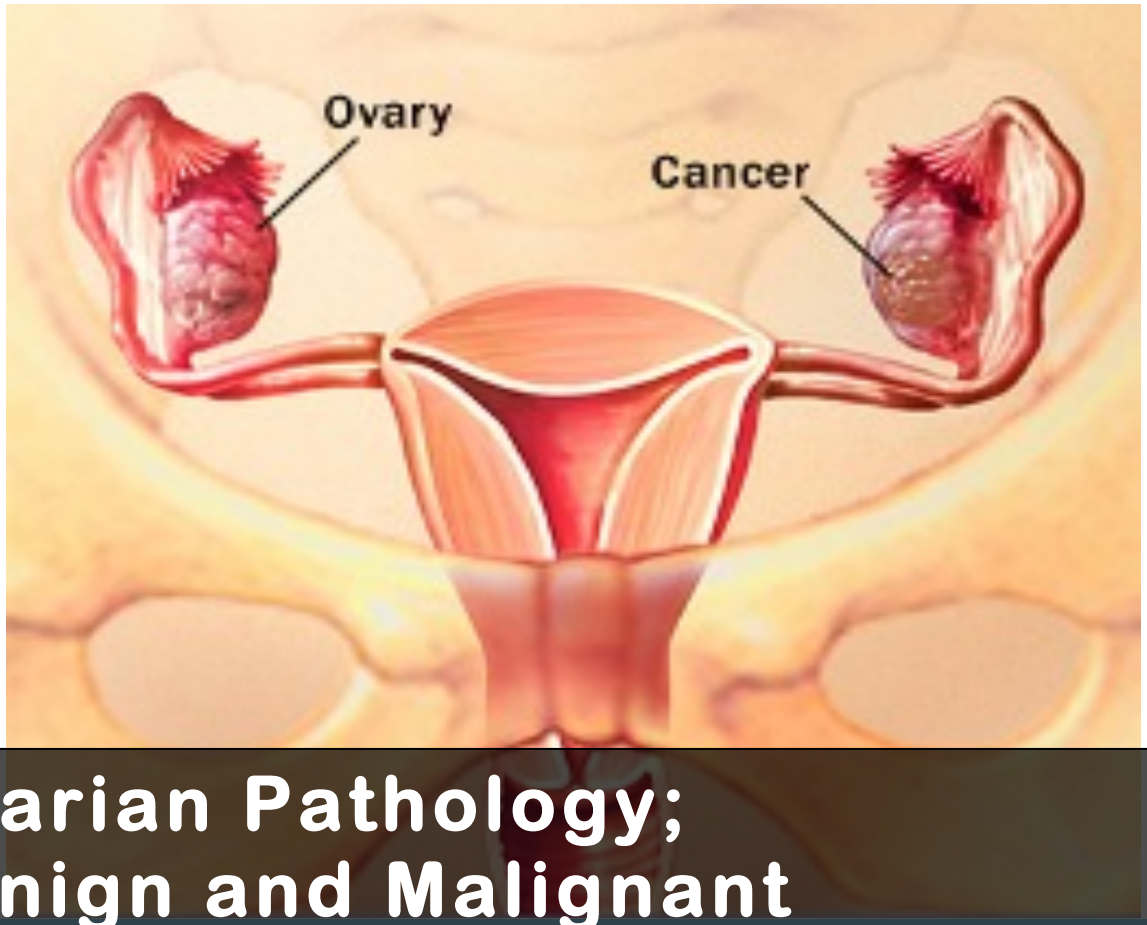


Ovarian Pathology; Benign and Malignant

429 Team Notes

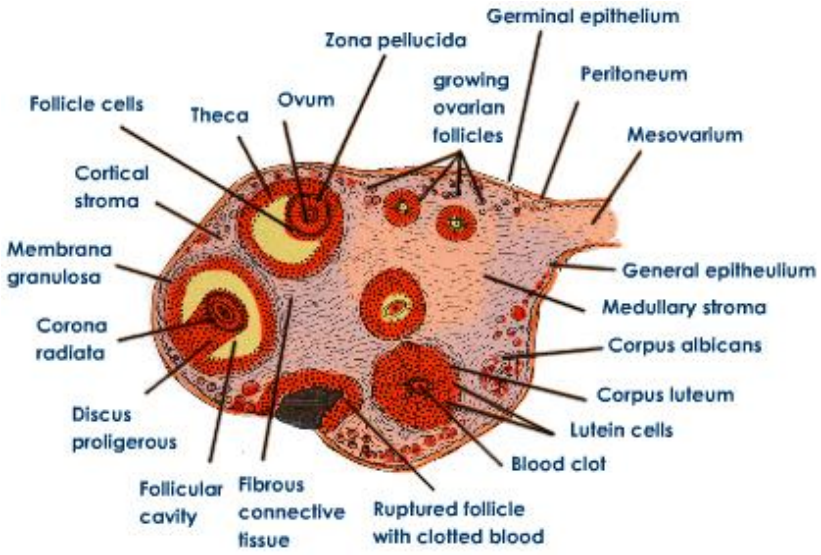
Sources: Hacker and Moore's Essentials of Ob/Gyn, both lectures' slides, 428 team notes and Wikipedia.

Made By: Dona Barakah

OVARIAN PATHOLOGY

NORMAL OVARIES

- The ovaries are normally **not palpable** in pre-menarche, and after the menopause
- In reproductive age group, the ovaries **are palpable** in lean patients.
- Ovarian size:
  - At pre-menopause: 3.5 X 2 X 1.5 cm
  - At early menopause, 1-2 years; 2 X 1.5 X 0.5 cm (shrinks in size)
  - At late menopause, 2-5 years; 1.5 X 0.75 X 0.5 cm (shrinks more)
- If the ovaries are palpable at any age group when it's not supposed to be, thorough investigations and work up should be carried out



BENIGN OVARIAN TUMOURS

PREVALENCE

- In general, benign tumors are more common than malignant ones
- During the Childbearing age, 70% of noninflammatory benign ovarian tumors are functional, 20% are neoplasms and 10% are endometriomas.

CLASSIFICATION

- Functional:
  - Follicular Cyst
  - Lutein Cysts (corpus luteum and theca luteum).
  - Polycystic Ovaries
- Inflammatory:
  - Salpingo-oophoritis
  - Pyogenic oophoritis (pueperal, abortal or related to an intrauterine device)
  - Granulomatous oophoritis
- **Metaplastic:** Endometrioma
- Neoplastic:
  - Benign:

        - Serous Cystadenoma
        - Mucinous Cystadenoma
        - Endometrioma
        - Dermoid Cyst
        - Fibroma
    - Borderline
    - Malignant

FUNCTIONAL CYSTS

- Cysts that are related to ovarian function (i.e. in the process of ovulation)
- They are the **most common detected cysts** in the reproductive age group
- Can reach up to 10cm, but resolve spontaneously
- To be classified a functional cyst; the follicle must reach a diameter of ***at least 3cm***
- Functional cysts may cause pelvic pain, dull sensation or heaviness in the pelvis.

FOLLICULAR CYST

Lining:

A layer or two of Granulosa Cells

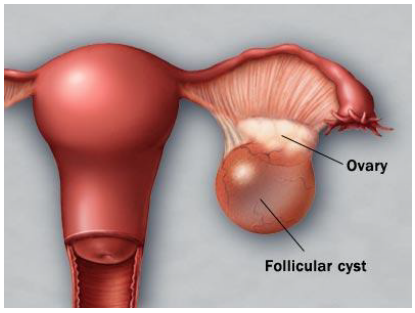
Cause:

Develops when a Graafian follicle grows, but fails to rupture (and doesn't ovulate either), and that's due to either of the following:

- Continuous, excessive FSH stimuli
- Lack of pre-ovulatory LH surge

Characteristics

- Rarely grow larger than 10 cm.
- Most are asymptomatic.
- Larger cysts may cause pelvic discomfort or heaviness.
- Thin-walled, unilocular, and appear simple on ultrasound.
- Usually unilateral.



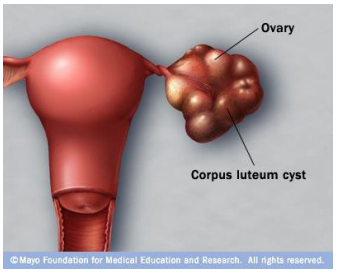
Management

- Observation (70% to 80% resolve spontaneously)
- Usually regress withing the subsequent menstrual cycle
- Oral contraceptives.
- If it persisted → surgical removal.

CORPUS LUTEUM CYST

Cause:

Occur when the corpus luteum becomes cystic, grows to larger than 3cm and fails to involute after 14 days



Characteristics

- Most corpus luteum cysts are asymptomatic
- May produce dull, unilateral pelvic pain
- Usually unilateral

Hemorrhagic Corpus Luteum Cysts:

- Result from invasion of ovarian vessels into corpus luteum (2-3 days after ovulation)
- They are more likely to cause symptoms and more likely to rupture toward the end of the menstrual cycle.
- If ruptured, it can result in a Hemoperitoneum requiring surgery

Management

- Resolve with observation and analgesia
- If it persisted → surgical removal

THECA LUTEIN CYST

Cause:

- A specific type of lutein cysts that may occur with an "abnormally high serum levels of hCG or increased ovarian sensitivity to gonadotropins
- They may develop with the association of the high levels of hCG present in patients with:
  - Hydatiform mole
  - Choriocarcinoma
  - Patients undergoing ovulation induction with gonadotropins or clomiphene

Characteristics

- Usually bilateral
- May be quite large (>30cm)
- Characteristically regress slower after gonadotropin levels fall
- Rarely, when the follicles are stimulated by gonadotropins, theca-lutein cysts can become so extensive and cause ***Massive Ascites*** and a dangerous problem with systematic fluid imbalance

LUTEOMA OF PREGNANCY

Cause

A hyperplastic reaction of theca cells, related to theca-lutein; presumably from prolonged hCG stimulation, but happens characterstically during pregnancy

Characteristics

- Appear as brown-to-reddish-brown nodules
- May be cystic or solid
- May be associated with Multifetal pregnancies or hydramnios
- Cause maternal virilization in 30% of women (and less often; ambiguous genitalia in a female fetus)

Management

They might be too large, but they are rarely resected as they regress spontaneously at postpartum

In general, lutein cysts are smaller and more firm or even solid in consistency and is more likely to cause pain or peritoneal signs of irritation. It also causes delayed menses, due to its continuous production of "progesterone"

POLYCYSTIC OVARIAN SYNDROME

A functional disorder, generally associated with (if 2 of these 3 are positive, POS is diagnosed):

- Chronic Anovulation (would cause irregular menses in the clinical picture)
- Hyper-androgenism (causes excessive hirsutism and acne)
- Enlarged follicles with multiple simple follicles

RISK OF MALIGNANCY INDEX (RMI)

Is used to help identify those ovarian masses that could be malignant (with both high sensitivity - 87% - and specificity -97%)

Criteria	Scoring system
A- menopausal states Premenopausal postmenopausal	 1 3
B- US findings: Multiloculated Solid Bilateral Ascites	 1 feature = 1 ≥2 features = 3
c- serum CA-125 titer	Absolute value

MANAGEMENT OF FUNCTIONAL CYSTS

1. Meets requirements for observation (wait and re-examine the patient after her next menses, also Oral Contraceptives help in gonadotropin suppression and preventing the development of another cyst):
   - Reproductive-aged patient
   - Asymptomatic (or experiencing only mild symptoms)
   - Present with an adnexal Cyst
   - RMI determined through: pelvic US and CA-125 titer, and is low
2. Doesn't meet the requirements of observation(surgical exploration or referral to an gynecological oncologist is indicated, and only a laproscopic cystectomy allows histologic evaluation to differentiate between a functional and a neoplastic ovarian cyst), due to any of the following:
   - Solid
   - Painful
   - Fixed
   - In late >40-year-old patients, a higher chances of a neoplasm are precieved.
   - Has an elevated RMI (determine through pelvic US and CA-125 titer)

BENIGN NEOPLASTIC TUMOURS

- 80% of ovarian neoplasms are benign
- They can be solid or cystic
- They are divided generally by cell type of origin into three main group:
  - Epithelial (80-85%)
  - Stromal (10-15%)
  - Germ Cell (10-15%)
- The Epithelial neoplasms, ***as a group***, are the most common neoplasms
- The benign cystc teratoma (dermoid cyst), ***as single neoplasm***, is the most common benign ovarian neoplasm

EPITHELIAL OVARIAN NEOPLASMS

- Are derived from the mesothelial cells lining of the peritoneal cavity and the ovary's lining surface
- The most common epithelial ovarian tumors are; **Serous Cystadenoma**

Serous Cystadenoma

- Resembles the lining of the fallobian tubes and is derived from the ciliated tubal epithelium
- The most common *epithelial ovarian neoplasm*
- 70% of Serous tumors are benign
- 5-10% of serous tumors have borderline malignant potential
- 20-25% are malignant (depending largely on the patient's age)
- **Pathological Characteristics:**
  - **Gross:**
    - Bilateral in about 10% of cases
    - Large serous cystadenomas tend to be multilocular
    - Small unilocular serous cystadenomas also occur
    - Have a smooth surface and are fluid filled
  - **Histologically:**
    - Serous tumors characteristically form ***Psammoma Bodies*** (a greek word meaning *sand*, concretions that are calcific and concentric)
    - Psammoma bodies occur occasionally in benigh serous neoplasms and frequently in serous cystadenocarcinomas
    - Papillary pattern is common
- If the size is >6cm, excision is indicated, but if they are small (<6m); they are treated conservatively

Mucinous Cystadenoma

- Histologically resembles the Endocervical epithelium
- Can attain a HUGE size, often filling the entire pelvis and abdomen
- Are filled with Thick Mucinous material
- Are often associated with a ***mucocele of the appendix***
- 85% of mucinous cystadenomas are benign and 15% are malignant
- They are often multilocular
- Benign mucinous tumors are bilateral in less than 10% of cases

- A complication when perforated called; **Psuedomyxoma Peritonei** where chemotherapy may be needed
  (Happens to the benign mucinous tumor where many benign implants seed on the surface of the bowel and other peritoneal surfaces, and produce large quantities of mucus).

Brenner (Transitional) Tumor

- A small, smooth solid ovarian neoplasm, usually benign, with a large fibrotic component that encases *Epitheloid Cells* that resemble the *Transitional Cells of the Bladder (Urothelium)*.
- In about 33% of cases, Brenner tumors are associated with mucinous epithelial elements
- Because these are solid tumors, excision is indicated and curative.

Endometrioma (Endometroid Neoplasm; Chocolate Cysts)

- A collection of Endometrosis in the ovary, formulating what looks like a “chocolate” cyst
- Resembles the endometrium

SEX-CORD OVARIAN NEOPLASMS

- Tumors derived from the sex cord and specialized stroma of the developing gonad
- If the ultimate differentiation of cell types occurring in the tumor is feminine, the neoplasm becomes a granulosa cell tumor, a theca cell tumor or a mixed granulosa-theca tumor (most common)
- Neoplasms differentiate to a masculine type, become Sertoli-leydig cell tumor (least common)
- The Granulosa-theca cell neoplasms as well as their androgenic counterparts, are generally referred to as ***Functioning*** ovarian tumors (the term functional is inaccurate).
- Occur in any age group, from birth on, but are more common in postmenopausal years
- Except **Pure Thecomas**, all these tumors (granulosa-theca and sertoli-leydig) have a low malignancy potential.

Granulosa-Theca Cell Neoplasms

- Most common sex-cord type
- Derived from the specialized Granulosa stroma of the developing ovary
- Have a solid-yellow appearance
- Promotes feminizing signs and symptoms by their estrogen production, such as:
  - In childhood:
    - Precocious menarche
    - Precocious thelarche
    - Premenarchal uterine bleeding during infancy and childhood
  - In reproductive years:
    - Menorrhagia (with alternating amenorrhea)
    - Endometrial hyperplasia
    - Infrequently; Endometrial cancer
    - Breast tenderness and fluid retention
    - Post-menopausal bleeding

- Management:
    - Bilateral salpingo-oophorectomy with hysteroscopy
    - If pregnancy is considered; unilateral sapingo-oophorectomy is considered.

Sertoli-Leydig Cell Neoplasms (Gynandroblastomas)

- Less common than granulosa-theca cell tumors
- Are responsible for **virilizing** effects of androgens such as:
    - Hirsutism
    - Temporal baldness
    - Deepening of the voice
    - Clitoromegaly
    - A defeminizing change in the body habitus to a muscular build
- 15% percent of them produce no obvious endocrinologic effects

Ovarian Fibromas

- A stromal cell **benign** neoplasm developing from mature fibroblasts in the ovarian stroma.
- Usually asymptomatic as it is not hormonally active.
- Form encapsulated, solid, smooth-surfaced tumor made up of interlacing bundles of fibrocytes
- It is glistening white on its cut-surface
- Is associated with ascites caused by the transudation of fluid from the ovarian fibroid
- The flow of this ascetic fluid through the *Transdiaphragmatic lymphatics* into the *right pleural cavity* may result in **Meig's Syndrome** (hydrothorax + ovarian fibroma)
- When associated with *theca cell elements*, it is called "fibrothecoma".

GERM-CELL TUMORS

- Make up about 60% of ovarian neoplasms occurring in infants or children, but can occur at any age.
- The most common germ-cell tumor is the **benign cystic teratoma** (mature cystic teratoma)

MATURE CYSTIC TERATOMA (DERMOID CYST)

- Not just the most common germ cell tumor, but also the most common ovarian neoplasm.
- A germ cell that can take on a great variety of forms, with virtually all adult tissues being represented within the mass
- Almost always benign
- Are slow-growing tumors
- 10-15% are bilateral and most are less than 10cm in diameter
- Half of women are diagnosed at 25-50 ages
- Tissue Variety:
    - Composed primarily of ectodermal tissue (such as sweat, sebaceous glands, hair follicles and teeth)
    - Contains some mesodermal and endodermal elements
    - Other tissue components commonly found in benign cystic teratomas include; mature brain, bronchus, thyroid, cartilage, intestine, bone and

carcinoid cells (unlike malignant immature teratomas; the tissue are all in adult well-differentiated form)

- Has a characteristic gross and histological appearance due to:
  - Oily secretions of the sebaceous glands
  - Desquamated squamous cells
  - The presence of hair
  - The presence of a dermoid tubercle (of rokitansky)
  - Often contain a hard well-formed tooth
- Clinical Manifestations:
  - Most are asymptomatic
  - Symptoms depend upon the size of the mass
  - Torsion is may occur
  - Rupture can occur (Shock and hemorrhage)
- Management:
  - Ovarian Cystectomy
  - Salpingo-oophorectomy

MIXED TUMORS

- Most common ovarian tumor that originates from more than one cell type is a **cystadenofibroma** or the **fibrocystadenoma**
- These tumors generally take their characteristics from the epithelial component (but they tend to be more solid than the epithelial ovarian neoplasms)

GONADOBLASTOMAS

- A tumor composed of cells resembling those of dysgerminoma and others resembling granulosa and sertoli cells
- Characteristically calcific concretions are a prominent feature of this neoplasm
- Almost **ALL** patients with a gonadoblastoma (detected in 90% of them) have **dysgenetic gonads** and a **Y chromosome**
- Although the gonadoblastoma is initially benign, about 50% of these tumors may predispose the patient to have a **dysgerminoma** (or other germ cell tumors) developed.

OVARIAN MASSES MANAGEMENT

EVALUATION OF A PATIENT WITH ADNEXAL MASS

- Complete history and physical exam
- Ultrasound, serum CA-125
- CT scan with contrast or IVP
- Ba enema or colonoscopy
- Laparoscopy or laparotomy accordingly

DIAGNOSIS

- The clinical features of benign ovarian tumors are often nonspecific
- Except for the **functioning** ovarian neoplasms, most ovarian tumors are asymptomatic unless:

- They undergo torsion (the tumor twists in its pedicle, then infarction induces severe pain and tenderness)
- They rupture (due to internal hemorrhage or intracystic pressure, bimanual pelvic examination or after intercourse, and this results in pain and peritoneal irritation)
- The escape of thin serous fluid without hemorrhage may evoke little pain or tenderness

- Clinical signs and symptoms:
  - Increased abdominal girth and abdominal discomfort
  - Pressure symptoms on the bladder and the bowel.
  - Acute abdomen (due to hemorrhage, rupture or torsion)
  - Asymptomatic that is coincidentally diagnosed

RADIOLOGICAL FEATURES OF BENIGN OVARIAN MASSES

- Unilocular
- Smooth surface
- No solid elements
- No external or internal growth
- No ascites
- Unilateral
- Normal Doppler flow

CLINICAL FEATURES OF BENIGN OVARIAN TUMORS

- Unilateral
- Cystic
- Mobile
- No ascites
- No cul de-sac nodules (Nodules in the Pouch of Douglas with scarring and puckering of the peritoneum).
- Doesn't grow, or grows slowly

Age	Malignancy chance
Prepubertal	10%
Reproductive years	15%
Postmenopausal years	50%

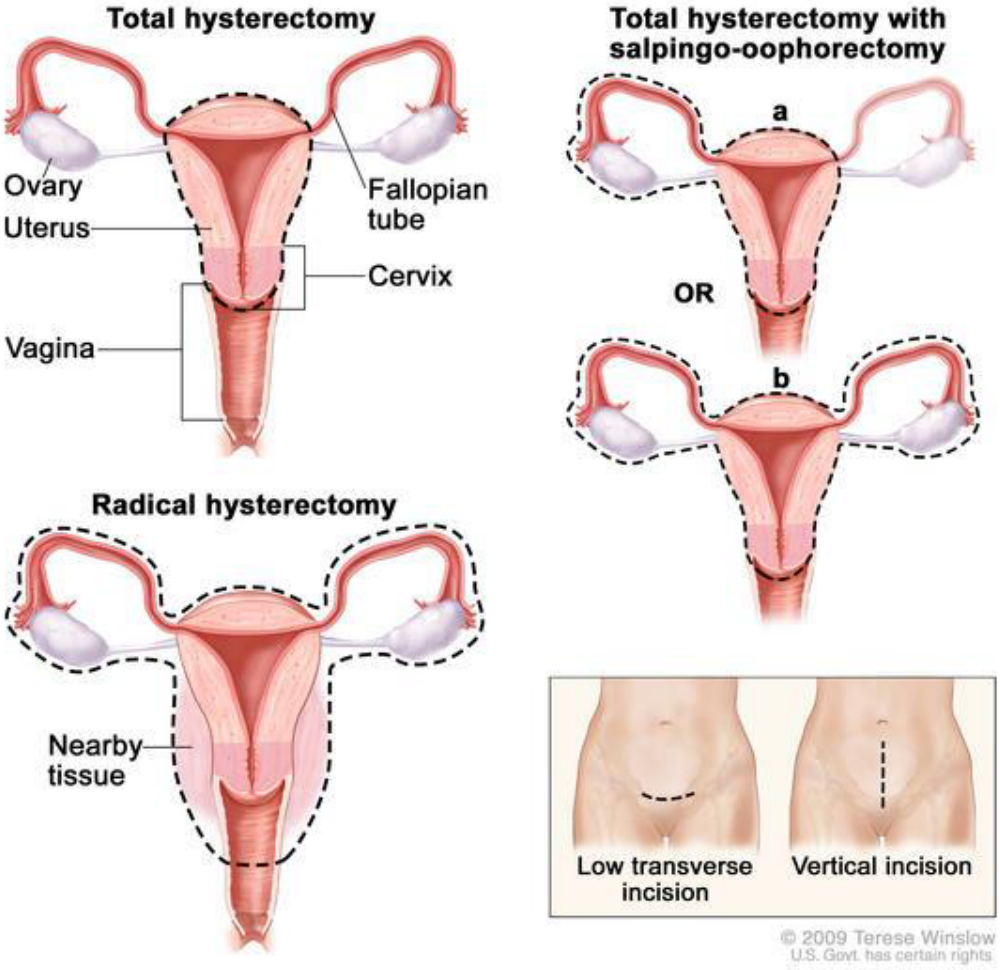
Benign tumor	Malignant tumor
-Cystic	-Solid
-Simple cyst	-Loculated cyst
-Mobile	-Fixed
-Unilateral	-Bilateral
-Small	-Large

INDICATIONS FOR SURGERY

- Ovarian cyst that is >5cm followed for 6-8 weeks
- Solid lesions
- Papillary vegetation
- Mass that is >10cm at the time of presentation
- Ascites
- Palpable mass in premenarchal or post-menopausal
- Suspicion of torsion or rupture

MANAGEMENT

- Epithelial ovarian neoplasm treated by unilateral salpingo-oophorectomy and contralateral ovary should be inspected
- In old women, bilateral salpingo-oophorectomy with hysterectomy maybe appropriate.



MALIGNANT OVARIAN TUMORS

- The lifetime risk for developing ovarian cancer is 1.6% in the general population
- Ovarian cancer accounts for 3.3% of all new cases of cancer
- The fifth in cancer deaths among women and accounts for more deaths than any other cancer of the female reproduction system
- Only 19% of ovarian cancers discovered at early stage.
- Most cases are diagnosed in the seventh decade of life.
- The leading cause of gynecological cancers
- Is difficult to detect in its early stages, due to lack of screening

RISK FACTORS

- Risk of Ovarian Cancer increases with:
  - Older women
  - Race
  - Geographic locations
  - Early menarche
  - Late menopause
  - Family History of ovarian, breast, or bowel cancer
  - Nulliparity
  - Genetic mutation
    (BRCA1 and BRCA2, but also in genes for hereditary non-polyposis colorectal cancer - **breast-ovarian cancer syndrome**)
  - Postmenopausal estrogen replacement therapy

- Risk of Ovarian Cancer decreases with:
  - Combined oral contraceptive pills
  - Tubal ligation
  - Hysterectomy
  - Salpingo-oophorectomy
  - Increase in the number of pregnancy
  - Breastfeeding
- However, 95% of all ovarian cancers occur in women without risk factors.

SCREENING

- Effective screening tests are available for several common cancers, including: mammography for breast cancer, the Pap test for cervical cancer but no standardized screening test exists to reliably detect ovarian cancer.
- Hence, Screening is done only to women who has family history of ovarian cancer, due to high false positive, and the following are used:
  - Serum CA-125 titers
  - Pelvic
  - Serial transvaginal ultrasonography

CLINICAL FEATURES

- Vaginal Bleeding
- Irregular menses if she is premenopausal
- Symptoms of a mass compressing the bladder or rectum, such as urinary frequency or constipation

- Bloating, abdominal distension or changed bowel habits
- Lower abdominal or pelvic "fullness" or of dyspareunia
- Acute symptoms: pain secondary to:
    - Torsion
    - Rupture
    - Intracystic hemorrhage
- In advanced-stage disease:
    - Abdominal pain or swelling (due to ascites, from the tumor)
    - Decrease in weight
    - Loss of appetite
- Signs: solid, irregular, fixed pelvic mass with or without ascites

INVESTIGATIONS

- Initially:
    - History and Examination is suggestive
    - Blood tests; for CA-125, and sometimes AFP & B-HCG
    - Transvaginal ultrasound

- Definitive diagnosis is confirmed by **Biopsy** (frozen section through laparotomy or laparoscopy)

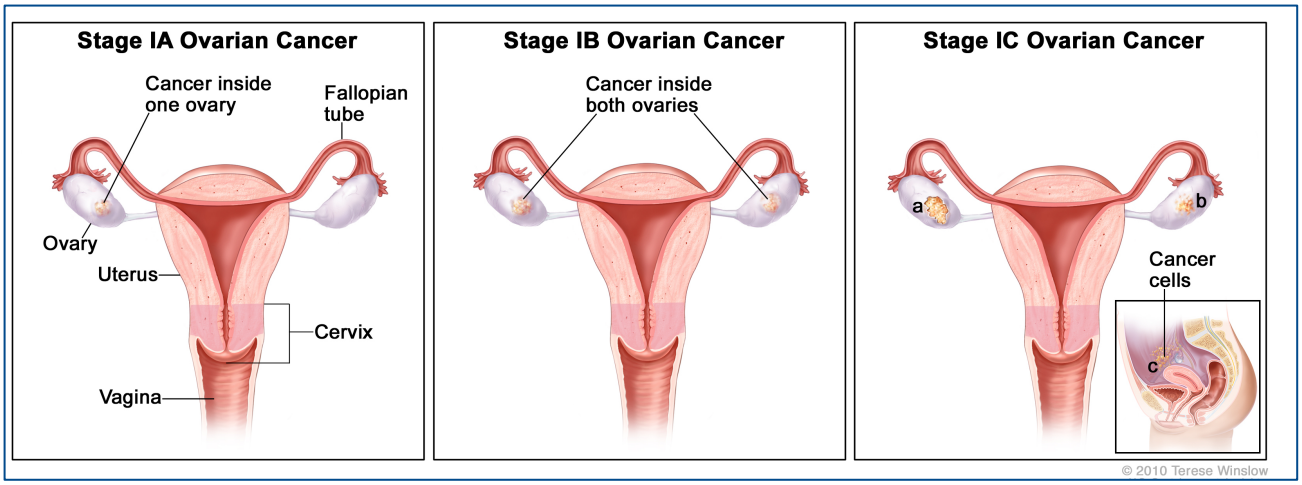
Pre-operatively, and before undergoing Laproscopy/Laprotomy; Certain lab tests should be done (routine for exclusion):
- Blood Tests: CBC, LFTs, U & E.
- CT scan for liver metastasis
- Endometrial biopsy
- Endoscopy in patient with bloody stool
- U/S for pelvis, kidney and liver
- Abdominal radiograph: may be useful in a younger patient to locate calcifications (bone or teeth, and this is associated with a benign cystic teratoma - **dermoid cyst** - which is the most common neoplasm in patients who are younger than 25 years of age).

STAGING

- **Metastatic ovarian spread:**
  - Direct: tubes → uterus → bladder
  - Exfoliating along peritoneal surface (Typical pattern of spread).
  - Lymphatic spread → pelvic and para-aortic lymph nodes
  - Hematogenous spread → liver and lungs
- Ovarian cancer staging is by the ***FIGO*** staging system, which uses information obtained after surgery
- The surgery can include (usually):
  - Total abdominal hysterectomy
  - Removal of both ovaries and fallopian tubes
  - Removal of the omentum, and pelvic (peritoneal) washings for cytopathology.

FIGO STAGING SYSTEM:

- **Stage I - Growth limited to the ovaries**
  - **Stage Ia** - Growth limited to 1 ovary, no ascites, no tumor on external surface, capsule intact
  - **Stage Ib** - Growth limited to both ovaries, no ascites, no tumor on external surface, capsule intact
  - **Stage Ic** - Tumor either stage Ia or Ib but with tumor on surface of one or both ovaries, ruptured capsule, ascites with malignant cells or positive peritoneal washings
- **Stage II - Growth involving one or both ovaries, with pelvic extension**
  - **Stage IIa** - Extension and/or metastases to the uterus or tubes
  - **Stage IIb** - Extension to other pelvic tissues
  - **Stage IIc** - Stage IIa or IIb but with tumor on surface of one or both ovaries, ruptured capsule, ascites with malignant cells or positive peritoneal washings
- **Stage III** - Tumor involving one or both ovaries, with peritoneal implants outside the pelvis and/or positive retroperitoneal or inguinal nodes; superficial liver metastases equal stage III
  - **Stage IIIa** - Tumor grossly limited to pelvis, negative lymph nodes but histological proof of microscopic disease on abdominal peritoneal surfaces
  - **Stage IIIb** - Confirmed implants outside of pelvis in the abdominal peritoneal surface; no implant exceeds 2 cm in diameter and lymph nodes are negative
  - **Stage IIIc** - Abdominal implants larger than 2 cm in diameter and/or positive lymph nodes
- **Stage IV - Distant metastases**; pleural effusion must have a positive cytology to be classified as stage IV; parenchymal liver metastases equals stage IV


Stage IA Ovarian Cancer
Cancer inside one ovary
Fallopian tube
Ovary
Uterus
Cervix
Vagina
Stage IB Ovarian Cancer
Cancer inside both ovaries
Stage IC Ovarian Cancer
a
b
Cancer cells
c
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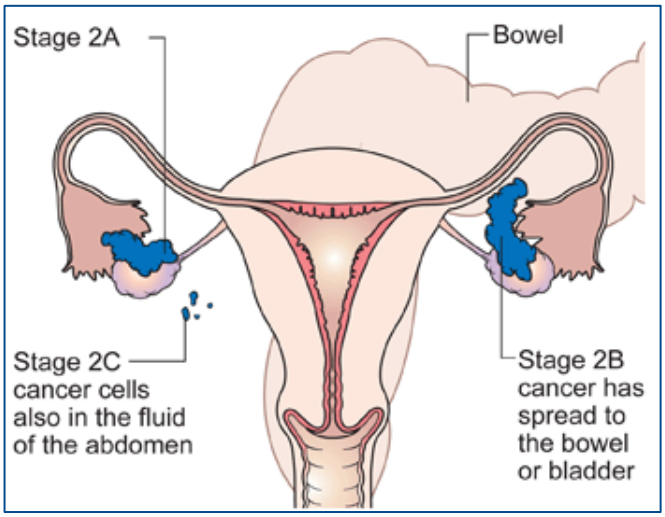
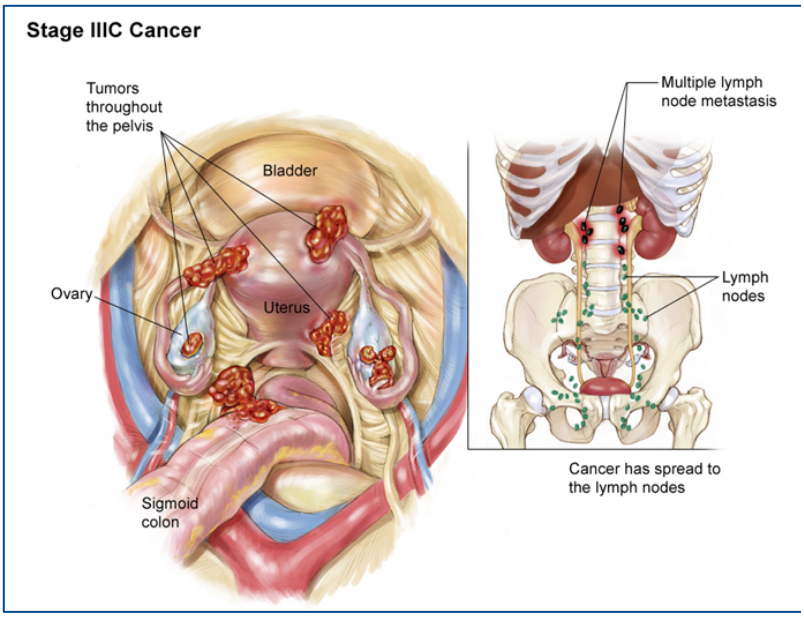
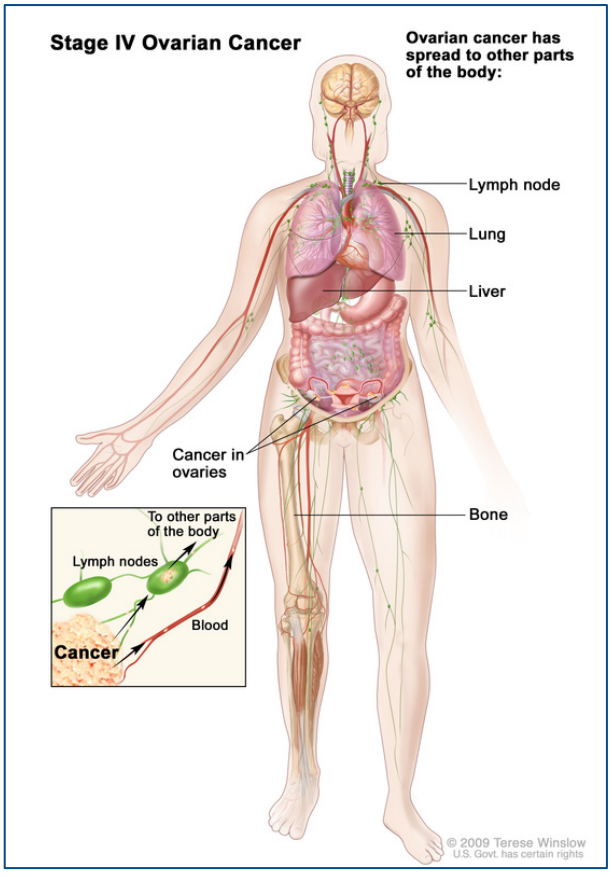

Stage 2A
Bowel
Stage 2C cancer cells also in the fluid of the abdomen
Stage 2B cancer has spread to the bowel or bladder


Stage IIIC Cancer
Tumors throughout the pelvis
Bladder
Ovary
Uterus
Sigmoid colon
Multiple lymph node metastasis
Lymph nodes
Cancer has spread to the lymph nodes


Stage IV Ovarian Cancer
Ovarian cancer has spread to other parts of the body:
Lymph node
Lung
Liver
Cancer in ovaries
Bone
To other parts of the body
Lymph nodes
Blood
Cancer
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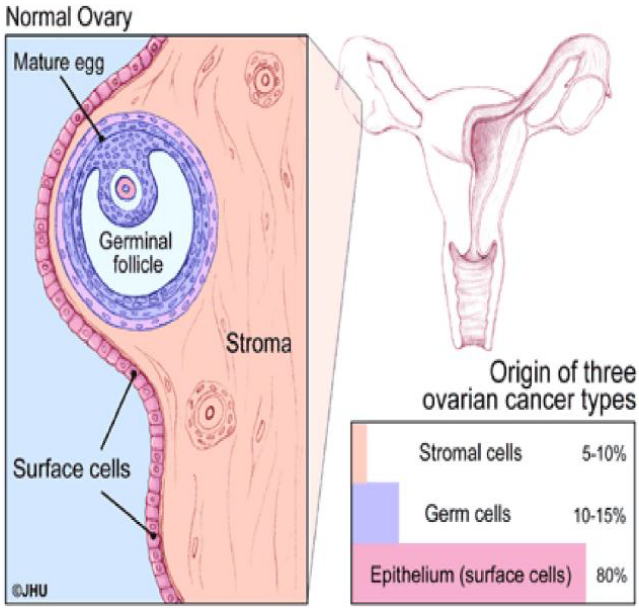
PATHOLOGICAL CLASSIFICATION

- **Epithelial Tumors:**
- Serous tumor (40%)
- Mucinous tumor (25%)
- Endometrioid tumor (20%)
- Clear tumor (5%)
- Brenner (3%)
- Mixed tumor
- Undifferentiated and Unclassified tumor
- **Sex-Cord Stromal tumors:**
- Granulosa –theca stromal cell tumors.
- Sertoli–stromal cell tumors
- Gynandroblastoma
- Lipid cell tumor
- Sex – cord tumor with annular tubules
- Unclassified sex-cord tumors Steroid cell tumors
- **Ovarian germ-cell tumors:**
- Dysgerminoma
- Teratoma (immature, mature and monodermal)
- Yolk sac tumor (endodermal sinus tumor)
- Embryonal carcinoma
- Polyembryoma
- Choriocarcinoma
- Mixed germ-cell tumor.



EPITHELIAL

- Arise from *the surface epithelium* of the ovary
- Account for 60-65% of ovarian tumors
- Approximately **90%** of epithelial tumors are **malignant**
- Is commonly bilateral
- Types:
- **Serous tumors:** resemble fallopian tube epithelium histologically
- **Mucinous tumors:** resemble endocervical epithelium histologically, and are often large.
- **Endometrioid tumors:** closely resemble carcinomas of the endometrium and arise in association with primary endometrial cancer in about 20% of patients.
- **Clear cell carcinomas**:
  - Worse prognosis
  - In about 25% of cases, they occur in association with endometriosis.
- **Borderline ovarian tumor**:
  - Account for approximately 15% of epithelial ovarian cancer.
  - Have a low malignant potential.
  - Common in: young women and may present in pregnancy
  - Microscopically they show malignant features, but come without any stromal invasion.
  - Have a good prognosis.

SEX-CORD

- Tumors that are composed of granulosa, theca, and sertoli cells.
- **Estrogen** and **progesterone** are typically associated with ***granulosa-theca cell*** tumors.
- **Testosterone** and other androgens may be secreted by many ***Sertoli-Leydig cell*** tumors.
- Most of the sex-cord tumors are benign
- The most clinically malignant sex-cord tumors are granulosa cell Tumor.
- **Meigs' syndrome**: is the triad of (1) ascites, (2) pleural effusion and (3) benign ovarian tumor (fibroma)

GERM-CELL

- Account for approximately 30% of ovarian tumor.
- Germ-cell tumors are rare and they occur predominantly in young patients and frequently produce either:
- Human chorionic gonadotropin (hCG) by ovarian Choriocarcinoma
- α-fetoprotein (AFP) by Yolk sac tumor.

Dysgerminoma

- 75% of Dysgerminomas are present in stage I disease.
- 10-15% of them are Bilateral
- Dysgerminoma is the commonest type of **malignant germ cell ovarian cancer**
- 5-10% occur in females previously with abnormal gonads (gonadal dysgenesis or the testicular feminization syndrome)
- Commonly produce: **lactate dehydrogenase**
- *Pure dysgerminomas* do not produce the tumor markers: hCG or AFP.

Teratoma

- Derived from 2-3 embryonic layers.
- **Mature teratoma** is typically *benign* (grade 0) and is found more commonly in women, while an **immature teratoma** is typically *malignant* and is more often found in men
- **Mature teratoma (Dermoid Cysts):**
- Commonest ovarian tumor as a single tumor
- Benign, but might Lead to torsion
- Contain teeth and hair in the cyst
- Malignant transformation risk is 2% only
- **Immature teratomas**
    - Do not produce the tumor markers: hCG or AFP
    - Are 2nd commonest germ cell malignancies

SECONDARY

- Account up to 10% of ovarian tumors.
- Usually metastases from:
- Colon
- Stomach
- Breast
- Female genital tract
- **The Krukenberg tumor:**
    - A specific type of secondary, metastatic tumors
    - Origin: gastric or colon cancer.
    - Microscopic assessment shows signet ring cells
    - Associated with CEA marker