CAS 2025

Equipment Monitoring Abstracts

Contents

Artificial intelligence in anesthesia: transforming perioperative care

Submission ID

97

AUTHORS

Saeed, Huzaifa;[1] Hussain, Adam A.;[1] Saeed, Sabir[2]

[1]College of Medicine, University of Saskatchewan, Saskatoon, SK, Canada; [2]Department of Anesthesiology, Perioperative Medicine and Pain Management, University of Saskatchewan, Saskatoon, SK, Canada

INTRODUCTION

Artificial intelligence (AI) is poised to revolutionize anesthesiology by transforming patient care, enhancing clinical workflows, and addressing systemic challenges in perioperative medicine. Artificial intelligence applications leverage advanced algorithms to analyze complex datasets, enabling predictive analytics, personalized interventions, and improved resource allocation. In anesthesiology, AI has demonstrated promise across the perioperative continuum, from preoperative risk stratification and intraoperative monitoring to postoperative complication prevention.[1,2] These advancements are vital in addressing challenges such as rising surgical volumes, workforce shortages, and the need for precision in high-risk environments.[3] Despite its transformative potential, AI integration faces challenges, including concerns about data privacy, algorithm transparency, and ethical considerations.[4,5]

This study explores the current and potential applications of AI in anesthesiology, focusing on its clinical utility and addressing the barriers to successful implementation.

METHODS

A systematic review was conducted to investigate the applications of AI in anesthesiology, emphasizing its clinical utility, challenges, and potential for integration across the perioperative continuum. A structured search was performed in major academic databases, including PubMed, Embase, IEEE Xplore, and Scopus, covering publications from January 2015 to December 2024. Search terms combined “Artificial Intelligence,” “Machine Learning,” “Anesthesia,” “Perioperative Care,” and “Predictive Analytics,” employing Boolean operators to refine the scope. Inclusion criteria encompassed studies focused on AI applications in anesthesiology that provided original research, systematic reviews, or meta-analyses addressing clinical, ethical, or technical aspects of AI. Excluded were articles unrelated to anesthesiology, non-peer-reviewed content, and studies with significant methodological limitations. Data were extracted systematically using a standardized template to capture study design, AI technologies, targeted perioperative phases, and key outcomes such as efficacy, safety, and clinical impact. Thematic synthesis categorized findings into preoperative, intraoperative, and postoperative applications, as well as ethical and implementation challenges. Quality assessment was conducted using Critical Appraisal Skills Programme checklists to ensure methodological rigor

and eliminate studies with substantial bias. The review aimed to synthesize actionable insights into how AI is transforming anesthesiology while identifying areas requiring further research and addressing challenges in implementation.

RESULTS

Artificial intelligence applications in anesthesiology have demonstrated significant advancements in clinical decision-making, patient safety, and workflow efficiency. Preoperative AI tools enhance risk stratification by predicting complications such as cardiac events and respiratory failure with superior accuracy compared to traditional risk models. Intraoperatively, AI-powered closed-loop systems optimize anesthetic delivery, maintaining precise sedation levels and reducing complications. Predictive analytics systems have shown utility in identifying early signs of adverse events, such as hypotension or hypoxia, allowing timely interventions. Postoperatively, AI-driven remote monitoring systems improve complication detection and patient recovery through continuous tracking of vital parameters (Figure). However, challenges such as algorithm opacity, data quality variability, and training dataset biases remain significant barriers to implementation. Ethical concerns, including disparities in algorithm performance for underrepresented populations and the “black box” nature of some models, underscore the need for transparent, equitable, and clinician-centred AI development.

DISCUSSION

Artificial intelligence is transforming anesthesiology by enhancing clinical workflows, improving patient outcomes, and addressing systemic challenges. Despite its potential, successful integration requires overcoming barriers related to data privacy, algorithm transparency, and equity. Interdisciplinary collaboration among clinicians, data scientists, and policymakers is essential to develop AI systems that are clinically effective, transparent, and equitable. By focusing on robust regulatory frameworks, clinician training, and equitable access to AI technologies, anesthesiology can fully harness the potential of AI to revolutionize perioperative care while safeguarding the humanistic aspects of clinical practice.

REFERENCES

1. *Hashimoto DA, Witkowski E, Gao L, Meireles O, Rosman G.* Artificial intelligence in anesthesiology: current techniques, clinical applications, and limitations. Anesthesiology 2020; 132: 379–94. https://doi.org/10.1097/aln.0000000000002960
2. *Connor CW.* Artificial intelligence and machine learning in anesthesiology. Anesthesiology 2019; 131: 1346–59. https://doi.org/10.1097/aln.0000000000002694
3. *Lopes, S., et al.* AI-driven closed-loop systems for automated anesthetic delivery: a systematic review. Journal of Clinical Monitoring and Computing 2023; 37: 451–67. https://doi.org/10.1007/s10877-022-00834-9
4. *Doshi-Velez F, Kim B.* Towards a rigorous science of interpretable machine learning. Nat Mach Intell 2017; 1: 22–31. arXiv:1702.08608 (**Preprint**). 28 February 2017. https://doi.org/10.1038/s42256-019-0048-x (accessed May 2025).

5. *Rajkomar A, Hardt M, Howell MD, Corrado G, Chin MH.* Ensuring fairness in machine learning to advance health equity. Ann Intern Med 2018; 169: 866–72. https://doi.org/10.7326/m18-1990

Figure Summary of artificial intelligence applications in anesthesiology

Phase of Care	AI Application	Examples	Challenges
Preoperative	Risk stratification, patient optimization, personalized education	Predicting pulmonary embolism risk, chatbots for patient education	Data quality, interoperability, ethical concerns about bias
Intraoperative	Real-time monitoring, closed-loop anesthetic delivery, decision support	AI-driven hypotension prediction, automated anesthetic dosing	Algorithm transparency, over-reliance on AI, ethical concerns
Postoperative	Complication prediction, personalized pain management, remote monitoring	Wearable devices for monitoring, predictive models for chronic pain	Data security, patient compliance, maintaining equity

AI = artificial intelligence

The introduction of capnography for intrahospital transport of ventilated patients with congenital heart disease

Submission ID

77

AUTHORS

Brown, Morgan L.; Whiting, David; DiNardo, James A.; Nasr, Viviane G.

Division of Cardiac Anesthesia, Boston Children's Hospital, Boston, MA, USA

INTRODUCTION

Pediatric patients with congenital heart disease (CHD) undergo multiple procedures that require general anesthesia. Intra-hospital transport is necessary to move patients from the operating room or cardiac catheterization/electrophysiology suite to the intensive care unit and imaging departments with the patient endotracheally intubated and manually ventilated. End-tidal capnography ($EtCO_2$) is a non-invasive measurement of the partial pressure of CO_2 from the airway obtained during both inspiration and expiration. It provides physiologic information on ventilation, perfusion, and metabolism and is necessary to confirm placement of the endotracheal tube in the trachea. Capnography is recommended during transport by several societies.[2–4] In addition, many patients with CHD have circulatory physiology that is sensitive to changes in pH that can be identified with changes in $EtCO_2$. Our objective was to introduce a new capnography monitor for intrahospital transports.

METHODS

Institutional Review Board (Boston Children's Hospital, Boston, MA, USA) approval was obtained. Multiple plan, do, study, act cycles were performed to identify and introduce this new technology to our anesthesia group. The electronic medical record was used to record the use of capnography in patients who were transported intubated to our intensive care units. A control chart was used to demonstrate compliance.

RESULTS

From 1 January 2022 to 30 May 2024, there were 2,996 patients with CHD who were transported endotracheally intubated and manually ventilated to the intensive care unit by the anesthesia team. Missing data on equipment used during transport occurred in 119 transports (4%). In patients with complete data, the median age was 1 year [interquartile range (IQR), 0.22–5.9 yr], the median weight was 8.1 kg [IQR, 4.1–18.1 kg], and 56.1% were male. Patients were transported from the operating room (*n* = 2,139, 74.4%), the cardiac catheterization laboratory (*n* = 698, 32.3%), and the cardiac imaging areas (*n* = 698,1.3%). In the last 3 months of data, we were able to achieve compliance of 86.3%, 80.7%, and 87.6% (Figure).

DISCUSSION

Capnography can be successfully introduced into intrahospital transport for high-risk patients. Barriers to its use are primarily the cost of the device and availability of the monitors.

REFERENCES

1. *Tobias JD, Lynch A, Garrett J.* Alterations of end-tidal carbon dioxide during the intrahospital transport of children. Pediatr Emerg Care 2006; 12: 249–51. https://doi.org/10.1097/00006565-199608000-00003
2. *Walsh BK, Crotwell DN, Restrespo RD.* Capnography/capnometry during mechanical ventilation: 2011. Resp Care 2011; 56: 503–9. https://doi.org/10.4187/respcare.01175
3. *Intensive Care Society.* Guidance. Available from URL: http://www.ics.ac.uk/ics-homepage/guidelines-and-standards/ (accessed May 2025).
4. *Warren J, Fromm RE Jr, Orr RA, Rotello LC, Horst HM*. Guidelines for the inter- and intrahospital transport of critically ill patients. Crit Care Med 2004: 32: 256–62. https://doi.org/10.1097/01.ccm.0000104917.39204.0a

Figure Control chart for the introduction of capnography in ventilated transported patients with congenital heart disease