What’s new in 3D Ultrasound of the pelvis?

Beryl Benacerraf M.D
Harvard Medical School

3D is Volume Scanning
It’s all about the displays

• Obtaining a volume of information has got to be better than a single slice!!!!
• The volume contains ALL of the information available and we can display the images in ANY plane, using lots of different methods. We have only begun to explore the ways that we can display it.

What is 3D Ultrasound?

Volume of Data
Infinite # of Planes

Three Right Angled Planes

• Volume acquisition is done to obtain an image in 3 planes. A dot representing a single point in space can be seen in all 3 images.
• The dot can be moved, with the 3 right-angle planes changing continuously to show the location of the dot in all three orientations.
• This technology provides the ability to see anatomic sections in an orientation different from the acquisition section.

3D is Volume Scanning

• 3D scanning is a volume acquisition which permits an infinite number and types of displays for the information - THE DISPLAY OF IMAGES PREVIOUSLY ONLY IN THE MIND’S EYE OF THE SONOGRAPHER.
• 3D enables the ultrasound practitioner to be far less dependent on the method of initial acquisition, since any view can be reconstructed from the stored volume information.
The value of having a volume rather than a slice:  
*It is in the display*

- Three Right Angled Planes (MPR)
- The coronal view (rendered)
- Inverse mode
- Tomographic parallel cuts (TUI)
The Most Important Benefit of 3D in Gynecology

• The 3 orthogonal planes are necessary to evaluate the shape of the ut cavity. Short of an MRI, the coronal plane shows cervix and 2 cornua (same plane).

• Distinguish a septate from a bicornuate uterus

Abn. Located IUDs may be a common cause of pain and bleeding

Where is the IUD?
167 consecutive patients with IUDs were evaluated using the 3D reconstructed coronal view.

28 (16.5%) had their IUD imbedded in the myometrium or cervix.

All of the IUDs that were considered low in the uterus or upper cervix on 2D were imbedded.

<table>
<thead>
<tr>
<th>Indication for scan</th>
<th>Bleeding</th>
<th>Pain</th>
<th>Either bleeding or pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUD Imbedded</td>
<td>10/28</td>
<td>11/28</td>
<td>21/28</td>
</tr>
<tr>
<td></td>
<td>35.7%</td>
<td>39.2%</td>
<td>70.4%</td>
</tr>
<tr>
<td>IUD Not Imbedded</td>
<td>21/139</td>
<td>27/139</td>
<td>48/139</td>
</tr>
<tr>
<td></td>
<td>15.1%</td>
<td>19.4%</td>
<td>34.5%</td>
</tr>
</tbody>
</table>

Fisher Exact test

\[ p = 0.02 \]
\[ p = 0.03 \]
\[ p = 0.0001 \]

Some IUDs are easier to see than others

The coronal view is necessary to imaging the position of the arms of the IUD

An abnormal positioning of the arms of an IUD may result in abnormal bleeding and pelvic pain.

A 3D coronal image is a necessary part of a pelvic scan for anyone with an IUD
Is the uterus too small? Does the IUD fit?

Are IUDs too big for the average uterus?

- Do women with embedded IUD’s have a narrower transverse cavity than those with normally located IUD’s?
- We measured the width of the endometrial cavity at the fundus on coronal images using electronic calipers in 132 patients with normal and 29 with embedded IUDs.
- The mean width of the cavity was 32mm in patients with normal IUD placement vs. 25mm for those with embedded IUD (p = 0.0003).

The transverse diameter of T-shaped IUD’s (Mirena and ParaGard) is 32 mm.

- Only 4 (13.8%) pts with an embedded IUD had a cavity width > 32 mm vs 43 (32.6%) pts with a normally placed IUD, p = 0.046.

- Who decided that the IUDs should measure 32mm across the top? Maybe there should be different sized IUDs to match the uteri.

- Could it help to do a 3D ultrasound with measurement of the cavity coronally prior to inserting a 32mm wide IUD?

Hard to find IUDs

Shipp et al. JUM 2010
Hard to find IUDs

Using the shadow

Size of normal uterine cavity - 221 consecutive premenopausal patients

- The mean width of nl ut cavity: 29mm
- Mean 27 mm in nulliparous women compared to 32 mm in those with ≥ 1 pregnancy.
- There was no appreciable relationship between the width of the uterine cavity and prior C-section or patient age (in patients who were never pregnant).

Uterine cavity size

- The normal uterine cavity width varies with gravidity and parity.
- The mean width of the uterine cavity of nulliparous pts (27mm) is narrower than the width of a standard IUD (32mm). Should pts have an ultrasound to measure the uterine cavity prior to having an IUD inserted.

Benacerraf et al. Obstet Gynecol 2010;116:305

The Shape of the Uterine Cavity
Suggested Prevalence of Mullerian Duct Anomalies:

- 3-10% in infertility and recurrent pregnancy loss.
- 1-0.4% for other patients

Bicornuate versus Broad Septum

Surgery
Surgery

T-shaped uterus

Severely scarred cavity

Scarred Uterus

Is the sac in the uterus?
Fibroids seen best in reconstructed views:

Use the endometrium as your contrast

Submucous Fibroids

3D Sonohysterography

- 3D sonohyst. Shows intraut. cavity: a quick acquisition is sufficient to then reconstruct the three orthogonal planes and show the cavity in every orientation desired (rescanning the volume).
Ovarian cyst?

Is there a diff. DX? Two cases

The floor of the pelvis
Second opinion for perineal pain

Bartholin duct cyst

Urethal tic

3-D volume imaging is one of the most important advances in modern sonography.

- 3-dimensional imaging is not new, as CT and MR have used it for decades with reconstruction of volumes in many planes and displaying the images in soft tissue or bony windows.
- Now that ultrasound has acquired similar capabilities, the benefits of using ultrasound as the first imaging test are infinite. 3-D ultrasound will challenge MR’s imaging capabilities.

The ability to view reconstructed planes in the pelvis is key to further developing helpful imaging techniques

- I believe that 3D ultrasound has more to offer a GYN patient than an OB patient.
- I suspect that 3D will soon be used routinely in the Gyn patient.