Liver 3D modeling and hepatectomy simulation for the residents' preoperative education

Zygomalas A.[1,2], Megalooikonomou V.[2], Koutsouris D.[3], Karavias D. D.[1], Karagiannidis I.[1], Maroulis I.[1], Giokas K.[3], Karavias D.[1]

[1]Hepatobiliary and Pancreatic Unit, University Hospital of Patras

[2]Computer Engineering and Informatics Department, University of Patras

[3]Biomedical Engineering Laboratory, National Technical University of Athens

Background

Liver segmentation from medical images produces high quality patient specific 3D liver models which are used for preoperative planning and intraoperative guidance. These 3D models can be manipulated and visualized in various ways and can be useful for residents' education.

Objective

The aim of this study was to evaluate the implementation of a novel liver segmentation and hepatectomy simulation application as a tool for the residents' preoperative education.

Method

We developed in MATLAB® 2013a a liver segmentation and preoperative planning application. Ten liver imaging datasets of a prospectively selected random sample of patients undergoing elective hepatectomies at our institution were used for liver segmentation and 3D modeling. Residents were asked to identify anatomical and pathological structures and propose liver resection plans. Intraoperatively, they could consult the computer models in real time. Their surgical scenarios were evaluated and discussed with specialized liver surgeons. Learning objectives were defined and their accomplishment was evaluated using the Kirkpatrick's four levels model.

Results

The residents learned to; 1)identify anatomical and pathological structures 2)calculate future liver remnant volume (FLR) from segmented liver images 3)propose liver resection plans based on FLR and liver vascular tree and tumor relations 4)consult liver medical images (CT and MRI) 5)understand the role of computer assisted surgery. They evaluated in-vivo their preoperative planning decisions and understood better the surgical operations.

Conclusions

Our proposed liver segmentation and hepatectomy simulation application appears to be appropriate for the preoperative education of resident surgeons.