



Personalized Perioperative Medicine: Moving Beyond One-Size-Fits-All Anaesthesia

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Commentary

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Abstract

Perioperative care has traditionally relied on standardized protocols and population-based recommendations. Although standardized care has improved safety, substantial differences exist between individual patients in physiological reserve, comorbidities, medication response, pain sensitivity, and risk of postoperative complications. Personalized perioperative medicine seeks to incorporate these differences into clinical decision-making. Recent advances in predictive analytics, digital monitoring, biomarkers, pharmacogenomics, and artificial intelligence may facilitate more individualized anaesthetic care. This commentary discusses the potential transition from protocol-driven care toward adaptive perioperative management while emphasizing the need to preserve clinical judgment and avoid unnecessary technological complexity.

Keywords: Personalized medicine; precision medicine; perioperative medicine; anaesthesia; artificial intelligence; individualized care

Introduction

Two patients undergoing the same operation may have very different perioperative risks.

One may be young and physiologically resilient. Another may have cardiovascular disease, renal impairment, frailty, sleep-disordered breathing, or previous postoperative complications. Yet many perioperative pathways remain fundamentally standardized. Standardization is valuable for patient safety, but personalization may allow clinicians to adapt to individual risk.

What Does Personalized Anaesthesia Mean?

Personalized anaesthesia does not necessarily require genomic testing.

It may involve combining:

- age;
- frailty;
- comorbidities;
- physiological reserve;
- previous anaesthetic history;
- medication exposure;
- laboratory results;
- imaging;
- biomarkers;
- postoperative risk prediction.
- The objective is to identify which interventions are most appropriate for a particular patient.
- Individualized Risk Prediction
- AI and machine learning may help clinicians estimate postoperative risks.

- Potential predictions include:
- postoperative respiratory complications;
- acute kidney injury;
- cardiovascular complications;
- prolonged ICU admission;
- postoperative delirium;
- prolonged mechanical ventilation.
- The value of prediction depends on whether clinicians can modify the risk.
- A risk score without an actionable response has limited clinical value.

Personalized Analgesia

Pain response varies considerably between patients. Multimodal analgesia provides a framework for reducing opioid exposure while maintaining adequate analgesia. Future systems could potentially integrate patient characteristics and previous analgesic responses to support more individualized analgesic strategies.

Precision Fluid and Hemodynamic Management

Patients differ in their tolerance of fluid administration. A younger patient without cardiac or renal disease may respond differently from a patient with heart failure or chronic kidney disease. Combining haemodynamic monitoring with individualized risk prediction could potentially support more targeted fluid and vasoactive management.

Role of Artificial Intelligence

AI may assist with integrating large datasets.

However, personalization should not become a justification for unnecessary complexity.

The clinician should still be able to understand the major factors influencing the recommendation.

Clinical Implications

- Personalized perioperative medicine may improve:
- preoperative risk stratification;
- anaesthetic planning;

- haemodynamic management;
- analgesic selection;
- postoperative monitoring;
- ICU triage;
- recovery pathways.

Challenges

Important challenges include data availability, algorithmic bias, interoperability, cost, explainability, and clinician acceptance. There is also a danger that personalized medicine becomes technology-centered rather than patient-centered.

Future Directions

Future research should determine which patient characteristics genuinely improve clinical prediction and which simply increase model complexity. Prospective trials are needed to determine whether personalized decision support reduces complications or improves recovery.

Conclusion

Personalized perioperative medicine represents a logical evolution of modern anaesthetic practice.

The objective is not to abandon standardized care. Rather, it is to identify where standardized pathways should be adapted to the individual patient. The future may therefore be best described as standardized foundations with personalized decisions.

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