World Journal of Clinical Cases

Submit a Manuscript: https://www.f6publishing.com

World J Clin Cases 2024 August 16; 12(23): 5304-5307

DOI: 10.12998/wjcc.v12.i23.5304

ISSN 2307-8960 (online)

EDITORIAL

Application of artificial intelligence in the diagnosis and treatment of Kawasaki disease

Yan Pan, Fu-Yong Jiao

Specialty type: Medicine, research and experimental

Provenance and peer review: Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's classification

Scientific Quality: Grade C

Novelty: Grade B

Creativity or Innovation: Grade C

Scientific Significance: Grade C

P-Reviewer: Singh A

Received: April 11, 2024

Revised: May 15, 2024

Accepted: June 4, 2024

Published online: August 16, 2024

Processing time: 84 Days and 17.2 Hours

Yan Pan, Department of Pediatrics, The First Affiliated Hospital of Yangtze University, Jingzhou 434000, Hubei Province, China

Fu-Yong Jiao, Shaanxi Kawasaki Disease Diagnosis and Treatment Center, Shaanxi Provincial People's Hospital, Xi'an 710000, Shaanxi Province, China

Corresponding author: Fu-Yong Jiao, MD, Research Scientist, Shaanxi Kawasaki Disease Diagnosis and Treatment Center, Shaanxi Provincial People's Hospital, No. 256 West Youyi Road, Xi'an 710000, Shaanxi Province, China. 3105089948@qq.com

Abstract

This editorial provides commentary on an article titled "Potential and limitations of ChatGPT and generative artificial intelligence (AI) in medical safety education" recently published in the *World Journal of Clinical Cases*. AI has enormous potential for various applications in the field of Kawasaki disease (KD). One is machine learning (ML) to assist in the diagnosis of KD, and clinical prediction models have been constructed worldwide using ML; the second is using a gene signal calculation toolbox to identify KD, which can be used to monitor key clinical features and laboratory parameters of disease severity; and the third is using deep learning (DL) to assist in cardiac ultrasound detection. The performance of the DL algorithm is similar to that of experienced cardiac experts in detecting coronary artery lesions to promoting the diagnosis of KD. To effectively utilize AI in the diagnosis and treatment process of KD, it is crucial to improve the accuracy of AI decision-making using more medical data, while addressing issues related to patient personal information protection and AI decision-making responsibility. AI progress is expected to provide patients with accurate and effective medical services that will positively impact the diagnosis and treatment of KD in the future.

Key Words: Artificial intelligence; Kawasaki disease; Diagnosis; Prediction; Image

Core Tip: Artificial intelligence (AI) holds transformative potential in the diagnosis and treatment of Kawasaki Disease (KD). Utilizing machine learning algorithms, AI can analyze complex biomarkers to enhance diagnostic accuracy. Gene signal calculation tools can differentiate KD from similar inflammatory conditions, while deep learning algorithms can improve the precision of cardiac ultrasound detection. However, successful integration of AI into clinical practice requires addressing challenges such as data privacy, ethical considerations, and the need for robust, diverse datasets to ensure the reliability and accountability of AI systems.

Citation: Pan Y, Jiao FY. Application of artificial intelligence in the diagnosis and treatment of Kawasaki disease. *World J Clin Cases* 2024; 12(23): 5304-5307
URL: https://www.wjgnet.com/2307-8960/full/v12/i23/5304.htm
DOI: https://dx.doi.org/10.12998/wjcc.v12.i23.5304

INTRODUCTION

Artificial intelligence (AI) is a sophisticated computational system that transcends the mere execution of pre-programmed instructions. AI systems possess the capacity to autonomously acquire knowledge from diverse datasets and make independent decisions. The pervasive utilization of the internet has facilitated the digitization of a vast array of resources. Moreover, the rise in smartphone usage and the growth of the "Internet of Things" have resulted in the quick gathering of information from people and electronic gadgets, which has contributed to the expansion of big data. Additionally, improvements in computer processing speeds have made it possible to analyze and handle large sets of data, which has enabled the creation of AI algorithms using vast amounts of data. This not only surpasses the limitations of conventional data analysis methods, but also has the ability to identify subtle data patterns that may elude human analysis, resulting in novel insights.

The rapid advancement of AI technology has ushered in a new era where its application is pervasive in various aspects of everyday life and business; it is widely used in various industries, such as commerce, weather prediction, and transportation, as well as in the medical field for tasks, such as automatic analysis of lung X-rays, bone age measurement, fracture diagnosis, and cancer diagnosis and treatment. While the healthcare sector is still in the early stages of incorporating AI technology compared to other industries, there is growing momentum for its development, and it is anticipated that AI will continue to expand across various fields in the future[1].

Kawasaki disease (KD), a systemic vasculitis with an unclear etiology, is the primary cause of acquired heart disease in developed countries[2]. The possibility of clinical similarities between KD and other conditions may lead to both KD being missed and misdiagnosed. Healthcare providers and scientists are currently focused on improving the accuracy and effectiveness of diagnosing KD. In this regard, AI is anticipated to serve as a valuable supplementary tool that has the potential to revolutionize KD management in practical clinical environments. This study presents several examples of how AI can be utilized in the realm of KD.

POTENTIAL APPLICATIONS OF AI IN THE FIELD OF KD

Using machine learning to assist in KD diagnosis

Machine learning (ML) is a branch of AI. The calculation method can acquire knowledge and predictions without relying on complex coding[3]. Portman *et al*[4] developed a blood biomarker group with high sensitivity and specificity for identifying children with KD. Blood samples were obtained from a single-center cohort of children with KD (n = 50) and control children (n = 100), and 11 candidates were selected to develop biomarkers according to the principle of clinical availability. ML was used to identify the 11 blood markers. The values for these markers were included in the model. The model provided a binary predictive risk score for KD as determined by the Youden index. The area under the final receiver operating characteristic curve (AUC) was 0.94 (95%CI: 0.90–0.98). Of the 97 non-KD patients 88 were diagnosed as negative, and of the 50 KD-positive patients 47 were diagnosed as positive. The sensitivity was 0.94 (95%CI: 0.87–1.0), and the specificity was 0.91 (95%CI: 0.85–0.96). When the biomarkers were reduced to three, C-reactive protein, NT prob-type natriuretic peptide, and thyroid hormone, the AUC of the prediction model was 0.92 (95%CI: 0.87–0.96), and the sensitivity and specificity were 86%. However, the generalizability of the research results is limited by its single-center design, small cohort size, and potential deviation from the control group[4]. Liu *et al*[5] conducted a retrospective study in China on 1398 KD patients hospitalized in seven hospitals affiliated with Chongqing Medical University from January 2015 to August 2020, and a prediction model was built based on the ML algorithm. A total of 1240 of the 1398 patients responded to intravenous immunoglobulin G (IVIG), while 158 were resistant to IVIG. According to the results of the logistic regression analysis of the training set, four independent risk factors were identified: total bilirubin [odds ratio (OR) = 1.115, 95%CI: 1.067–1.165], procalcitonin (OR = 1.511, 95%CI: 1.270–1.798), alanine aminotransferase (OR = 1.013, 95%CI: 1.008–1.018) and platelet count (OR = 0.998, 95%CI: 0.996–1). Using the ML algorithm to construct the KD prediction model, the model performed well in terms of sensitivity, specificity, and AUC. The results of this study can help clinicians predict IVIG-resistant KD early and adjust treatment plans over time[5]. Wang *et al*[6] retrospectively collected the medical records of KD patients hospitalized at Fujian Maternal and Child Health Hospital from March 2013 to June 2019 using the electronic medical record system. The results showed that platelet count, blood calcium level, albumin-to-globulin ratio, days of fever before hospitalization, and body weight were predictive factors for IVIG-resistant KD. The AUC of this model was 0.74 (95%CI: 0.87–0.96), the sensitivity was 30%, and the specificity was 99%[6]. A retrospective cross-sectional study can assist ML study, but because the patient's condition is constantly changing, there may be some errors in judging from a single cross-sectional study.

Using the gene signal calculation toolbox to assist in identifying KD

Ghosh *et al*[7] used the gene signal calculation toolbox (two types of gene signals developed in the context of a new coronal pneumonia infection, VIP/SVIP signal) to compare children with multiple system inflammatory syndrome (MIS-C) and KD. Using VIP/SVIP signals and 13 transcriptional signals to diagnose KD, they verified that KD and MIS-C were on the same host immune response continuum and that both were concentrated in the cytokine storm centered on IL15/IL15RA, indicating that there was a common immune pathogenesis between the two factors. However, they differed in other laboratory parameters (left ventricular ejection fraction, C-reactive protein, white blood cell count, and lymphocyte count) and cardiac phenotypes (cardiac function decline and coronary artery expansion). The VIP signal revealed the unique targeting cytokine pathway of MIS-c. SVIP signals indicated disease severity, and the signal in MIS-c was stronger than that in KD, indicating that the MIS-c condition was more serious than KD. Key clinical features (cardiac function decline) and laboratory parameters (thrombocytopenia and eosinophilia) can be used to monitor disease severity[7-9].

Using deep learning to assist cardiac ultrasound detection

The workload of medical image labeling and manual interpretation is large and primarily depends on the expertise of professional doctors. In addition, there are limitations, such as misdiagnosis, missed diagnosis, and time consumption. The recent and continuous development of AI and big data has made computer-aided diagnosis possible. Compared to the traditional inspection mode, deep learning (DL) does not require significant preprocessing or manual feature extraction. It can automatically extract features that are difficult for humans to distinguish without losing information and realize end-to-end learning. This shows great potential for complex recognition of subtle patterns. Because the contour of echocardiography is not clear and the speckle noise is large, traditional manual segmentation is time consuming and error prone; an automatic segmentation algorithm based on DL can solve this problem. Incomplete KD is often misdiagnosed because of the lack of clinical manifestations of typical KD[10]. However, it was also associated with a significantly higher prevalence of coronary artery disease. It is important to identify coronary artery lesions using echocardiography for timely diagnosis and a good prognosis of KD. They obtained coronary artery images of children through echocardiography (KD, n = 138; pneumonia, n = 65) and used the collected data to train six DL networks (vgg19, xception, resnet50, resnext50, Se resnet50, and Se resnext50). Se-resnext50 shows the best performance in terms of classification, specificity, and accuracy. The accuracy, sensitivity, and specificity of Se resnext50 were 81.12%, 84.06%, and 58.46%, respectively. Research results have shown that the DL algorithm performs similarly to experienced cardiologists in detecting coronary artery lesions to promote the diagnosis of KD[11]. DL can guide untrained novices in diagnosing cardiac ultrasound to assess the size, function, and pericardial effusion of the left and right ventricles[12]. It has great application value in remote areas where resources are scarce; however, its safety and stability still need to be further verified.

RISKS OF AI UTILIZATION

The primary obstacle hindering the clinical implementation of AI by clinicians is accountability. Controversies arise in assigning responsibility when the use of AI algorithms by pediatricians in clinical settings leads to misdiagnosis or unforeseen adverse reactions. The creation of AI algorithms involves multiple stakeholders, including clinical physicians, developers, data managers, and healthcare institutions. Therefore, it is crucial to determine the root causes of errors or defects and identify the specific timing and content of their occurrences to determine the responsibility when problems arise. Additionally, the need for a reproducibility assessment of the results generated from AI-driven studies is critical, especially in studies utilizing techniques such as DL on large datasets acquired across different institutions. This ensures that AI systems are not only effective, but also reliable and consistent across various clinical environments. Reproducibility assessments help validate the robustness of AI algorithms and their applicability to diverse patient populations and settings. Specifically, the development of AI systems requires access to large amounts of medical data. However, only essential data relevant to the intended purpose should be collected and utilized. Given the sensitivity of personal health information involved in AI development, obtaining appropriate legal authorization for data processing and ensuring that security measures are in place is essential.

CONCLUSION

This study explored the use of AI in the diagnosis of KD. In addition to the applications discussed in this study, AI has several other potential applications. Before the actual implementation, it is necessary to improve the efficacy of AI algorithms through the accumulation of data from different healthcare institutions for AI training. Furthermore, to effectively integrate AI into KD management, comprehensive guidelines must be established to address patient privacy concerns during the data collection process and the ethical and legal obligations associated with AI system decisions. It is expected that the real-world challenges associated with AI integration will gradually be addressed in the future. This will have a transformative impact on the treatment and delivery of medical services for patients with KD.

FOOTNOTES

Author contributions: Jiao FY designed the study; Pan Y edited the manuscript significantly; Pan Y reviewed literature and provided input in writing the paper.

Conflict-of-interest statement: There is no conflict of interest associated with any of the senior authors or other coauthors who contributed their efforts to this manuscript.

Country of origin: China

ORCID number: Yan Pan 0000-0003-0240-7085; Fu-Yong Jiao 0000-0002-8306-2543.

S-Editor: Liu H
L-Editor: Filipodia
P-Editor: Chen YX

REFERENCES

1 **Wang X**, Liu XQ. Potential and limitations of ChatGPT and generative artificial intelligence in medical safety education. *World J Clin Cases* 2023; **11**: 7935-7939 [PMID: 38073698 DOI: 10.12998/wjcc.v11.i32.7935]

2 **Jiao F**, Jindal AK, Pandiarajan V, Khubchandani R, Kamath N, Sabui T, Mondal R, Pal P, Singh S. The emergence of Kawasaki disease in India and China. *Glob Cardiol Sci Pract* 2017; **2017**: e201721 [PMID: 29564342 DOI: 10.21542/gcsp.2017.21]

3 **Kaul V**, Enslin S, Gross SA. History of artificial intelligence in medicine. *Gastrointest Endosc* 2020; **92**: 807-812 [PMID: 32565184 DOI: 10.1016/j.gie.2020.06.040]

4 **Portman MA**, Magaret CA, Barnes G, Peters C, Rao A, Rhyne R. An Artificial Intelligence Derived Blood Test to Diagnose Kawasaki Disease. *Hosp Pediatr* 2023; **13**: 201-210 [PMID: 36775804 DOI: 10.1542/hpeds.2022-006868]

5 **Liu J**, Zhang J, Huang H, Wang Y, Zhang Z, Ma Y, He X. A Machine Learning Model to Predict Intravenous Immunoglobulin-Resistant Kawasaki Disease Patients: A Retrospective Study Based on the Chongqing Population. *Front Pediatr* 2021; **9**: 756095 [PMID: 34820343 DOI: 10.3389/fped.2021.756095]

6 **Wang T**, Liu G, Lin H. A machine learning approach to predict intravenous immunoglobulin resistance in Kawasaki disease patients: A study based on a Southeast China population. *PLoS One* 2020; **15**: e0237321 [PMID: 32853226 DOI: 10.1371/journal.pone.0237321]

7 **Ghosh P**, Katkar GD, Shimizu C, Kim J, Khandelwal S, Tremoulet AH, Kanegaye JT; Pediatric Emergency Medicine Kawasaki Disease Research Group; Bocchini J, Das S, Burns JC, Sahoo D. An Artificial Intelligence-guided signature reveals the shared host immune response in MIS-C and Kawasaki disease. *Nat Commun* 2022; **13**: 2687 [PMID: 35577777 DOI: 10.1038/s41467-022-30357-w]

8 **Zhong H**, Lv X, Sun X, Jiao W. Progress in the Diagnosis and Treatment of Kawasaki Disease and Other Multi-system Inflammatory Syndromes by Artificial Intelligence. *IJTDH* 2023; **44**: 52-57 [DOI: 10.9734/ijtdh/2023/v44i51408]

9 **Zhong H**, Sun X, Lv X, Jiao W. Advances in the Co-Host Immune Response to Multisystem Inflammatory Syndrome and Kawasaki Disease in Children with AI-Guided Features. *IJTDH* 2023; **44**: 51-58 [DOI: 10.9734/ijtdh/2023/v44i61415]

10 **Zhong HP**, Zhang YQ, Jiao W. A Short Review of Coronary Artery Lesions in Children. *IJTDH* 2023; **44**: 1-8 [DOI: 10.9734/ijtdh/2023/v44i131447]

11 **Lee H**, Eun Y, Hwang JY, Eun LY. Explainable Deep Learning Algorithm for Distinguishing Incomplete Kawasaki Disease by Coronary Artery Lesions on Echocardiographic Imaging. 2021 Preprint [DOI: 10.2196/preprints.27053]

12 **Narang A**, Bae R, Hong H, Thomas Y, Surette S, Cadieu C, Chaudhry A, Martin RP, McCarthy PM, Rubenson DS, Goldstein S, Little SH, Lang RM, Weissman NJ, Thomas JD. Utility of a Deep-Learning Algorithm to Guide Novices to Acquire Echocardiograms for Limited Diagnostic Use. *JAMA Cardiol* 2021; **6**: 624-632 [PMID: 33599681 DOI: 10.1001/jamacardio.2021.0185]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: office@baishideng.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com