Biomedical Innovation Competitor #1

AORTA – ML

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Video: https://w21cinnovationacademy.com/competitors/#Competitor5

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AORTA-ML is a project that aims to revolutionize how surgical emergencies like aortic dissections are rapidly diagnosed, assessed and treated by creating a comprehensive machine learning model that can rapidly assimilate clinical and imaging information and extract concise data to guide surgical management. We are working towards building a model that would be able to diagnose, characterize and assess aortic dissections on CT imaging studies and combine this information with clinical parameters to guide surgical decision making and prognostication. This would allow for rapid evaluation of these patients, freeing practitioners to concentrate on rapid healthcare delivery.

Type-1 aortic dissection has mortality of 60-90% increasing by 1% per hour. Emergent surgery is critical but is a complex high-risk endeavor. Numerous surgical techniques are now available with no consensus on best management for individual patients. CT imaging is standard of care and key component in surgical decision-making along with patient clinical profiles. Surgical planning is based on rapid interpretation of complex CT imaging studies and patient clinical profiles with available expertise, often at night! This makes such decision making difficult, inconsistent and time-intensive, all of which could adversely affect patient survival. Rapid consistent data extraction is critical.

Machine learning (ML) powers current technology in a wide variety of fields today, from the web to self-driving cars. With this rise in computational power and size of data available, ML models are becoming easier and faster to generate. Recently developed models such as the Inception architecture and AlexNet have shown to be better than humans at recognizing patterns and images, allowing for their use in various interesting applications. Recent applications in the field of cardiology and neurology have shown how man and machine can unite to improve patient care and overall outcomes. As personalized medicine progresses and surgical techniques become more nuanced, treatment decisions are based on review of large datasets by multidisciplinary expert teams. However, the emergent nature of this condition, often occurring at times when relevant expertise is sparse makes this exceedingly difficult to achieve. We believe that machine learning can rapidly facilitate data extraction and review in such situations freeing practitioners to concentrate on treatment delivery in this emergency setting. Machine learning models have begun to be utilized both in interpretation of imaging findings as well as in prognostication and risk-stratification of patients based on clinical profiles. We hope to move forward based on these. Interpretation of CT studies in aortic dissections is time-intensive often needing detailed measurements and annotation and slice-by-slice review for critical features and we hope to build a model to rapidly perform these tasks. Further, we hope to combine this information with clinical parameters to provide concise data extraction and prognostication to guide surgical decision making. Currently, our model is being trained to analyze CT-Scans with preliminary results indicating success, however larger data sets are required for rigorous testing and statistical analysis.

To our knowledge, no machine learning model exists which can annotate and extract data from CT studies for complex vascular conditions like aortic dissections. We are unaware of any models that can combine imaging and clinical data for risk stratification of such patients. This will be a first-ever model to address complex surgical patient cohorts in emergency settings and could be adapted to a variety of disease states. Such datasets are available to select academic institutions and relevant all-round expertise is only available in select teams. This project will open avenues for future research, moving even closer to personalized medicine.