

Quantification of Donor Liver Steatosis Using a Computer Imaging Platform

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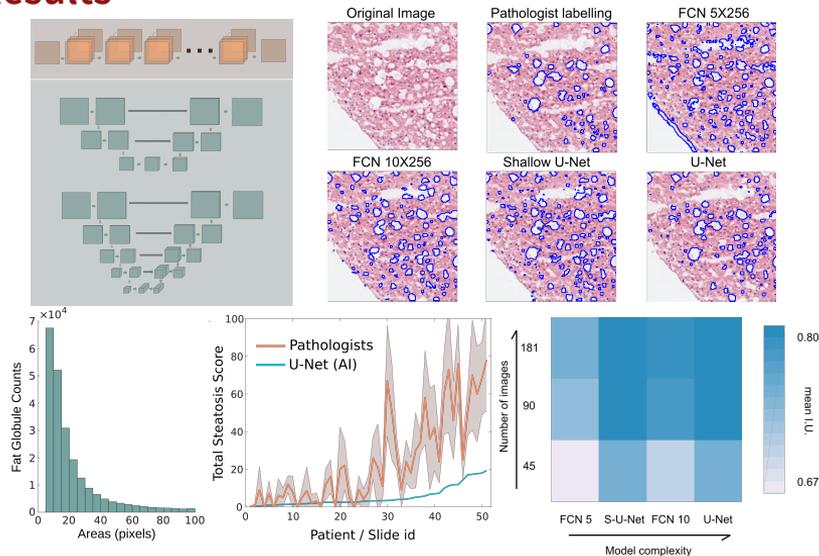
Introduction

Hepatic steatosis, is a risk factor for graft failure after liver transplantation. Steatosis is scored qualitatively by a pathologist estimating the percentage of fat globules identified on a liver slide. This approach is subjective and can vary among discerning pathologists. Therefore, we hypothesized that a deep-learning algorithm quantifying hepatic steatosis could facilitate histopathologic assessment of donor liver slides.

Methods

- Biopsied liver tissue from 54 donors were hematoxylin and eosin stained and reviewed by five independent pathologists.
- Liver slides were partitioned into unique tiles.
- Several deep learning models: U-Net, “shallow” U-Net, FCN 5X256, and FCN 10X256.
- To probe how training data quantity affects the performances, we used 3 separate training datasets with 181, 90, and 45 image tiles (dimension 256 X 256 pixels), respectively.

Results

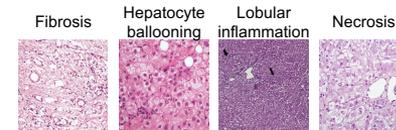


- U-Net-based models consistently obtained a higher mean Intersection-over-Union. (mean I.U.)
- Shallow U-Net achieved a mean IU and RMSE similar to U-Net, which is one of the state-of-the-art cell segmentation models.
- U-Net-based model performed equally well when trained on half the dataset compared to corresponding models trained on the entire dataset.
- U-Net achieves similar evaluation trend as pathologists, and the predicted steatosis scores are (on average) 25% of pathologists' evaluations.

Conclusions

We have developed several AI models to assess hepatic steatosis in biopsy images. The Shallow U-Net and U-Net models outperformed the other FCN models. The number of parameters in the shallow U-Net model is much smaller than the U-Net model. We were able to train robust models with only half of our dataset (90 images).

Future Directions



- Link AI predictions to liver transplant outcome.
- Apply AI to other liver pathology diagnosis.