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Artificial intelligence: the stairway to better medicine?

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Artificial intelligence in science

Artificial intelligence (AI) is centre stage in many scientific fields. PubMed lists an impressive number of publications on the topic; as of end of May, 397,379 articles just in medicine. Many of us may remember that in 1997 the then world chess champion, Garry Kasparov, lost the second game against IBM's supercomputer *Deep Blue*. That a machine was smarter and faster than the world chess champion was a turning point. However, AI is a black box that we do not fully understand, even those working with it. Specifically, unsupervised deep learning leaves us out of the box unable to precisely understand what exactly the computer does. Nevertheless, AI provides impressive algorithms for physicians, including those working in cardiovascular medicine, which, if confirmed in independent large datasets, may be clinically useful.

To address this expanding topic, Alex Lyon, Thomas F. Lüscher, both from the Royal Brompton and Harefield Hospitals and Imperial College, and Alan Maisel from the University of San Diego, organised at the end of May 2021 the first meeting in cardiovascular medicine focusing on AI (figs 1 and 2).

Artificial intelligence in medicine

In clinical medicine, we wish to address the following issues in our everyday practice: (1) to identify those at risk of acquiring a given disease when still healthy; (2) to diagnose a disease as the patient develops signs and symptoms; (3) to understand the natural history of a given disease; and (4) optimal prevention and management.

In all these areas, AI and machine learning are able to provide valuable algorithms to help physicians in their practice, particularly in cardiovascular medicine. Indeed, the risk of acquiring a given disease can today be predicted with unforeseen precision using genetics, biomarkers, imaging and other parameters. For instance, using coronary computer angiography, Charalambos Antoniades from Oxford showed that through AI, clinical events can be predicted before symptoms have arisen on the basis of fat attenuation around the inflamed coronary arteries [1–3]. Similarly, Paul Friedman, using ECG information based on the vector electrocardiogram, is able to determine whether a given patient has had episodes of atrial fibrillation beforehand, even if the current ECG reveals sinus rhythm (fig. 2) [4, 5]. Similarly, the Mayo team showed that, based on a few beats of a random ECG, their AI algorithm can determine whether the left ventricular ejection fraction is normal or reduced in a given patient and their probability of having aortic stenosis [6]. Thus, AI is not only faster than humans, and cardiologists in particular, but also sees signals of value for clinical assessment that our eyes or brain do not pick up.

Artificial intelligence and big data

AI and machine learning are able to process an enormous number of variables. Indeed, this is a true problem for physicians working in the modern era. For instance, as Lars Wallentin from Uppsala pointed out, an increasing number of biomarkers are available and for most physicians it is difficult to integrate them into a global picture to assess a patient and the outcomes [7]. Again, the overwhelming amount of data from uncountable trials and those assessed during evaluation of an individual patient have to come together for precise risk prediction and appropriate management, a challenge that can only be addressed using this technology.

Cardiovascular medicine lends itself particularly well to the use of machine learning, not only because of the vast amount of clinical data, biomarkers and biochemical data, but also because of the intense use of different imaging modalities. The latter aspect was discussed by Paul Leeson from Oxford, who outlined the enormous potential of AI in the interpretation of echo data in general [8, 9]. This was further exemplified by Jeroen J. Bax from Leiden, the Netherlands, in valvular heart disease. Again, here AI is not only faster, but also is able to pick up findings that escape the human eye [10].

Artificial Intelligence 21 – the first of a series

The *Artificial Intelligence in Cardiovascular Medicine 21* conference aimed to bring an outstanding faculty together to discuss the use and limitations of AI for the epidemiology, diagnosis and management of patients with cardiac disease. Besides the enormous potential of this technology for clinical practice, the speakers and panellists also evaluated the downsides and the quality standards required. In

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particular, it was mentioned by many faculty members that external, independent validation of any results obtained in a given registry or database using this approach is mandatory to confirm the accuracy and usefulness of a developed algorithm [11]. Few studies provide externally validated results or have compared the performance of their deep learning algorithms with healthcare professionals using the same dataset. To be of use in practice, any algorithm ideally should be better than an experienced clinician. Additionally, poor reporting has been noted in such registries, which limits the reliability and accuracy of such studies and algorithms derived thereof. Thus, proper re-

Figure 1: : The meeting *Artifical Intelligence in Cardiovascular Disease 21* in London.

porting standards that address these issues of deep learning are urgently required.

The *Artificial Intelligence in Cardiovascular Medicine 21* Conference was a hybrid meeting with a low number of onsite participants because of the remaining fear of COVID-19 and in particular the recently evolved Delta variant. However, there were a substantial number of participants from all over the world. It is hoped that this meeting will become a yearly tradition, hopefully face-to-face in the future, and we are looking forward to welcoming an increasing number of physicians who realise the importance and usefulness of this approach for research and clinical practice.

Importantly, as Eric Topol pointed out, AI will not replace physicians (with the possible exception of radiologists…) [12], but will become any doctor's little helper, accelerating any diagnostic work and decision making, and thereby allowing more time for the patient and their questions and fears. Thus AI, in the end, will be patient-centred if properly applied as suggested by the faculty at the meeting.

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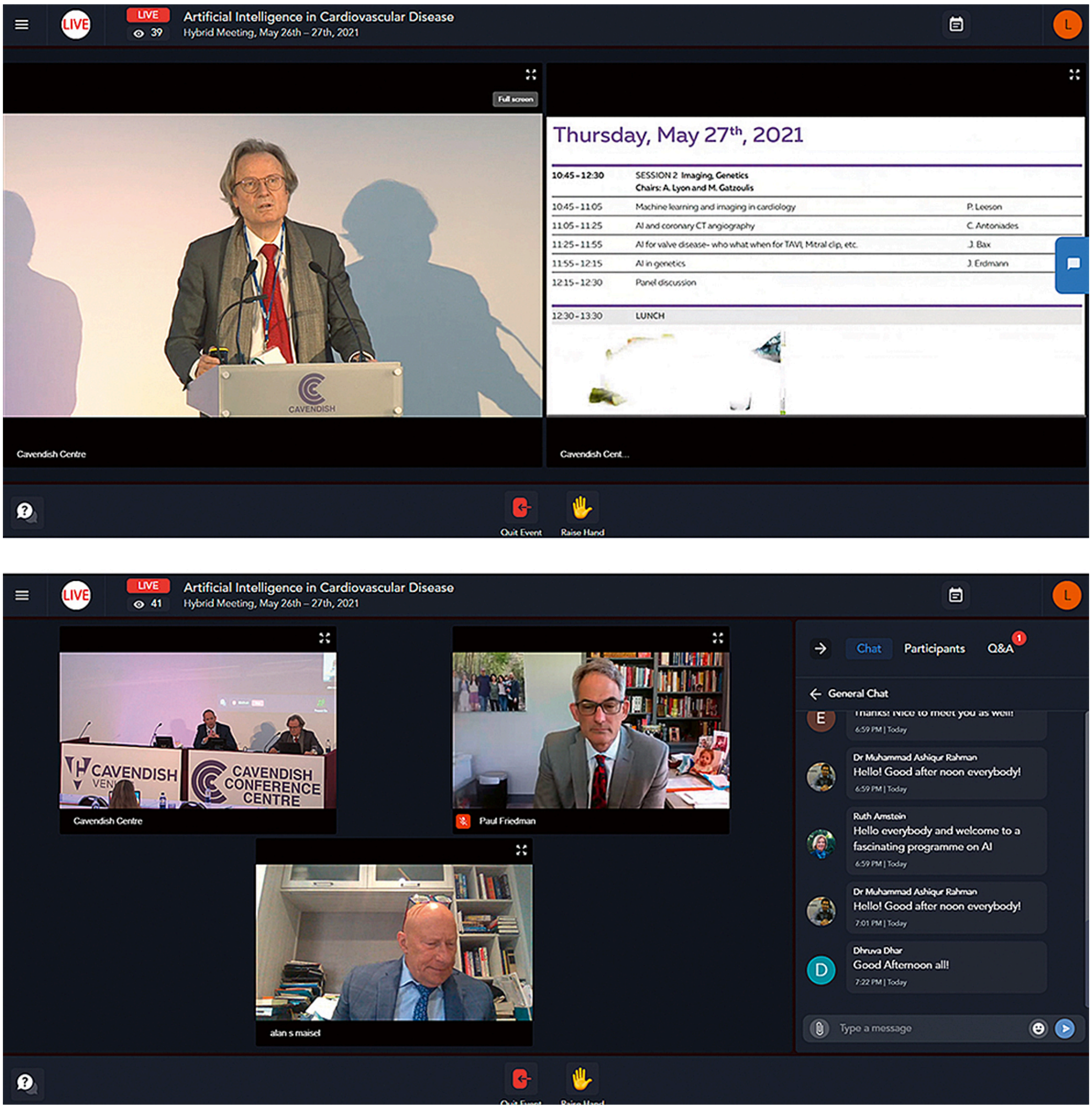
Figure 2: : Thomas F. Lüscher opening the *Artificial Intelligence in Cardiovascular Medicine 21* meeting in London (top) and key-note speakers Paul Friedman from the Mayo Clinic in Rochester, Minnesota (inset top right) and Alan Maisel from San Diego (inset below), both joining virtually at this hybrid meeting.



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