# Artificial Intelligence in the Detection of Fatty Liver Disease

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**Background:** The current gold standard for quantification of the fat content of the liver (i.e., nonalcoholic fatty liver disease, NAFLD) is the visual microscopic inspection of liver biopsies by pathologists. Percentage of macrosteatosis (%MaS), used in determining NAFLD diagnosis, is vital in determining the transplant suitability of a donor liver. A major limitation of this method is inevitable human error which causes interobserver variability and overestimation of %MaS which could cause a potential discard of donor livers. We hypothesize that artificial intelligence (AI) can assist pathologists in providing a more objective and accurate measure of %MaS.

**Methods:** Our literature review identified HALO (image analysis) and U-Net (deep-learning) as AI programs currently available for high-accuracy %MaS calculation in liver biopsies. We compared the pathologist-reported %MaS from de-novo liver transplant (LT) biopsy samples taken 2h post-reperfusion to the %MaS calculated by HALO and/or U-Net (Fig. 1). 250 patients had undergone de novo LT at Indiana University between 2019-2020, and 211 of these patients had sufficient data (liver enzyme tests, biopsy results) to be included. Each biopsy sample was digitized into 5 random non-overlapping tiles at 20x magnification using a Leica microscope. Early allograft dysfunction (EAD) is defined by the presence of at least one of the following: (i) INR >1.6 on postoperative day (POD) 7, (ii) total bilirubin >10 mg/dL on POD7, or (iii) AST/ALT >2000 IU/L within the first 7 days following LT.

**Results:** Our literature review identified that both HALO and U-Net estimated the %MaS in liver allograft biopsies significantly lower than pathologists' estimation (Fig.1). Of 211 included patients, 46 (21.8%) had EAD. In this ongoing project, we found U-Net to have a 97.3% training accuracy with eight epochs (2000 biopsy images each). Tiles from the first ten patients are being analyzed by HALO and/or U-Net to calculate an average %MaS for each patient. These calculations will be compared to the %MaS estimation made by pathologists.

**Conclusions:** The rapidly evolving field of AI is emerging as a promising method in the quantification of the fat content of the liver with increased accuracy. AI will therefore help pathologists and transplant surgeons to determine liver transplant viability and better predict EAD in transplant patients.

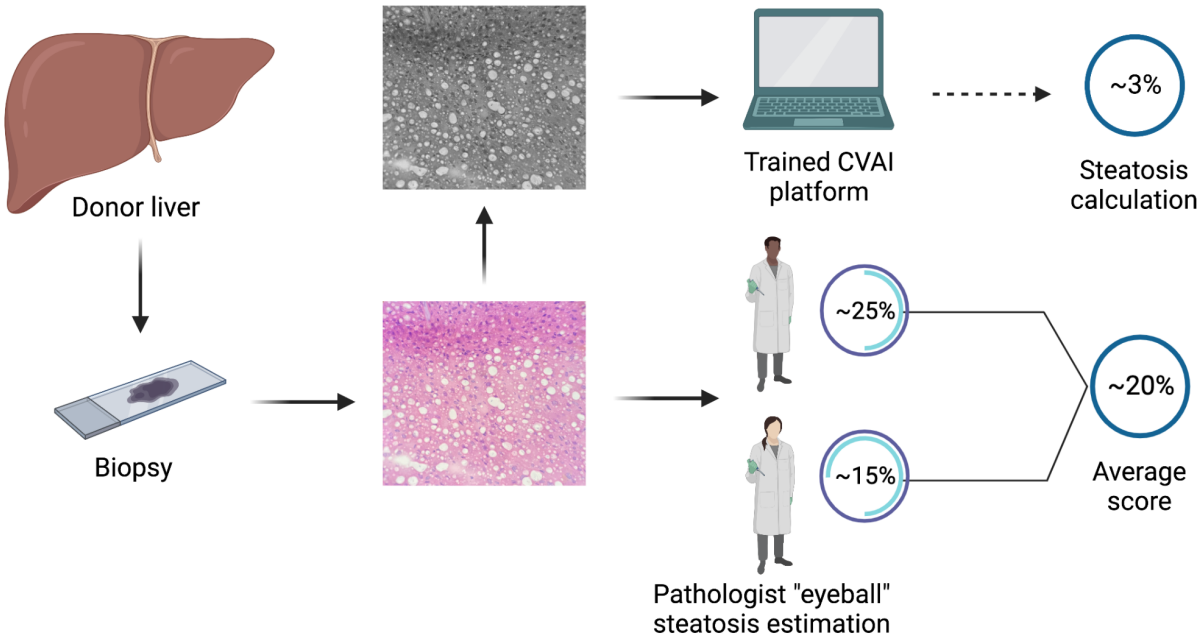


**Fig. 1. Steps to compare AI %MaS calculation of biopsy to pathologist visual estimation.** The same donor liver biopsies that were inspected by pathologists were digitized into high-resolution images and uploaded to AI platforms that calculate %MaS by fat vacuole identification. Most studies have found that %MaS estimated by pathologists is consistently higher and more variable than AI calculations.