Machine Learning Augmented Histopathological Diagnosis of an Aggressive Variant of Liver Cancer

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Purpose: Liver cancer (Hepatocellular carcinoma) is one of the most common and fatal cancers. Subtypes associated with poor outcomes need proper characterisation. “Macrotrabecular-massive Hepatocellular carcinoma” (MTM-HCC), a recently identified aggressive variant, is characterised by thick trabeculae in 50% of tumour. Histopathology is gold standard for diagnosis of subtypes; however, manual microscopy of tumour tissue slides is labour intensive and time-consuming. Machine learning model is required to assist Pathologists. Procedure: 4400 anonymized digital images of HCC resection histopathology were used to create 3 main models and randomly allocated to training (1600), validation (400), and test (400) for each. CNN model was created in Python using TensorFlow and Keras to predict occurrence of Macrotrabecular pattern. After experimenting with different architectures (Inception V3, MobileNet V2, ConvNet and VGG), optimisers and loss functions, InceptionV3, RMSProp and BinaryCrossentropy were chosen. The performances were evaluated by confusion matrix and AUROC. Data augmentation improved accuracy by 25%. A Mobile App, using Flutter that uses the ML model for realtime detection of images, was created. Independent internal and external validation was performed. Data: Training, validation, and test accuracies for Macrotrabecular vs non-Macrotrabecular, Macrotrabecular vs Microtrabecular and Macrotrabecular vs Pseudoglandular ranged from 96%-98%. AUROC ranged from 0.97-0.99. Internal and external validation showed accuracy of 96-98%. Conclusion: This model showed good performance and high accuracy and is the first to apply ML model to assist Pathologists in detecting aggressive variant of liver cancer. It makes Pathologist’s task less labour-intensive and saves time.

Awards Won:
Fourth Award of $500