EVALUATION OF ADNEXAL MASSES

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Simple adnexal cysts

- most commonly functional in origin.
- vary in size, up to 7 cm in diameter.
- Follow-up US will show a reduction in the size of the cyst and a change in the appearance of the internal echoes.
DDX of a simple adnexal cyst includes:

- Paraovarian cysts
- Endometriomas
- Hydrosalpinx
- Neoplastic cysts
- Peritoneal cysts
Differential diagnosis of a simple adnexal cyst includes:

- **Paraovarian cysts**
  - may reach up to 10 cm, close to, but separated from, ovary

- **Endometriomas (chocolate cysts)**
  - usually contain internal echoes and have a thick wall but may look entirely simple.
Differential diagnosis of a simple adnexal cyst includes:

- **Hydrosalpinx** - small hydrosalpinx may mimic an ovarian cyst but can be distinguished by
  - elongated shape,
  - position around or on surface of ovary
  - incomplete septations due to mucosal folds.
Differential diagnosis of a simple adnexal cyst includes:

- Neoplastic cysts -
  - particularly benign cystadenomas and some borderline tumours.
Peritoneal cysts (entrapped ovary syndrome).
- fluid trapped around the ovary due to adhesions.
- asymptomatic or cyclical pain
- usually history of complicated pelvic surgery or infection.

Peritoneal inclusion cyst in a 29-year-old woman. (a) Transverse TVUS scan shows a complex left adnexal cyst (arrows) with septa. A portion of the cyst conforms to the contour of the uterus (U). (b) Transvaginal US scan reveals a normal ovary (arrows) at the periphery of the cyst.
Complex adnexal masses

- Complex adnexal masses can be due to complicated simple cysts;

- however, various inflammatory, neoplastic and non-gynaecological causes must be considered.
DDX of a complex adnexal mass

- Hemorrhagic cyst
  - contains diffuse internal echoes or an
  - irregular clump of echoes due to clot.
  - Repeat scans helpful to show change.

- Ruptured cyst-
  - typical history,
  - irregularly-shaped cyst with surrounding fluid.

- Torsion of cyst or ovary
  - heterogeneous enlarged ovary
  - with or without a thick-walled cyst with internal echoes.
  - Presence of colour flow within the ovary is said to indicate viability of the ovary, laparoscopy is worthwhile to try and preserve function.
- Endometriosis.
- Acute / chronic tubo-ovarian abscess.
- Dermoid cyst
  - complex mass with cystic / solid areas, fat and/or calcification.
- Other neoplastic ovarian tumours, benign and malignant.
- Pedunculated fibroid
  - (identification of the ovaries separately)
- Ectopic pregnancy-
  - should always be considered in a patient of child-bearing age.
  - Pregnancy test.

- Non-gynecological:
  - Other inflammatory masses-
    - e.g. appendix or diverticular mass.
  - Other neoplastic masses-
    - e.g. arising from the bowel or peritoneum (benign peritoneal mesothelioma).
Endometriosis

- is an incidental finding in up to 25% of laparoscopies.
- variable symptoms (most common is dysmenorrhoea).
- Majority (up to 90%) of endometriotic (chocolate) cysts contain diffuse internal echoes due to old blood.
- Echoes may show fluid-fluid level.
- Wall thickness of the cysts varies and highly reflective foci or flecks of calcification may be seen within the wall.
- Septations, creating multilocular cysts, are common, the various locules containing echoes of differing densities, indicating haemorrhage of different ages.
Endometriotic cysts may attain very large size

Echogenicity of internal echoes varies from very low level, to moderately high,

These may cause some confusion with a dermoid cyst or may mimic a solid mass;

- compression of the mass with the probe will usually demonstrate
  - the mass is deformable
  - internal echoes move very slowly.

- No vascularity on Doppler.
Endometriomas.
A: left cystic mass filled by low intensity echoes, with more homogeneous pattern than hemorrhagic cysts
B: The same endometrioma, with visualization at color Doppler US, showing absence of vessels in its interior, thus ruling out the presence of a solid mass.
Hemorrhagic cyst vs Endometrioma
Endometriosis

- Deposits are most easily recognized on the ovary and in the broad ligament;
- however, endometriotic deposits do occur anywhere in the pelvis or indeed outside the abdomen.
- Rarely nodules occur on the bowel, on the pleura and in the soft tissues, particularly at the sites of scars.
- Normal US scan does not exclude endometriosis because adhesions and diffuse small endometriotic deposits cannot be visualized with US.

- Endometriosis normally resolves after the menopause but may be reactivated if the patient is taking HRT.
Pelvic inflammatory disease (PID)

- PID is a common cause of adnexal masses, both in the acute and chronic phases.
- US in acute infection may show free fluid (pus) in association with a complex adnexal mass, (ovary + thickened tube).
- Doppler scan shows low impedance flow (inflammatory reaction).
In more chronic disease the ovary may be more easily definable with a thin-walled hydrosalpinx adjacent to the ovary.

Hydrosalpinx may contains internal echoes due to either blood or pus.
A: TVUS showing an anechoic tubular shape, adjacent to the ovary (asterisk).
B: The arrow indicates the incomplete septations with linear projection in an anechoic structure with tubular shape in LIF, characterizing hydrosalpinx
Hydrosalpinx in a 26-y woman. Transvaginal US scan shows a tubular-shaped cystic mass. The finding of indentations (arrows) on opposite sides of the tubular mass, termed the **waist sign**, is a good indicator of a hydrosalpinx.

1. Waist sign is a strong predictor of hydrosalpinx.
2. Waist sign in combination with a tubular-shaped cystic mass has been found to be pathognomonic of a hydrosalpinx.
- Ovary may look like a polycystic ovary because of follicular fluid trapped by surface adhesions.

- Rarely patients present with right hypochondrial pain due to perihepatitis (Curtis-Fitz-Hugh syndrome).

- Pelvic US may be normal in even quite severe PID.
Ovarian tumor

- classified into three main types, according to cells of origin:
  - Epithelial tumors (60-70%),
  - Germ cell tumors (15-20%).
  - Sex cord stromal tumors (5-10%)

- ~5% of ovarian tumours are *metastatic* in origin.

- Primary tumours can be associated with the production of hormones, including oestrogens, progestogens and androgens.

- They may be:
  - benign
  - malignant,
  - borderline malignant, (better prognosis, a low risk of local recurrence lower risk of metastases.)
Malignant ovarian tumours

- 80% of tumours occur in women over 50 years of age.
- Presenting symptoms usually occur late in the disease (pain, abdominal distension, vaginal bleeding, bowel and urinary dysfunction).
- 2/3 having spread outside the pelvis at the time of diagnosis.
- Late presentation is responsible for the overall high mortality (70% at 5 years).
- Metastatic spread occurs most commonly to the peritoneum.
- Lymphatic spread to the para-aortic nodes and liver metastases are also seen.
Risk factors for development of ovarian carcinoma include:

- **Age:**

- **Family history of ovarian, breast, endometrial or colorectal carcinoma.**

- **Increased number of episodes of ovulation, for example:**
  - Following treatment with ovulation induction agents
  - Nulliparous state.
  
  - **Some protection is conferred by**
    - multiparty,
    - breast-feeding
    - contraceptive pill.
Epithelial ovarian tumours

- 85% of malignant ovarian tumours are epithelial
- Commonest epithelial carcinoma is a serous cystadenocarcinoma (60-80%).
Serous tumours are

- predominantly cystic masses.
- may show wall thickening and nodularity, internal solid areas and septations.
- Malignant tumours tend to have more nodularity and solid areas than their benign counterparts.
- 60 and 70% are bilateral.
Serous cystadenocarcinoma of the ovary in a 38-year-old woman.

Transvaginal color Doppler US scan demonstrates a complex ovarian cyst with septum and a solid nodule (arrow). There is flow within the solid nodule, typical of malignancy.
Epithelial ovarian tumours

- Mutinous cystadenocarcinomas
  - large predominantly cystic masses
  - multiloculated with multiple thick internal septations and diffuse internal echoes due to their high mucin content.
  - In the absence of ascites or lymphadenopathy, it is impossible to distinguish a benign from a malignant mucinous tumour.
  - However, only 10% of mucinous tumours are actually malignant.

- 5 and 10% are bilateral.
Mucinous cystadenoma. TVUS of ovary demonstrating a multiloculated mass with numerous septations, with echogenic content varying among the several compartments of the mass (arrows), a cluster of small cysts and fine echoes
Other rarer epithelial tumours include

- Endometrioid carcinomas
  - associated with endometrial thickening due to endometrial hyperplasia or carcinoma in approximately 20-30%

- Brenner's tumours are
  - invariably benign,
  - large at presentation
  - may be associated with a mucinous cystadenoma or dermoid cyst.

- Clear cell carcinomas.
Sex cord tumours

- includes fibromas and the hormone-secreting tumours such as thecomas, granulosa cell tumours and Sertoli cell tumours.
- They are usually benign solid tumours.
- Patients with functioning tumours often present with the symptoms due to the excess hormone production, e.g. post menopausal bleeding.
**Sex cord tumours**

- **Fibromas**
  - almost always benign slow-growing tumours
  - when large may be associated with ascites and pleural effusions, a condition known as Meigs syndrome.
  - However Meigs is uncommon
  - can be heavily calcified
Ovarian fibroma in a 24-y woman.
Sagittal transvaginal US scan reveals a slightly hypoechoic solid mass (M) within and replacing most of the ovary (calipers). No distal acoustic shadowing is present.

Ovarian fibroma in a 23-y woman.
Sagittal TV US scan reveals a solid adnexal mass (M) with marked distal acoustic shadowing (arrows), which obscures the back border of the mass. Such a finding might be attributed to shadowing from bowel gas and could be overlooked. However, recognition that this is a focal area of intense acoustic shadowing that does not arise from an echogenic interface should help in recognition of the mass, particularly if the ipsilateral ovary is not seen.
Germ cell tumours

Dermoid cysts (or benign cystic teratomas)

- are the commonest Germ cell tumours
- 95% are benign particularly in patients between 20-50 y.
- typically complex adnexal masses with variable amounts of cystic and solid areas.
- show areas of markedly increased reflectivity and acoustic shadowing due to fat, calcification or teeth.
- Fat commonly floats at the top of the cyst, obscuring deeper structures and the true extent of the mass
- 10 and 1 5% of are bilateral
Teratoma.
A: Finding of an echogenic fatty mass, with irregular and heterogeneous content, with linear echoes, and without vascularization at color Doppler US, in right ovary (arrow). B: Similar pattern, with the presence of posterior acoustic beam attenuation (arrows) compatible with fatty heterogeneous content with calcifications.
C,D: TVUS of different patients – mass with presence of diffuse echoes, hyperechogenic wall, typically irregular content with echogenic lines and spots, and with no sign of vascularization at color Doppler US.
Mature cystic teratoma in a 48-y woman.

TV US scan demonstrates a complex cystic ovarian mass (calipers). A portion of the mass consists of fluid with hyperechoic lines and dots (arrows) and has been termed *dermoid mesh*. The mass contains a hyperechoic solid-appearing area (*), also typical of a teratoma.
~ 25% of dermoid cysts are discovered incidentally.

It is now acceptable not to operate on asymptomatic small (<5 cm), incidentally discovered dermoid cysts providing:

- ultrasound findings are typical
- no growth on follow-up scans.
Malignant germ cell tumours
(dysgerminomas, immature teratomas)

- occur predominantly in young women (mean age of 20 y).
- usually large solid tumours but typically only stage I at presentation.
- associated with raised levels of various tumour markers, e.g. hCG, AFP, CA-I25.
Ovarian metastases

(Kruckenberg's tumours)
The Krukenberg tumor was originally described by Paget (1854). The eponym is attributed to Dr. Friedrich Krukenberg, a German gynecologist and pathologist. In 1896, he published five case reports on what he believed to be at the time a new type of ovarian tumor. However, in 1902, Dr. Schlagenhauffer determined that these tumors were in fact of metastatic gastrointestinal tract origin.
Ovarian metastases

(Kruckenberg's tumours)

- most commonly arise from primary tumours of the stomach, colon, pancreas or breast.
- Krukenberg tumors are pathologically “signet ring cell” ovarian adenocarcinoma.
- account for 1-2% of all ovarian tumors.
- The stomach is the primary site in 70% of these cases.
- For those tumors originating from the intestinal tract, 80% are found to be within the sigmoid colon or rectum.
Ovarian metastases

(Krueckenberg's tumours)

- solid, cystic or complex ovarian masses,
- frequently bilateral (80% of cases)
- usually with ascites.
- less likely to be multilocular than primary ovarian tumours but otherwise there are no specific distinguishing features.
Differentiation of benign from malignant masses

A reliable method for differentiating benign from malignant adnexal masses would provide a basis for appropriate management; either conservative non-surgical, surgical locally for benign masses or at a specialist cancer center if the mass is thought to be malignant.
Clinical, demographic, biochemical, and US features were used but were found to have poor diagnostic accuracy.

Tumor marker CA125 has:
- is elevated in ~80-85% of cases of epithelial ovarian cancer.
- limited specificity (raised in nonmalignant such as endometriosis,
- limited sensitivity, (particularly in early-stage disease.

US:
- sensitivity improved by using TV scan and morphologic scoring systems,
- limited specificity.
- combination of both morphology and Doppler indices is more accurate than either used alone but
- accuracy rates of US in differentiating benign from malignant adnexal masses ranged from **50 to 98%**.
The use of a **risk of malignancy index (RMI)** incorporating menopausal status, CA125 and US offers improvements in sensitivity and specificity over US or tumor markers used in isolation.
Features suggestive of malignancy are:

1. **Hypoechoic solid** area within the mass
   (highly echogenic solid areas due to fat or calcification are typical of dermoids).

2. **Thick** (more than 3 mm) nodular septations.

3. Size of mass $> 7$ cm,
   although very large but simple cysts are usually benign cystadenomas.

4. **Vascularity:** Central rather than peripheral.

5. **RI < 0.6.**

RI $>0.8$ is suggestive of benign disease but there is an indeterminate range of 0.6-0.8;
Role of MRI

- Sonography remains the primary modality;

- MR imaging is considered a problem-solving technique.

- T1W fat-suppressed pre & post-contrast-enhanced & T2 WMR imaging appears to be more accurate than sonography for the assessment of adnexal masses
Role of MRI

- Localization (ovarian extra ovarian?)
- Morphology of mass.
- Characterization of mass:
  - Cystic, solid, mixed.
- Presence of a hemorrhage or fat.
- Tissue with low signal intensity on T2-W
- Other features: e.g.
  - ascites or
  - peritoneal disease,
  - lymph node
  - involvement of adjacent organs and pelvic sidewall.
62-year-old woman with poorly differentiated serous cystadenocarcinoma
Dermoid.
(A) TVU shows a heterogeneous echogenic adnexal mass with areas of increased echogenicity (arrows).
(B) T1W shows a left adnexal mass (arrows) with areas of increased signal.
(C) Precontrast fat-suppressed shows fat suppression of high T1 signal that is consistent with a fat-containing lesion (arrows).
(D) There is no discernible enhancement on this T1W postcontrast. The adjacent myometrium is enhanced (arrowhead).
Q- Hemorrhage in a cystic lesion?

> benign or malignant

- **25% of malignant lesions**

Endometriosis. (A) An axial T2W, (B) a precontrast axial T1W fat-suppressed (C) a postcontrast axial T1W fat-suppressed show bilateral adnexal hemorrhagic lesions (arrowheads), which are consistent with endometriomas with low-signal “shading' on the T2W image and high signal on the T1W images without internal enhancement.
Q- Low T2 signal-intensity in solid lesions?
> benign or malignant
✓ found in many benign ovarian tumors, especially fibrotic tumors.

58-year-old woman with right ovarian fibroma
Q- Presence of necrosis in a solid lesion?

> benign or malignant

✓ **is not a feature of malignancy** eg. In degenerating fibroid & cystic changes in some thecomas & fibromas.

82-y woman has benign ovarian fibroma with central necrosis
Imagination is more important than knowledge,...
Knowledge is limited.... Imagination encircles the world