



Artificial intelligence and ChatGPT in neuroanesthesia and neurocritical practice: a revolution or a discombobulation

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Abstract

The advent of Artificial Intelligence (AI) and ChatGPT has marked its effect on the various aspects of society and the medical field is not exempt from its influence. The AI and ChatGPT can prove to be of great assistance to neuroanesthesiologists by helping in clinical decision-making during the perioperative period and in the neurocritical management and prognostication of the patients. Along with that, it can also help in medical recordkeeping, translations of medical education and research. However, the progress of technology isn't exempted from its evil potential. The boon of increasing productivity and lightening the load off Neuroanesthesiologist' shoulders comes with the bane of false information, misinterpretation, piracy and plagiarism. Hence, AI and ChatGPT should be allowed to analyze or develop sensitive information or decisions only under the scrutiny of a human assessment.

Keywords: artificial intelligence; ChatGPT; neuroanesthesia; neurocritical care; neurosurgery; artificial neural networks; anaesthesia training; anaesthesia examination; language model.

Introduction

Once considered a mere figment of imagination, Artificial Intelligence (AI) has set its foot strong in today's world. Artificial intelligence is described as the study of algorithms that enable machines to think and carry out tasks including word and object recognition, inference of world states, solving problems, and making decisions [1]. Stating that it has revolutionized working in all sectors including health care and is making human resources insecure about their employment wouldn't be an overstatement. AI is being used in various fields of medicine and surgery ranging from largely diagnostic applications to therapeutic interventions [1-4].



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Evidence in Context

- ChatGPT, developed by OpenAI, processes language using extensive data from books, websites, and Wikipedia.
- In Neuroanaesthesia, ChatGPT improves perioperative management, intraoperative decisions, and post-operative care.
- It aids in training Neuroanaesthesia residents by grading papers, creating assessments, and simplifying medical concepts.
- Challenges include data accuracy, privacy concerns, and potential biases in clinical decisions.

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This manuscript focuses on the pros and cons of AI and ChatGPT. The articles for this review were searched on databases including EMBASE, PubMed Central, and Google Scholar. The keywords searched were "Artificial Intelligence", "ChatGPT", "Neuroanaesthesia", "Neurocritical care", and "Neurosurgery". The authors performed an extensive review of the searched articles before drafting this article.

ChatGPT

ChatGPT model (Open AI, San Francisco, CA, USA) is a variant of GPT (Generative Pre-Trained Transformer) designed for conversational interaction with the users. This chatbot was developed by Open AI and has been in use since 30th November 2022 [5]. ChatGPT is a kind of large language model (LLM) that can imitate language processing abilities just like humans. It employs deep learning techniques, such as neural networks, and extracts its knowledge from the enormous amounts of text data from various print and electronic data sources. This extensive training and learning techniques due to the large language models enable it to generate highly systematic and pragmatic manuscripts [6]. The upgraded version of ChatGPT which is ChatGPT 3.5 is popular due to its effective programming. It allows a human chatbox interface and provides human-like replies to typed questions. Further, it uses supervised, reinforcement and proximal policy optimisation techniques for its training. A mammoth data of 570 GB is the source of its information which is extracted from books, websites, Wikipedia and other text-based sources [7]. The advent of ChatGPT 4 in March 2023 became an icing on the cake, especially for physicians as it accepts visual inputs as well.

Efficacy

The ChatGPT app was able to defend its ballyhoo as it cleared three stages of the United States Medical Licensing Exam (USMLE) [8]. GPT-3.5 (Codex and InstructGPT) could attain human-level performance on various datasets including USMLE (60.2%), PubMedQA (78.2%), and MedMCQA (57.5%). Talking specifically about the Anesthesiology questions, a study found that ChatGPT could correctly answer about 61.1% of multiple choice questions extracted from the Anesthesiology Examination and Board Review book, a resource book for preparing for board exams [9]. This study however found that it lacks consistency in providing scientifically acceptable explanations [10].

Applications

The ChatGPT can have a multitude of applications in the realm of Neuroanesthesia (Figure 1)

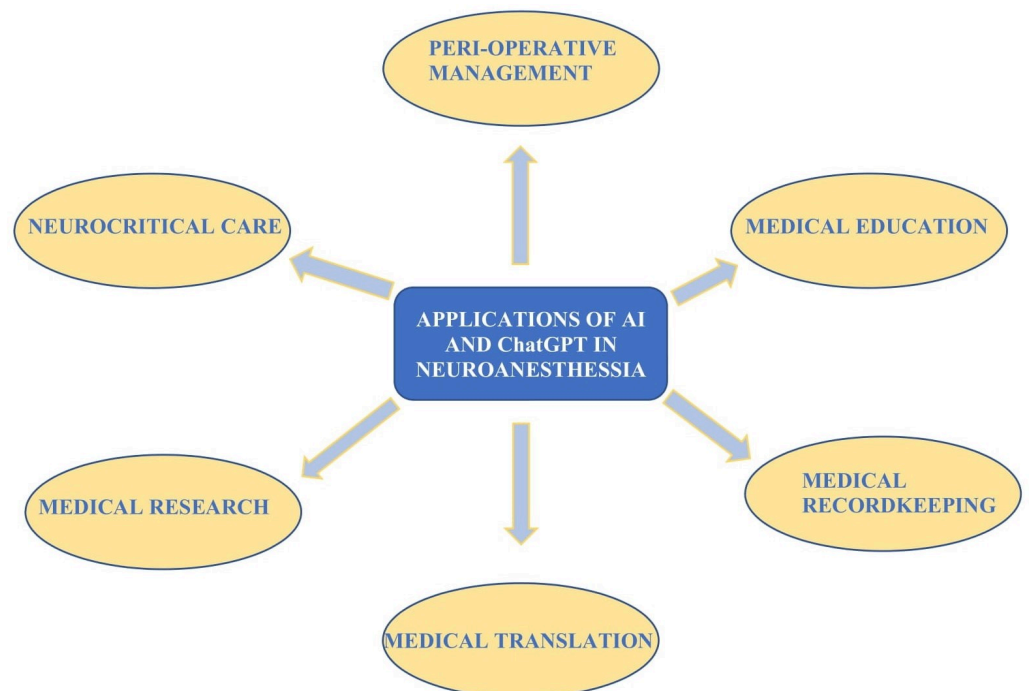


Figure 1: Figure highlighting the various applications of Artificial Intelligence (AI) and ChatGPT in Neuroanesthesia and Neurocritical care

Peri-operative management

Pre-Operative period

ChatGPT can help in the pre-anaesthetic check-up by evaluating the signs, and symptoms of the patients, reviewing the comorbidities and the current medications. It can also give its inputs regarding the clinical decisions based on the given data set. In case of a language barrier, it can act as an interface for translation and explaining the peri-operative concerns and obtaining consent from the patient. Previously, AI had been used for perioperative risk stratification, and prediction of postoperative complications [11,12]. It can also help in the prediction of difficult airways and even in modelling airway strategies [13,14]. Pre-operative patient education regarding the procedure and its complications, framing and explaining of the patient-specific and the procedure-specific pre-operative instructions to the patients can be ameliorated by the use of ChatGPT and AI. For neurological and neurosurgical patients scheduled for deep brain surgeries, awake craniotomies, and preoperative cognitive function assessment and documentation, this can be of great assistance with preoperative evaluation, explanation, and psycho-preparation.

Intraoperative period

The decision regarding the mode of anesthesia, the best anesthetic drugs to be used, and the drugs to be avoided can be individualized in the patients by taking the help of ChatGPT. The other AI techniques can also help us in monitoring the depth of anesthesia, control the delivery of anesthetic agents [15], neuromuscular blockers [16], and even control mechanical ventilation [17]. Future may hold the use of AI to automatically control the delivery of anesthetic agents and other physiological parameters in response to the measured evoked potentials for to optimum level of tracings to be obtained in cases done with neuromonitoring.

Post-operative period

ChatGPT can help us to formulate a personalized analgesia plan based on the patient's medical history, pain threshold and other factors including the intra-operative and pre-operative parameters. Furthermore, the occurrence of early postoperative nausea and vomiting can be predicted by using AI and machine learning and deep learning techniques [18]. AI can also help in the postoperative assessment of cognitive function.

Neurocritical care

A systemic review and meta-analysis by Zhao et al [19] have provided us with evidence that AI can prove to be effective assistance to doctors in establishing the diagnosis of Intracerebral Hemorrhage (ICH). Creation of predictive models to predict hypotension, hospital-acquired infections, prognosis and functional outcome after stroke [20-23]. Machine learning models also help in the interpretation of radiological imaging [24].

Prognostication

Machine learning algorithms developed by AI have shown promising results in predicting prognosis in patients with traumatic brain injury [25]. Similarly, the prediction of the prognosis of the patients with ICH via deep learning models has been demonstrated [26]. Machine learning techniques when applied to the CT, MRI and EEG data proved quite effective in the prognostication of SAH patients [27]. AI models that used clinical and radiological data proved to be about 89% accurate for diagnosing and prognosticating stroke outcomes [28].

Medical education

ChatGPT can additionally be helpful on the academic and training front as well. It can help in the assessment and grading of students' papers hence decreasing the workload of the teachers [29,30]. It can also help in formulating question papers, quizzes, and exercises and simplify complex concepts and texts for the neuroanesthesia trainees [31].

Medical research

Neuroanesthesia practioners especially the trainees can feel lost in the heaps of extensive review present. ChatGPT can conduct literature searches across various databases and in multiple

Languages [32]. It can analyze multiple studies and provide a clear, lucid conclusion and summary of the studies conducted to address the question raised. It also helps to create and correct a draft of a paper. It can help in finding, highlighting and rectifying the limitations of a particular study.

Medical recordkeeping

ChatGPT can help in preparing automated medical histories and summaries and help in organizing and storing medical records. It can formulate discharge summaries of the patients admitted in neurosurgery wards and neurointensive care units. It uses the fed medical details and improves the quality of discharge summaries [33]. Effective and accurate medical recordkeeping can then help in improving the quality of the prospective and retrospective studies conducted on the data set.

Medical translations

Neuroanesthesiologists can utilize ChatGPT to do the medical translations to communicate with patients speaking different languages and improve their provision of medical care. It can help in eliciting history during the pre-anaesthetic check-up, explaining the pre-operative instructions and consent to the patients.

Limitations

The source of knowledge of the ChatGPT is driven from the databases and gets updated very fast, so the information provided in this review needs to be interpreted accordingly [34]. All the information sourced from the internet is not always correct and hence can be misleading. However efficient ChatGPT might be, its accuracy will remain lower than the various Medical chat boxes which have been specifically designed to answer queries related to Medicine [35,36].

The authenticity of the data searched by ChatGPT was also found questionable by Grigio et al [37] who discovered that ChatGPT had quoted certain fabricated articles and hence should be used with ultimate caution. Although ChatGPT and AI have been speculated to increase productivity exponentially, the possibility of misinterpretation of the study remains [38].

Ethical concerns

Certain ethical issues can be highlighted with the use of ChatGPT which include data content, data use, privacy and integration, safety, patient trust, transparency and confidentiality between all participants [34]. Additionally, the risk of plagiarism and copyright infringement will be significantly increased with the use of ChatGPT and AI [39]. Last but not the list, cybersecurity is an important concern for AI and ChatGPT to protect patient data.

Conclusion

AI and ChatGPT are useful tools for creating human-like text responses to questions. It has numerous applications in the health care system. The scope of AI and ChatGPT ranges from operation theatre to neurocritical care to maintenance of medical records. However, their use can make us further vulnerable to misinterpretation of data, wrong clinical decisions, ethical wrongdoings and bias. With a little bit of debottlenecking, AI and ChatGPT can prove to be a boon for the modern-day Neuroanesthesiologist if used judiciously for the patients and trainees.

Supporting information

None

Ethical Considerations

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Priya Thappa: Collection of data, literature review, and manuscript preparation; **Amiya Kumar Barik:** literature review, manuscript preparation, editing, and review; **Chitta R Mohanty:** literature review, manuscript preparation, editing, and review; **Kiran Jangra:** literature review, manuscript preparation, editing, and review; **Ashwini Reddy:** manuscript preparation, editing, and review; **Rajeev Chauhan:** manuscript preparation, editing, and final approval; **Kirandeep Kaur:** manuscript preparation, editing, and final approval; **Ankur Luthra:** manuscript preparation, editing, and final approval;

All authors attest they meet the ICMJE criteria for authorship and gave final approval for submission.

Data availability statement

Data included in article/supp. material/referenced in article.

Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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