Image Fusion Guidance with Pre-procedural CT with Real-time Fluoroscopy for Adrenal Venous Sampling

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Conflicts of Interest

• Nothing to disclose
Introduction

- The success rates of AVS differ among the reports, 74%-96%, as cannulation of the RAV is technically demanding [1-2].
- Some reports show that the technical success rate can be improved by identifying the adrenal veins using CE-CT [3].
- Recently, image fusion guidance (IF) with pre-procedural CT with intraprocedural fluoroscopy has been used for some interventional procedures [4].


AVS = adrenal venous sampling
CE-CT = contrast enhanced CT
RAV = right adrenal vein
Purpose

• To assess the effectiveness of image fusion guidance (IF) with pre-procedural CT with intraprocedural fluoroscopy for AVS.
Materials and methods (1)

Subjects

- We retrospectively compared the technical success rates, procedure time, radiation exposure, and volume of contrast medium used between

  62 patients with IF (From Nov 2016 to Jul 2017)
  (median age: 52 (28-75) years old; male : female=28 : 34)

  vs.

  49 patients without IF (From Apr 2016 to Oct 2016)
  (median age: 51 (27-79) years old; male : female=23 : 26)

  who underwent AVS
Materials and methods (2)  
Basic methods of AVS

• One of 3 senior radiology residents or a radiologist with a supervised interventional radiologist performed the procedure [5].

• Using two sheaths, **5Fr catheters** for the LAV and RAV (Gadelius Medical K.K., Tokyo, Japan), and a **1.7-Fr microcatheter** (Peak hunter; JMS Co. Ltd., Tokyo, Japan) [6]

• Sampling **pre and post ACTH stimulation** in the IVC, left renal vein, common trunk of the LAV, LAV, and RAV, with **bilateral segmental sampling** after ACTH stimulation [6]

Materials and methods (3)

Methods of IF

- A 3D VR image, including adrenal glands/veins and bones, was extracted from the CE-CT images previously obtained 45 or 55 s after injecting contrast medium for 30 s during the same breath holding at the shallow expiratory phase [7] on a workstation (Ziostation2).
- Outlines were manually added along the adrenal veins.
- The VR image was manually registered to the real-time X-ray fluoroscopy with the vertebrae used as the reference.

VR = volume rendering

Materials and methods (4)
Conventional methods of CT reference

- In cases without IF, a transaxial CT image and a scout view, which indicated the height of the RAV, were displayed as a reference during the procedure [5].

RAV is explored with referring to the height on CT

Results (1)

Technical success rates

• No significant differences in the technical success rates with and without IF were observed for the RAV and LAV.

<table>
<thead>
<tr>
<th></th>
<th>With IF</th>
<th>Without IF</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAV</td>
<td>98.4%</td>
<td>91.8%</td>
<td>0.168</td>
</tr>
<tr>
<td>LAV</td>
<td>98.4%</td>
<td>100%</td>
<td>1.000</td>
</tr>
</tbody>
</table>
## Results (2)

### Technical factors

<table>
<thead>
<tr>
<th></th>
<th>With IF</th>
<th>Without IF</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procedure time (min)</strong></td>
<td>95.6 ± 18.8</td>
<td>108.4 ± 20.0</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>Time for selecting the RAV (min)</strong></td>
<td>6.5 ± 7.2</td>
<td>10.5 ± 12.3</td>
<td>0.036</td>
</tr>
<tr>
<td><strong>Total dose-area product (Gy·cm²)</strong></td>
<td>43.1 ± 30.7</td>
<td>72.2 ± 45.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Peak skin dose (mGy)</strong></td>
<td>432 ± 304</td>
<td>678 ± 400</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Fluoroscopy time (min)</strong></td>
<td>32.3 ± 12.3</td>
<td>38.3 ± 11.7</td>
<td>0.012</td>
</tr>
<tr>
<td><strong>Number of radiographic frames</strong></td>
<td>146 ± 70</td>
<td>195 ± 118</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>Radiation dose to operator (μSv)</strong></td>
<td>13.8 ± 11.8</td>
<td>25.5 ± 29.6</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>Volume of contrast media (mL)</strong></td>
<td>54.6 ± 21.9</td>
<td>65.7 ± 27.6</td>
<td>0.020</td>
</tr>
</tbody>
</table>

Better in every factor
Results (3)
A case of IF

A venogram (arrow) is somewhat unusual as a RAV (a). Fusion images clearly indicate that the vein is the RAV because the location of the orifice of the RAV marked with a green line (arrows) and the shape of the right adrenal gland (arrowheads) of the VR image on the frontal (b) and RAO view (c) correspond to those of the venogram. The location of the LAV marked with green line (arrow) and the shape of the left adrenal gland of the VR image correspond to those of the venography (d).
Discussion (1)

IF for technical success

• The present results show that no significant difference in technical success rate is observed between with and without IF.
  • This is because our technical success rate is originally high even without IF, more than 90%, and we originally refer to CE-CT images in cases without IF.
• However, we believe that IF is essentially helpful, especially for beginners in institutions with lower technical success rates.
Discussion (2)
Advantages of IF

• The present results show that IF can help reduce procedure time resulting in reducing radiation exposure and the volume of contrast media.
  • IF can reduce the time for cannulation of the RAV by narrowing the range of exploration.
  • For anomalous veins, IF helps with cannulation (Figs).
  • Left renal venography can be abbreviated.
Discussion (3)
Advantages of IF

• Displaying the adrenal glands virtually on real-time fluoroscopy with IF is useful for
  • confirming whether the vein was the adrenal vein with distinguishing the other veins (Fig.a,b)
  • comprehending the segmental branches (Fig.c)
  • IF can be tracked in any angle due to the nature of the 3D data.

Inferior hepatic vein
Superior branch of RAV
RAV
Discussion (4)
Discrepancies of IF

• Some *discrepancies* of the location between the venogram and VR image are observed which would be caused by
  • Differences of *respiration status and body position*
  • *Misregistration* of IF

→ The RAV can be explored after accounting for a height discrepancy between the VR image and venography of the LAV.
Discussion (5)
Limitations

- Retrospective study
- Multiple operators involved
- Bias of learning curve
  - because the period of performing AVS with IF was more recent than that without IF
Conclusion

• Although the contribution to improving the technical success rates was small in our study, IF can effectively reduce procedure time, radiation exposure, and volume of contrast medium during AVS.