Ultrasound frontiers

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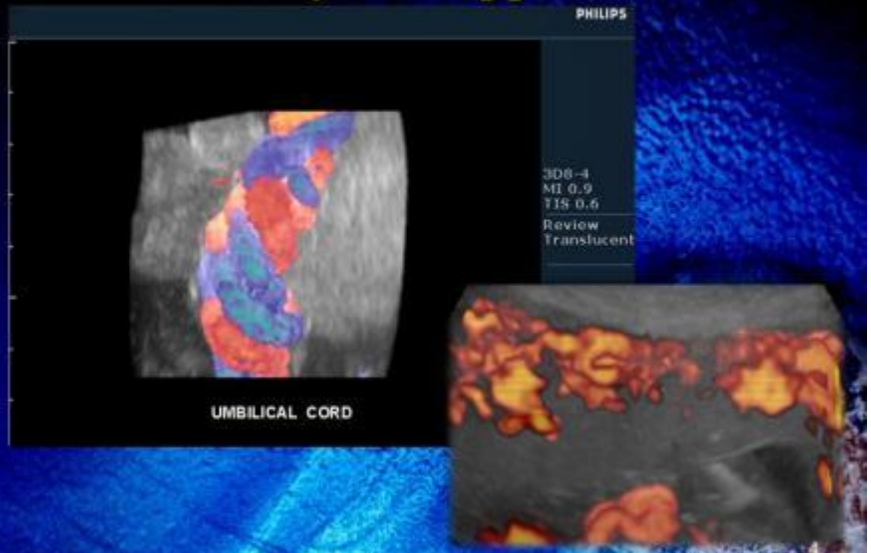
Objectives

- Define 3D Doppler and its potential clinical applications
- Describe automatic fetal biometry
- Discuss clinical potentials of handheld ultrasound

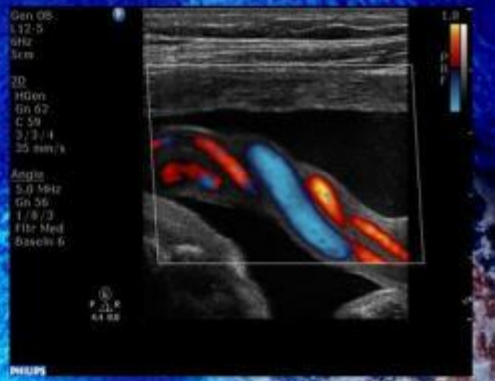
Kurjak A et al. Am J Obstet Gynecol. 2007;196(1):16-28

Why 3D Doppler?

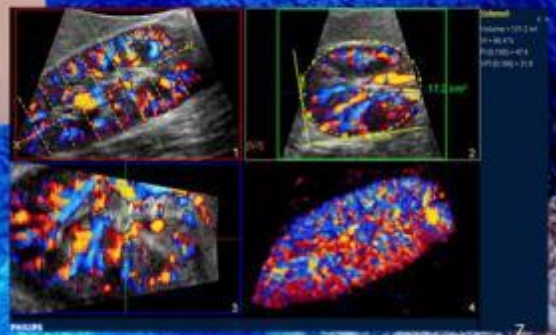


Doppler Ultrasound

Color Doppler



3D Doppler



Shih JC et al. Ultrasound Obstet Gynecol. 2004;24(2):202

- Potential value of 3D Doppler in prenatal diagnosis and monitoring of pregnancies complicated by large, vascularized chorioangioma

Hata T et. Gynecol Obstet Invest. 2004;57:61-5

- 3D sonography has the potential to be a supplement to 2D and Doppler ultrasound in identifying placental masses and provides a novel means of visualizing placental abnormalities in utero

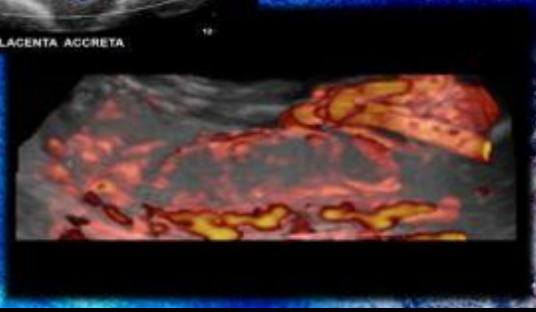
Henrich W, Tutschek B: Ultraschall Med. 2008;29 Suppl 5:271-2

- 3D Doppler can be used to acquire volume data comprising information on umbilical color Doppler flow, providing a very graphic depiction of cord entanglement in twin pregnancy.

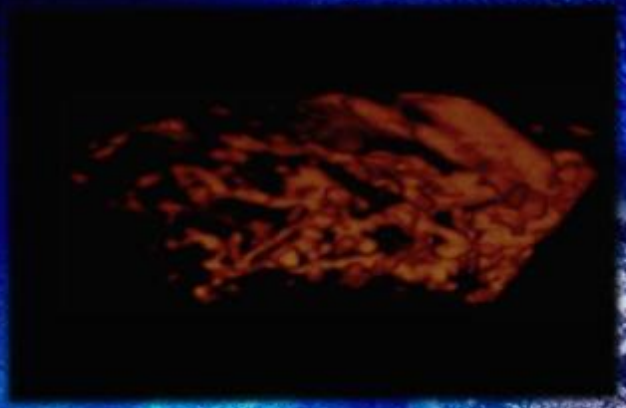
Guiot et al. Ultrasound Obstet Gynecol 2008;31(2):171-6

- 3D Doppler can provide new insights into placental pathophysiology. FI, which identifies the most severe cases of placental impairment, appears to be the most reliable index.

Placenta - 3D Doppler

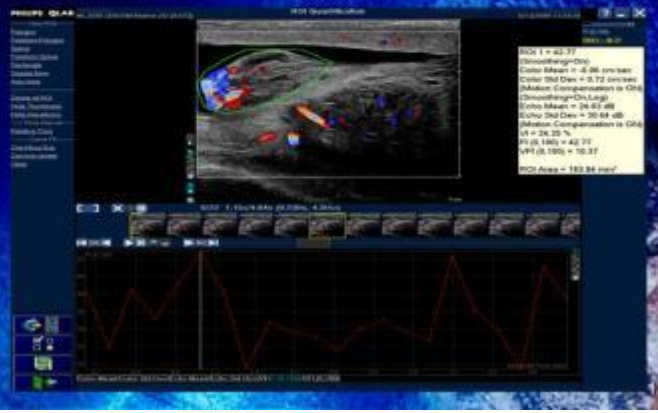


Placenta - 3D Doppler



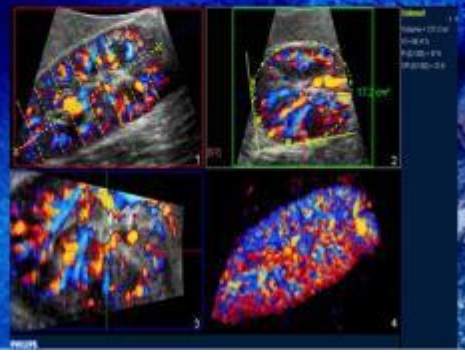
Vascularization Index (VI)

- VI = measures % of color pixels in ROI that represent flow

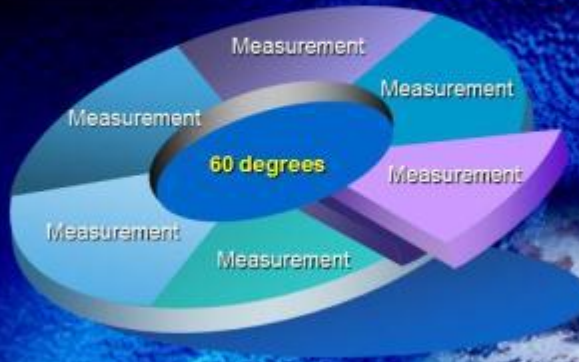


Flow Index (FI) & Vascularization Flow Index (VFI)

- FI = measures intensity of color pixels in ROI
- VFI = combines % of color pixels and intensity in ROI (0-100 normalized)

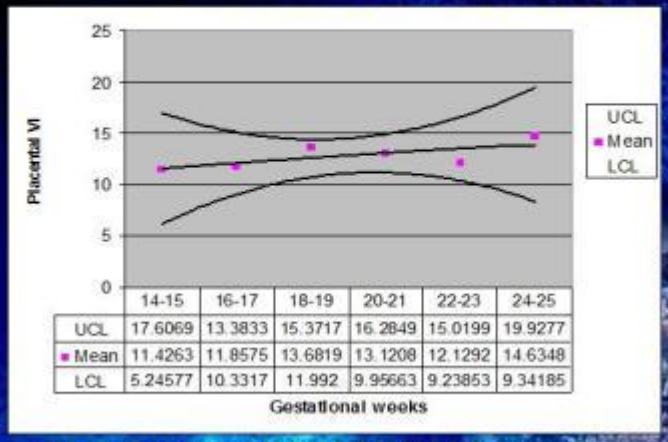


3-D Calculations



Doppler & Hawaii

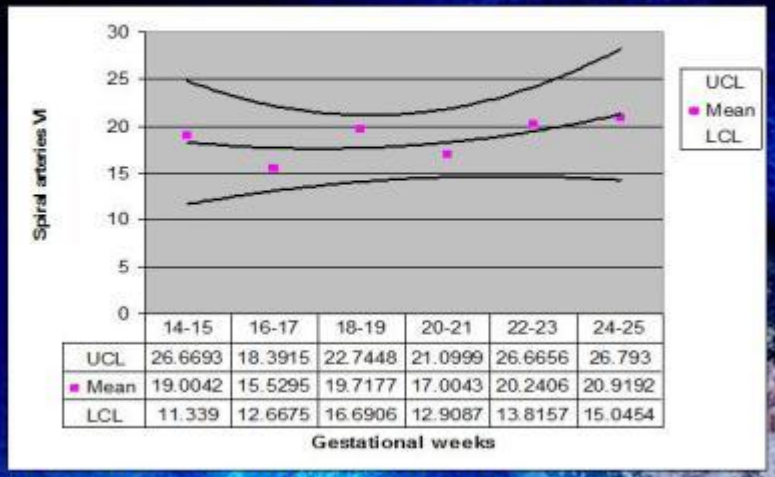
Placental VI at 14-25 weeks of gestation in patients with normal pregnancy outcome



	14-15	16-17	18-19	20-21	22-23	24-25
UCL	17.6069	13.3833	15.3717	16.2849	15.0199	19.9277
Mean	11.4263	11.8575	13.6819	13.1208	12.1292	14.6348
LCL	5.24577	10.3317	11.992	9.95663	9.23853	9.34185

J Matern Fetal Neonatal Med 2007;20:299-305

Spiral arteries VI at 14-25 weeks of gestation in patients with normal pregnancy outcome



	14-15	16-17	18-19	20-21	22-23	24-25
UCL	26.6693	18.3915	22.7448	21.0999	26.6656	26.793
Mean	19.0042	15.5295	19.7177	17.0043	20.2406	20.9192
LCL	11.339	12.6675	16.6906	12.9087	13.8157	15.0454

Gestational weeks

J Matern Fetal Neonatal Med 2007;20:299-305

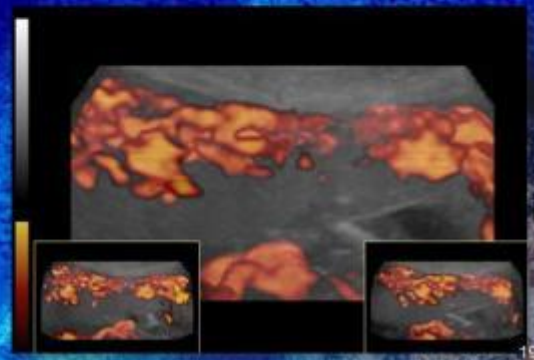
Evaluation of the utero-placental circulation by 3D Doppler ultrasound

- Significant difference among placental VI, FI and VFI related to gestational age at the time of the ultrasound exam. The same was true for spiral arteries ultrasound measurements. (P=0.219; P=0.954)
- Placental vascular indices slowly increased indicating progressive development of vascular network and increase in the volume blood flow.

Zalud I, Shaha S: J Matern Fetal Neonat Med 2007;20:299–305

Pre-eclampsia

- Patients with pre-eclampsia showed some abnormal 3D Doppler indices before onset of disease.



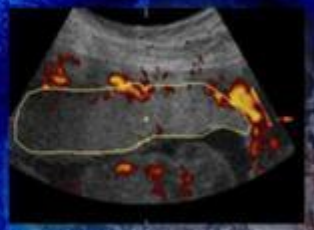
Pre-eclampsia

- The tendency of a sudden decrease in the spiral arteries VI, FI and VFI in patents with pre-eclampsia is quite opposite to the tendency of steady or very slow increase of these indices in pregnancies with normal outcomes.
- Most likely these changes in 3D Doppler indices could reflect profound changes in the hemodynamics of placenta and especially spiral arteries in patients developing pre-eclampsia.

3D Doppler of the placenta and spiral arteries: Influence of maternal age and parity

Zalud I, Shaha S: J Clin Ultrasound. 2008;36(7):391-6

- The parity influenced all placental 3D Doppler indices (larger indices in multipara).
- Maternal age influenced the spiral arteries volume (larger volume in patients younger than 25).



Application of 3D Doppler in prenatal diagnosis

Hartung J et al. Ultraschall Med. 2004;25(3):200-5.

- 3D Doppler demonstration of fetal vessels is possible.
- The feasibility is limited by fetal movements and unfavorable fetal positioning.
- The possible benefit of the method is to diagnose complex fetal vascular malformations in the future.

Conclusion

- 3D Doppler is a unique technique that enables assessment of vascular signals within the whole investigated area.
- Homodynamic changes included in the process of placentation are one of the most exciting topics in the investigation of early human development.

3D Doppler: New Frontiers

Potential clinical role:

- in early detection of pre-eclampsia and/or IUGR
- aneuploidy
- PTL, chorioamnionitis
- multiple gestation (TTT Sy)

Automatic Fetal Biometry

- **Time to perform measurements** — Automate core measurements
- **Repetitive stress injuries** — Reduce keystrokes and potentially reduce repetitive stress injuries
- **Lengthy exam time** — Improve everyday workflow to increase patient throughput and profitability
- **User variability** — Decrease user variability, improves accuracy and consistency

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Automatic Fetal Biometry

Concept

Automatically generate BPD, HC, FL and AC measurements on B-Mode ultrasound images

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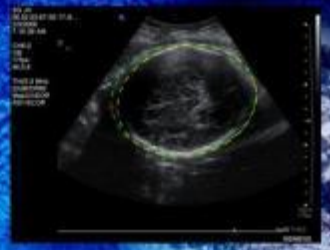
Objectives

We compared the performance of experienced sonographers vs. automated fetal biometry measurements (Auto OB) :

- BPD
- HC
- AC
- FL



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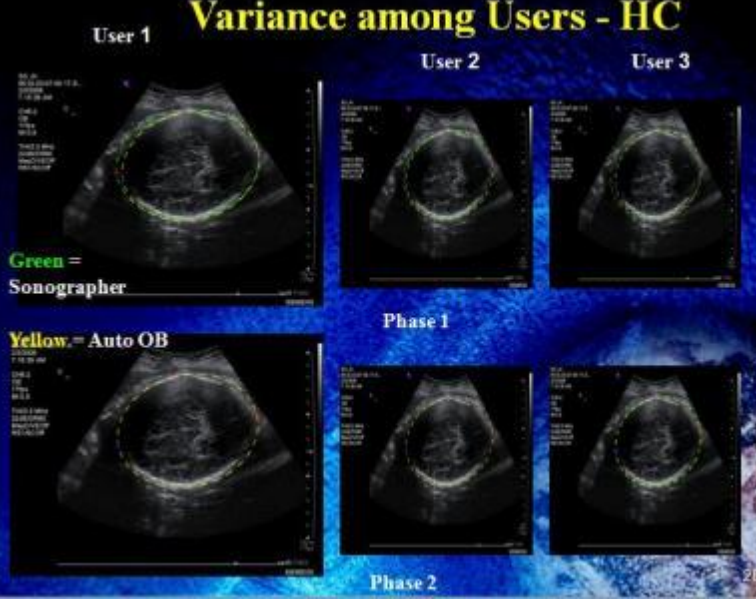
Variance among Users - HC



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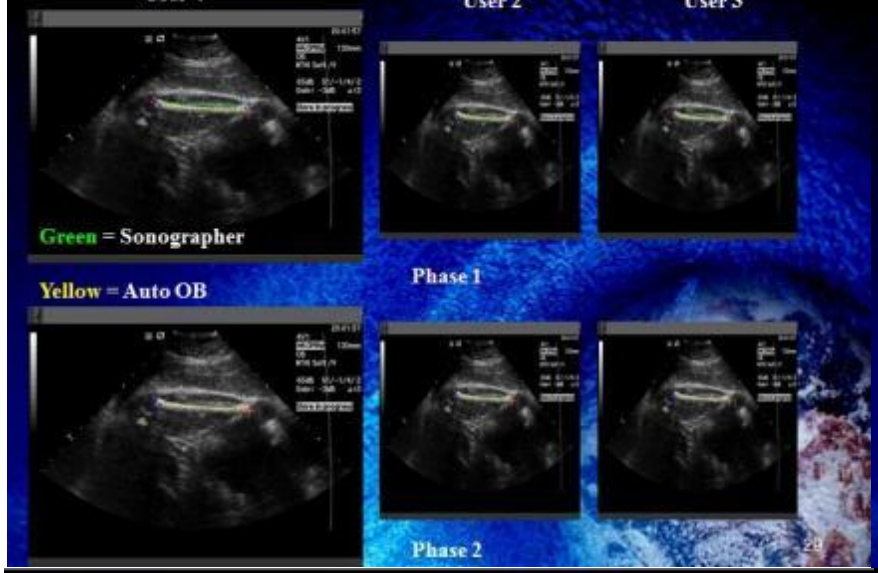
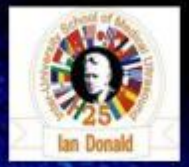
Variance among Users - FL



Conclusions



- The automation of ultrasound measurement has great potentials:
  - improving productivity & patient throughput
  - enhancing accuracy & consistency of measurements
  - reducing the risk of repetitive stress injuries (RSI) users

Handheld Ultrasound

Why OB/GYN Ultrasound?

- Ultrasound is "light" into female pelvis

Ultrasound can "help" in:

1. Diagnosis
2. Management

Objectives

- Handheld ultrasound is a new diagnostic modality that brings a small portable ultrasound unit at bed side and in every physician office.
- The purpose of this study was to establish clinical utility of the basic ultrasound exam with handheld ultrasound machine in limited OB/GYN evaluation.

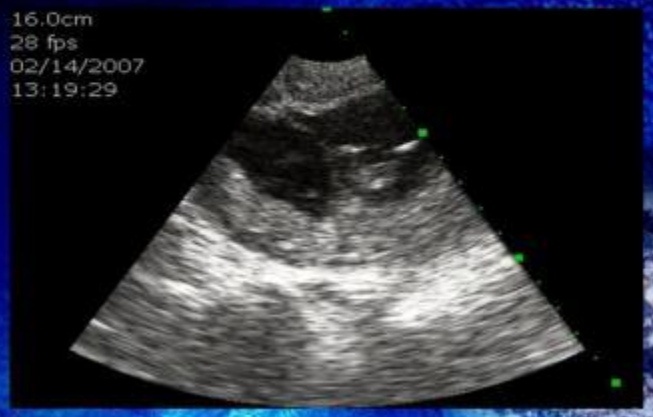
University of Hawaii Study 2008
Handheld vs. Standard limited ultrasound

Methods:

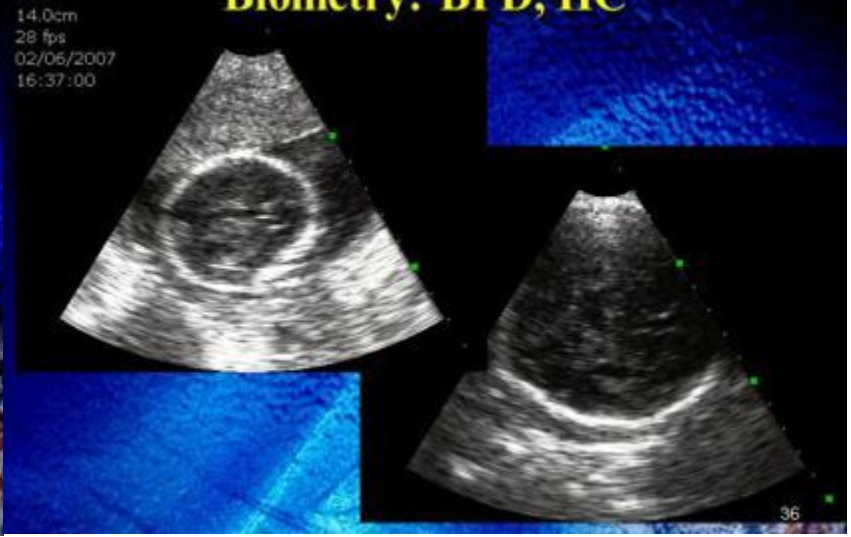
N=195 patients

- **P-10, Siemens, Mt. View, CA with 3-5 MHz TAS probe**
- **Variety of clinical indications were limited (initial) ultrasound exam is established to be useful.**
- **P-10 ultrasound exam (each clinical indication N=15) vs. formal ultrasound exam**
- **P-10 ultrasound: 5 minutes or less.**

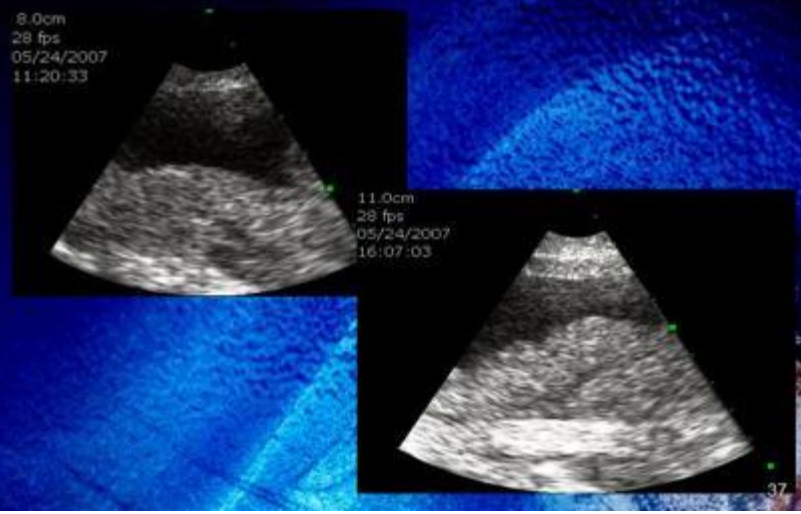
University of Hawaii Study 2008
Early IUP - Twins



University of Hawaii Study 2008
Biometry: BPD, HC



University of Hawaii Study 2008
Placenta



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University of Hawaii Study 2008

- Handheld ultrasound exam was reliable in making initial diagnosis required by the limited ultrasound exam in obstetrics and gynecology.
- Caution should be taken when examining patients with placenta previa and IUGR.

Zalud I et al. J Matern Fetal Neonat Med 2009;22:43-50.

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4D Ultrasound

Kurjak A et al. Am J Obstet Gynecol 2007196(1):16-28.

- The fetal face represents a "diagnostic window" for fetal diseases and syndromes.
- 4D ultrasound, by adding the temporal component to the examination, allows visualization of facial expressions that might be useful in the study of fetal behavior.

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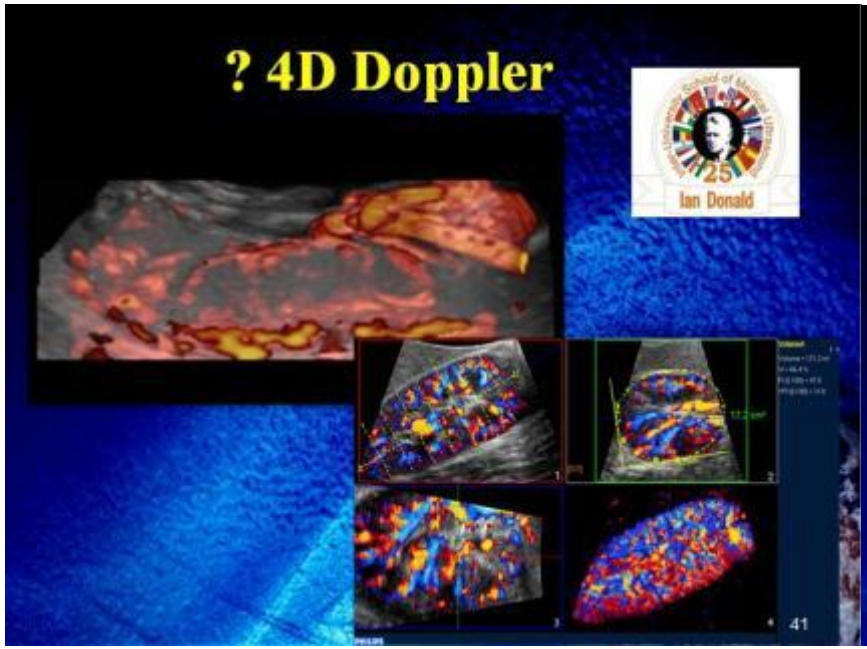
? 4D Doppler
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