein contents and the degraded hemorrhagic products which can be seen any type of hemorrhagic pathology
17 year old with chronic pelvic pain. Figures A, B – Axial MRI T1 weighted images showing hyperintense bilateral ovarian masses (red arrows) with internal separations (orange arrows). There is a loculated hyper intense fluid along the anterior pelvic wall (blue arrow).

C and D- Coronal MRI T2 weighted images showing typical shading effect secondary to the blood products of different ages in the hyperintense masses (green arrow) Uterus containing some endometrial fluid (Green star)
Rare cases

Hemorrhagic Infarct - Right Ovary - Acute Sickle Cell Crisis

A - CT coronal reformat showed absent spleen (white arrow), typical end plate avascular necrosis (red arrow) and a large right ovary with hemorrhagic contents (orange arrow).

B - Axial contrast enhanced CT showing a hemorrhagic mass in the right ovary in this patient who presented with an acute pelvic pain (orange arrow).

Teaching Point: Infarction is a well known complication in all the parts of body in a sickler. Superimposed crisis occurs after the hemorrhagic conversion of the infarct.

Bilateral Ovarian Hemorrhage and Spontaneous Hemoperitoneum, INR 6.8

A and B- Transvaginal ultrasound showing enlarged ovaries (orange arrows) with mixed echogenic echotexture of unclear etiology with some free fluid

C and D- Axial CT without contrast showing hyperdense contents in the ovaries (red arrows) consistent with acute bleeding in the ovaries

In addition, there is a large amount of hemoperitoneum (yellow arrows)

Teaching point: MRI can detect intra versus extra ovarian hematoma

Hemoperitoneum is demonstrated by varying intensity fluid with characteristic layering of the blood products. CT may not be able to differentiate ovarian parenchyma from the adjacent structures.
Anti-NMDA-Receptor Encephalitis: A Neuropsychiatric Syndrome Associated with Ovarian Teratoma

Figures A & B: Young female who presented with acute psychosis to the emergency - Axial FLAIR and DWI through the temporal lobes demonstrate increased FLAIR signal intensity in bilateral hippocampus with restricted diffusion, compatible with encephalitis. The patient’s CSF was positive for elevated lymphocytes and anti-NMDA receptor antibody. Due to a high index of suspicion for anti-NMDA receptor encephalitis, a search ovarian teratoma was made and CT revealed a right ovarian teratoma (Figure C).

Teaching Point: Anti-NMDA-receptor encephalitis is one of the rare systemic manifestations of ovarian teratoma. Immunosuppression and surgical removal of the ovarian are the treatment for anti-NMDA receptor.
Teaching points

- Ultrasonography is a primary rapid, readily available modality used to evaluate ovarian emergencies.
- Cross sectional imaging is used to further characterize the lesion identified on USG.
- CT and MRI are more sensitive and specific to detect the complications like torsion, hemorrhage or rupture.
- CT may underdiagnose recurrent neoplasms.
- MRI is the modality of choice to determine the extent of involvement and to determine the organ of origin in huge pelvic masses.

Increased awareness of such entities will contribute to optimized care of patients.
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