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DISCLOSURE

I have no conflict of interest with respect to any of the material presented in this lecture. I am on the Ob/Gyn Board of advisors of Philips Medical and Siemens. I will not discuss off-label or unapproved uses of drugs or devices.

Presentation objectives

At the end of the presentation the listener should be able to:
Appraise the value of 3D ultrasound in daily clinical practice
Judge the merits or lack thereof of non-medical ultrasound
Identify possible artifacts while performing 3D ultrasound
Because real-life is three-dimensional

1. Is there evidence-based medicine (or some evidence) for value of 3D/4D in Ob/Gyn even w/o reimbursement (The Good)?

2. Non-medical uses of 3D/4D (The Bad)

3. Artifacts (The Ugly)
3D ultrasound in the first and second trimester—hype or helpful?

For: Richard Davis

Against: Janet I Vaughan

Australasian Journal of Ultrasound in Medicine, 2009;12;28-34


What can be done with 3D/4D, not necessarily what should be done

3D in gynecology


1. Assessment for congenital anomalies of the uterus;
2. Evaluation of the endometrium and uterine cavity with or without saline infusion sonohysterography;
3. Mapping of myomata for planning myomectomy;
4. Cornual ectopic pregnancies;
5. Intrauterine device location and type;
6. Imaging of adnexal lesions, to distinguish ovarian from tubal origin and ovarian from uterine origin;
7. Abscess drainage in the pelvis and abdomen;
8. Three-dimensional guidance in interventional procedures for infertility;
9. Evaluation and monitoring of patients with infertility, including patients with polycystic ovaries and tubal occlusion.

3D in obstetrics


1. Facial anomalies (eg, cleft lip and palate, micrognathia, abnormal midline profile, and genetic syndromes);
2. Nasal bone;
3. Ears;
4. Central nervous system (eg, agenesis of the corpus callosum and Dandy-Walker malformation);
5. Cranial sutures;
6. Thorax (eg, rib evaluation, intrathoracic masses, and lung volumes);
7. Spine (eg, level of neural tube defect and vertebral abnormalities);
8. Extremities (eg, clubfeet, amputation defects, and skeletal dysplasia);
9. Heart (eg, conotruncal anomalies and evaluation of normal anatomy);
10. Placenta (eg, vasa previa) such as to determine the relationship of the vessel to the internal os;
11. Visual depiction for reassurance or demonstration of an abnormality for consulting clinicians and patients;
12. Extent of anomalies, such as cystic hygroma;
13. Multiple gestations (eg, conjoined twins and vascular mapping for twin-twin transfusion);
14. Umbilical cord (eg, cord insertion sites or cord knots).

**Telemedicine and Offline Image Review**

1. Storing of volumes for subsequent review and interpretation;
2. Central monitoring of data for quality and accuracy in remote clinical sites and in multicenter research studies;
3. Telemedicine and offline image review on an independent workstation.

**Education**

1. Teaching standardized views and postprocessing techniques for training;
2. Teaching normal and abnormal anatomy using volumes as simulated scans.

**“Proven” advantages**

1. Any plane, any direction
2. Send volumes across hospital, town, country (...space)

**Main issues**

1. Better targeted exams?
2. Better diagnosis of fetal abnormalities?
3. Faster exams?
4. Improved maternal (paternal)-fetal bonding?

If answers to above are yes, then ethically, are we obliged to perform it, even without reimbursement?
204 patients; 3D reconstruction was helpful in 62%. But in 36% of the time 3D imaging was disadvantageous (movement artifacts and technical problems).


159 women w/ routine 12-13 weeks pregnancies. Survey of fetal anatomy obtained by 2-D. Subsequently, 2 volumes of whole fetus acquired w/ 3D.

Complete anatomy in 93.7% w/ 2D vs. 80.5% w/ 3D. "...3D can be useful addition to clinical practice, 2D remains best way to examine fetal anatomy in 1st trimester."

Michailidis et al., 2002, Br J Radiol 75:215

Cranium: surface rendering (craniosynostosis)

Coronal plane

Corpus callosum


As good as MRI in majority of cases

Malinger G et al.: Fetal brain imaging: a comparison between magnetic resonance imaging and dedicated neurosonography. Ultrasound Obstet Gynecol 2004;23:333
**STIC and xMATRIX**

1. Fast acquisition
2. Information available offline
3. Simultaneous visualization of 3 planes
4. Clearer correlations between chambers, vessels, valves.

But...

STIC is one cardiac cycle, “rebuilt” from 25 cycles (12-15 sec)

xMatrix is real-time reconstruction (<1 sec)

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Opinion

The added value of 3D/4D ultrasound imaging in fetal cardiology: has the promise been fulfilled?

Shen O and Yagel S, Ultrasound Obstet Gynecol, 35:260, 2010

“...our experience, in a tertiary referral center, of the added value of 3D/4D ultrasound to our examination protocols is only moderately encouraging.”

3D/4D added to the diagnostic accuracy in 11/155 cases of confirmed anomalies

Fetal structural anomalies

Spine anomalies

3D is superior to 2D to exactly delineate level of defect (8 vs. 6 out of 9)

Lee W et al.: A diagnostic approach for the evaluation of spina bifida by three-dimensional ultrasonography. JUM 2002;21:619

Hemivertebra

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Hemivertebra
7/8/2011

3472 fetuses; 2D and 3D
Total malformations: 1012 (w/o cardiac)
3D advantageous in 61%
In 42 (4.2%) defect seen only with 3D

"3D sonography is not competitive but complimentary technique to 2D"


"...additional diagnostic information for the diagnosis of facial anomalies, especially facial clefts...[and] in neural tube defects and skeletal malformations...large studies comparing 2DUS and 3DUS for the diagnosis of congenital anomalies, particularly heart disease and CNS anomalies have not provided conclusive results...sonographic tomography may decrease the examination time of the obstetric ultrasound examination...Additional research is needed..."

Merz and Welter, Ultraschall in Med 2005;26:9

"...Parents have a change in attitude regarding their fetus after undergoing 3D/4DUS. Mothers showed an increase in bonding to their fetus after 3D/4DUS in more categories than fathers."

D. Pretorius et al.: JUM 2006;25:1411

"...mothers who had 3DUS showed their ultrasound images to a greater number of people compared to mothers who had 2DUS alone and this may represent mother’s social support system. 3DUS may have a greater impact on the maternal-fetal bonding process."

“…with 3D recognition is better, particularly in primiparas, but bonding is no better”

“…This randomized study indicates that the addition of 3D/4D ultrasound does not cause a significant reduction in maternal anxiety in pregnancies at risk of fetal abnormalities compared with conventional 2D ultrasound alone.”

The Good: conclusions
3D can provide additional and more specific diagnosis in normal and high-risk fetuses, as well as several gynecological situations.

No studies demonstrate positive (or negative) impact on clinical outcome

No evidence 3D/4D can replace 2D.

The Bad

Womb with a view
First look sonogram
My baby ultrasound
Little sprout imaging
Miracle in Progress...
Las Vegas
Baby’s Debut, 3D/4D ultrasound imaging studio...
California
The conflict

1. "Mall clinics": ultrasound is perfectly safe. No effects have ever been described in humans. We use the same ultrasound as doctors in hospitals

2. The "Establishment" (ACOG, ACR, AIUM, ASUM, ECMUS, FDA, ISUOG, WFUMB...) and others: based, partly, on safety concerns, ultrasound should be used only with a medical indication.
Artifacts

1. Originating in 2D ultrasound
2. Resulting from 3D data acquisition
3. Caused in rendering

2D acquisition artifacts

Resolution
Problem: shape and size of organs

Attenuation
Problem: missing part or abnormal appearance

Propagation
Problem: distortion in shape and/or orientation, "mirage"

3D specific artifacts

Acquisition
Problem: abnormal angles, jagged or thickened borders, shape and/or size distortion

Rendering
Problems: hole in organ, missing part, pseudo-defect

Editing
Problems: absent parts

What to do about artifacts?

Be aware
Recognize
Modify
Look at original images
Rescan: wait for fetus to be quiet, ask mother to hold breath
3D/4D is good
First, be a good 2D sonographist
As any other medical technology, should be used with valid indication
Be aware of possible artifacts
The more you use it, the more you'll like it and the less mistakes you'll make

So...
Should we use 3D/4D ultrasound in Ob/Gyn, even if it is not reimbursed? The answer has to be: Yes
But... for specific indications and not as a routine procedure