Neonatal and Pediatric Medicine
ISSN: 2572-4983

Mini Review Open Access

Machine Translation in Neonatal Medicine Review

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Abstract

While AI clinical decision support tools appear superior to rule-based tools in many situations, their use can pose additional challenges. An example of this is the lack of large data sets and the existence of imbalanced data (e.g. due to low rates of adverse events) commonly observed in neonatal medicine. This paper describes the latest and most powerful applications of AI in neonatal medicine and highlights future research directions relevant to the neonatal population. AI applications currently being tested in neonatology include vital signs monitoring, disease prediction (respiratory distress syndrome, bronchopulmonary dysplasia, apnea of prematurity), risk stratification retinopathy of prematurity, intestinal perforation, jaundice it is included. including tools for neurological diagnosis and prognostic support. New image recognition techniques (especially useful for staging, neuroimaging, etc.) and timely detection of infections. Tools like these that support neonatal doctors in their daily practice could be very revolutionary in the near future. On the other hand, in order to use AI technology correctly, it is important to be aware of its limitations.

Keywords: Infant; Machine learning; Predictive models; Clinical algorithm

Introduction

While the term "artificial intelligence" (AI) refers to the general ability of computer algorithms to mimic human decision-making, machine learning (ML) refers to the ability of machines to learn from data without explicit programming. Branches of AI that includes technologies that enable both have had a major impact on personalized diagnosis and therapy, drug development, and medical imaging over the past decades [1].

Supervised ML, Unsupervised ML, Neural Networks. Supervised ML uses labeled records to train data classification algorithms especially for predictive applications. Unsupervised ML is typically used as a tool for exploring data, requiring less human input Inspired by biological neural networks, neural networks can "learn" from unexpected deviations and are useful for processing image data. So far, supervised ML has been used primarily in pediatrics and neonatology to develop predictive models [2]. For example, algorithms designed to identify patients at risk for pneumonia; urinary tract infections, bacterial meningitis, intra-abdominal injuries, or clinically relevant traumatic brain injuries use straightforward methods. Developed by While AI clinical decision support tools appear superior to rule-based tools in many situations, their use can pose additional challenges [3]. These include the need for large datasets, the challenge of generalizability, the presence of imbalanced data (i.e. due to low incidence of adverse outcomes), lack of evidence-based support, interchildren including differences in maturity [4].

Neonatal intensive care units typically generate a certain amount of underutilized data that AI can compute and analyze. This review presents and discusses the latest and most powerful applications of AI in neonatology and provides directions for future research relevant to this patient population [5].

Applications of artificial intelligence

The revolution in AI, especially in the subcategory of ML, has impacted research on neuromonitoring of critically ill neonates over the past decades. Advances in computing power and data storage have enabled AI to enable computer systems to inspect and analyze vast amounts of information to decipher disease patterns. Clinical neuromonitoring can generate a large amount of data, especially regarding electroencephalogram (EEG) data. EEG is a non-invasive recording of electrical activity in the cerebral cortex that provides a real-time assessment of background cortical function and can help determine prognosis in newborns. EEG is also a reference tool for seizure diagnosis as it can distinguish between epileptic seizures and non-epileptic events and can detect non-convulsive seizures. Continuous EEG (cEEG) recordings maximize the diagnostic utility of this tool, as they are more likely to record electrographic events, but also its prognostic significance, permitting the assessment of the evolution in background activity over time. In any case, interpreting the plethora of information generated requires expertise and is resource-consuming, aspects that limit the diffusion of cEEG monitoring [6].

A number of ML algorithms based on EEG background activity have been proposed with various aims. Much research has been undertaken in the area of automated EEG interpretation regarding the early severity grading of perinatal hypoxic-ischemic encephalopathy (HIE) in order to provide diagnostic decision. Recently, advanced techniques for signal processing and ML, such as convolutional neural network structures able to self-extract convolutional features from raw EEGs have demonstrated strong performance metrics for classifying HIE severity grades also investigated the potential role of AI in predictive modeling for electrographic seizures in neonates with aiming to identify infants at the highest risk of subsequent seizures early [7]. ML models were developed for clinical features as well as qualitative EEG features (assessed by a neurophysiologist) and quantitative EEG features (automatically generated by discrete activity weighting) individually or in combination. Interestingly, automated quantitative EEG analysis and analyzes performed by experienced neurophysiologists enhanced the predictive value of these models by adding clinical information. These

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Received: 01-May-2023, Manuscript No: nnp-23-99068; **Editor assigned:** 03-May-2023, Pre-QC No: nnp-23-99068(PQ); **Reviewed:** 17-May-2023,QC No: nnp-23-99068; **Revised:** 19-May-2023, Manuscript No: nnp-23-99068 (R); **Published:** 26-May-2023, DOI: 10.4172/2572-4983.1000307

Citation: Perera M (2023) Machine Translation in Neonatal Medicine Review. Neonat Pediatr Med 9: 307.

reports highlight the potential of using ML to process background EEG activity in neonates with HIE [8].

AI has also been extensively studied in preterm and premature infant sleep research, using EEG data to automatically classify neonatal sleep stages. Sleep studies are particularly relevant to the treatment of sick infants due to their prognostic value. Because alternating manifestations of wakefulness (that is, the sleep-wake cycle) are a positive prognostic factor and an overall marker of neurological health. In any case, research on AI-driven tools to assess background cortical activity in neonates is still in the preclinical stage [9].

Detection of paroxysmal events is another important purpose of EEG monitoring. Newborns are at the highest risk of seizures compared to other periods of life, and seizures are the most common neurological emergency in this age group. The incidence of seizures in newborns is estimated to be approximately 8% and increases parabolically with gestational age, with seizures occurring more frequently in infants born at 30 and 36 weeks' gestation. Early detection of seizures often reflects underlying pathologic conditions such as HIE, meningitis, and stroke, suggesting that early diagnosis and treatment of seizures improves drug response. It is very important because there is recent evidence. Furthermore, it is well established that long-term neurodevelopmental impairment is associated with increased seizure burden. Seizure recurrence itself appears to have additional effects on neurodevelopment, regardless of the underlying etiology. On the other hand, treating non-epileptic events unnecessarily exposes newborns to harmful drugs. Because seizures are usually only electrical recordings, their manifestations can be masked by drugs, and even when seizures are present, they can be difficult to distinguish from normal neonatal movements. Therefore, EEG monitoring is very important for detecting neonatal seizures and cEEG monitoring is the recommended standard of care for this purpose. According to current guidelines, high-risk newborns should undergo 24-hour EEG monitoring to check for seizures. Additionally, if seizure activity is detected, seizure-free for 24 hours is recommended. In her HIE infants receiving therapeutic hypothermia, EEG recordings up to 72 hours should be considered, as the rewarming period is the most likely phase of late-onset seizures [10].

Discussion

As recent research has shown, artificial intelligence has great potential to improve understanding of disease and improve treatment outcomes in neonatal medicine and beyond. We showcase the most relevant research in this area, and the most important applications of AI include neuromonitoring, assessment and prediction of critical respiratory illnesses, retinopathy of prematurity, neonatal sepsis, jaundice, and intestinal perforation. Found to contain predictions of these disorders are serious complications of premature birth that can have lasting effects and even death. The development of point-of-care tools is another promising approach to helping physicians predict and effectively treat specific conditions such as irritable bowel syndrome. In any case, there are some ethical challenges in applying AI to neonatal clinical care. As newborns cannot consent, permission to participate is usually given by their legal representative parents. Given the need for surrogate consent, newborns need additional protection as research participants. In addition, parents of sick and premature babies have to deal with many challenges during the first weeks and months of their baby's life. Mental, physical, and emotional fatigue can affect a parent's ability to give informed consent. Therefore, special attention was paid to adhering to strict ethical standards in perinatal studies. There are also some ethical and legal pitfalls when using ML in clinical decision making. For example, if a validated algorithm makes a mistake, which is to blame generalizability issues, lack of evidence-based care for some neonatal diseases, maturation variability, and cost.

Conclusions

In the medical field, there is a growing interest in modern applications of artificial intelligence in neonatal care. In this narrative review, we have presented some of the latest and most important findings on this topic to provide an overview of the potential applications of AI in neonatology.

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