Clinical application of 3-dimensional image fusion guidance (VesselNavigator, Philips) during EVAR: a single-center assessment of its beneficial role in reducing contrast-induced nephropathy and radiation hazard

Byung Chan Lee, M. D., Jae Kyu Kim, M.D., Nam Yeol Yim, M. D., Hyoong Ook Kim, M. D., Yang Jun Kang, M. D.

Department of Radiology, Chonnam National University Hospital. Gwang-ju. The Republic of Korea

PURPOSE
To evaluate the feasibility and potential benefit of using 3-D VesselNavigator during endovascular aneurysmal repair (EVAR) for the treatment of AAA

MATERIALS AND METHODS
Study population
From Mar. 2016 to Sep. 2017
Retrospective case collection and analysis
38 patients who underwent EVAR
(M.F = 32:6, mean age = 71.1 ± 7.9)

Using 3D navigation tool group
16 patients
(M.F = 13:3, mean age = 69.2 ± 8.9)

Without using 3D navigation tool group
22 patients
(M.F = 19:3, mean age = 72.3 ± 6.7)

EVAR procedure
Done by 2 experienced Interventional radiologists (at least 10 year of experience)
Digital angiography: AlluraClarity (Philips Healthcare, Best, The Netherlands)
with low radiation dose mode
Bifurcated stent graft
- Endurant II (Medtronic, Mineapolis, MN, USA) (n=20)
- Excluder (W. L. Gore & Associates, Flagstaff, AZ, USA) (n=10)
- InCord (Cordis Corp., Milpitas, CA, USA) (n=5)
- AXF2 (Endologix inc., Irvine, CA, USA) (n=3)

Image Fusion Technique
VesselNavigator (Philips Healthcare, Best, The Netherlands)

RESULTS

Table 1. Total contrast agent amount and CIN occurrence rate

<table>
<thead>
<tr>
<th>Group</th>
<th>Contrast (cc)</th>
<th>Mean Cr. (mg/dL)</th>
<th>Change of Cr. (mg/dL)</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Fusion (n=16)</td>
<td>49.06 ± 62.22</td>
<td>0.01 ± 0.14</td>
<td>-0.46 ± 0.24</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td>Non-Image Fusion</td>
<td>147.05 ± 50.25</td>
<td>0.01 ± 0.14</td>
<td>-0.46 ± 0.24</td>
<td>3 (18.8%)</td>
</tr>
</tbody>
</table>

P-value <0.001

Table 2. Procedure time and radiation dose

<table>
<thead>
<tr>
<th>Group</th>
<th>Procedure Time (min)</th>
<th>Fluoroscopy Time (min)</th>
<th>Air-Kerma (mGycm²)</th>
<th>DAP (mGy/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Fusion (n=16)</td>
<td>68.9 ± 12.4</td>
<td>20.06 ± 6.4</td>
<td>185.0 ± 30.0</td>
<td>53.4 ± 9.0</td>
</tr>
<tr>
<td>Non-Image Fusion</td>
<td>86.9 ± 34.6</td>
<td>26.55 ± 15.5</td>
<td>181.8 ± 36.6</td>
<td>127.2 ± 80.6</td>
</tr>
</tbody>
</table>

Difference ± 6.9 | ± 6.5 | ± 16.3 | ± 7.72 ± 6 |

P-value 0.81 ± 8.9 | 0.89 ± 8.9 | 0.94 ± 8.9 | 0.094 ± 8.9 |

Table 3. Patients with hostile anatomical feature

Total 8 patients
2 EVARs with image fusion and 6 EVARs without image fusion

<table>
<thead>
<tr>
<th>Group</th>
<th>Patient No.</th>
<th>Change of Cr</th>
<th>Procedure Time (min)</th>
<th>Fluoroscopy Time (min)</th>
<th>Air-Kerma (mGycm²)</th>
<th>DAP (mGy/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image fusion (n=2)</td>
<td>1</td>
<td>0</td>
<td>50 ± 10</td>
<td>361.1 ± 116.1</td>
<td>107.3 ± 116.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>▲ 0.1</td>
<td>70 ± 10</td>
<td>352.1 ± 102.1</td>
<td>125.2 ± 102.1</td>
<td></td>
</tr>
<tr>
<td>Non-Image fusion (n=6)</td>
<td>3</td>
<td>▲ 0.1</td>
<td>135 ± 47</td>
<td>181.8 ± 90.7</td>
<td>90.7 ± 90.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>▲ 0.1</td>
<td>75 ± 15</td>
<td>181.9 ± 90.7</td>
<td>69.2 ± 90.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>▲ 0.1</td>
<td>149 ± 48</td>
<td>356.6 ± 129.5</td>
<td>129.4 ± 129.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>▲ 0.1</td>
<td>71 ± 19</td>
<td>216.2 ± 102.1</td>
<td>57.2 ± 102.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0</td>
<td>57 ± 24</td>
<td>89.6 ± 25.2</td>
<td>25.2 ± 25.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>▲ 0.1</td>
<td>150 ± 57</td>
<td>478.7 ± 129.5</td>
<td>152.4 ± 129.5</td>
<td></td>
</tr>
</tbody>
</table>

P-value 1.06 ± 0.074 | 0.89 ± 0.074 | 0.84 ± 0.074 | 0.079 ± 0.079 |

Unintended occlusion of internal iliac artery
Unintended occlusion of internal iliac artery by stent-graft occurred in 2 cases
Unintended occlusion result from arterial configuration mismatch with 3D navigation tool by guide wire or device

CONCLUSIONS
EVAR using 3D navigation can be a useful way to reduce radiation hazards and has a potential benefit in reducing the risk of contrast-induced nephropathy, procedure or fluoroscopy time.