Cardiovascular Imaging and Artificial Intelligence

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Cardiovascular disease remains the leading cause of death worldwide. With the advancement of new technology, multiple applications and models for artificial intelligence (AI) are being proposed and developed, particularly in the field of cardiovascular imaging. This is in fact important in order to minimize human error and increase diagnostic accuracy.

Application of AI to cardiovascular imaging modalities include echocardiography, cardiovascular computed tomography, magnetic resonance imaging and positron emission tomography. However, the processes involved in implementing AI in cardiovascular imaging are highly diverse, varying by imaging modality, patient subtype, features to be extracted and analyzed, and clinical application. For instance, many softwares have been proposed for the automatic analysis of one disease subtype, such as valvular heart disease. With the emerging technology, many sophisticated softwares have been developed in order to broaden the spectrum of automated analysis, especially in ventricular volumes and dimensions as well as valve regurgitation quantification and prosthetic devices sizing.

At Clemenceau Medical Center (CMC) Affiliated with Johns Hopkins International, AI is gaining attention as a unique platform for patient service in the region. Providing quality of care to the community is one of the missions lead by CMC. From an institutional perspective, the mission is to identify the activities in which AI might produce the greatest incremental value creation. The various perspectives that are taken into consideration help the imaging cardiologist, adds value to the clinicians, improve diagnosis, and guide management. Nevertheless, integrating the perspectives of all health care stakeholders is critical for creating value and ensuring the successful deployment of AI tools in a real-world setting.

In echocardiography, automated methods to measure left (LV) and right ventricular (RV) dimensions and functions is now implemented in the routine postprocessing analysis. Transaortic flow and 4D cardiac output, as well as 2D and 4D LV deformation using speckle tracking have become essential measurements in our daily practice. This new technology allows the echocardiographer to create a robust report based on accurate measurements provided by the EchoPAC software.

In cardiovascular computed tomography, the RevolutionApex scanner developed by GE Healthcare is a true revolution in its field. With a single beat acquisition, radiation exposure and patient preparation time are significantly reduced. The image quality of the scan is improved, and post processing analysis has become easier. For example, vessels automatic tracking has become more "intelligent" in defining the appropriate coronary artery tree, and the origin and course of each coronary artery. Interpretation of coronary stents is also made more feasible, as the spatial resolution is improved with the advancement of spectral imaging that is able to depict small abnormalities.

In cardiovascular magnetic resonance imaging, the circle: cardiovascular imaging software (CVI42) has become a useful tool for best measuring LV and RV volumes and functions. The implemented AI tool allows accurate quantification with significant reduction in analysis time. For instance, manual tracing of LV and RV contours may take 15 minutes on average. With AI, full contouring is made with less than one minute. This is significant as it reduces the time spent in writing and reporting. Also with AI, calculation of scar burden has become more reliable by including different standard deviations in the calculation of essential fibrosis, which varies and depends on the underlying pathology. Last but not the least, flow quantification using AI is providing accurate information on disease severity, thus allowing to reject aliasing and to track the appropriate flow. This is in fact a game changer in the patient's management as it defines prognosis and interferes in the clinical decision making.

CMC strives for excellence. In the field of cardiovascular imaging, CMC is a leader in diagnosis and management. The quality provided depends on the new clinical models and applications installed and on the expertise of the imaging cardiologist.