Cloud Based System For Image Fusion Techniques With Mobile C-Arms (The Cydar System): How Does It Work And Advantages For All Vascular Interventions

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Disclosure(s)
• Unpaid consultant for Cydar

Fusion technique
• For today’s talk we used fusion technology to:
  • Merge two talks on fusion technology

Importance of accurate imaging in 3 dimensions….

Benefits of 3D Fusion CT*
• Decreased radiation exposure
• Decreased fluoroscopy time
• Decreased contrast use

*data derived from mechanical based systems

Limitations of Traditional 3D Image Fusion Strategies
• Manual registration
• Hardware based tracking
• Distortion of pre-op anatomy by wires/hardware
• Deep machine learning might lead to solution
Image-based 3D Fusion?

1. Digitally reconstructed radiographs (DRRs) are derived from the preoperative CTA.
2. DRRs are a series of images that mimic fluoroscopic images across a range of C-arm angles and magnifications.
3. Tracking is based on identifying two or more vertebral bodies.
4. An automated algorithm matches the most appropriate DRR to the live fluoroscopic image.

Computer vision searches for vertebrae in 3D space

- Artificial Intelligence recognizes bony anatomy to automatically register the CT with the X-ray fluoroscopy image.
- Tracks the patient, not the operating table.
- Corrects automatically for postural changes and patient movement.

Cloud-Based Technology: Some More Advantages

- Digital technology improves much faster than hardware/updated in real time.
- Works with any fluoro equipment, including C arm.
- Enhanced accuracy compared to mechanical registration systems.
CYDAR Clinical Application(s)

- Fluoroscopy guided endovascular procedures in the lower thorax, abdomen and pelvis:
  - EVAR/FEVAR
  - Mid distal TEVAR: at present need for two vertebral bodies limits use in the proximal aorta
- Angioplasty stenting and/or embolization of:
  - the common iliac, proximal external and proximal internal iliac artery

Applying image fusion to a wide range of vascular interventions - embolization

Aortoiliac occlusions

Standard EVAR

Complex EVAR

CYDAR Clinical Application(s)

- If the benefits of image fusion are to be available to all and become "standard-of-care"
  - it must be available on all types of X-ray fluoroscopy
Image-tracking software enables image fusion on all X-ray sets, including mobile C-arms.

Vascular cases on a mobile C-arm

- Aortoiliac occlusive disease
- Bilateral kissing stents
- Cydar EV and Ziehm RFD C-arm
- 5 mls iodinated contrast used

Courtesy of Dr. Peter Goverde, ZNA Clinic Switzerland

Recent data: use of fusion in EVAR

<table>
<thead>
<tr>
<th>Study Design – Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Urgent/Emergent Cases</td>
</tr>
<tr>
<td>2. Parallel Endografts</td>
</tr>
<tr>
<td>3. Iliac Branch Endoprosthesis</td>
</tr>
</tbody>
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Duke Experience

Use of fusion imaging reduced air kerma and DSA runs in standard EVAR

Duke Experience

EVAR/FEVAR
108 Patients
(10/16 – 12/17)

Pre-Image based 3D Fusion CT
67 patients

Post-Image based 3D Fusion CT
41 patients
Study Design – Primary Endpoints
1. Radiation Exposure
2. Contrast Use
3. Fluoroscopy Time
4. Procedure Time

Results

Patient Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pre-Image based 3D fusion CT (n = 67)</th>
<th>Post-Image based 3D fusion CT (n = 41)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>74.8</td>
<td>70.9</td>
<td>0.061</td>
</tr>
<tr>
<td>Male</td>
<td>54 (80.6)</td>
<td>37 (90.2)</td>
<td>0.182</td>
</tr>
<tr>
<td>BMI</td>
<td>27.6</td>
<td>27.6</td>
<td>0.918</td>
</tr>
<tr>
<td>Hypertension</td>
<td>58 (86.6)</td>
<td>33 (80.5)</td>
<td>0.399</td>
</tr>
<tr>
<td>Diabetes</td>
<td>11 (16.4)</td>
<td>6 (14.6)</td>
<td>0.085</td>
</tr>
<tr>
<td>COPD</td>
<td>32 (47.8)</td>
<td>12 (29.2)</td>
<td>0.06</td>
</tr>
<tr>
<td>Tobacco Use</td>
<td>21 (31.3)</td>
<td>17 (41.5)</td>
<td>0.285</td>
</tr>
<tr>
<td>CAD</td>
<td>37 (55.2)</td>
<td>19 (46.3)</td>
<td>0.005</td>
</tr>
<tr>
<td>CHF</td>
<td>3 (4.5)</td>
<td>2 (4.9)</td>
<td>0.923</td>
</tr>
</tbody>
</table>

Aneurysm Details

<table>
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<tr>
<th>Characteristic</th>
<th>Pre-Image based 3D fusion CT (n = 67)</th>
<th>Post-Image based 3D fusion CT (n = 41)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Infrarenal 48 (71.6)</td>
<td>Fenestrated 7 (17.1)</td>
<td>0.183</td>
</tr>
<tr>
<td>Diameter</td>
<td>60.1</td>
<td>58.5</td>
<td>0.399</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index, COPD, Chronic Obstructive Pulmonary Disease, CHF, congestive heart failure, CAD, coronary artery disease
Conclusions

- Image based 3D Fusion CT decreases:
  - Radiation exposure
  - Fluoroscopy time
  - Procedure time
- Image-based fusion software enables 3D overlays on all X-ray sets, including mobile C-arms
- Image based 3D Fusion CT has the potential to reduce costs and improve clinical outcomes

Thank you