Introduction

- Manual tracing of the right and left liver lobes using systems such as Rapidia, Voxar 3D, and syngo.via from CT images for graft volumetry is common at most medical centers.
- Although the manual method is accurate, it is cumbersome and time-demanding (> 30 min) and has relatively large intra- and inter-observer variations.
- A function of liver graft weight estimation, which is important for donor candidate selection and liver surgery planning, is not available in other systems.
- The present study developed an effective and accurate surgical planning system (named Dr. Liver) consisting of: liver/vessels segmentation and virtual liver resection stage for liver graft volumetry.

Methods

- Comparison of the proposed system with a manual tracing method in syngo.via (Siemens Co., Germany)
  - 50 patient datasets for LDLT in CBNUH
- Measures
  1) Graft weight estimation accuracy: assessed by absolute difference (AD) and percentage of AD (%AD) between preoperatively estimated graft weight and intraoperatively measured graft weight.
  2) Intra- and inter-observer agreements of liver graft weight estimation: assessed by intraclass correlation coefficients (ICCs) using 10 cases randomly selected.
  3) Task completion time.

Results

- AD & Completion Time: The proposed system showed significantly higher accuracy and efficiency in liver graft weight estimation than the manual tracing method on syngo.via.

<table>
<thead>
<tr>
<th>Method</th>
<th>AD (g)</th>
<th>% AD</th>
<th>Percentage of %AD &gt; 10%</th>
<th>Task completion time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposed system</td>
<td>21.0 ± 18.4</td>
<td>3.1% ± 2.8%</td>
<td>0%</td>
<td>7.3 ± 1.4</td>
</tr>
<tr>
<td>syngo.via</td>
<td>70.5 ± 52.1</td>
<td>10.3% ± 7.5%</td>
<td>46%</td>
<td>37.8 ± 7.0</td>
</tr>
</tbody>
</table>

Discussion

- ICCs: The proposed system showed slightly higher intra- and inter-observer agreements in liver graft weight estimation than syngo.via.

<table>
<thead>
<tr>
<th>Method</th>
<th>Intra-observer agreement</th>
<th>Inter-observer agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>The proposed system</td>
<td>Observer 1: 0.996 Session 1: 0.997</td>
<td>Observer 2: 0.998 Session 1: 0.997</td>
</tr>
<tr>
<td>Observer 1: 0.998 Session 2: 0.999</td>
<td>Observer 2: 0.999 Session 2: 0.993</td>
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<tr>
<td>syngo.via</td>
<td>Observer 1: 0.987 Session 1: 0.979</td>
<td>Observer 2: 0.999 Session 2: 0.993</td>
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</table>

- AD between estimated graft weight and actual graft weight:
  1) The proposed system showed high accuracy (AD = 21.0 ± 18.4 g, %AD = 0.8% ± 4.1%), Percentage of %AD > 10% = none) and time efficiency (7.3 ± 1.4 min) in liver graft weight estimation.
  2) The proposed system overcomes the weaknesses of the manual tracing method in terms of accuracy and user interaction time.
  3) Future study is needed to comprehensively examine the usability and reliability of the proposed system for liver graft volumetry in planning of LDLT.

Conclusion

- The proposed system Dr. Liver is accurate and efficient in segmentation of liver and vessels and virtual liver resection and can be effectively applied to preoperative liver surgical planning in LDLT.