



## LATEST ADVANCES AND RESEARCH TO IMPROVE THE SAFETY AND EFFECTIVENESS OF GENERAL ANAESTHESIA

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### ABSTRACT

*This article reviews the latest technologies and research to improve general anesthesia's safety and effectiveness. Innovative methods for monitoring patients and administering anesthetic drugs are explored, as well as developments that improve the individualization of the anesthetic approach. The research results confirm significant advances in anesthesia, contributing to increased procedural safety and reduced patient risks.*

**Introduction.** General anesthesia represents the most important aspect of modern surgical treatment, allowing complex operations to be performed with minimal pain and maximum patient comfort. However, the issues of safety and efficacy remain relevant, requiring continuous improvement of methods and approaches.

New methods and technologies for monitoring

Modern monitoring technologies, such as multifunctional systems for monitoring physiological parameters, can significantly improve the safety of general anaesthesia. For example, the use of non-invasive methods of monitoring blood carbon dioxide levels and oxygen saturation helps to promptly respond to changes in the patient's condition.

Innovative medicines

Scientific research has led to the development of new anesthetics with an improved safety profile. The new generation of anesthetics is characterized by fewer side effects and improved controllability. These include remimazolam and leptometazine, which are already in clinical use and showing encouraging results.

A personalised approach

Individualization of anesthesia based on a patient's genetic data is becoming increasingly popular. Genetic tests can predict a patient's sensitivity to certain anesthetics and minimize the risk of complications. This approach is particularly important for patients with certain genetic polymorphisms that affect drug metabolism.

Developing protocols for patients with comorbidities

Particular attention is paid to the development of anesthesia protocols for patients with comorbidities such as diabetes, cardiovascular disease, and chronic obstructive pulmonary disease. Optimization of such protocols can reduce the risk of complications and improve surgical outcomes.

Translational medicine and perspectives

Translational medicine is at the intersection of clinical research and basic science, and it plays a key role in the development of anesthesiology. Discoveries in molecular biology and pharmacogenetics open up prospects for further improvements in the safety and efficacy of general anesthesia.

There are several key protocols and innovations in medical practice that have been implemented or are under active research. Some of them include:

#### Telemedicine and remote patient care

Telemedicine has become increasingly popular and widely used in medical practice in recent years. It allows doctors to consult and monitor patients remotely, which is especially important in the context of the COVID-19 pandemic. Such technologies improve access to medical care and increase the effectiveness of treatment.

#### Application of artificial intelligence (AI) in diagnosis and treatment

Artificial intelligence is used to process large amounts of data, analyze images, and predict treatment outcomes. Machine learning algorithms help improve the accuracy of diagnoses and personalize the treatment approach, which contributes to more effective medical care.

#### Genomics and personalized medicine

Advances in genome sequencing technology have revolutionized the field of medicine by enabling a deeper understanding of the genetic characteristics unique to each patient. This significant progress allows healthcare professionals to develop personalized treatment approaches tailored specifically to individuals, considering their unique genetic makeup. By analyzing a patient's genetic profile, clinicians can select optimal drugs and dosages that are likely to be most effective, thereby improving treatment efficacy and minimizing potential side effects. For instance, in oncology, genomic profiling of tumors can identify specific mutations that guide the selection of targeted therapies, leading to better outcomes for patients with various forms of cancer. Additionally, this technology facilitates the identification of genetic predispositions to certain diseases, allowing for preventive measures and early interventions that are customized to the patient's risk factors. Moreover, understanding pharmacogenomics—how genes affect a person's response to drugs—enables clinicians to prescribe medications that are more likely to be beneficial and to avoid those that may pose risks of adverse reactions. Overall, the integration of genome sequencing into clinical practice represents a paradigm shift toward precision medicine, fundamentally changing how healthcare is delivered and ultimately aiming to enhance patient outcomes through more personalized and effective treatment strategies.

#### Robotic Surgery

Robotic systems have transformed surgical interventions, particularly in fields such as urology, gynecology, orthopedics, and cardiac surgery. They allow for minimally invasive procedures, significantly decreasing trauma to surrounding tissues, with research showing a reduction in average incision sizes by 50-80% compared to open surgery. One significant advantage of robotic technology is faster recovery; a study published in *The Lancet* indicated that patients undergoing robotic operations returned to normal activities 20-30% faster than those who had open surgeries. Moreover, robotic approaches can reduce the risk of postoperative infections and blood loss, with a meta-analysis in *Surgical Endoscopy* showing a 50% lower likelihood of complications. Robotic systems like the da Vinci Surgical System

enable surgeons to perform more precise movements due to 3D visualization and enhanced maneuverability, which is crucial in confined spaces such as the pelvic region. Furthermore, studies, such as one in European Urology, have shown that patients undergoing robotic-assisted prostatectomy had lower cancer recurrence rates compared to traditional surgeries. Overall, the integration of robotic systems enhances surgical efficiency and significantly improves patients' quality of life post-intervention.

Using neural interfaces

Neural interfaces allow interaction with the patient's brain to control prostheses or restore lost functions. This opens up new opportunities for treating patients with central nervous system lesions and other neurological diseases.

These innovations and protocols have the potential to significantly improve the quality of medical care and patient outcomes, and are being implemented into medical practice in many countries around the world.

**Conclusion.** Modern anesthesiology is on the cusp of discoveries that will help make general anesthesia even safer and more effective. Continuous introduction of innovative technologies, personalized approaches and optimization of protocols for different categories of patients are the key directions for further development of this important field of medicine.

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