Will 3D-Ultrasound be of use for risk stratification in carotid disease?

Henrik Silleßen and Benjamin Sandholt
Dept. Vascular Surgery, Rigshospitalet
Univ. of Copenhagen, Denmark
Conflicts of interest

- Philips Ultrasound: research grant
Will 3D-Ultrasound be of use for risk stratification in carotid disease?

YES
Benefits of 3D US in carotid disease

- Plaque volume assessment
  - Changes over time

- Plaque morphology assessment
  - Changes over time

- Velocity measurements optimized

- More accurate automation
Benefits of 3D US in carotid disease

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- More accurate automation
Why not 3D at present?

- Technology there, however awaiting refinement – high res. matrix transducers – in clinical testing now
Mechanical movement of transducer

Spence JD, 2002
“Mechanical” 3D?
Automatically acquires calibrated 3D data of carotid artery with a field of view approximately 5 x 5 x 5 cm in about 5 seconds.
3D scan VL 13-5
Solution:

3D matrix

2D – single array
Does 3D work?

- Nice images – yes
- Improve quantification?
  - Test compared to golden standard
  - Repro
- Data shown are using first version of high-res. matrix transducer – further improvements are up shortly
Reproducibility study

- 37 pt.s with carotid plaques
- Cases with severe calcification excluded
- 2 experienced sonographer’s
- Scanned patients blinded for each other’s scans and US-machine settings
- 3D acquisition ”normalized” by obtaining same 3D volume from phantom
- Phantom back-scatter subtracted from patient/plaque acquisition
Method used so far: 3mm slices using the flow divider as reference.
XVT Repro of Plaque Volumes

37 plaques scanned by 2 different operators
Read by one reader separated by 2 weeks

| Variable            | Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | Pr > |t| |
|---------------------|------|-------------|---------|----------------|-------|
| Volume S1 vs S2     | -8.9 | -20.8       | 3.1     | 37.3           | 30.5  | 47.8 | 0.1408 |

S1 vs S2 volume

bs_VOL

KAS_VOL
3mm slices using the flow divider as reference.
XVT Repro
Plaques Slices
159 slices
XVT Repro
Largest Plaques Slice
Automated identification of max plaque thickness
XVT Repro
Max Thickness - 37 plaques

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 Max plaque thickness</td>
<td>37</td>
<td>2.3</td>
<td>0.75</td>
<td>1.07</td>
<td>4.14</td>
</tr>
<tr>
<td>S2 Max plaque thickness</td>
<td>37</td>
<td>2.3</td>
<td>0.68</td>
<td>1.16</td>
<td>3.85</td>
</tr>
</tbody>
</table>

| Variable      | Mean | 95% CL Mean | Std Dev | 95% CL Std Dev | Pr > |t| |
|---------------|------|-------------|---------|----------------|-------|
| Max thickness | -0.02| -0.09       | 0.05    | 0.18           | 0.28  | 0.54  |

Max thickness

![Graph showing correlation between max thickness and another variable](image-url)
Automated identification of max plaque thickness

1 cm slice centered on max plaque thickness
10mm Slice centered on Max Thickness
37 plaques
3D-US Potential for carotid disease risk stratification

- Risk assessment
  - How large is the plaque
  - More accurate assessment of velocity/degree of stenosis
  - Plaque morphology in volume – more accurate than 2D

- Monitoring of treatment
  - Does medical treatment work
    - progression, stable, regression
    - Change in morphology
Thank you for your attention