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3D Auto-segmentation Of Liver Anatomy Based On Liver MRI Using Deep Learning Algorithm Based On 114 Cases Undergoing Liver Resection: Five Different Anatomical Structures From Single Sequence

Namkee OH[1], Jinsoo RHU*[1], Gyu-Seong CHOI[1], Jong Man KIM[1], Jae-Won JOH[1], Woo Kyung JEONG[2], Jae Hun KIM[2]

[1]*Department Of Surgery, Samsung Medical Center, REPUBLIC OF KOREA*
[2]*Department Of Radiology, Samsung Medical Center, REPUBLIC OF KOREA*

Background : Deep learning algorithm is increasingly adapted in the field of medicine with diversity in specific field. We managed to start a 3D auto-segmentation of liver anatomy study based on liver magnetic resonance imaging using deep learning algorithm.

Methods : Liver malignancy cases scheduled for surgical resection which seemed eligible for the surgeon to model the image to 3D during the period of January 2020 to December 2021 were included to the study. The 20 minutes delayed hepatobiliary phase sequence after Gadolinium infusion was selected for 3D modeling. Liver parenchyme, hepatic vein, Glissonean pedicles, tumor and bile ducts were reconstructed. Expert biomedical artists reconstructed the 3D model and liver surgeons double checked the accuracy. Deep-leaning algorithm for auto-segmentation of separate anatomical parts were trained and validated with the ratio of 10 to 1. The accuracies of validated cases were assessed by reconstructed volume using intersection of union (IoU).

Results : A total of 114 cases were included to the study and 104 cases were set as training set and 10 cases were set as validation set. There were no demographical differences between the two groups regarding sex (P=1.000), age (P=0.571), diagnosis (P=0.684), number of tumor (P=0.686) and median size of tumor (P=0.397). Mean IoU of total area was 0.92±0.03. Mean IoU of cancer was 0.66±0.20. Mean IoUs of central region of hepatic vein and portal vein were 0.66±0.05 and 0.60±0.04, respectively. Mean IoUs of peripheral region of hepatic vein and portal vein were 0.21±0.06 and 0.27±0.04, respectively.

Conclusions : Although deep leaning algorithm for 3D auto-segmentation of liver showed high accuracy in liver parenchyme, cancer and main vascular structures, more accuracy is required especially for segmental branches.

Corresponding Author : **Jinsoo RHU** (jsrrules@gmail.com)