Automated segmentation of diffuse large B cell lymphoma (DLBCL) lesions in \([^{18}\text{F}]\text{FDG-PET/CT}\) images using pre-trained deep learning models

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BACKGROUND

- Total metabolic tumor volume (TMTV) measured from baseline \([^{18}\text{F}]\text{FDG-PET/CT}\) images of diffuse large B-cell lymphoma (DLBCL) has strong prognostic value for progression-free and overall survival.
- TMTV is not routinely reported in clinic, since:
  - Manual delineation is time consuming
  - Manual delineation is prone to inter-observer center variabilities
  - There is no consensus on thresholding-based approaches.
  - Supervised AI techniques requires large number of delineated cases to be trained for automatic TMTV calculation
- Some studies suggested lack of a need to design a specific deep model for each cancer type to detect the pathological tumor and MTV calculation

OBJECTIVES

Question: Can a deep segmentation model designed and trained on images from other pathologies be used for DLBCL segmentation?

In this study we explore the feasibility of applying a deep segmentation model trained on \([^{18}\text{F}]\text{FDG-PET/CT}\) images of different cancer types for lesion segmentation in DLBCL cases:

- Head and Neck (H\&N) data from (The Cancer Imaging Archive)
- Primary mediastinal large B cell lymphoma (PMBCL) data from BC Cancer

METHODS

- Pre-processing: Z-score normalization for each scan
- Segmentation model: Bi-modal 3D U-net model with a squeeze-and-excitation (SE) normalization module (Iantsen, Visvikis et al. 2020) and Mumford-Shah (MS) loss function (Kim and Ye 2019)

RESULTS

Average Dice similarity score (DSC) values of DLBCL lesion segmentations when using the trained segmentation model on different types of cancer (reference standard: delineations by expert nuclear medicine physicians)

<table>
<thead>
<tr>
<th>Model</th>
<th>DSC (mean ± std)</th>
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<tbody>
<tr>
<td>trained on H&amp;N</td>
<td>0.51 ± 0.14</td>
</tr>
<tr>
<td>trained on PMBCL</td>
<td>0.54 ± 0.08</td>
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CONCLUSION

- The missing small lesions in some cases show room for our ongoing efforts to improve performance, e.g. including further usage of self-supervised AI and contextual information.
- An automated AI based detection framework can help reduce these missing lesions.

REFERENCES