



Artificial Intelligence in Regional Anesthesia: Promise, Pitfalls, and Practicality

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Introduction

Advances in regional anesthesia (RA) focus on nerve localization, accurate needle placement, and patient monitoring.

Artificial intelligence (AI) tools in RA may support ultrasound, trainee education, and patient monitoring, though clinicians remain uncertain of clinical applicability.

Purpose: Conduct comprehensive review of current literature on artificial intelligence in regional anesthesia.

Methods

Databases:

PubMed, ScienceDirect, EBSCO

Keywords:

Artificial intelligence, AI, machine learning, regional anesthesia, nerve block, ultrasound-guided anesthesia

Analysis:

Titles/abstracts were screened for relevance. Due to study heterogeneity, findings from full-text review of selected articles were synthesized qualitatively.

Findings

Ultrasound Guidance

- ScanNav = AI tool highlights ultrasound structures with color overlays (FDA approval 2022)⁴
- Lower complication + block failures with AI assistance⁴⁻⁵
- AI-assisted anatomy ID + needle tracking helpful in 99.7% of cases¹

Medical Education + Training

- Residents using AI support have lower nerve block complications/failure but higher first-attempt successes^{1,11-12}
- 3D-rendered VR + haptic feedback allows for simulated training in risk-free environment¹³

Perioperative Monitoring

- Preop risk stratification via AI analysis of comorbidities, labs, vitals
- Real-time patient monitoring with early patient instability alerts
- Track anesthetic spread and anatomy landmark identification
- Early success in pain assessments for critically ill/nonverbal pts²¹⁻²²

Figure 1. Primary benefits of AI-assisted tools in regional anesthesia workflows.

Dataset Limitations	Resource Constraints	Overreliance on AI	Ethics and Regulation
• Little exposure to rare conditions for training³⁰ • Variable pt anatomy • Heterogenous EMRs • Institutions hesitant to share PHI²³ • Minority groups (sex, race/ethnicity, SES) cause algorithm bias^{23,25}	• High investment (AI-enabled hardware, proprietary software, data storage, EMR access, cybersecurity)^{30-31,39} • Budget reallocation may strain resource-limited hospitals^{30-31,39} • Disparities in underfunded settings	• AI anatomical misidentification³¹ • Skill degradation³¹⁻³³ • Lack of transparency in AI decision-making³⁵⁻³⁶ • “Appropriate trust” proportional to AI reasoning and demonstrated performance³⁵⁻³⁶	• Standardization challenges; few reports of external validation in AI-assisted tools^{4,31} • Informed pt consent • Question of responsibility with errors/data breaches • Robust FDA frameworks and ongoing audits required^{25,31}

Figure 2. Limitations and considerations to AI integration in regional anesthesia.

Conclusions

AI-assisted tools may improve outcomes and reduce complications in RA.

Benefits: ultrasound guidance, trainee education, patient monitoring, needle localization, risk stratification

Challenges: Limited data, complex populations, ethics/regulation, possible overreliance

AI should only support and not replace clinical training and judgement.

AI integration in RA workflows requires multidisciplinary approaches with anesthesiologists, software/hardware developers, industry, and regulatory bodies.

References

