https://archtrauma.kaums.ac.ir/
Archives of Trauma Research. 2023; 12(4): 217-219
https://doi.org/10.48307/ATR.2024.186838

Letter Open Access

Prognosis prediction in traumatic brain injury patients using machine learning algorithms

MirMohammad Miri [1], **Jamie Cone** [2 *]

[1] Department of Anesthesiology and Critical Care, School of Medicine, Emam Hosein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2] Royal College of Emergency Medicine, Cambridge University Hospitals NHS Trust, East of England Deanery, United Kingdom

* **Corresponding Author:** Jamie Cone, Royal College of Emergency Medicine, Cambridge University Hospitals NHS Trust, East of England Deanery, GMC Registration 7829117. **Email:** jcone90@gmail.com

Received: 7 December 2023 **Revised:** 18 December 2023 **Accepted:** 23 December 2023 **e-Published:** 23 December 2023

Keywords: Traumatic brain injury, Artificial intelligence, Machine learning algorithms.

Dear Editor

Traumatic brain injury (TBI) is a common cause of death and disability, with long-term consequences including cognitive impairment, emotional disturbances and physical disability. Prognosis prediction in TBI patients is critical for guiding treatment decisions and improving patient outcomes. The Glasgow coma scale (GCS) and Glasgow outcome scale (GOS) are useful tools to assess and monitor TBI patients, but other factors such as age, motor component of GCS, and type of injury also significantly influence clinical outcomes. With the advent of artificial intelligence (AI), there is growing interest in using machine learning algorithms to predict prognosis in TBI patients.[1] Here we discuss the harnessing of AI in prognosis prediction for TBI patients, as well as its potential benefits, disadvantages, challenges and predicted future directions.

Current state of AI in prognosis prediction for TBI patients

Reflecting on large bodies of data (clinical, radiographic and laboratory), AI has shown promise in predicting prognosis in TBI patients. Machine learning algorithms (MLA) can identify patterns in data that may not be immediately apparent to human clinicians, allowing for more accurate predictions of patient outcome. There are several studies that have used MLA to develop diagnostic systems for TBI and predict patient outcomes. These studies have used various clinical inputs such as vital signs, electroencephalography (EEG), hospital volume, Charlson comorbidity index and length of stay to develop machine learning (ML) models.[2] In a study conducted by Mawdsley et al, the effectiveness of ML models in predicting psychosocial aspects of TBI cases was systematically reviewed. The study included nine studies with eleven types of ML used to predict various outcomes of traumatic brain injury, concussion and psychosocial outcomes. The results indicated that while these models were able to develop predictive models successfully, there is insufficient evidence to consider ML algorithms as a dependable tool for clinical decision-making.[3] Alanazi et al., conducted a review in 2017 to assess the effectiveness of ML models in predicting patient outcomes for various disorders. The study revealed that AI has the potential to create several promising models that can predict outcomes using clinical, demographic, and imaging data. However, there are still limitations in applying these models in clinical settings. Therefore, further research is necessary to improve the reliability of these models in the future.[4]

Potential benefits of AI in prognosis prediction for TBI patients

The use of AI in prognosis prediction for TBI patients has several potential benefits. First and foremost, it can provide clinicians with more accurate and reliable predictions of patient outcomes, allowing for more informed treatment decisions. This can lead to improved patient outcomes and reduced healthcare costs. AI can help identify patients who are at high risk for poor outcomes, allowing for early interventions that may

improve their prognosis, or early decision making around withdrawal of treatment. For example, if an algorithm predicts a patient is at high risk of adverse effects from an intracranial hemorrhage, clinicians can perform early surgical interventions or administer medications early to prevent further bleeding. In addition, AI can help identify patients who are likely to have favorable outcomes, or who do not require intervention, which allows for more efficient distribution of healthcare resources. For example, if an algorithm predicts a patient is likely to have a good outcome, they may not require intensive care unit (ICU) admission, or may not require prolonged rehabilitation services. Finally, AI can also help reduce the workload of medical professionals by performing repetitive tasks such as data entry and analysis. This can free up time for physicians and nurses to focus on providing high-quality care to patients.[1,5]

Potential disadvantages of AI in prognosis prediction for TBI patients

There are several potential disadvantages of using AI in predicting the clinical outcomes of patients with TBI. AI algorithms rely on large amounts of data to make accurate predictions. However, there may not be enough high-quality data available to train AI models effectively. Data entry relies on human factors and may be poorly or incorrectly entered, making errors possible. Also, AI algorithms may be biased if the data used to train them is not representative of the population being studied. For example, if the data used to train an AI model on TBI outcomes comes from a specific hospital or region, the model may not generalize well to other populations. AI models can be complex and difficult to interpret. Clinicians may struggle to understand how the model arrived at a particular prediction, which could lead to skepticism or mistrust of the technology. Finally, there are ethical considerations around the use of AI in healthcare. If an AI model predicts that a patient has a poor prognosis, this could lead to decisions about end-of-life care, which may go against the patient's wishes or values. Clinicians must carefully consider the potential risks and benefits of using AI in clinical decision-making.[1,5]

Future Directions

The future of prognosis prediction in TBI patients using AI is promising. However, there are several challenges that must be addressed. One challenge is the lack of standardized data collection and reporting. To develop accurate algorithms, large amounts of high-quality data are required. However, there is currently no standardized way to collect and report TBI data, making it difficult to develop accurate, widely transferable algorithms. Another challenge is the need for validation studies. While initial research has shown promising results, further validation studies are needed to confirm the accuracy and reliability of AI algorithms in predicting TBI prognosis,[3,4] as well as ensuring safety in clinical practice.[1,6]

With the increasing availability of electronic health records and the development of advanced AI algorithms, there is potential for more accurate and reliable predictions of TBI outcomes. AI can help identify patterns and correlations in patient data that may not be easily recognizable by human clinicians, leading to more personalized and effective treatment plans, however, there is the challenge of integrating AI into clinical practice. Clinicians must be trained on how to interpret and use AI predictions in their decision-making processes. This will require collaboration between clinicians and AI experts to develop user-friendly interfaces that can be integrated into clinical workflows.

Conclusion

The reliability of prognosis prediction in TBI patients using AI depends on the quality and completeness of the data, the type of algorithm used and the level of validation testing performed. Conclusions surrounding the selection of optimal clinical or para-clinical features and the most precise machine learning model for predicting outcomes in TBI patients is still inconsistent. However, early studies have shown that AI algorithms can accurately predict mortality and functional outcomes in TBI patients by analyzing large amounts of patient data, including clinical, radiographic, and laboratory data. Therefore, further validation studies are needed to confirm the accuracy and reliability of AI algorithms in predicting TBI prognosis before they can be integrated into clinical practice. With continued research and collaboration between clinicians and AI experts, the use of AI in prognosis prediction for TBI patients has the potential to revolutionize TBI care and improve patient outcomes.

Acknowledgment

None.

Competing interests

None.

Authors' contributions

The authors read and approved the final manuscript. They takes responsibility for the integrity of the data and the accuracy of the data analysis.

Abbreviations

Traumatic brain injury: TBI;
Glasgow coma scale: GCS;
Glasgow outcome scale: GOS;
Artificial intelligence: AI;
Machine learning: ML;
Machine learning algorithms: MLA;
Electroencephalography: EEG;
Intensive care unit: ICU.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

None.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

References

1. Courville E, Kazim SF, Vellek J, Tarawneh O, Stack J, Roster K, et al. Machine learning algorithms for predicting outcomes of traumatic brain injury: A systematic review and meta-analysis. Surg Neurol Int. 2023;14. doi:10.25259/SNI_312_2023 PMid:37560584 PMCid:PMC10408617
2. Moya A, Pretel E, Navarro E, Jaén J. A systematic literature review of clustering techniques for patients with traumatic brain injury. Artif Intell Rev. 2023:1-69. doi:10.1007/s10462-023-10531-2
3. Mawdsley E, Reynolds B, Cullen B. A systematic review of the effectiveness of machine learning for predicting psychosocial outcomes in acquired brain injury: Which algorithms are used and why?. J Neuropsychol. 2021;15(3): 319-339. doi:10.1111/jnp.12244 PMid:33780595
4. Alanazi HO, Abdullah AH, Qureshi KN. A critical review for developing accurate and dynamic predictive models using machine learning methods in medicine and health care. J Med Syst. 2017; 41(4): 1-10 doi:10.1007/s10916-017-0715-6 PMid:28285459
5. Alouani AT, Elfouly T. Traumatic brain injury (TBI) detection: past, present, and future. Biomedicines. 2022;10(10):2472 doi:10.3390/biomedicines10102472 PMid:36289734 PMCid:PMC9598576
6. McNamara R, Meka S, Anstey J, Fatovich D, Haseler L, Jeffcote T, et al. Development of traumatic brain injury associated intracranial hypertension prediction algorithms: a narrative review. J Neurotrauma. 2023;40(5-6):416-34. doi:10.1089/neu.2022.0201 PMid:36205570 PMCid:PMC9986028

How to Cite this Article:
Miri M, Cone J. Prognosis prediction in traumatic brain injury patients using machine learning algorithms. Arch Trauma Res. 2023; 12(4): 217-219. doi:10.48307/atr.2023.419936.1037