Adnexal Masses

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Disclosures
Ilan E. Timor-Tritsch
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We have no relevant financial relationships

Learning Objectives
After completing this presentation, the learner will be able to:
1. Understand the technical aspects transabdominal and transvaginal ultrasound probes and effectively use them to characterize sonographic, adnexal features on the road to a clinical diagnosis.
2. Recognize the most frequently occurring adnexal pathologies using gray scale, color and power Doppler as well 3D ultrasound techniques
3. To use the most advanced scoring systems to distinguish benign from malignant ovarian tumors.

Lecture Outline
1. Introduction
2. General & technical aspects
3. The bladder and the cervix
4. The normal ovary
5. Pathology of the ovary
   1. PCO
   2. Non neoplastic ovarian cysts
   3. Ovarian neoplasms
   4. Malignant neoplasms
6. Scoring systems
   1. The Kentucky system
   2. The IOTA systems
7. The Fallopian tube
   1. Inflammatory Tubal disease
   2. Tubal cancer
8. Additional sites to check
9. Summary and conclusions

Scanning for adnexal pathologies
• It IS the hardest gynecologic scanning task.
• You MUST arrive at a conclusion!
  – Use primarily transvaginal sonography (TVS), and as needed, combine it with transabdominal sonography (TAS)!!
  – In addition to the adnexae, do not skip the bladder, kidneys, Morrison's pouch etc…
  – Use a variety of transducers for depth, color and power Doppler, employ 3D....
Scanning for adnexal pathologies

- Remember: not all masses are ovarian.
- If you scan your own patient:
  - Take a short history; examine the patient before the scan, but do so after the scan to confirm your ultrasound findings.
- If you scan a referred patient:
  - Take a short history yourself: don’t trust the referral slip; it is usually useless!!
  - If in doubt: perform a bimanual exam yourself.

Important!!

- In the reproductive years, physiologic as well as pathologic processes are driven by the menstrual cycle or by (therapeutic or pathologic) hormonal stimulation.
- Know the day of your patients’ day of the cycle, therefore...

Important!!

- …clearly mark the LMP on the screen to avoid erasure every time you unfreeze the picture (type in the LMP or the letters PM 1998 [for: postmenopausal since 1998] to carry them over to every picture).
- Judge EVERY US finding (ovarian findings, pelvic fluid, endometrium etc) as a function of the hormonal status (or day in cycle)

Technical aspects

1. The most efficient pelvic evaluation is by using transvaginal US probes. (If the bladder is full you may want to do first a transabdominal scan)
2. Vaginal probes operate at frequencies of 5-9 (or 6-12) MHz.
3. Their most effective scanning depth is 2 to 10-12 cm.
4. They accommodate Doppler, harmonic imaging & 3D.

Technical aspects

"Sliding organs sign"

What is the sliding organs sign…?
Generated by the to-and-fro movement of the vaginal probe aided by the abdominal hand moving the cervix, uterine body, ovaries to evaluate their movement relative to the pelvic floor and/or each other, to diagnose or rule out pelvic adhesions.
Sliding organs sign

Useful to diagnose adhesions in the pelvis as well as the upper abdomen. Useful even at the time of laparoscopy (selection of safe port placement site)

Example: If patient with infertility or suspect for a frozen pelvis, a discrete endometrioma on US has absent sliding pelvic or abdominal organs, she most probably has pelvic adhesions.

Record the mobility or fixed nature of pelvic organs

- Lately US machines are equipped with the ability to record scanning sequences using two kinds of features: “on-the-fly” (going forward) or “retro-view” (reviewing a structure just seen before)
- Use them to record the mobility (“sliding”), or fixed nature of pelvic organs.
- Add credibility to your report!
- Acquire also a “sweep” of the adnexa

3. The Bladder and the cervix

Even though it is not strictly the adnexum,* on the way in, look at the bladder and the cervix.

* Latin: Adnexum = singular, adnexae = plural; adnexa = grammatically incorrect but can be used, since it is already deeply rooted in our vocabulary!

4. The Normal Ovary

General

Location of the normal ovaries

- Best imaged by TVS (TAS may be of help)
- In the reproductive age:
  - Follicles are their sonographic markers.
  - They “live” close to the hypogastric vessels.
  - In the secretory phase look for the corpus luteum (CL) with color or power Doppler.
- In menopause:
  - Harder to find (no, or rare follicles as markers).
  - Linger on the adnexae and look for hypoechoic 1-3-cm structures amidst constantly moving bowel.
Location of the normal ovaries in

- Best imaged by TVS (TAS can be of help)
- In the reproductive age:
  - Easy to see **follicles**: their sonographic markers.
  - They “live” close to the hypogastric vessels.

Physiologic follicles of the ovary

- During a normal (NL) cycle 1 or MORE follicles mature.
- At midcycle one matures achieving 2-2.5 cm.
- **DON’T CALL THEM CYSTS, THEY ARE FOLLICLES!**

In the secretory phase of the cycle look for the corpus luteum using color Doppler

Hemorrhagic Corpus Luteum

They may be slightly larger than a 2-3 cm CL. They may have a “threatening” appearance. BUT Do not call them “complex masss” or “cyst”. They are a hemorrhagic CL!

Postmenopausal ovaries

- Harder to find (no, or rare follicles as markers).
- Linger on the adnexae & look for hypoechoic 1-3 cm structures amidst constantly moving bowel.

Ovarian sizes

- Data from 58,673 observations of ovarian volume.
- Less than 30 years: 6.6cm³
- 30-39 years: 6.1cm³
- 40-49 years: 4.8cm³
- 50-59 years: 2.6cm³
- 60-69 years: 2.1cm³ and
- >70 years: 1.8³
- Polycystic ovaries >10-11cm³
- Mean ovarian volume: 4.9cm³ in premenopausal
- and 2.2cm³ in postmenopausal women (P < 0.001).
- Ovarian volume was unrelated to patient weight but was greater in tall women (>68 in.) than in short women (<58”)


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Notes:

- Best imaged by TVS (TAS can be of help)
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  - Easy to see **follicles**: their sonographic markers.
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5. Ovarian Pathology: What to look for?

- Internal echo structure ("echogenicity"):  
  - Anechoic (fluid component)  
  - Echogenic (solid component)  
  - Low-level echoes (ground glass appearance)  
  - Mixed echogenicity, reticular etc

- Wall structure:  
  - Thickness  
  - Internal and/or external papillae  
  (the moment you see papillae, apply power Doppler [not color!] and set it to the highest sensitivity to rule in or out blood flow). Blood vessels in a papilla is highly predictive of malignancy

- Septae

Ovarian lesions (findings)

What do you look for?

- Appearance:  
  - "Bizarre shapes"  
  - Mixed components  
  - Size  
  - Is it bilateral?  
  - Ascites  
  - Motion tenderness  
  - Vessels  
  - Sliding of the ovary

When these are documented, the next step is: LOOK AT THE VASCULARITY.

Ovarian lesions: What do you look for?

- General appearance  
  - Solid  
  - Cystic:  
    - without solid component  
    - With solid component  
  - Unilocular, Multilocular,

Ovarian lesions: What do you look for?

- Internal echo structure:  
  - Anechoic/hypoechoic  
  - Echogenic (solid)  
  - Low-level echoes (ground glass appearance)  
  - Mixed echogenicity  
  - Reticular, etc

- Vascularity  
  - CAN ANY VESSELS BE SEEN AT ALL?  
  - If seen: Look for their qualitative appearance:  
    - Location (central/peripheral)  
    - Amount of vascularity  
    - Tortuous appearance  
    - Caliber changes  
    - Anastomoses  
    - "Lakes"  

  - If seen: Measurements can be done (less used lately, however a low RI & PI is common in cancer):
Ovarian lesions (findings)
What do you look for?

• Wall structure:
  – Thickness
  – Inner, mural papillae

(The moment you detect papilla/e, apply power [not color!] Doppler and set it to the highest sensitivity to rule in, or rule out blood flow).

Three kinds of papillae

• Hyperechoic papillae
  • No vessels in papilla
  • Papilla does shadow

Usually benign (cystadenofibroma)
Goldstein & Timor – Tritsch JUM 2010

• Hypoechoic papillae
  • Smooth, rounded borders
  • No vessels in papilla
  • Does not shadow

In pregnancy c. appropriate history: Decidualized endometrioma
Mascilini F. et al, UOG 2014;
Timor & Monteagudo

• Hypoechoic papillae
  • Irregular borders
  • Vessels in papilla
  • Does not shadow

Usually borderline ovarian tumor or frank epithelial Ca.
Timmerman et al, UOG 2008;

The significance of papillary formations in ovarian masses

• Agreement on both shores of the Atlantic:
  – “Small”, hyperechoic papilae without blood vessels can be followed by periodic imaging

The Ovary

5-1. PCO

Polycystic ovaries

Sono criteria:
• Peripherally crowded, small follicles
• ≥12 follicles of <10mm
• Size x1.5–3 of NL ovary
• Hyperechoic hilus
• Rich hilar blood supply

Ovaries are usually larger than 12 mL in volume
True PCO or only “sonographic PCO,” aka multicystic ovary?

- Not every ovary that fulfills the sono criteria is a PCO syndrome!
- An ovary can have a PCO appearance in the following clinical situations:
  - Hyperthyroid state (36%)
  - Hyperprolactinemia (50%)
  - Hypothalamic hypogonadism (24%)
  - Or without any known reason

Paraovarian/paratubal cyst

Frequently seen, benign appearing cysts with the following sono markers:
1. Very thin
2. Smooth wall
3. Anechoic
4. Unilocular
5. Ipsilateral ovary HAS TO BE SEEN!!

Postoperative peritoneal inclusion cysts in loculated pelvic fluid

- The Dx should be suspected in the right clinical setting.
- Dx depends on the presence of normal ipsilateral ovary with surrounding loculated fluid conforming to the peritoneal space.


5-2. Non neoplastic ovarian cysts

Non-neoplastic ovarian cysts

These are by far the most common cystic structures.

FUNCTIONAL
- Follicular “cysts” (E)
- Corpus luteum (P)
- Theca-lutein cyst (E)

NONFUNCTIONAL
- Serous cyst
- Corpus albicans
- Endometrioma

Except the endometrioma: most resolve and do not need surgical treatment, provided they do not twist. If Dx. in doubt, scan the patient in the next cycle (days 5-9).

Non-neoplastic ovarian cysts

These are by far the most common cysts.

FUNCTIONAL
- Follicular “cysts” (E)
- aka SIMPLE CYSTS
  - The corpus luteum (P)
  - Theca-lutein cyst (E)

NONFUNCTIONAL
- Size: up to 4-5 cm, sometimes more
- Smooth wall, unilocular, no papillae
- Lined with flat granulosa cells
- Circular blood flow around the wall
- Almost never malignant (<1%)<br> No additional information by MRI

These resolve and no surgery (Sx) needed, provided no rupture or torsion exists.
Non-neoplastic ovarian cysts
These are by far the most common cysts.

**Simple cysts**

Ovarian tumors with cystic or septate morphology are at minimal risk of malignancy and can be followed with serial ultrasonography evaluations, thereby avoiding the morbidity and cost of surgery.


**Non-neoplastic ovarian “cysts”**

These are by far the most common cystic structures.

**FUNCTIONAL**

- Follicular “cysts” (E)
- The corpus luteum (P)
- Theca-lutein cyst (P)

- Size: ≥2.5-3 cm, sometimes more
- Thick wall, unilocular, no papillae
- Filled with interphases, mesh-like texture, bizarre forms and shapes created by the clot as it shrinks, lyse, etc
- Abundant blood flow in wall and around them also called: “ring of fire”
- They regress!!!


Risk of malignancy in cystic & septated ovarian tumors<10cm in diameter

<table>
<thead>
<tr>
<th>Author</th>
<th>Morphology</th>
<th>Spontaneous Resolution</th>
<th>Surgeon</th>
<th>Malignancy</th>
<th>Follow-up (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailey et al</td>
<td>Unilocular</td>
<td>256</td>
<td>125 (49)</td>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td>Modseit et al</td>
<td>Unilocular</td>
<td>3,359</td>
<td>2,364 (69)</td>
<td>133</td>
<td>0</td>
</tr>
<tr>
<td>Sanders et al</td>
<td>Septated</td>
<td>2,870</td>
<td>1,114 (39)</td>
<td>128</td>
<td>06</td>
</tr>
</tbody>
</table>

—Castillo G, Alcázar JL, Jurado M. Natural history of sonographically detected simple unilocular adnexal cysts in asymptomatic postmenopausal women.

The “jiggling” blood clot in a hemorrhagic CL

“Injigging” blood clot in a hemorrhagic CL. Timor & Monteagudo

Cyst vs follicles vs corpora lutea

“Before embarking upon descriptions and definitions of ovarian physiology and pathology, please remember that uttering the word ‘cyst’ or including it in a US report, for most, if not all obstetric and gynecologic (Ob/Gyn) practitioners, implies: pathology.

Therefore do not use the word ‘cyst’. When describing a follicle or a CL: simply call them follicles and corpora lutea”.

Timor-Tritsch IE, Goldstein SR: The simplicity of a simple cyst and the complexity of a complex mass. JUM Editorial 2005
**Physiologic “cysts” of the ovary**

- After ovulation, a CORPUS LUTEUM appears.
- A mesh of blood vessels are in the wall which bleed at ovulation.
- The CL may reach a size of 2.5 cm. Sometimes more!
- In hyperstimulated ovaries may be more than 1 CL.
- Color or power Doppler helps in identifying them.

DON’T CALL THEM CYSTS! THEY ARE CORPORA LUTEA!!

* Timor-Tritsch & Goldstein. JUMI Editorial 2005

**Non-neoplastic ovarian cysts**

**FUNCTIONAL**

- Follicular “cysts” (E)
- The corpus luteum (P)
- Theca-lutein cyst

- Size may achieve: ≥5-10 cm
- Thick wall, multilocular, no papillae
- In fact: they are hyperstimulated ovaries

May occur in diabetes, molar pregnancy, pregnancies with hydrops fetalis, hormones

These resolve and no Sx needed, if no rupture or torsion

* Timor & Monteagudo

**NONFUNCTIONAL**

- Serous cyst
- Corpus albicans
- Endometrioma

- Size: up to 2-4 cm, hyper- or anechoic (not really a cyst)
- Occur mostly in the late secretory phase, may “roll over” to next cycle/s and persist for a long time
- Should be noted, since its differential Dx is: intra-ovarian benign teratoma

These resolve and do not need surgical treatment.

* Timor & Monteagudo

**Non-neoplastic ovarian cysts**

These are by far the most common cysts.

- Serous cyst
- Corpus albicans
- Endometrioma

Rarely septated, thick walled
- Homogeneous, low-level echo filled
- Rarely vessels run through it
- May be large (10+ cm)
- MRI can help detecting blood
- Rarely can become malignant will show papillae with blood vessels, The result is endometroid carcinoma

Test for adhesions: push to see if organs slide

DOES NOT resolve, and most need surgical treatment.

* Timor & Monteagudo

**Endometrioma**

If blood vessels and papillae are seen in, or close to the wall, think of clear cell carcinoma, aka endometrioid carcinoma.

Decidualized endometrioma
A subset of endometrioma seen in pregnancy

- Fruscione E et al. Sonographic features of decidualized ovarian endometriosis suspicious for malignancy. UOG 2004; 24: 578

Decidualization

- A morphological and biochemical transformation of endometrial stromal fibroblast into differentiated decidual cells, which is critical for correct trophoblast invasion and formation.
- An ectopic decidual reaction may be encountered within the ovarian stroma as a response of the indigenous cells to the hormonal milieu of pregnancy.

Diagnostic “pointers”

- Often pre-existing endometrioma/endometriosis
- Most characteristics of endometrioma are preserved:
  - low-level echoic (ground-glass) appearing fluid
  - uni- or sometimes bilocular
  - no or thin septum

Make everything possible to obtain reliable history, previous US images, laparoscopy results etc. A proven diagnosis of endometriosis by the above saves surgery during pregnancy!!

- Shallow, mostly smooth, rounded papillae protruding from a thick inner surface “lining”
- Moderate amount of vessels in papillae
- As pregnancy progresses picture returns to the basic character of the preexisting EOMa

The point of the matter

- With decidualization the sonographic appearance of endometriomas can become more heterogenous with papillary excrescences and increased vascularization
- A richly vascularized ovarian lesion is considered malignant unless proven otherwise. Correct diagnosis IMPERATIVE!
- The proof is usually surgical exploration that may lead to pregnancy loss or premature labor

Non-neoplastic ovarian cysts
These are by far the most common cysts.

- Ovarian fibroma
  - Benign ovarian tumor
  - Cystic
  - Solid

Ovarian fibroma
Benign ovarian tumor

- Cystic
  - Sono markers:
    - Hyperechoic, shadowing mural papillae
    - Avascular papillae
    - Anechoic fluid
    - Mostly unilocular
    - 30% multilocular
    - Thin wall, thin septae
    - Slow rate of growth

Differential Dx: simple cyst

Machida S, 2008; Sammour RN, 2005
Timor & Monteagudo
Goldstein, Timor & Monteagudo JCU 2009
Benign ovarian tumor

Sono markers:
• Myometrium-like texture
• Anechoic/hypoechoic
• Few/no vessels in stroma
• Very slow rate of growth

Differential Dx: Brenner tumor, Krukenberg tumor

Non-neoplastic ovarian cysts
These are by far the most common cysts.

Ovarian fibroma

Solid

Differential diagnosis: intraligamentar myoma or myoma on a pedicle

Search for vascular connection between the uterus and the mass

5-3. Ovarian neoplasms

• 75% of all neoplasms occur in premenopause (of these, only 13% are malignant).
• 75% of malignant neoplasms are diagnosed in menopause.

Ovarian neoplasms: several facts

• Thin, unilocular, anechoic cysts without papillae, without solid component, without thick septae, <6 cm, without significant and prominent blood vessels, (i.e. “simple cysts”) are virtually never malignant.
  (Some believe in no follow-up of them at all.)
• Caveat: Before calling them “simple cysts” scrutinize them for the above sono characteristics, possibly using gray scale and color Doppler transvaginal ultrasound

Ovarian neoplasms

• Most prevalent: dermoid cysts (cystic teratoma) and serous cystadenomas.
• Size matters: malignant neoplasms are larger than benign.

<table>
<thead>
<tr>
<th>Tumor size</th>
<th>Total</th>
<th>Malignancies</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5cm</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>5 - 10 cm</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td>&gt; 10 cm</td>
<td>63</td>
<td>40</td>
</tr>
</tbody>
</table>

Rulin & Preston. Obstet Gynecol 1987; 70:578
Cystic teratoma (dermoid cysts)

Sono markers:
1. Variable, sometimes bizarre appearance
2. Shadowing!!!
3. Rarely has blood vessels (if so: think struma ovarii!)
4. There is ALMOST no typical or UNIFORM appearance

Benign cystadenoma mucinous or serous

Characteristic features:
- Septae fanning from one point
- No shadowing solid component
- Sonoluent (serous) or low-level echogenic (mucinous) fluid
- Paucity of blood vessels
- RI >0.46, PI >0.62, PSV <12 cm/s

Hormone-secreting tumors

- Usually vascular
- Have general clinical symptoms
- Watch out for effect on target organs.

Steroid cell tumors

Sono characteristics:
- Male hairline
- Small size, homogeneous echogenicity
- High vascular ring around its periphery

Granulosa cell tumor

Sono markers:
- Ovary with multiseptated, multicellular structures
- Solid hyperechoic areas
- Usually vascular
- Usually in patients with high BMI

In this case blood flow with: Low RI and PI

Best clue to the correct Dx is NOT the ovary!
Look at the next slide.
Granulosa cell tumor

16 patients with surgically proven ovarian GCTs. Ages ranged from 10 to 64 years (mean, 37.7 years).

- Diameters were 2.0 to 15.4 cm (mean, 8.2 cm).
- The morphologic appearances classified into 3 patterns:
  - Solid and cystic (n = 10), with macrofollicular and microfollicular patterns with trabecular pattern without cystic changes or hemorrhagic foci.
  - **Solid with a sponge form appearance** (n = 4) had prominent hemorrhagic necrosis and diffuse proliferation of granulosa
  - ** Entirely solid** (n = 2). The measured resistive index and pulsatility index of the solid portions were 0.23 to 0.5 and 0.26 to 0.62, respectively.

As a matter of fact: IT IS endometrial hyperplasia as a result of estrogen production of the tumor

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The Ovary

5-4. Malignant Neoplasms

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It is worth to recapitulate the building blocks of ovarian pathology

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Morphologic building blocks for adnexal mass characterization by gray scale US

- **Wall thickness**: thin or thick
- **Loculations**: unilocular or multilocular
- **Papillations**: yes or no
- **Echogenicity**: sonolucent, low level echoes, highly echogenic, solid appearance(?)
- **Shadowing**: yes or no
- **Complex or bizarre appearance**
Echogenicity/“texture” of tissues (gray scale)

- Clear, anechoic fluid: serous fluid
- Low level echoes: cellular debris? “Old” blood?
- Echogenic or reticular: Blood clots 1st 72 hrs?
- Highly echo: Bone, dense tissue

Blood vessels in an ovarian cancer using color and power Doppler interrogation

- Rich (using PRF 0.9 Hz)
- Irregular
- Changing calibers
- Papillary vessels
- Central vessels
- Lakes
- Anastomoses

6. Scoring systems to differentiate between benign and malignant ovarian masses

Before using scoring systems I want you to understand that subjective evaluation based upon understanding and using the sono definitions of ovarian pathology there is a realistic possibility to assess an adnexal mass/es by the practicing gynecologist

I base it on a scientifically proven set of articles suggesting that subjective evaluation of adnexal masses is almost as good as the evaluation based upon strict scoring systems

US-based scoring systems

- Translate macroscopic, clinical, and pathologic features and appearances to sonographically recognizable features.
- All or most sono-scoring systems are based upon the same building blocks:
  - Wall thickness
  - Septations
  - Echogenicity
  - Papillary formations
  - Solid components
  - Blood supply (vascularity)
- Some systems add: size, ascites, age, etc...
You may use Morphology Scoring Systems: they are out there.

- Sassone M, Timor-Trisch et al, AJOG 1991
- Kentucky. DePriest et al. Gynecol Oncol 1997
- 1993: Osmers, AJOG 1994
- Bromley et al. Obstet Gynecol 1994
- Lerner JP, Timor-Trisch al, AJOG 1994
- Kurjak, UOG 1994
- Ferazzi, UOG 1998
- IOT A. Timmerman, UOG 1999 (Neural Network analysis)

However, you do not have to apply them to the letter. Just understand their basic idea to differentiate benign tumor from suspicious or malignant.

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**6-1. The Kentucky scoring system**

Sonographic images of benign and malignant ovarian morphology. Numeric representation of increasing morphologic complexity is noted in the first column.

- 0: Benign simple cyst
- 1: Benign hemorrhagic cyst
- 2: Benign cyst with septation(s)
- 3: Malignancy with papillary projections
- 4: Malignancy with solid components
- 5: Solid malignancy with calcification

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**6-2. The IOTA scoring systems**

The simple rules by the IOTA group

But first: What is the IOTA group?

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**The IOTA group**

- The International Ovarian Tumor Analysis (IOTA) group was founded in 1999 by Dirk Timmerman, Lil Valentin and Tom Bourne.
- Its first aim was to develop standardized terminology.
- In 2000, IOTA published a consensus statement on terms, definitions and measurements to describe the sonographic features of adnexal masses, which is now widely used.
- IOTA now covers a multitude of studies examining many aspects of gynecological ultrasonography within a network of contributing centers throughout the world that are coordinated from KU Leuven.

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Risk assessment of adnexal masses based on the IOTA Simple Rules

Dirk Timmerman, MD, PhD(1,2); Ban Van Calster, MSc, PhD(1); Antonia Testa, MD, PhD(1); Luca Savelli, MD, PhD(1); Daniela Fischerova, MD, PhD(1); Wouter Froymann, MD, PhD(1); Laura Wynants, MSc(1); Caroline Van Holshove, MD, PhD(1); Elisabeth Epstein, MD, PhD(1); Dorella Franchi, MD(1); Jeroen Kauser, MD, PhD(1); Artur Czekierdowski, MD, PhD(1); Stefano Guerriero, MD, PhD(1); Robert Franciscicco, MD, PhD(1); Francesco PG Leone, MD(1); Alberto Rossi, MD(1); Chiara Landolfo, MD(1); Ignace Vergote, MD, PhD(1); Tom Bourne, MD, PhD(1,2); Lil Valentin, MD, PhD(1)*; AJOG 2016

* Joint first author
Background

• Accurate methods to preoperatively characterize adnexal tumors are pivotal for optimal patient management.
• A recent meta-analysis* concluded that the International Ovarian Tumor Analysis (IOTA) algorithms such as the Simple Rules are the best approaches to preoperatively classify adnexal masses as benign or malignant.


IOTA Simple Rules

**Ultrasound features predictive for a malignant tumor (M-features)**
- **M1** Irregular solid tumor
- **M2** Presence of ascites
- **M3** At least 4 papillary structures
- **M4** Irregular multilocular-solid tumor with largest diameter ≥ 100 mm
- **M5** Very strong blood flow (color score 4)

**Features predictive for a benign tumor (B-features)**
- **B1** Unilocular
- **B2** Presence of solid components where the largest solid component has a largest diameter < 7 mm
- **B3** Presence of acoustic shadows
- **B4** Smooth multilocular tumor with largest diameter < 100 mm
- **B5** No blood flow (color score 1)


• If one or more M-features apply in the absence of a B-feature, the mass is classified as malignant.
• If one or more B-features apply in the absence of an M-feature, the mass is classified as benign.
• If both M-features and B-features apply, the mass cannot be classified. If no feature applies, the mass cannot be classified.
• Correct application of the Simple Rules requires the knowledge and proper use of the ultrasound features, as published by the IOTA group.*


IOTA Simple Rules

**Ultrasound features used in the international Ovarian Tumor Analysis (IOTA) simple rules, illustrated by ultrasound images. B1–B5, benign features; M1–M5, malignant features.**


IOTA Simple Rules

**International Ovarian Tumor Analysis (IOTA) "easy descriptors" illustrated by ultrasound images. BD1–BD4, benign descriptors; MD1–MD2, malignant descriptors.**

**M5 Very strong blood flow (color score 4)**

**Benign US features (B)**

- **B3** Unilocular cyst
- **B2** Presence of solid components: largest solid component < 7 mm
- **B3** Presence of acoustic shadows
- **B4** Smooth multilocular tumor with largest diameter < 100 mm
- **B5** No blood flow (color score 1)

**So………**

Don’t be scared by the ultrasound image !! Based upon your gynecologic knowledge base, your clinical experience…….and some of what you will here today…. YOU CAN differentiate benign from malignant masses in most patients! The following 4 slides attest to the importance and validity of subjectively assessing adnexal masses.

**IOTA color score**

- **Subjective assessment of blood flow**
  1. Color score 1 is given when no blood flow within the septa, cyst walls, or solid tumor areas.
  2. Color score 2 is given when minimal flow can be detected.
  3. Color score 3 is given when moderate flow is present.
  4. Color score 4 is given when the adnexal mass appears highly vascular with marked blood flow.

**Sensitivity and specificity of simple rules, subjective assessment, logistic regression models 1 & 2, & “risk-of-malignancy” index**

<table>
<thead>
<tr>
<th>All cases</th>
<th>Total (n=1501)</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
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<tbody>
<tr>
<td>Simple rules</td>
<td>92 (89 to 94)</td>
<td>96 (94 to 97)</td>
<td></td>
</tr>
<tr>
<td>Subjective assessment</td>
<td>91 (88 to 94)</td>
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<tr>
<td>Logistic regression model 1</td>
<td>94 (91 to 96)</td>
<td>92 (91 to 94)</td>
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<tr>
<td>Logistic regression model 2</td>
<td>95 (92 to 97)</td>
<td>91 (89 to 92)</td>
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</table>
Sensitivity and specificity of simple rules, subjective assessment, logistic regression models 1 & 2, & “risk-of-malignancy” index

### Premenopausal

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<th>Sensitivity (95% CI)</th>
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<td>97 (95 to 98)</td>
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<tr>
<td>Subjective assessment</td>
<td>90 (83 to 94)</td>
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<tr>
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<tr>
<td>Logistic regression model 2</td>
<td>92 (85 to 96)</td>
<td>95 (93 to 96)</td>
</tr>
</tbody>
</table>

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Sensitivity and specificity of simple rules, subjective assessment, logistic regression models 1 and 2, and risk of malignancy index

### Cases with CA 125

<table>
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<tbody>
<tr>
<td>Simple rules</td>
<td>92 (89 to 95)</td>
<td>95 (93 to 96)</td>
</tr>
<tr>
<td>Subjective assessment</td>
<td>91 (87 to 93)</td>
<td>95 (93 to 96)</td>
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<tr>
<td>Logistic regression model 1</td>
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<td>91 (89 to 93)</td>
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<tr>
<td>Logistic regression model 2</td>
<td>95 (93 to 97)</td>
<td>89 (87 to 91)</td>
</tr>
<tr>
<td>Risk of malignancy index</td>
<td>75 (71 to 80)</td>
<td>95 (93 to 96)</td>
</tr>
</tbody>
</table>

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The normal Fallopian tube

- A normal Fallopian tube is almost impossible to detect sonographically, unless it is surrounded by pelvic fluid, or, fluid is injected in it (hydrosonography).
- However, tubal pathologies can be detected and diagnosed by gray scale and color Doppler transvaginal US.

### Tubal carcinoma

- Primary fallopian tube cancer is the rarest among female genital tract cancers.
- It accounts for 0.3% to 1.8% of these cancers.
- Papillary serous adeno-carcinoma represents more than 90% of these cancers [2, 3].
- Other less common types include clear cell carcinoma, endometroid cancer, germ cell cancers, and sarcoma.

### 7. The Fallopian tube

#### 7-1. Inflammatory tubal disease

Main shapes of fluid filled tubes (longitudinal sections)

1. Oval
2. Pear, sausage
3. Retort
4. Serpiginous

Inflammatory tubal disease, Sonographic marker: Incomplete septum/ae

- The septum does not reach the opposite wall
- Results from the kinking of the fluid filled tube
- Present in acute or chronic cases

If identified: pathognomonic of hydrosalpinx

Acute salpingitis

Ultrasound markers:
- "cogwheel sign"
- thick wall

Clinical setting: Acute signs & symptoms

Acute Salpingitis

Clinical setting: Acute signs & symptoms

Acute salpingitis

Clinical implication: Acute signs & symptoms:
- Fever, high white count, extreme motion tenderness

On US: thick wall, "cogwheel sign", low level echogenic fluid, color flow under the tubal serosa

Chronic hydrosalpinx

Sonographic markers:
- Anechoic fluid, thin walls, beads-on-a-string mural nodule

"Beads-on-a-string" sign

No acute signs & symptoms, therefore harder to diagnose and tell apart from other pelvic structures or vessels
Chronic bilateral hydrosalpinges

Sonographic markers:
- Anechoic fluid,
- Thin walls

Sonographic Assessment of chronic hydrosalpinx

Definition: “Beads-on-a-string”
- Thin, distended wall
- Anechoic fluid
- Fibrosed endosalpingeal folds

Together they render the tubal wall the appearance of a rosary

Clinical picture & natural history of PID

1st step in a pelvic inflammatory process:
- Tubo-ovarian-complex (TOC)
  - Clinically: Acute disease, tenderness reversible
  - Sonographically: Ovary/tube recognizable
    - Thick walls, tubal fluid
    - Acute attributes present
    - Ovary/tube recognizable
    - Thick walls, tubal fluid & incomplete septa
    - “Cogwheel sign” (After S. Rottem)

This is not a TOA (yet)!

2nd step in a pelvic inflammatory process:
- Tubo-ovarian-complex (TOC)
  - Clinically: Acute disease, tenderness usually requires surgical treatment
  - Sonographically: Ovary/tube un-recognizable
    - Confluent fluid loculations
    - Speckled fluid
    - Usually bilateral
    - Located in the cul-de-sac

This, now IS aTOA or an abscess!!

7-2. Tubal cancer

Timor & Monteagudo
**Tubal carcinoma: ultrasound**

- Combine c. clinical impression
  - Very rare (1% of all Gyn Ca.)
  - Look for a primary site
- Sono characteristics usually:
  - Adnexal mass, as in ovarian Ca.
  - If sausage shaped, thick wall, cystic area seen, suspect it
  - Finding low RI and PI helps
- If "mistaken" for ovarian Ca., you made a good call!

8. Additional sites to check

9. Summary and conclusions
Summary and conclusions

• Most of the time adnexal masses carry defined sono characteristics and pathognomonic features (markers)
• The main sono markers of the commonly seen adnexal masses were described to enable a better recognition of their possible histology
• Where relevant, clinical features helping the diagnosis were mentioned
• Where applicable, relevant articles from the contemporary literature were quoted

Conclusions

• Most adnexal masses can be assessed subjectively using:
  – A transvaginal US probe (TAS if large mass)
  – An enhanced basic US knowledge (Reading REVIEWS)
  – Liberal use of power Doppler
  – Recognizing benign and malignant sono markers
• If you like to use the term: “complex mass”, describe the mass in terms of their sonographic characteristics (possibly the IOTA descriptors

Conclusions

• Avoid the word “cyst” referring to follicles or corpora lutea
• Be attuned to the issues of papillae in a cyst (size, number, blood vessels in it)
• Avoid the sentence: “...malignancy can not be ruled out”, use it when really needed
• Use the sentence: “My suspicion of the structure to be malignant is: high, moderate, low, none or can not classify”
• Ask for the help of a GO when in real need

Key References