Insights into the Potential Role of Artificial Intelligence in Diagnosis of Heart Failure

Pooja Chowdary Yerram[1]

1. Department of Medicine, Katuri Medical College and Hospital, Guntur, India.*

Dear Editor,

Globally, cardiovascular diseases (CVDs), particularly heart failure, are the leading cause of death and disease.[1,2] One of every five individuals fosters cardiovascular breakdown (HF).[3] Heart failure is very common, with a death rate of 10.4% at 30 days, 22% at 1 year, and 42.3% at 5 years after hospitalisation. In 5 years, 50% of HF patients pass away.[1,3,4] Accurate diagnosis of heart failure can be difficult, even for HF specialists, because it is a complex syndrome that can arise from both structural and functional cardiac disorders rather than a single disease entity.[2,5] HF is linked to high rates of recurrence, mortality, and cost burden in addition to poor patient outcomes.[1]

Based on its ejection fraction, HF is currently separated into three groups: HF with a mid-range ejection fraction (HFmrEF), HF with a preserved ejection fraction (HFpEF), and HF with a reduced ejection fraction (HFrEF).[7] Before beginning the appropriate treatment, a correct diagnosis is required.[5,6] Physicians nowadays face additional challenges due to the intricacy of HF management guidelines, especially in outpatient clinics, and the rapidly evolving body of scientific evidence.[2] Artificial intelligence (AI) is becoming increasingly important in cardiology as a result of significant advancements in information and communication technologies, such as the ease with which big data and knowledge can be stored, acquired, and recovered.[5,7]

The popular, nontechnical term "artificial intelligence" (AI) refers to various forms of machine learning, most frequently deep neural networks. This area of computer science research focuses on creating intelligent agents that know how to behave optimally in specific scenarios.[2] It makes use of computational algorithms to simulate and carry out activities like problem-solving and learning that typically call for human intelligence.[1] Artificial intelligence necessitates close collaboration between computer scientists, clinicians and clinical investigators, and other users in order to identify the most important challenges that need to be solved.[5]

Cardiology is at the forefront of AI in the niche of medicine [1]

AI integration has transformed clinical care, outcome prediction, risk assessment, diagnostic modalities, and heart failure (HF) medication development.[1,3] AI in cardiology has a bright future as long as researchers and clinicians continue to work together superbly.[6] Artificial intelligence uses tools like Machine Learning and its subtype Deep Learning to carry out human intelligence-dependent tasks. Determining the best course of action for HF patients in terms of medication and surgery requires early detection of heart failure. This has been made possible by the development of the neural network (NN) as their model, whose accuracy of 85 percent has been shown.[6]

A collection of machine learning models for HF diagnosis and outcome prediction have been created using a variety of factors obtained from EHR data, such as demographic, medical note, laboratory, and image data.[4] These models have produced results that are expert-comparable for prediction. AI models are capable of utilising both the ID and precise patient-explicit assessment of heart failure patients' risk of readmission and death.[4] Furthermore, innovative AI techniques for resolving disparate data and enhancing the predictive accuracy of models in unbalanced informational indices are essential for further development of these encouraging demonstrating approaches.[5]

Submitted 24-06-2023 Accepted 1-08-2023 Published 17-08-2023

Access this Article Online

Scan this QR Code

https://doi.org/10.25259/GJMS.2022.v2i3.91

Corresponding author:

Dr. Pooja Chowdary Yerram, Department of Medicine, Katuri Medical College and Hospital, Guntur, India.
Email ID: poojayerram2029@gmail.com

Because AI is still in its infancy, the tools that have been developed will undoubtedly improve over time to help doctors determine whether a patient has a cardiac condition or a problem with how their heart works. Most patients approach the specialist when they have side effects like heaviness in the chest or trouble in breathing - computer based intelligence will analyse heart conditions before the side effects begin provoking early treatment according to study. Researchers found that clinicians were twice as likely to correctly diagnose low ejection fraction (EF), a sign that the heart isn't functioning as it should, when they followed the advice of an artificial intelligence (AI) tool.[8]

Nearly every aspect of human life is poised to be affected by artificial intelligence and machine learning, and cardiology is no exception. What is the need for artificial intelligence in cardiology? Algorithms created by AI typically predict and classify with greater accuracy. Therefore, cardiovascular medicine can benefit from the application of AI and machine learning.

Artificial Intelligence (AI) has the potential to significantly improve analysis of raw image data from cardiac imaging techniques (echocardiography, computed tomography, cardiac MRI, etc.) and electrocardiogram recordings by integrating an algorithm.[1] Optimising outcomes for cardiovascular disease has relied heavily on AI's ability of early detection of future mortality and destabilisation events.[4]

AI has significantly altered the field of HF diagnosis in recent years..[6] One example is the use of AI-CDSS for diagnosing heart failure. The AI-CDSS, or Artificial Intelligence-Clinical Decision Support System, provides the potential to help physicians diagnose heart failure.[2] Physicians can use CDSS, a health-informed technology, to make clinical decisions. The development of AI-CDSS for cardiology utilized a hybrid method of knowledge acquisition—expert-driven and machine-learning-driven—in order to expand the knowledge base regarding heart failure diagnosis.[5]

97 patients with dyspnea participated in a prospective clinical pilot study that compared the diagnostic accuracy of AI-CDSS to that of non-heart failure specialists. 97 patients with dyspnea participated in a prospective clinical pilot study that compared the diagnostic accuracy of AI-CDSS to that of non-heart failure specialists.[2] Examined was the concordance rate between heart failure specialists and AI-CDSS. The test dataset had a concordance rate of 98.3% in the retrospective cohort.[5] Finally, AI-CDSS demonstrated a high level of diagnostic accuracy for heart failure..[2] Hence, when heart failure specialists are unavailable, AI-CDSS may be helpful in diagnosing the condition.[5]

The demands for improved care and the need to translate the most recent medical discoveries and knowledge into an actionable plan make clinical decision-making for cardiologists difficult..[2] Therefore, it is crucial to connect AI models and clinical practitioners through hybrid expert and ML-driven systems like the AI-CDSS in order to produce more accurate results.[1]

AI systems have the potential to revolutionise accurate diagnosis and prediction of decompensation and mortality in heart failure patients, even though they cannot possibly replace a human brain's expertise. [5] AI best practices include selecting the best data sources, accounting for common difficulties in interpreting, validating, and generalising findings, and addressing ethical and safety concerns prior to final implementation..[2]

However, the medical field was probably the latest to adopt AI into daily operations. The potential of AI in future cardiology is demonstrated by the development of AI methods for the precise prediction of outcomes in patients with heart failure (HF). With the promotion of precision medicine and advancements of AI, these cutting-edge digital technologies will play a major role in the field of cardiology in the future.[2] However, there are still moral conundrums surrounding the application of AI technology in the real world that need to be resolved.

AI has the potential to fill in any clinical experience gaps and is poised to revolutionise medicine. This can be very helpful in primary care when it comes to promoting prompt treatment, early detection, and proper referral procedures. It is obvious that those who are able to employ AI effectively can improve patient care and increase diagnostic precision.

Although AI can interpret large databases more effectively than the human brain can, it has the potential to revolutionize medical diagnosis, treatment, risk prediction, clinical care, and drug discovery. However, the healthcare system does not support AI, and there is a shortage of qualified clinicians who can use AI models in clinical decision-making and patient monitoring.[3,6]

AI training is recommended for experts treating heart failure patients in the post-COVID-19 era, when hospitals will be overloaded with heart failure-related hospitalizations. This will enable AI-dependent medicine to operate more efficiently and deliver timely, correct diagnoses.[1,6]

END NOTE

Author Information

1. Pooja Chowdary Yerram
   Department of Medicine, Katuri Medical College and Hospital, Guntur, India.
   Email ID: poojayerram2029@gmail.com

Declaration of Conflicting Interests: The author has declared no potential conflicts of interest related to the research, writing and/or publication of this article.

Funding: For the purpose of conducting the research, writing, and/or publishing this paper, the author received no funding.

REFERENCES

1. Karatzia L, Aung N, Aksentijevic D. Artificial intelligence in cardiology: Hope for the future and power for the present. Front Cardiovasc Med. 2022 Oct 13;9:945726. doi: 10.3389/fcvm.2022.945726. PMID: 36312266; PMCID: PMC9608631.
2. Johnson KW, Torres Soto J, Glicksberg BS, Shameer K, Miotto R, Ali M, Ashley E, Dudley JT. Artificial Intelligence in Cardiology. J Am Coll Cardiol. 2018 Jun 12;71(23):2668-2679. doi: 10.1016/j.jacc.2018.03.521. PMID: 29880128.
3. Lopez-Jimenez F, Attia Z, Arruda-Olson AM, Carter R, Chareonthaitawee P, Jouni H, Kapa S, Lerman A, Luong C, Medina-Inojosa JR, Noseworthy PA, Pellikka PA, Redfield MM, Roger VL, Sandhu GS, Senecal C, Friedman PA. Artificial Intelligence in Cardiology: Present and Future. Mayo Clin Proc. 2020 May;95(5):1015-1039. doi: 10.1016/j.mayocp.2020.01.038. PMID: 32370835.
4. Gupta MD, Kunal S, Girish MP, Gupta A, Yadav R. Artificial intelligence in cardiology: The past, present and future. Indian Heart J. 2022 Jul-Aug;74(4):265-269. doi: 10.1016/j.ihj.2022.07.004. Epub 2022 Jul 30. PMID: 35917970; PMCID: PMC9453051.
5. Yasmin F, Shah SMI, Naeem A, Shujauddin SM, Jabeen A, Kazmi S, Siddiqui SA, Kumar P, Salman S, Hassan SA, Dasari C, Choudhry AS, Mustafa A, Chawla S, Lak HM. Artificial intelligence in the diagnosis and detection of heart failure: the past, present, and future. Rev Cardiovasc Med. 2021 Dec 22;22(4):1095-1113. doi: 10.31083/j.rcm2204121. PMID: 34957756.
6. Ski CF, Thompson DR, Brunner-La Rocca HP. Putting AI at the centre of heart failure care. ESC Heart Fail. 2020 Oct;7(5):3257-3258. doi: 10.1002/ehf2.12813. Epub 2020 Jun 17. PMID: 32558251; PMCID: PMC7524229.
7. Sabouri M, Rajabi AB, Hajianfar G, Gharibi O, Mohebi M, Avval AH, Naderi N, Shiri I. Machine learning based readmission and mortality prediction in heart failure patients. Sci Rep. 2023 Oct 31;13(1):18671. doi: 10.1038/s41598-023-45925-3. PMID: 37907666; PMCID: PMC10618467.