ISSN 2307-8960 (online)

World Journal of *Clinical Cases*

World J Clin Cases 2024 January 16; 12(2): 236-465

Published by Baishideng Publishing Group Inc

World Journal of Clinical Cases

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Editorial Board Member of *World Journal of Clinical Cases*, Xin Ye, MD, Professor, Department of Oncology, The First Affiliated Hospital of Shandong First Medical University, Jinan 250014, Shandong Province, China. yexintaian2020@163.com

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RESPONSIBLE EDITORS FOR THIS ISSUE

NAME OF JOURNAL
World Journal of Clinical Cases

ISSN
ISSN 2307-8960 (online)

LAUNCH DATE
April 16, 2013

FREQUENCY
Thrice Monthly

EDITORS-IN-CHIEF
Bao-Gan Peng, Salim Surani, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati

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PUBLICATION DATE
January 16, 2024

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World J Clin Cases 2024 January 16; 12(2): 236-239

DOI: 10.12998/wjcc.v12.i2.236

ISSN 2307-8960 (online)

EDITORIAL

Use of artificial intelligence in the field of pain medicine

Min Cheol Chang

Specialty type: Medicine, research and experimental

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

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): A
Grade B (Very good): B
Grade C (Good): C
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Chen Q, China; Wan XH, China

Received: November 7, 2023
Peer-review started: November 7, 2023
First decision: December 5, 2023
Revised: December 6, 2023
Accepted: December 21, 2023
Article in press: December 21, 2023
Published online: January 16, 2024

Min Cheol Chang, Department of Physical Medicine and Rehabilitation, College of Medicine, Yeungnam University, Daegu 705-717, South Korea

Corresponding author: Min Cheol Chang, MD, Professor, Department of Physical Medicine and Rehabilitation, College of Medicine, Yeungnam University, 317-1, Daemyungdong, Namku, Daegu 705-717, South Korea. wheel633@gmail.com

Abstract

In this editorial we comment on the article "Potential and limitations of ChatGPT and generative artificial intelligence in medial safety education" published in the recent issue of the *World Journal of Clinical Cases*. This article described the usefulness of artificial intelligence (AI) in medial safety education. Herein, we focus specifically on the use of AI in the field of pain medicine. AI technology has emerged as a powerful tool, and is expected to play an important role in the healthcare sector and significantly contribute to pain medicine as further developments are made. AI may have several applications in pain medicine. First, AI can assist in selecting testing methods to identify causes of pain and improve diagnostic accuracy. Entry of a patient's symptoms into the algorithm can prompt it to suggest necessary tests and possible diagnoses. Based on the latest medical information and recent research results, AI can support doctors in making accurate diagnoses and setting up an effective treatment plan. Second, AI assists in interpreting medical images. For neural and musculoskeletal disorders, imaging tests are of vital importance. AI can analyze a variety of imaging data, including that from radiography, computed tomography, and magnetic resonance imaging, to identify specific patterns, allowing quick and accurate image interpretation. Third, AI can predict the outcomes of pain treatments, contributing to setting up the optimal treatment plan. By predicting individual patient responses to treatment, AI algorithms can assist doctors in establishing a treatment plan tailored to each patient, further enhancing treatment effectiveness. For efficient utilization of AI in the pain medicine field, it is crucial to enhance the accuracy of AI decision-making by using more medical data, while issues related to the protection of patient personal information and responsibility for AI decisions will have to be addressed. In the future, AI technology is expected to be innovatively applied in the field of pain medicine. The advancement of AI is anticipated to have a positive impact on the entire medical field by providing patients with accurate and effective medical services.

Key Words: Artificial intelligence; Pain medicine; Diagnosis; Prediction; Image

Core Tip: Artificial intelligence (AI) technology is revolutionizing the field of pain medicine by facilitating accurate diagnosis, ensuring precise interpretation of medical images, and predicting treatment outcome. AI algorithms assist clinicians in selecting appropriate diagnostic tests, analyzing complex imaging data, and personalizing treatment plans, thereby enhancing overall patient care. For efficient utilization of AI in the pain medicine field, it is crucial to enhance the accuracy of AI decision-making by using more medical data, while issues related to the protection of patient personal information and responsibility for AI decisions will have to be addressed. In the future, AI technology is expected to be innovatively applied in the field of pain medicine.

Citation: Chang MC. Use of artificial intelligence in the field of pain medicine. *World J Clin Cases* 2024; 12(2): 236-239
URL: https://www.wjgnet.com/2307-8960/full/v12/i2/236.htm
DOI: https://dx.doi.org/10.12998/wjcc.v12.i2.236

INTRODUCTION

Artificial Intelligence (AI) is a complex computing system which does not simply involve executing predefined commands. Indeed, AI systems have the capability to learn directly from a wide array of data and make autonomous decisions. The widespread use of the internet has enabled the digitization of myriad materials. Furthermore, with the growing use of smartphones and the spread of the "Internet of Things", data generated by both individuals and electronic devices is being stored at an unprecedented rate, increasingly facilitating the creation of big data. Additionally, recent improvements in computer data processing speeds have made the analysis and processing of big data possible, thereby fostering the evolution of AI algorithms due to learning from the vast data available. These AI algorithms not only surmount the constraints of traditional data analysis techniques, but can also discern nuanced data patterns that may be missed by human analysis, leading to innovative conclusions.

AI technology has experienced rapid advancement in a short period. Humanity is now living in an era where, for the first time in history, AI is being applied throughout everyday life and business. Its utilization is especially vigorous in areas such as commerce, weather forecasting, and transportation. Currently, AI is being employed in the medical field for tasks such as automatic lung radiography analysis, bone age measurement, fracture diagnosis, and determination of cancer diagnoses and treatments. Compared to other industrial fields, the adoption of AI by the healthcare sector is still in its infancy, but momentum for its advancement is swiftly accumulating, and the influence of AI is expected to grow across multiple fields in the future.

Pain is one of the most common complaints encountered in the healthcare sector, and is known to emanate from neural as well as musculoskeletal disturbances/dysfunctions. To address this, an array of diagnostic tools is employed, complemented by a range of treatment strategies. Clinicians and researchers continually seek to enhance the accuracy and efficacy of their interventions. In this context, AI holds promise as a powerful adjunct, poised to transform pain management in real-world clinical scenarios. This article presents some examples of how AI can be applied in the field of pain medicine.

POTENTIAL APPLICATIONS OF AI IN THE FIELD OF PAIN MEDICINE

AI has numerous potential applications in the field of pain medicine. First, AI has the potential to guide the selection of diagnostic tools that identify the origins of pain, enhancing diagnostic accuracy. When a patient reports pain in a specific region, physicians must consider multiple possible causes, narrowing down potential conditions based on the patient's clinical profile and physical examination results. Subsequently, the root cause of the pain can be identified through additional diagnostic measures, encompassing imaging, neurophysiological assessments, and diagnostic blocks. Throughout this procedure, physicians must consider potential disorders inducing pain from a multitude of sources, such as the spinal nerves, peripheral nerves, muscles, tendons, ligaments, joints, and bones. However, as the different medical fields become more specialized, there is an increasing risk of knowledge gaps. For example, neurologists may not be fully acquainted with musculoskeletal issues, and vice versa. This can result in misdiagnosis due to a limited perspective based solely on the attending doctor's specialized training, even though a comprehensive consideration across both neural and musculoskeletal diseases is required. Based on clinical big data, AI diagnostic algorithms can be developed using patient demographics, symptomatology, test outcomes, and prior diagnoses. AI algorithms developed in this manner can be trained to automatically suggest necessary tests when patient symptoms are input, and based on test results, advise physicians on likely sources of pain.

Second, AI can assist in image interpretation. Imaging tests, pivotal for diagnosing neural and musculoskeletal disorders, are heavily relied upon by clinicians. However, clinicians not specializing in radiology often experience difficulty interpreting these images. One of the most salient advantages of using AI for data analysis lies in its ability to analyze image data and identify essential features. A surge in the number of AI algorithms, crafted for the automatic

diagnosis of various neuromuscular skeletal images, radiographs, computed tomography images, and magnetic resonance imaging scans, has emerged recently. However, in real-world clinical scenarios, only those AI algorithms focused on bone fracture detection are in active use. A significant portion of these algorithms have diagnostic accuracy rates below 90%, which is suboptimal for clinical use[1-3]. Nonetheless, with the continued accumulation of image data from numerous clinics and hospitals, the accuracy of these algorithms is expected to keep improving over time. In the future, AI algorithms are expected to help doctors interpret neuromuscular skeletal disorders and explain the imaging results to patients. Furthermore, the use of automatic image interpretation by AI algorithms could also reduce consultation times.

Third, AI can be useful in predicting pain treatment prognosis. The ability to predict a patient's response after pain treatment is integral to establishing an effective treatment plan. Numerous previous studies that used a traditional statistical analysis have delved into understanding treatment responses based on the specific type and severity of conditions. However, these studies typically highlight trends within larger patient groups, falling short of predicting individual treatment responses. However, when fed with individual data, AI algorithms can predict the individual patient's treatment response based on the corresponding output[4,5]. Such AI-driven prognostic predictions can play a pivotal role in crafting tailored pain management strategies, potentially optimizing treatment outcomes. However, for a tangible implementation in clinical settings, it is essential to augment the prediction accuracy of these AI algorithms by training them with more data.

RISKS OF THE USE OF AI

The primary reason why clinicians hesitate to apply AI in clinical practice is the issue of "responsibility". If misdiagnoses or unexpected adverse therapeutic effects occur following the use of AI algorithms in clinical settings by pain physicians, the assignment of responsibility is ambiguous. Numerous stakeholders, including healthcare professionals, algorithm developers, data managers, and medical institutions, are involved in the development of AI algorithms. Therefore, understanding the origin of errors or defects and at which stage they occurred is crucial when determining responsibility in the event of an incident. However, the black-box nature of AI makes identifying the cause of issues arising from its application challenging.

In addition, the most significant aspect in the realm of ethical concerns related to AI is the issue of "privacy protection". Indeed, a large volume of medical data is required to develop medical AI systems. However, only the minimum required data within the scope of the intended purpose should be collected and utilized. Furthermore, as the development of medical AI involves the processing of a substantial amount of sensitive private health-related information, obtaining appropriate legal approval for handling personal data and maintaining security is crucial.

CONCLUSION

Herein, we explored how AI can be utilized in pain medicine. However, it should be noted that there are many other potential applications for AI in addition to those mentioned here. However, there is a need to improve the performance of AI algorithms prior to actual implementation; this can be achieved by collecting more data from various healthcare facilities to train the AI. Furthermore, for AI to be actively used in the pain medicine, clear guidelines need to be established concerning patient privacy issues during data collection and legal/moral responsibilities regarding the decisions made by AI. Practical issues associated with AI integration are expected to be resolved gradually over time. In the future, AI is anticipated to have a revolutionary impact on pain treatment methods and the provision of medical services.

FOOTNOTES

Author contributions: Chang MC designed the study, performed the study, analyzed the data, and wrote the manuscript; Chang MC has read and approve the final manuscript.

Supported by the National Research Foundation of Korea Grant funded by the Korea Government, No. 00219725.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Country/Territory of origin: South Korea

ORCID number: Min Cheol Chang 0000-0002-7629-7213.

S-Editor: Wang JJ
L-Editor: A
P-Editor: Yu HG

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