How to utilize ultrasound in infertile patients?

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Dep of Reprod Med and IVF
INFERTILITY

• Approximately 15-20%
Diagnostic Tools

- TVUSG - 2D - 3D - 4D
- Saline infusion sonohysterosalpingography
- Ultrasound with contrast
- Hysterosalpingography
- Hysteroscopy
- Laparoscopy
Tagging, Planes, Localization, Terms
**Terms defining localization**

*Proksimal*: close to the origin

*Anterior or ventral*: organs close to the front of the patient

*Superior, cranial or cephalad*: organs close to the head of the patient

*Inferior or caudal*: organs close to the feet of the patient

*Distal*: far from the origin

*Posterior or dorsal*: organs close to the back of the patient
Longitudinal scanning
(Sagittal scanning)
Longitudinal scanning (Sagital scanning)
Transverse Scanning
Transverse Scanning
Coronal scanning
Uterus in coronal plane
• **Anechogenic or sonolucent** – *(appears black)*, is filled with fluid, ultrasound penetrates easily *(opposite of echogenic)*
• Echogenic or hyperechogenic- (opposite of anechoic) creates an ultrasound echo:
• Appears in bright density on ultrasound
• **Hypoechogenic:** lower echogenicity as the normal parenchyma
• **isoechogenic:** if the echogenicity is the same as the normal parenchyma
Hypoechogenic: ovarian cyst with low echogenic content, endometrioma
• **Homogeneous**- (opposite of heterogeneous) whole tissue has the same echogenicity; myometrium, endometrium
Heterogeneous- tissue containing areas with different echogenities
Complex- containing cystic and solid compartments
smooth thin wall x irregular thick wall
Normal Anatomy and Cyclus Evaluation
• 2-4 th day of cycle
• 2-10 mm sized follicles
• If total antral follicle count < 4
  low ovarian reserve
• If total antral follicle count > 24
  risk of OHSS increases
Cancellation Rates Per Cycle By Antral Follicle Count
Female Age 35-39, Years 2002-2004 (151 cycles)

% of Cycles Resulting in Cancellation

<table>
<thead>
<tr>
<th>Antral Follicle Count</th>
<th>% of Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-7</td>
<td>15.8</td>
</tr>
<tr>
<td>8-10</td>
<td>12.5</td>
</tr>
<tr>
<td>&gt; 10</td>
<td>3.1</td>
</tr>
</tbody>
</table>
Ovarian Volume \((d_1 \times d_2 \times d_3 \times 0.5)\)

OV: 4.5 mL
AFC: 9

OV: 1.0 mL
AFC: 1

OV: 1.5 mL
AFC: 2
Relation between rise of OHSS and Antral Follicle Count-Ovarian Volume (AFC - OV)

<table>
<thead>
<tr>
<th>AFC # (2-6 mm)</th>
<th>&lt; 5: low</th>
<th>5-15: normal</th>
<th>&gt; 15: increased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovarian volume (OV)</td>
<td>&lt; 3 mL: low</td>
<td>3-9 mL: normal</td>
<td>&gt; 9 mL: increased</td>
</tr>
</tbody>
</table>

Low-dose ovarian stimulation regimen
Folliculometry

- Maximum diameter
- Two diameter (dimension)
- Three diameter (dimension)
Differential Diagnosis

- Internal iliac artery / vein
- Bowel
- Hydrosalpinx
- Ovarian cyst
- Paratubal cyst
Follicular Growth

- approximately 1.5-2 mm/day
- Diameter of Follicule
  14 – 24 mm
- > 24 mm the chance of retrieving follicules and fertilization decreases
Sono-AVC has been used to automatically calculate the mean relaxed sphere diameter (dV) and the mean diameter (m-d) calculated from the maximal dimensions (dx, dy, dz) of the follicles.
Endometrial Thickness

1-4 mm menstruel phase,
4-8 mm midproliferative
8-14 mm late follikuler
7-14 mm sekretuar phase

At the day of hCG endometrium > 7 mm

Endometrial Thickness

- Decrease in pregnancy rate – increase in spontaneous abortion rate
  - < 5 mm
  - < 6 mm
  - > 13 mm
  - > 14 mm
  - > 18 mm
  - Upper limit ??
Clinical pregnancy rate (%) vs. Endometrial thickness at ET (mm)

- <=7: 20%
- 8-9: 25%
- 10-11: 30%
- 12-13: 25%
- 14-15: 20%
- >16: 15%
Endometrium

- Hypoechoic:
  - Proliferative phase;
  - midline echogenic line

- Hyperechogenic:
  - Sekretuar phase; No
  - midline echogenic line
The cycles were sorted into six groups according to the extent of the upward hyperechogenic transformation of the endometrium.

<table>
<thead>
<tr>
<th>Echogenicity Groups</th>
<th>Extent of Hyperechogenic Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \leq 30% ) (( n = 34 ))</td>
<td>( \leq 30% ) (( n = 34 ))</td>
</tr>
<tr>
<td>31-40% (( n = 37 ))</td>
<td>31-40% (( n = 37 ))</td>
</tr>
<tr>
<td>41-50% (( n = 37 ))</td>
<td>41-50% (( n = 37 ))</td>
</tr>
<tr>
<td>51-60% (( n = 55 ))</td>
<td>51-60% (( n = 55 ))</td>
</tr>
<tr>
<td>61-70% (( n = 37 ))</td>
<td>61-70% (( n = 37 ))</td>
</tr>
<tr>
<td>&gt; 70% (( n = 28 ))</td>
<td>&gt; 70% (( n = 28 ))</td>
</tr>
</tbody>
</table>

Relation between extent of hyperechogenic transformation on day of BhCG injection and pregnancy rate (p<0.001)

Fanchin, 1999
Doppler ve Endometrial Receptivity

- Evaluation of endometrial and subendometrial blood flow with Power doppler;
  - Increases in follicular phase,
  - Decreases with age,
  - Low diagnostic predictor for implantation,
Ultrasonographic diagnosis and classification of gynecologic pathologies
Classification of Uterine Fibroids
Congenital Anomalies
Suspicion of Uterine Anomaly

- Using ultrasound for diagnosis of uterine anomalies
  - 2D sensitivity %88 specificity %94
  - 3D sensitivity and specificity %98-100
- Sensitivity and specificity of MRI %100
- Diagnostic Laparoscopy:
  - Accompany hysteroscopy
  - Diagnosis and treatment of symptomatic patients

Diagram of arcuate uterus ratio. When ratio of height (H) to length (L) is less than 10%, adverse reproductive outcomes are not expected. (Reprinted, with permission, from reference)

Arcuate uterus. Transverse fast spin-echo T2-weighted MR image (6166/130) demonstrates nonspecific low signal intensity of fundal myometrium (arrow)
F Classification criteria for US differentiation of septate from bicornuate uteri. 

A, When apex (3) of the fundal external contour occurs below a straight line between the tubal ostia (1, 2) or; B, 5 mm (arrow) above it, the uterus is bicornuate. C, When apex is more than 5 mm (arrow) above the line, uterus is septate.
Wu et al, J Clin Ultrasound, 1997
Tips for 3D-4D Ultrasound

- Transvaginal 3D is better than transabdominal 3D
- Perform the ultrasound exam in the luteal phase when the endometrium is thick
- The bladder should be half full for a transabdominal ultrasound exam
- Try to obtain transverse or coronal planes
- Use video options and obstetric modes
Caliskan E et al, J Clin Ultrasound, 2010
Hydrosalpinx
Hidrosalpinx

- Incomplete septation
- Elongated dilatation
- Poor vascularisation
- Beads-on-a-string

### IMPLANTATION RATES AFTER LS SALPINGECTOMY VS NO INTERVENTION BEFORE IVF

Table VI. Mean implantation rates (IR) (of each individual’s mean implantation rate) in all transfer cycles in the total study population and in subgroups of patients with bilateral and ultrasound-visible hydrosalpinges in the two treatment groups.

<table>
<thead>
<tr>
<th>Study group</th>
<th>Laparoscopic salpingectomy&lt;sup&gt;a&lt;/sup&gt;</th>
<th>No intervention before IVF</th>
<th>P</th>
<th>Bonferroni–Holm adjusted P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean IR (SD)</td>
<td>n</td>
<td>Mean IR (SD)</td>
</tr>
<tr>
<td>Total study population</td>
<td>104</td>
<td>27.2 (29.1)</td>
<td>82</td>
<td>20.2 (28.6)</td>
</tr>
<tr>
<td>Bilateral hydrosalpinges</td>
<td>63</td>
<td>29.4 (31.5)</td>
<td>34</td>
<td>13.4 (23.4)</td>
</tr>
<tr>
<td>Ultrasound-visible hydrosalpinx</td>
<td>51</td>
<td>30.3 (29.4)</td>
<td>42</td>
<td>17.1 (30.4)</td>
</tr>
<tr>
<td>Bilateral and ultrasound-visible</td>
<td>33</td>
<td>34.2 (32.0)</td>
<td>19</td>
<td>10.5 (26.8)</td>
</tr>
</tbody>
</table>

Cycles after non-randomized surgery are excluded.

<sup>a</sup>n denotes the number of included patients.

<sup>a</sup>104 patients in the salpingectomy group is the sum of 103 patients with salpingectomy before any transfer + 1 patient with salpingectomy after oocyte retrieval but before transfer.

From Strandell et al 2001
Approach to hydrosalpenx before ART?

- Transvaginal needle aspiration
Asherman's Syndrome
Intrauterine Synechiae
postoperative
Endometrial polyps –
Differential diagnosis

✓ Focal hyperplasia

_Usually you don't see the endometrial border_

_Often confused with small and sessile polyps_
Endometrial polyps – Differential diagnosis

✓ Submucosal fibroid

Fibroids are more hypoechogenic

Endometrial echogenicity covers the mass
Adenomyosis

- The presence of ectopic endometrial glandular and stromal tissue in the myometrium
Adenomyosis
Epidemiology

- % 20 of women
  (J Minim Invasive Gynecol 2009; 16:622–625)

- More common in women with endometriosis

- More common in women with low BMI
  (Hum Reprod 2010; 25:1325–1334)
Adenomyozis

**Diagnosis - Ultrasound Findings**

- Enlarged uterus (no fibroid)
- Unclear endometrial lining edge
- Myometrial cysts
- Variable echogenicity
- No defined mass image
- Difficult to determine borders of the lesion
- Penetrating blood flow on Doppler US
Adenomyosis
Adenomyosis
Hemorrhagic cyst
Endometrioma vs Hemorrhagic Cyst

Hemorrhagic Cyst
- Retraction
- Organization

Endometrioma
- Homogenous increased concentration
Ultrasound Support During Invasive Procedures
Intrauterine Insemination
Oosyte Pick up
Embryo Transfer

1. Ultrasound guided vs. clinical touch ET

Ultrasound guided ET increases clinic PR and IR

(Buckett 2003, meta-analysis)
2. **Drop off point of Embryos:**

![Diagram showing the drop off point of embryos](image)

Transfer Distance from Fundus (TDF) =
IVF-ET outcome by embryo transfer distance from fundus using ultrasound guidance.

OHSS (Ovarian Hyperstimulation Syndrome)

- Enlarged ovaries
- Ascites
- Hemoconcentration
- Oliguria – kidney failure
- Shortness of breath
- Thrombosis
Ascites tapping in OHSS
Thank you...