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Dye Free Determination of NASH in Human Liver Samples Using NAD(P)H Autofluorescence and Machine Learning Analysis

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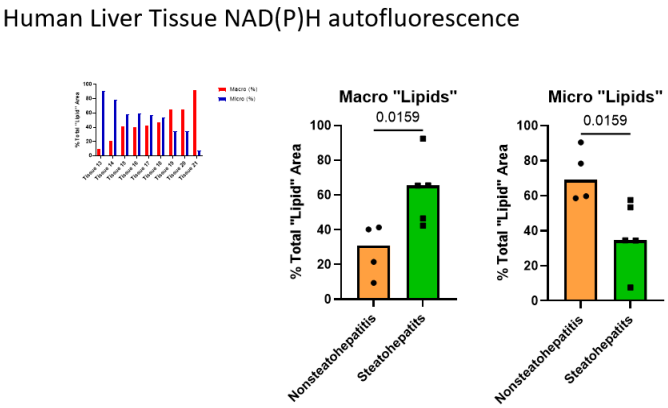
Non-Alcoholic Fatty Liver Disease (NAFLD) is a general term for a range of fatty liver disease. NASH (Nonalcoholic Steatohepatitis), is the most severe manifestation of NAFLD. NASH can cause scarring of the liver (cirrhosis), liver cancer or liver failure[1]. It is projected that by 2030 NASH will be the number one reason for liver transplants in the United States[2]. NASH affects between 2 – 5% of Americans which equals between 6.5 – 16.3 million people[2]. There are currently no medicines available for the treatment of NASH. The only treatments are lifestyle changes the lead to weight loss. Therefore the earlier NASH can be diagnosed the sooner lifestyle changes can be implemented. Thus the better the outcome for the patient.

Lipid droplet accumulation in hepatocytes is the distinctive characteristic of NAFLD[3]. Using liver sections obtained from BioIVT[4] a dye free method for imaging lipid droplets in healthy versus NASH tissue was developed. A femtosecond multiphoton laser was tuned to 740nm for the excitation of the endogenous autofluorescence from NAD(P)H that is prevalent in the lipid droplets. The emission signal from the NAD(P)H was collected in a non-descanned spectral HyD detector within the spectral range of 424nm - 475nm[5]. The liver sections were tile scanned and merged to get an high resolution image of the entire liver section. Thus the lipid quantification was more representative of the tissue. Then a pixel based machine learning algorithm was used to segment out the lipid droplets from the tissue section. To classify the different lipid droplet sizes a machine learning based object classification was performed to give two categories of lipids droplets. The classifications categories are big lipids droplets and small lipid droplets. From these measurements the tissue samples were able to be distinguished as healthy tissue and NASH tissue. This method could be applied to determine if patient samples as a quick screening method for NASH. Only fixed sectioned tissue is necessary for this method eliminating the need for staining the tissue before imaging.



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