



Aradhana Venkatesan
Gillian Lieberman,

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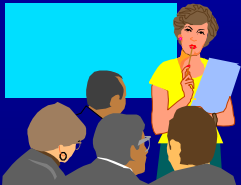
The Radiologic Evaluation of the Ovary

Aradhana M. Venkatesan, Harvard Medical School Year- IV
Gillian Lieberman, MD



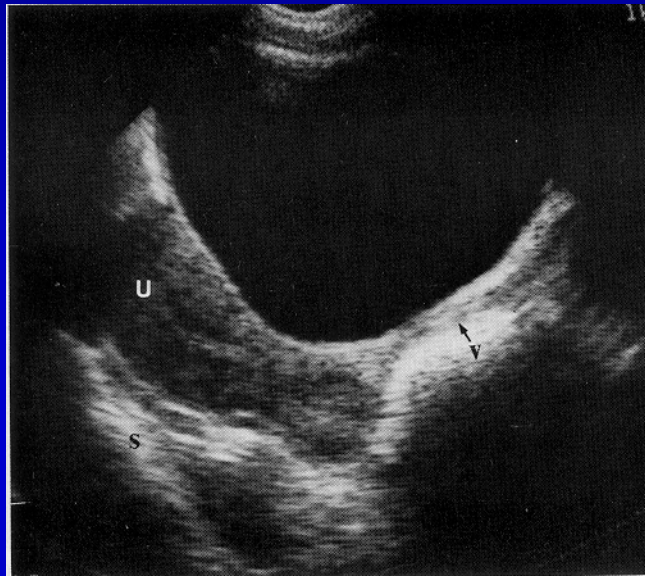
Menu of Tests

- Trans-abdominal pelvic ultrasound
- Trans-vaginal pelvic ultrasound
- Pelvic MRI- new, promising





Trans-abdominal Pelvic Ultrasound TECHNIQUE



**Midline longitudinal
trans-abdominal
sonogram of the
uterus (u) and vagina
(v). S, sacrum**

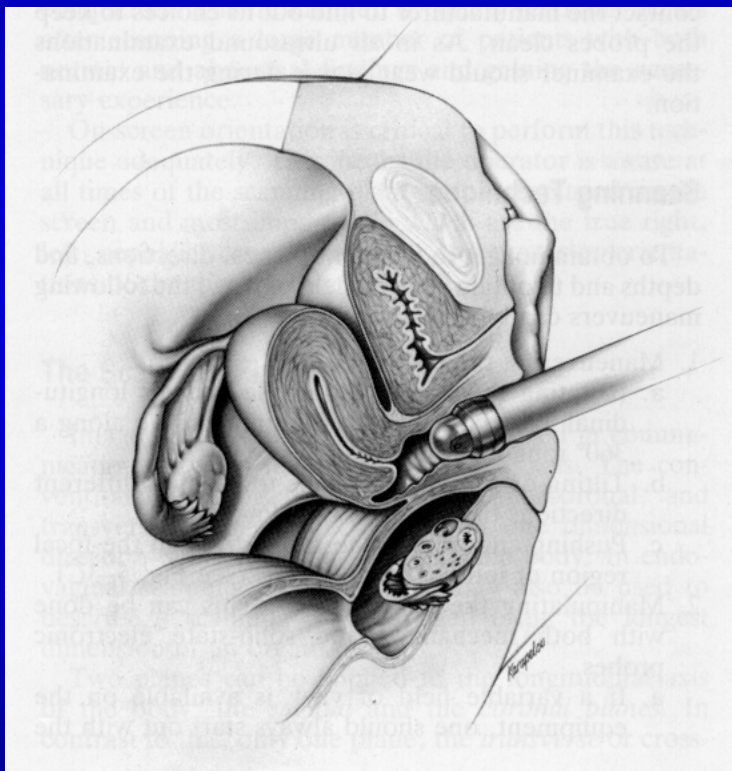
- A distended bladder is essential - this displaces gas-containing loops of bowel and also places the uterus in a horizontal position relative to the beam from the transducer. This allows optimal resolution of the uterus and adnexa.

- When an ovarian mass is detected, a full abdominal ultrasound is performed to look for hydronephrosis, ascites, or omental “cake”



Trans-vaginal Pelvic Ultrasound TECHNIQUE

Trans-vaginal ultrasound often follows trans-abdominal ultrasound



- The bladder should be non-distended and an organ-oriented rather than an image plane approach should be used.
- Angling the transducer laterally with some rotation, will usually reveal the ovaries.

From Callen, P.W. (Ed.) *Ultrasonography in Obstetrics Gynecology*. WB Saunders and Co., Philadelphia, 1994, p. 53.

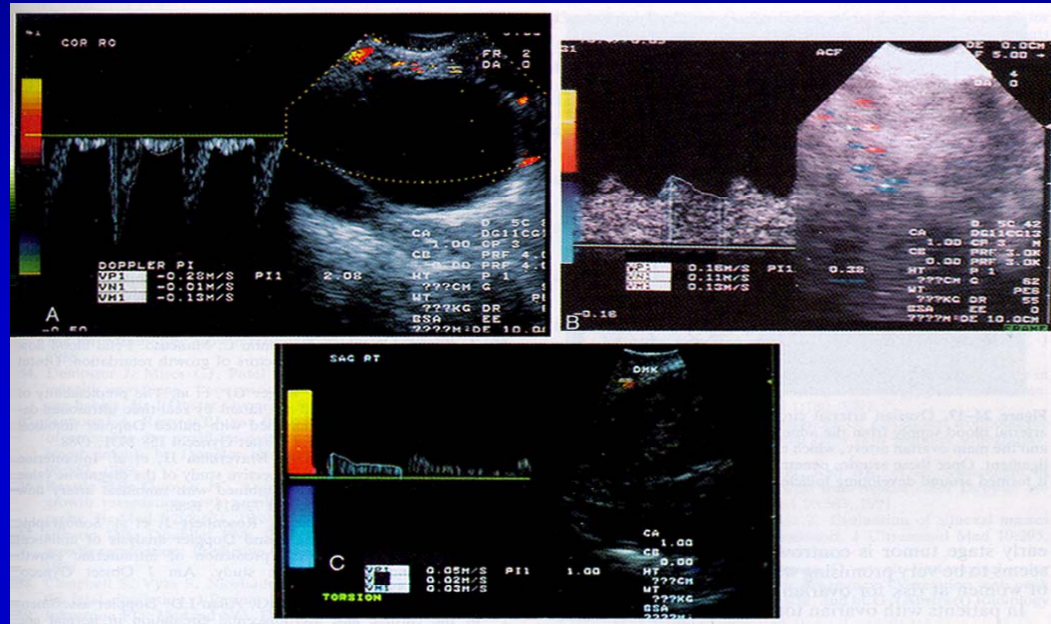


Doppler Evaluation of Ovarian Masses

- **May differentiate benign from malignant**
- **Ovarian carcinomas as a rule are vascular; tumor angiogenesis results in proliferation of sinusoidal vessels which lack smooth muscle in their vascular walls. This results in a low resistance network that can be analyzed with Doppler imaging and waveform analysis**
- **Inflammatory masses and corpus luteum cysts may demonstrate hypervascularity and low resistance to flow**



Doppler Evaluation of Ovarian Masses

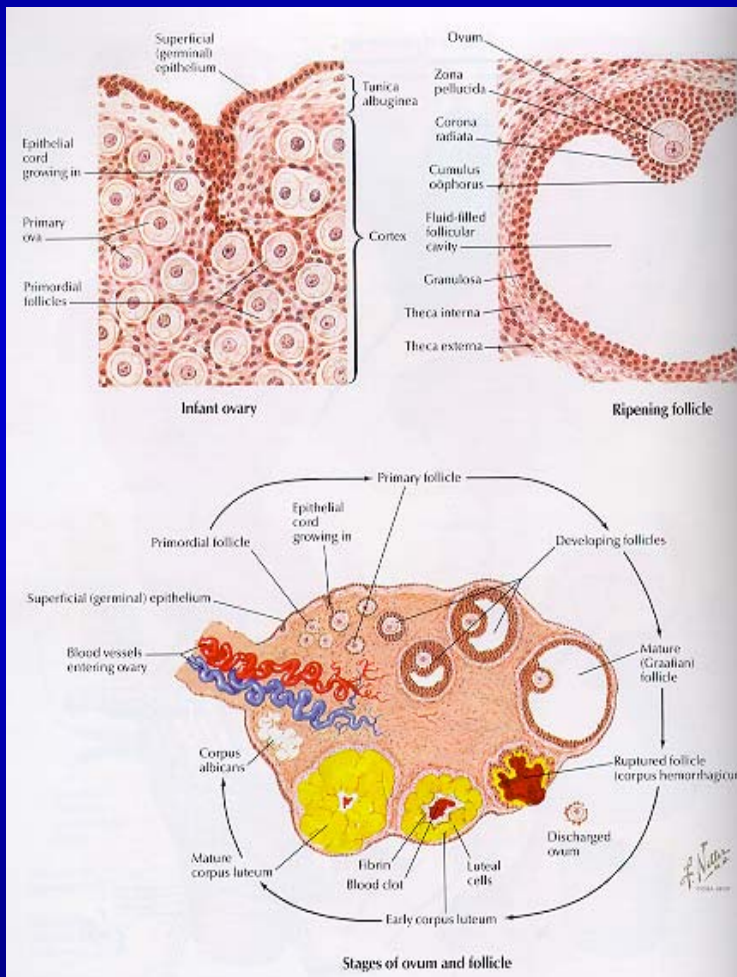


From Callen, P.W.
(Ed.) *Ultrasonography
in Obstetrics and
Gynecology*. WB
Saunders and Co.,
Philadelphia, 1994, p.
521.

Trans-vaginal color Doppler ultrasound of 3 ovarian masses. A) A benign cystic ovarian mass showing high impedance flow, B) Malignant ovarian dysgerminoma showing low impedance flow, C) Torsed ovary showing minimal capsular flow.



Physiology



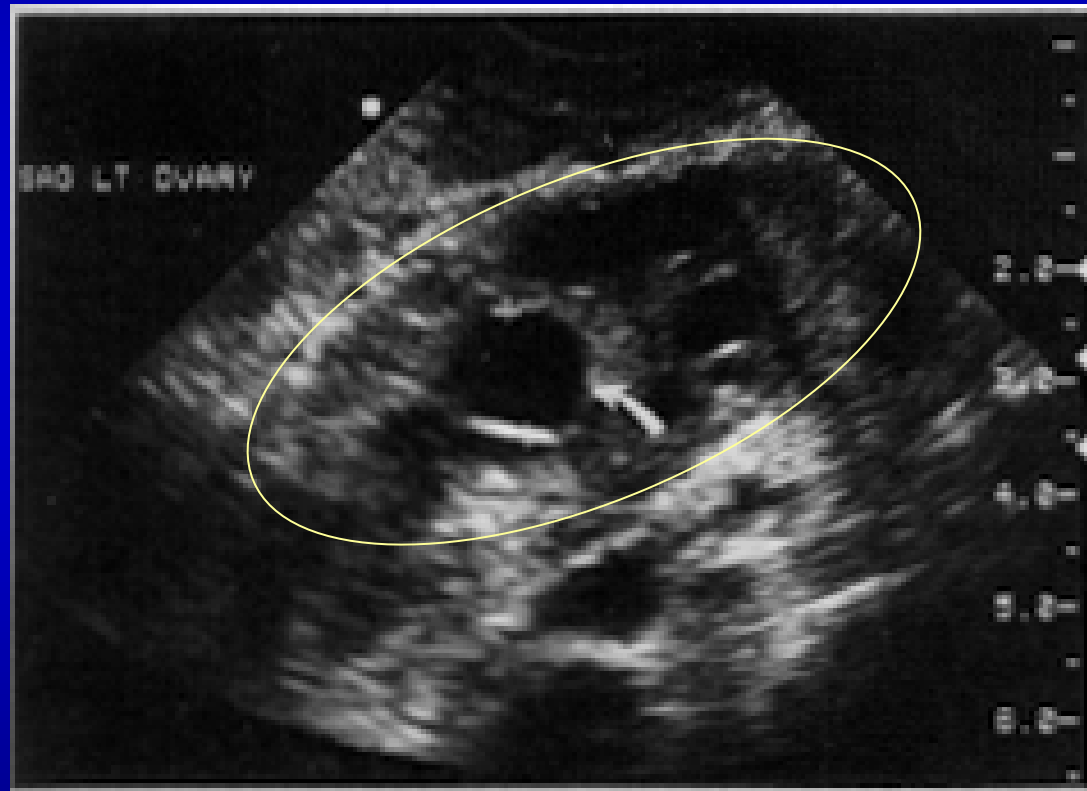
• During the course of a normal menstrual cycle, a mature Graafian follicle will be seen in mid-cycle, attaining a size of 20-25 mm.

• After ovulation, numerous capillaries from the theca interna spread between the granulosa cells. This can give rise to hemorrhage into the corpus luteum, resulting in a cyst. If small (2.5-3 cm) this is considered consistent with a normal cycle.



Normal Physiology on Trans-vaginal Ultrasound

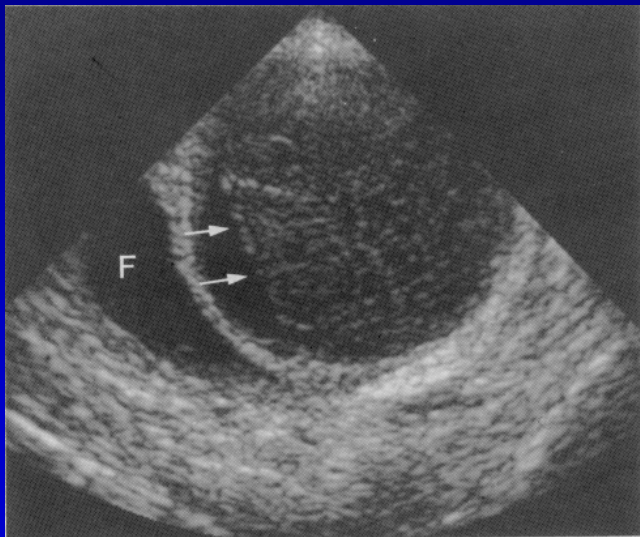
**Sagittal
sonogram of a
normal ovary
in the
follicular
phase (day 9)
with an early
dominant
follicle
(11mm)
(curved
arrow)
surrounded
by smaller
follicles.**



From Callen, P.W. (Ed.) *Ultrasonography in Obstetrics and Gynecology*. WB Saunders and Co., Philadelphia, 1994, p. 571.



Non-Neoplastic Ovarian Cysts



Echogenic adnexal mass with a mildly thickened wall and enhanced transmission. Margin of internal echoes defies gravity (white arrows) which is typical of clotted blood. This lesion disappeared in 6 weeks without treatment and was likely a corpus luteum cyst.

- **Most are due to irregular menstrual cycles, resulting in follicular or corpus luteum cysts. Smooth thin walled, unilocular, commonly complicated by hemorrhage.**
- **Other non-neoplastic cysts: theca lutein and serosal inclusion cysts and endometriomas.**
- **Usually resolve spontaneously; only removed if complicated by torsion or rupture.**



Primary Ovarian Neoplasms

- **Primary tumors of the ovary arise from one of the three ovarian components: surface epithelium, germ cells, and the stroma of the ovary (which includes the sex cords).**
- **Although some ovarian neoplasms are hormonally active, most are non-functional, producing only mild symptoms until they reach a large size. Abdominal pain/distension, urinary or GI tract symptoms due to compressive phenomenon or cancer invasion are the most common presenting symptoms.**

Primary Ovarian Neoplasms

OVARIAN NEOPLASMS

(1993 WHO CLASSIFICATION)

- Surface epithelial-stromal
tumors
- 1) Serous tumors
Benign
(cystadenoma)
Borderline
Malignant
- 2) Mucinous tumors,
Benign
Borderline
Malignant
- 3) Endometrioid
Benign
Borderline
Malignant
- 4) Epithelial-stromal tumors
5) Clear cell tumors
6) Transitional cell tumors
- Sex cord-stromal tumors
- 1) Granulosa-stromal cell
2) Sertoli stromal cell,
androblastomas
tumors
3) Sex cord
4)
Gynandroblastoma
- 5) Steroid cell tumors
- Germ cell tumors
- 1) Teratoma
2) Dysgerminoma
3) Yolk sac tumor
(endodermal sinus tumor)
4) Mixed germ cell tumor
- Malignant ovarian
neoplasm, NOS

Modified WHO Classification from Cotran R.S., Kumar, V., Collins T. Robbins Pathol. Basis of Dis. (6th ed.), WB Saunders & Co., Philadelphia, 1997, p.1067.



Broad Categories to Consider With Complex Adnexal Masses

- Hemorrhagic Physiologic cyst
 - Other non-neoplastic ovarian cyst, possibly complicated by hemorrhage
 - Primary ovarian neoplasms, both benign and malignant
 - Ectopic pregnancy
 - Ovarian torsion
 - Tubo-ovarian abscess
- Diagnoses aided by H&P and laboratory data(e.g. WBC count, β -HCG,etc.)



Features

- Consider whether the mass appears cystic or solid on ultrasound. A thin-walled unilocular cyst is almost always benign. In contrast, a cyst with a mural nodule or septations suggests that it is a neoplasm, though it may still be benign. Solid masses are often ovarian neoplasms.
- There are many types of ovarian tumors, both benign and malignant neoplasms. **As a general rule, neoplastic masses of the ovary are removed because over half of malignant ovarian tumors arise from pre-existing benign tumors.**



DDX FOR UNILOCULAR CYSTS

Differential Diagnosis Based on Sonographic Appearance

Very Common:

Follicular cyst

Corpus luteum cyst

Endometrial cyst

Rare:

Cystadenoma of low malignant potential

Cystadenocarcinoma

Less Common:

Para-ovarian cyst,

Serous inclusion cyst,

Serous cystadenoma

Uncommon:

Cystic teratoma

Mucinous cystadenoma

Cystadenofibroma

Large size (>10 cm), irregular thick walls, multi-loculated appearance with septations, mural nodules, solid component is suspicious for neoplasia.



DDX FOR SOLID OVARIAN MASSES

Adnexal leiomyoma

masquerading as a solid
ovarian mass

Benign ovarian neoplasms:

Ovarian fibromas

Adenofibromas

Thecomas

Brenner tumors.

Malignant ovarian neoplasms

especially if large in size, with
irregular walls, debridinous
internal echo pattern,
surrounding ascites, metastatic
nodules, fixation to pelvic
sidewall/omentum.



Benign vs. Malignant Patterns of Ovarian Tumors on Ultrasound

Benign

Size <10 cm

Smooth walls

**Unilocular cyst,
multilocular w/thin septae**

No debris

Mass effect only, mobile

Malignant

Size >10 cm

Irregular or poorly defined walls

**Complex cyst with solid
component/solid mass**

Debridinous

**Fixation to pelvic sidewall or
omentum, metastatic nodes or
nodules**



Patients

Patient #1: A 32 y.o. F who presented to the BIDMC with LLQ pain of unknown etiology. She had a PMH significant for appendectomy and ovarian cystectomy x 1 (large follicular cyst c/b torsion). A trans-vaginal ultrasound of the left ovary showed the following:

QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.



Patient #1

Impression: A thin-walled unilocular cystic structure in the left ovary measuring 4.6x3.8x3.0 cm, with low-level internal echoes and no evidence of septations, nodules, solid components.

The findings were read as consistent with a hemorrhagic cyst.

F/U: On f/u visit one month later, u/s showed complete resolution of the cyst.



Patients

Patient #2: A 34 y.o. F, originally from Ireland, presented to the BIDMC with pelvic pain and increasing abdominal girth. No significant PMH. FH significant for ovarian cancer in paternal grandmother and Hodgkin's disease in paternal uncle. An abdominal and pelvic CT showed abdominal ascites with omental thickening and enlargement of the R ovary to approx 6.6 cm. F/U trans-vaginal ultrasound was arranged and showed the following in the right ovary:



Patient #2

Film findings:

- **6 cm solid irregular adnexal mass (M) inseparable from the R ovary. Marked ascites (A). The uterus was noted to be normal in size and configuration, as was the contralateral ovary.**

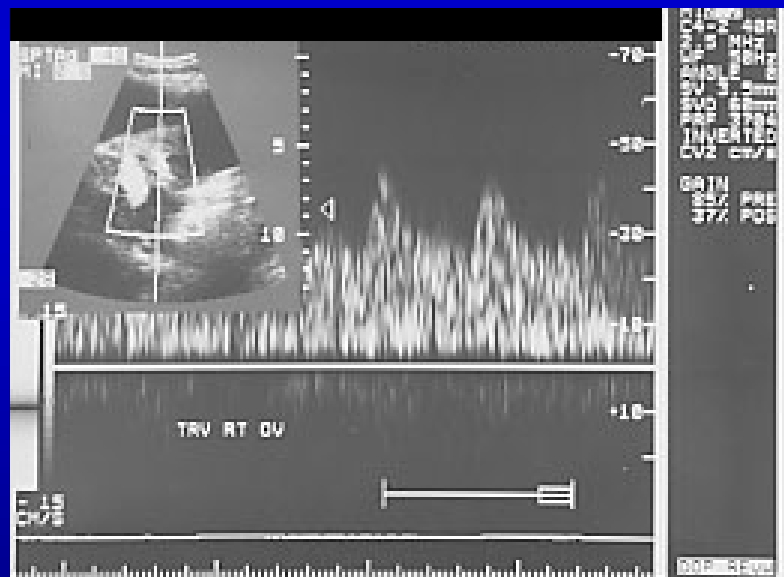


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Ultrasound Teaching Files, Dept. of Radiology, Beth Israel-
Deaconess Medical Center, Boston, MA.



Patients

Patient #2 (continued) Doppler analysis demonstrated hypervascularity.



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Ultrasound Teaching Files, Dept. of Radiology, Beth Israel-Deaconess
Medical Center, Boston, MA.



Patient #2 continued

- **These findings were read as highly suggestive of malignancy.**
- **The patient underwent an e-lap and TAH-BSO with omentectomy. The pathology report on the L and R ovaries, fallopian tubes, uterus and omentum were positive for poorly differentiated and invasive ovarian cystadenocarcinoma.**
- **Surgery was followed by two cycles of taxol/carboplatin.**
- **Following completion of her second cycle of chemo, the patient elected to move to Ireland to be closer to family. Her prognosis is poor.**



Additional Radiological Modalities in Ovarian Cancer Surveillance

- **Radiographs- poor**
- **UGI, BE, IVP-poor**
- **CT**
- **MRI-promising**
- **PET-promising**
- **Radio-immunoscintigraphy**



SUMMARY

- **Pathology of the ovary is difficult to assess clinically so trans-abdominal and trans-vaginal ultrasound is routinely ordered for suspected pathology.**
- **The ovary is a complex and dynamic organ, capable of manifesting a wide array of physiologic cysts, non-neoplastic cysts, benign and malignant ovarian neoplasms.**
- **Sonographic features supporting cysts are unilocular, anechoic, thin walled fluid collections**
- **Sonographic features suspicious for neoplasms are solid, echogenic, thick walled, septated collections. Although some may be benign, they are usually removed as malignancy often complicates benign ovarian neoplasms. Evidence of metastatic disease eg. ascites, liver lesions support malignant origin.**
- **The established imaging modalities of CT and MRI as well as evolving technologies, such as PET and radio-immunoscintigraphy, are available for ovarian cancer staging and surveillance.**



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The End.