Artificial Intelligence and Heart Failure

Authors: Evan Kimber, EMJ, London, UK

Citation: EMJ Cardiol. 2023;11[1]:24-26. DOI/10.33590/emjcardiol/10303109. https://doi.org/10.33590/emjcardiol/10303109.

ADOPTING a forward-thinking mindset, Olav Wendelboe Nielsen, Copenhagen University Hospital, Denmark, and Robyn Anne Clark, Flinders University, Adelaide, Australia, welcomed delegates to a futuristic session, focusing on the increasing role that artificial intelligence (AI) is playing in the cardiology specialty. This symposium was one of the highlights from the European Society of Cardiology (ESC) Congress 2023, which took place in Amsterdam, the Netherlands, between 25th–28th August.

SCREENING FOR CARDIAC DYSFUNCTION

To emphasise the importance of this topic, Oguz Akbilgic, Wake Forest School of Medicine, Winston-Salem, North Carolina, USA, stated that cardiovascular disease is the leading cause of death worldwide. Advances in treating other diseases have led to a higher risk of death from cardiovascular sources in older patients, with ischaemic heart disease alone being responsible for 16% of all deaths. Akbilgic continued by focusing on screening, and more specifically, targeting the asymptomatic patients early enough in the cardiovascular disease process, which develops in severity over time. Akbilgic highlighted the lack of population screening at present, bringing to attention the high treatment and hospitalisation costs associated with beginning intervention when symptoms arrive, persist, and worsen. Talking about the healthcare system in the USA, Akbilgic stated: "We have spent a lot of money treating heart failure, but not a lot preventing it."

> "We have spent a lot of money treating heart failure, but not a lot preventing it."

Discussing electrocardiographic AI, Akbilgic spoke about the remote applications, growing literature support, and ease in combining AI with ECG. The methodological approaches to applying this involve machine learning, feature engineering, and deep learning being employed to build on a conventional electrocardiography, with initiatives such as decision trees and symbolic pattern recognition. The goal of the research, which Akbilgic is involved in, is to screen large patient populations at the asymptomatic stage, identifying those at risk and in early stages of the disease. Akbilgic gave a quick run-through of the ECG-AIR app, which is a pioneer remote AI platform that enables retrieval and analysis of digital smartwatch electrocardiography for cardiovascular disease detection and prediction, and presents a first-look at the future of this field. Akbilgic acknowledged some of the minor teething points, as well as the next steps in this research, and finished by listing the opportunities electrocardiographic AI provides as a low-cost, accessible, and remote initiative, with the ability to assist with timely risk detection for cardiovascular disease.

ARTIFICIAL INTELLIGENCE-ENHANCED IMAGING FOR DIAGNOSIS AND MONITORING

Sandy Engelhardt, University Hospital Heidelberg, Germany, delivered an insightful segment informing on how AI can be utilised to create knowledge from image data and support

targeted therapies, building on important measures such as ejection fraction. Engelhardt presented a novel approach that estimates cardiac motion, using MRI to identify and label contractile and relaxative motions, and an algorithm that identifies five different phases in the cardiac cycle. This algorithm employs self-supervised motion modelling estimates, and uses vector fields between timestamps to classify motion patterns and detect cardiac phases based on these rather than blood pool volumes.

> **"The words "the data stays, but the algorithm travels," nicely summarise this initiative."**

Comparing this self-supervised approach with segmentation-based methods, Engelhardt praised the accuracy and drew attention to areas where AI-enhanced imaging outperformed the traditional technique. "This gives us, from a technical point of view, a lot of confidence in the motion curves we estimate," was Engelhardt's summary of the findings they presented. Engelhardt went on to demonstrate the direct usefulness of this method for clinicians in estimating characteristic curves for different pathologies, such as myocardial infarction or abnormal right ventricle, and in allowing comparison of these against healthy subjects. Engelhardt concluded by spotlighting the requirement of reproducible data and expansion onto a larger scale and into multiple centres. In order to take this work further, and allow the algorithm to develop, a federated learning infrastructure is being rolled out. The words "the data stays, but the algorithm travels," nicely summarise this initiative, as it aims to scale up the research but preserve privacy with cross-institutional co-operation.

IMPROVING OUTCOMES

Delivering their part of this fascinating symposium, discussing the lens of a cardiologist who is an expert in heart failure and not computational science, Harriette Van Spall, McMaster University, Hamilton, Canada, addressed the audience on the applications of AI in analysing the clinical outcomes of heart failure. Van Spall focused on machine learning algorithms, noting the separation between supervised and unsupervised machine learning brackets when identifying patterns and relationships, utilising either labelled or unlabelled datasets.

Detailing positive applications, Van Spall explained how machine learning allows for early diagnoses of left ventricle dysfunction, guides the interpretation of diagnostic data, and helps with classification of phenotypes, as well as aiding the labelling of disease stage and severity. Moreover, machine learning is useful in predicting

clinical events, and according to Van Spall, unlocks several possibilities for tailoring care in precision medicine to specific groups of patients. There are also numerous benefits for drug development and the enrichment of clinical trials, such as facilitating more precise populations who are less likely to experience adverse events via methods of remote recruitment. Van Spall underscored this exciting section nicely, by stating: "AI provides the potential for powerful answers, and ways in which we can analyse complex data."

Drawing attention to limitations in this field, Van Spall addressed the absence of actionable solutions involving the use of AI in heart failure. They highlighted how helpful these mechanisms are in communicating outcomes and risks to patients, but what remains unknown is which therapies will improve these outcomes. Furthermore, data privacy and cloud computing offer challenges to the future of this branch of medicine, not to mention the lack of prospective studies. However, there are numerous possibilities that AI offers for drug development, in particular facilitating production, efficiency, implementation through clinical trial monitoring, and automated manufacturing. Van Spall concluded by comparing knowledge gaps with the great potential AI offers the field of heart failure.

FROM SCREENING TO TREATMENT

Muthiah Vaduganathan, Brigham and Women's Hospital, Harvard Medical School, Boston, USA, urged clinicians to think critically about the ways in which they can implement AI into their decision-making, in order to improve efficiency in their own practice. One important question that arose during this session was: "Where does the use of AI fit in the new published guidelines?" Clark encouraged attendees to "go and make some noise" in order to address this uncertainty.

> **"AI provides the potential for powerful answers, and ways in which we can analyse complex data."**

Bringing home all the aspects mentioned, the importance of asking the right questions of AI and enhancing the human aspects involved were emphasised. As we step into a new age that incorporates AI in cardiology, selecting the right model to deploy, whether this is applied to diagnosis or treatment, and understanding the overlap between these new methods and traditional statistical modelling is more important than ever before.