Artificial Intelligence: AI and the Art of Sonography

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Sonography = The Art of Drawing with Sound
The Perinatal Quality Foundation Experience

- Nuchal Translucency Quality Review Credentialing Program
- Requires education, test, and image review
- Applies standardized measurement criteria
- Reviewers scored 5,359 images last year, and >59,700 since 2009
  - 2009 – 2020: 72% of images meeting 7/9 criteria required to pass
  - 2019 - 2020: 60% of images meeting 7/9 criteria required to pass
- Credentialed participants’ measurements are received from laboratories and monitored by comparison to referenced curves
- Successful in bringing participants closer to center
Providers > 30 data points November 2019

Sonographers (n= 2703)    88.4% are within range
Sonologists (n=753) 95.3% are within range
Program Impact

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Problem: Variety of Images
Problem: Inaccurate Measurements

Criteria requires placement of caliper on external edge of the boundary line which would under-measure Image B.
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Automated NT measurement does not adjust for reverberations or high gain leading to under-measurement
Conclusion: AI needs to help with acquisition of input images, not just analysis.
Sonography: The Acquisition of an Image

CLASSIFICATION
- Scanning a wide area
- Selecting images with the region of interest
- Requires supervision when learning

OPTIMIZATION / DETECTION
- Magnify
- Adjust gain, focus, dynamic range
- Fill in boundaries, reduce blurriness, speckle, thickness of lines

SEGMENTATION
- Selecting Pivot Point
- Applying angles and pressure to optimize ROI
- Assessing pathway and quality of echoes
- Moving pivot point as needed

APPLY DIAGNOSTIC ALGORITHM
- Measure
- Assess
Classification: Selection of Image Area

Wide area “scanning”

Learning to select requires supervision

Apply color to help pinpoint ROI in some situations
Segmentation:

- Select Pivot Point
- Angle to select pathway
- Apply pressure to bring out boundaries and detail
- Compensate for Adiposity
- Assess quality of echoes throughout region of interest (ROI)
- Move pivot point or angle as needed --- Location variable and determined by optimal appearance of ROI
- Determine acceptability of image for specific algorithm
Optimization / Detection

• Magnify ROI
• Fill-in boundaries
• Decrease thickness of lines and blurring of lines
• Optimize dynamic range of echo strength
• Optimize gain / strength of echoes
• Apply and optimize color if needed for diagnosis

• Apply measurement criteria or diagnostic algorithm
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Conclusions

- AI is needed in sonography
- Not just for analysis of images but for optimal acquisition
- Acquisition requires assessment of image quality throughout
- Mimicking sonography imaging methods may provide a roadmap for AI acquisition