



ARTIFICIAL INTELLIGENCE IN ANAESTHESIA: ASSISTANT OR SUBSTITUTION OF ANAESTHETIST? A REVIEW OF RECENT ADVANCES

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ABSTRACT

Artificial Intelligence (AI) is rapidly transforming anaesthesia, driven by advances in machine learning, deep learning, and data integration technologies. Recent developments have expanded AI applications across the perioperative continuum, including predictive analytics, automated drug delivery, AI-assisted imaging, and personalized anaesthetic care. While AI is often perceived as a potential threat to employment, current evidence suggests it functions primarily as a clinical assistant that enhances safety, efficiency, and decision-making. This paper reviews recent advances in AI in anaesthesia, evaluates its role as an assistant versus a job reducer, and discusses ethical, clinical, and workforce implications. Emerging technologies such as AI-guided ultrasound, closed-loop anaesthesia systems, hypotension prediction algorithms, and generative AI in clinical documentation demonstrate significant potential. However, limitations including data dependency, lack of interpretability, and need for human oversight persist. The future of anaesthesia is likely to be a collaborative model where AI augments, rather than replaces, anaesthesiologists. Understanding this evolving relationship is essential for safe and effective integration into clinical practice.

KEYWORDS : Artificial Intelligence, Anaesthesia, Machine Learning, Automation

INTRODUCTION

Anaesthesia has traditionally been a specialty reliant on continuous monitoring, rapid decision-making, and clinical expertise. In recent years, Artificial Intelligence (AI) has emerged as a transformative force, reshaping perioperative care through data-driven insights and automation. The rapid growth of AI research in anaesthesiology—especially since last decades—reflects its increasing clinical relevance and adoption.

This technological shift has raised an important question: does AI act as an assistant enhancing clinical practice, or does it threaten to reduce the need for anaesthesiologists? This paper explores this debate in light of recent advances and clinical evidence.

Recent Advances in AI in Anaesthesia

Recent years (2024–2025) have seen major breakthroughs in AI-driven anaesthesia technologies:

1. Predictive Analytics and Early Warning Systems

AI models can now predict intraoperative hypotension, hypoxia, and postoperative complications with high accuracy. These systems analyze real-time physiological data and historical patient records to enable proactive intervention.

2. Closed-Loop Anaesthesia Delivery Systems

Automated systems using AI regulate drug administration (e.g., propofol, opioids) based on continuous monitoring of depth of anaesthesia. These “smart systems” maintain optimal anaesthetic levels with minimal clinician input.

3. AI-Assisted Ultrasound and Regional Anaesthesia

AI-enhanced ultrasound imaging improves accuracy in nerve blocks, vascular access, and gastric assessment, reducing complications and increasing procedural success rates.

4. Intelligent Monitoring and Multimodal Data Integration

AI integrates electroencephalography (EEG), hemodynamic parameters, and imaging data to provide comprehensive patient monitoring and decision support.

5. Personalized Anaesthesia

AI enables individualized anaesthetic plans by analyzing patient-specific variables such as genetics, comorbidities, and pharmacological responses, leading to precision medicine approaches.

6. Generative AI and Clinical Documentation

Recent integration of large language models has enabled automated documentation, report generation, and clinical decision support, reducing administrative workload.

7. AI in Education and Simulation

Virtual reality (VR) combined with AI is revolutionizing anaesthesia training, allowing realistic simulations of critical scenarios and improving skill acquisition.

AI as an Assistant in Anaesthesia

AI's primary role in current clinical practice is assistive rather than substitutive. Key benefits include:

- **Improved Patient Safety:** AI detects subtle physiological changes earlier than humans, enabling timely intervention.
- **Enhanced Decision-Making:** AI provides evidence-based recommendations derived from large datasets.
- **Reduced Cognitive Load:** Automation of routine tasks allows clinicians to focus on critical aspects of care.
- **Operational Efficiency:** AI streamlines workflows, reduces documentation burden, and improves resource utilization.

AI functions as a “clinical co-pilot,” supporting anaesthesiologists while preserving human control over critical decisions.

AI and the Question of Job Reduction

Concerns about job displacement stem from increasing automation in monitoring and drug delivery. However, several factors limit AI's ability to replace anaesthesiologists:

- Anaesthesia requires complex clinical judgment, especially in emergencies
- Ethical decision-making and patient communication cannot be automated
- Unpredictable surgical scenarios demand human adaptability
- Legal accountability necessitates human oversight

While AI may reduce the need for manual or repetitive tasks, it is unlikely to eliminate the role of anaesthesiologists. Instead, it may shift the profession toward supervisory and cognitive roles.

Limitations and Challenges

Despite rapid progress, AI in anaesthesia faces several challenges:

- **Data Quality and Availability:** Reliable AI requires large, high-quality datasets, which are often limited
- **Algorithm Bias and Transparency:** Lack of interpretability (“black box” models) raises trust issues
- **Integration with Clinical Workflow:** Implementing AI systems in real-world settings remains complex
- **Technical Failures:** Dependence on technology introduces risks of system malfunction

Additionally, multimodal data integration and real-time processing remain areas requiring further research.

Ethical and Legal Considerations

The use of AI introduces new ethical dilemmas:

- **Responsibility:** Determining liability in case of AI-related errors
- **Informed Consent:** Patients must be aware of AI involvement
- **Data Privacy:** Protection of sensitive patient information
- **Equity:** Ensuring AI systems do not perpetuate healthcare disparities

Robust regulatory frameworks and guidelines are essential for safe implementation.

Future Perspectives

The future of AI in anaesthesia is characterized by increasing integration and collaboration:

- Development of fully autonomous anaesthesia systems for low-risk procedures
- Expansion of real-time predictive analytics
- Integration with wearable and remote monitoring devices
- Growth of AI-driven precision medicine
- Enhanced human-machine collaboration models

AI is expected to redefine anaesthesia practice, emphasizing oversight, interpretation, and patient-centered care.

CONCLUSION

Recent advances clearly demonstrate that AI is transforming anaesthesia into a more data-driven and precise specialty. However, AI currently functions as an assistant rather than a job reducer or substituter. While automation may change the nature of work, it does not eliminate the need for skilled anaesthesiologists. Instead, it enhances their capabilities, allowing them to deliver safer and more efficient care. The future lies in collaboration between human expertise and artificial intelligence, not competition.

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