The use of virtual noncontrast images derived from dual-energy CT for determining the tissue enhancement: a comparison among four different tissues in female pelvic area.

Poster No.: C-1266
Congress: ECR 2012
Type: Scientific Exhibit
Authors: R. Ono¹, N. Tomizawa², T. Nojo², M. Akahane², R. Torigoe², K. Ohtomo²; ¹Bunkyo-ku, Tokyo/JP, ²Tokyo/JP
Keywords: Pelvis, Radiation physics, CT, Computer Applications-General, Technical aspects, Tissue characterisation
DOI: 10.1594/ecr2012/C-1266

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

1. Virtual non-contrast (VNC) images derived from dual-energy CT show similar images compared with non-enhanced images. The major strength is that no additional radiation dose is necessary to achieve the VNC images.

2. It is reported that the VNC images are useful for detecting calcifications in kidneys or livers [1,2,3]. However, the usefulness of VNC images for determining the tissue enhancement is still unknown.

3. The objective of our study was to evaluate the VNC images for determining tissue enhancement.

Methods and Materials

Patients

This prospective study was approved by the local ethics committee, and all patients provided informed consent to participate in this study. Eight consecutive female patients who were suspected or had a disease in the pelvis were included in this study (average age, 46.5±9.9 y; range, 33-54 y). One patient was excluded from the analysis of the bladder because the bladder was too small to evaluate. Also, one patient was excluded from the evaluation of the uterus due to a history of hysterectomy.

Methods

All examinations were performed on a 320-row CT scanner (Aquilion ONE, Toshiba, Otawara, Japan). First, dual-energy (135kVp and 100kVp) non-enhanced scans were performed. Dual-energy venous-phase enhanced scans were performed subsequently. A dual-energy venous-phase scan was acquired 100 seconds after initiation of intravenous injection of an ionic contrast agent, iopamidol 350 or 370 mgI/mL. The injection time was 60 s. The amount of contrast agent was adjusted by the body weight; for patients with a body weight <50kg, iopamidol 350, 2.0 mL/kg; for patients with a body weight of 50-59kg, iopamidol 350, 100mL; for patients with a body weight #60kg, iopamidol 370, 100mL. The reconstructed slice thickness and the increment was 5mm. All images were reconstructed using adaptive iterative dose reduction (AIDR). Five circular region of interests (ROIs) were placed on the following four tissues; ovarian cyst/bladder, muscle, cervix of the uterus, and body of the uterus. The average CT numbers of the five ROIs were used for further analysis. Diff\textsubscript{VNC} was determined as the difference of the CT number between the
contrast images and the VNC images. $\text{Diff}_{\text{plain}}$ was determined as the difference between the contrast images and the non-enhanced images.

**Evaluation of ovarian cyst/bladder and muscle**

Bland-Altman analysis was performed for $\text{Diff}_{\text{VNC}}$ and $\text{Diff}_{\text{plain}}$ of ovarian cyst/bladder and muscle. A $p$-value of $<0.05$ was determined significant.

**Evaluation of cervix and body of the uterus**

Sensitivity of the VNC image and non-enhance image was calculated for evaluating whether the tissues are enhanced compared with the contrast image. A tissue was considered as enhanced when $\text{Diff}_{\text{VNC}}$ and $\text{Diff}_{\text{plain}}$ was $>15$ HU.

**Results**

**Ovarian cyst/bladder and muscle**

The average CT values of the VNC, non-enhanced, and enhanced images are summarized in Table 1. Although the Bland-Altman analysis showed no significant difference for $\text{Diff}_{\text{VNC}}$ and $\text{Diff}_{\text{plain}}$ of cyst/bladder ($p=0.37$ and 0.08, respectively), $\text{Diff}_{\text{VNC}}$ was smaller compared with $\text{Diff}_{\text{plain}}$ (Fig. 1 on page 4)(Table 2 on page 4). The Bland-Altman analysis of muscle showed no significant difference for $\text{Diff}_{\text{VNC}}$ ($p=0.99$), while the difference for $\text{Diff}_{\text{plain}}$ showed significant difference ($p=0.008$).

**Cervix and body of the uterus**

The sensitivity of the VNC image for determining enhancement was 100% for body of the uterus. However, the sensitivity for cervix of the uterus was 85.7%. The VNC image could not detect enhancement for one patient; $\text{Diff}_{\text{VNC}}$ was 12.5 HU while $\text{Diff}_{\text{plain}}$ was 34.9 HU for this patient.

**Images for this section:**
Table 1: Average CT number of VNC, non-enhanced, and enhanced images. Note. VNC, virtual non-contrast.

<table>
<thead>
<tr>
<th></th>
<th>VNC</th>
<th>Non-enhanced</th>
<th>Enhanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovarian cysts/Bladders</td>
<td>25.1±13.7</td>
<td>16.5±9.1</td>
<td>21.6±10.3</td>
</tr>
<tr>
<td>Muscles</td>
<td>68.9±10.7</td>
<td>58.5±4.9</td>
<td>68.9±5.5</td>
</tr>
<tr>
<td>Cervices</td>
<td>44.5±20.5</td>
<td>35.1±13.3</td>
<td>74.1±18.0</td>
</tr>
<tr>
<td>Bodies</td>
<td>62.1±17.8</td>
<td>47.4±9.0</td>
<td>149.5±35.1</td>
</tr>
</tbody>
</table>

Table 2: DiffVNC and Diffplain of cyst/bladder and muscle. * Statistically significant, p

<table>
<thead>
<tr>
<th></th>
<th>DiffVNC</th>
<th>p value</th>
<th>Diffplain</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovarian cysts/Bladders</td>
<td>-3.5</td>
<td>0.37</td>
<td>5.33</td>
<td>0.08</td>
</tr>
<tr>
<td>Muscles</td>
<td>-0.03</td>
<td>0.99</td>
<td>10.34</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Fig. 1: The figure shows a 54-year-old female patient who underwent CT for suspected ovarian tumor. The CT value of the bladder for the VNC image (upper left), non-enhanced image (upper right), and enhanced image (lower left) was 14.3 HU, 5.4 HU, and 11.7 HU, respectively. The calculated DiffVNC was -2.6 HU and Diffplain was 6.3 HU. The DiffVNC was smaller than Diffplain for this patient.
Conclusion

1. The present study showed that VNC images could determine non-enhanced tissues with the smaller "pseudo-enhancement" compared with non-enhanced images.

2. VNC images could determine whether a tissue is enhanced as well as non-enhanced images, however, false-negative might present when the tissue is only slightly enhanced.

3. The major limitation of this study is that the number of patients is very small, and further investigation with larger population is necessary to affirm the aforementioned results. Another limitation is that we did not evaluate the overall texture and image quality of the VNC image. The results in this study do not mean that VNC image could replace the non-enhanced image.

4. In conclusion, the VNC image could be useful to determine the tissue enhancement.

References


Personal Information

Runa Ono, Nobuo Tomizawa, Takeshi Nojo, Masaaki Akahane, Kuni Ohtomo

Department of Radiology, The University of Tokyo Hospital, Tokyo, Japan.
7-3-1, Hongo, Bunkyo, Tokyo, 113-8655, JAPAN

Mail to: runaono@gmail.com

Rumiko Torigoe

Toshiba Medical Systems Corporation, Tokyo Metropolitan Regional Office, 1-6, Tsukuda 2-Chome, Chuo-ku, Tokyo 104-0051, Japan