

# Anesthesia Comprehensive Teaching: The Role of Simulation Teaching

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**Abstract:** With advancements in medical education, simulation teaching has become increasingly important in anesthesia comprehensive teaching. By simulating real clinical scenarios, simulation teaching provides a safe and risk-free learning platform for anesthesia students and doctors, allowing them to learn and master essential clinical skills without compromising patient safety. This teaching method not only helps beginners establish a fundamental understanding of anesthesia concepts and skills, but also provides continuous education and skill enhancement opportunities for experienced anesthesiologists. This article aims to explore the role and impact of simulation teaching in anesthesia comprehensive teaching, analyzing its promotion of anesthesia safety, clinical decision-making abilities, and teamwork skills. Through comprehensive analysis of existing literature, we have found that simulation teaching not only strengthens students' practical abilities and critical thinking but also improves their reaction speed and accuracy in handling emergency situations. The application of simulation teaching in anesthesia education has driven the transformation of traditional teaching methods and laid a solid foundation for cultivating high-quality anesthesia professionals. However, this teaching method still has certain limitations in practical application, such as high costs and resource allocation issues. Future research needs to further explore how to effectively integrate simulation teaching into the anesthesia education system and evaluate its teaching effectiveness to better serve the cultivation of anesthesia

professionals.

**Keywords:** Anesthesia Comprehensive Teaching; Simulation Teaching; Clinical Skills; Educational Innovation; Professional Talent Cultivation.

## 1. Introduction

In the field of medicine, especially in anesthesia education, simulation teaching has become an important teaching method. In traditional teaching models, students often learn medical skills through textbooks and clinical internships, which may not provide enough practical opportunities for students to face complex and changing clinical situations. To address this issue, many educational institutions have started using simulation teaching to improve the quality of education and students' clinical skills [10].

Simulation teaching utilizes high-fidelity medical simulators to allow students to learn in a simulated clinical environment that closely resembles reality. It enables students to practice basic medical skills repeatedly and simulate rapid responses in emergency situations. Through this approach, students can make mistakes and learn from them in a risk-free environment, which is crucial for developing their independent thinking and clinical decision-making abilities [13]. Research by Dong Jun et al. [1] and Lin Jingyan et al. [2] has shown that the application of medical simulation teaching in anesthesia teaching improves students' learning interests and practical abilities. Ye Jianrong et al. [3] used problem-based learning (PBL) combined with scenario-based simulation teaching to achieve good results in teaching "Clinical Anesthesiology." This teaching

method encourages students to actively participate in teaching activities and learn relevant knowledge by solving practical problems.

Wang Xianyu et al. [4] further demonstrated the effectiveness of epidural anesthesia simulation teaching in anesthesia professional internships. Lu Meilin and Shao Jianlin [5] discussed the application and development of intelligent scenario-based simulation teaching in undergraduate anesthesia education, highlighting the significant improvement in educational quality. Zhang Shengmao et al. [6] studied the application of case-based learning (CBL) scenario simulation training teaching mode in undergraduate anesthesia interns and concluded that simulation teaching can effectively improve students' clinical thinking and practical operational skills. Pei Shenglin [7] observed the effect of micro-lecture embedded case teaching combined with scenario-based simulation teaching in anesthesia education, emphasizing the advantage of this method in improving students' learning efficiency. Research by Shi Xuanyu and Du Bing [8] also supported the application value of PBL combined with scenario-based simulation teaching in teaching "Clinical Anesthesiology." Simulation provides students with instant feedback during clinical skills training, which is helpful for skill mastery [9]. Training in cardiopulmonary resuscitation is another area where simulation teaching plays a significant role. Sun Changyi [12] discussed the application of problem-based learning (PBL) teaching method supported by high-fidelity simulation technology in this field. In addition to enhancing basic medical skills and clinical decision-making abilities, simulation teaching also demonstrates its unique value in cultivating advanced medical operation skills, such as epidural puncture technique [13]. Research by Ma Xingdui et al. [14] and Zou Leiyan, Yuan Liudanyan [15] analyzed the effects of CBL teaching model combined with simulation training in clinical anesthesia teaching, confirming its effectiveness. Finally, the study by Huang Zehan and Wei Zhongliang [16] emphasized the application of medical simulation teaching in anesthesia education research, providing further scientific evidence for this educational method. Through a comprehensive analysis of the literature, it is clear that simulation teaching has become an

important advancement in anesthesia education. It not only improves teaching methods but also enhances students' clinical abilities, potentially becoming a standard configuration in future medical education.

Anesthesiology is an important branch of medicine that involves maintaining patients' vital signs during surgical procedures, as well as preoperative assessment and postoperative pain management. Anesthesia education has a direct impact on the quality of medical services and patient safety. However, anesthesia education faces a series of challenges, such as the need for students to master complex clinical skills, safety teaching in high-risk medical environments, and a lack of practical opportunities [10].

To address these challenges, simulation teaching has been introduced as a new teaching method in medical education. This teaching approach provides a safe environment for students to practice repetitive operations and simulates various emergency and non-standard situations, which is beneficial for cultivating students' ability to handle real clinical situations [13]. The widespread application of simulation teaching not only improves educational effectiveness but also significantly enhances students' clinical skills and decision-making ability.

This article aims to explore the application and effectiveness of simulation teaching in anesthesia education. Through a comprehensive analysis of existing literature, this article will provide a detailed introduction to various aspects of simulation teaching, including its definition, characteristics, and applications in anesthesia education. Additionally, this article will discuss the current development status of simulation technology and how it is changing the landscape of anesthesia education.

## **2. Overview of Simulation Teaching in Anesthesia**

### **2.1 Definition and Characteristics of Simulation Teaching**

Simulation teaching refers to the use of specialized teaching equipment and techniques to create a realistic clinical environment for training students in medical procedures, diagnosis, and treatment. It is characterized by its high level of safety, repetitive practice, and

immediate feedback, effectively enhancing students' clinical skills and decision-making abilities. In this teaching environment, students can freely experiment and make mistakes without risking harm to real patients, allowing them to master various skills through continuous practice [13].

## **2.2 Application Areas of Simulation Teaching in Anesthesia**

In anesthesia education, simulation teaching is applied in various aspects, including basic skills training, complex procedural skills training, and handling emergency situations. For example, in simulation teaching for epidural anesthesia, students can practice puncture techniques and drug dosage calculations until they achieve proficiency [4]. In CPR training, feedback provided by high-fidelity simulators can help students master the correct compression rate and depth [12]. Furthermore, simulation teaching can be used to simulate rare but dangerous clinical scenarios, such as anesthesia accidents, allowing students to handle real situations with confidence.

## **2.3 Development and Current Status of Simulation Technology**

With advancements in technology, the application of simulation technology in medical education has become increasingly widespread. Current simulators can not only simulate human physiological characteristics but also accurately replicate patients' physiological responses, such as blood pressure, pulse, and respiration. These advanced simulators can also record students' performance for later analysis and discussion. Intelligent scenario-based simulation teaching can personalize simulated scenarios, providing more tailored and targeted education [5]. These advancements greatly enhance the effectiveness of simulation teaching, making it an indispensable part of medical education.

Through the exploration of the application of simulation teaching in anesthesia education, it is evident that this teaching method effectively addresses the shortcomings of traditional teaching, improves the quality of education, and will continue to influence future medical education models. As technology continues to advance, simulation teaching is expected to play an even greater role in anesthesia and

other medical fields.

## **3. Role of Simulation Teaching in Anesthesia Comprehensive Teaching**

### **3.1 Enhancing Clinical Skills and Proficiency**

Mastery of clinical skills is crucial in the field of anesthesia. Simulation teaching provides a simulated environment for students to practice real clinical procedures repeatedly, significantly improving their skill levels and proficiency. For example, in simulation teaching for epidural anesthesia, students can practice needle insertion and drug dosage calculations until they achieve mastery [4]. This repetitive practice not only enhances operational skills but also strengthens students' memory of the surgical process, effectively reducing error rates during actual procedures.

### **3.2 Enhancing Clinical Decision-Making Abilities**

Anesthesia not only requires operational skills but also demands high-level clinical decision-making abilities. Simulation teaching constructs complex clinical scenarios, exposing students to various emergency situations and rare cases, significantly enhancing their clinical decision-making abilities. When faced with simulated emergency situations, students must quickly analyze the situation, make judgments, and execute the appropriate medical interventions, fostering their clinical thinking and decision-making abilities.

### **3.3 Strengthening Emergency Situation Handling**

Dealing with emergency situations is a critical aspect of anesthesia education. Through simulation teaching, students can simulate the handling of anesthesia-related emergencies, such as anesthesia accidents and cardiac arrests, in a safe environment [12]. This training not only helps students learn how to remain calm under pressure but also reinforces the necessary surgical techniques and teamwork skills required in emergency situations. Simulating these emergency situations enables students to better understand and master the procedures and skills necessary for handling real-life medical emergencies.

### **3.4 Promoting Team Collaboration and Communication**

In clinical practice, teamwork and communication skills are equally important in the field of anesthesia. Simulation teaching provides interdisciplinary team training opportunities, allowing students to work together with students from other medical professions in simulated clinical environments. This interdisciplinary collaboration not only strengthens communication and collaboration between team members but also enhances the overall team's ability to handle emergency situations, preparing students for complex medical environments.

## **4. Educational Theory Foundations of Simulation Teaching**

### **4.1 Application of Adult Learning Theory in Simulation Teaching**

Adult learning theory emphasizes that learning should be self-directed, and learners should be proactive and capable of self-reflection during the learning process. Simulation teaching is based on this theory, motivating students to explore, analyze, and solve problems actively in simulated clinical scenarios, facilitating autonomous learning and self-improvement.

### **4.2 Simulation Teaching Supported by Reflective Practice Theory**

Reflective practice theory suggests that learning and skill enhancement are facilitated through reflection on practical experiences. In simulation teaching, after each simulation training, students engage in detailed reflection and discussion, evaluating their own performance and decision-making, deepening their understanding of clinical practice, and identifying areas for improvement.

### **4.3 Team Collaboration and Communication from a Social Learning Theory Perspective**

Social learning theory emphasizes that learning is a social interaction process, whereby individuals learn new behavioral patterns through observation, imitation, and interaction. In simulation teaching's team collaboration exercises, students learn effective communication and collaboration strategies by observing peers' performances and feedback, enhancing both individual capabilities and

team efficiency.

Supported by these educational theories, simulation teaching plays a significant role in anesthesia education, improving students' clinical skills, decision-making abilities, teamwork, and communication skills. With ongoing technological advancements and further application of educational theories, simulation teaching will continue to play an increasingly important role in future anesthesia education.

## **5. Implementation of Simulation Teaching in Anesthesia Education**

### **5.1 Steps and Principles in Designing Simulation Teaching Activities**

The steps and principles in designing simulation teaching activities are crucial to ensure the effectiveness and learning outcomes of the activities. Firstly, clear educational objectives serve as the foundation for activity design. Based on students' learning needs and the core competency requirements of anesthesia, appropriate objectives should be formulated. Secondly, suitable simulation teaching methods and tools should be selected. High-fidelity simulators, virtual reality technology, and other tools can be used for simulation teaching, and it is important to choose the tools and methods that are suitable for specific objectives. Then, the design process should follow the principle of increasing complexity gradually. Students should start with simple operational training and gradually transition to simulations of handling complex clinical scenarios, ensuring a progressive acquisition of knowledge and skills.

### **5.2 Selection and Integration of Simulation Teaching Content**

The selection and integration of simulation teaching content should consider the core areas and disciplinary requirements of anesthesia. These contents include drug dosages, patient assessment, emergency situation handling, etc. By integrating theoretical knowledge with practical operations in conjunction with actual clinical work, simulation teaching allows students to apply the learned knowledge in simulated environments through case analysis, role-playing, and other forms.

### **5.3 Methods and Criteria for Assessing Teaching Effectiveness**

Assessing teaching effectiveness is essential to ensure the effectiveness of simulation teaching and learning outcomes. Assessment should include formative assessment and summative assessment. Formative assessment can be done through observing students' performance in simulated environments to assess their skill mastery, decision-making abilities, and teamwork skills. Summative assessment can be conducted through exams, simulated scenario assessments, etc., to evaluate students' comprehensive abilities. Assessment criteria should include specific and quantifiable indicators based on the requirements of the anesthesia profession to ensure the objectivity and accuracy of the assessment.

## **6. Challenges and Strategies in Simulation Teaching**

### **6.1 Challenges of Cost and Resources**

Simulation teaching involves significant costs and resource investment. Purchasing and maintaining equipment and facilities, as well as training teachers and technical personnel, require substantial resources and funds. To address this challenge, seeking funding from governments and industries or collaborating with other educational institutions to share resources can help alleviate cost pressures.

### **6.2 Challenges of Technology Updates and Maintenance**

Simulation teaching technologies and equipment are constantly advancing, requiring regular maintenance and updates to maintain their effectiveness. To address this challenge, establishing long-term relationships with technology vendors can provide timely technical support and maintenance services. Additionally, regular training for technical staff and teachers to keep them abreast of the latest technological developments can improve the efficiency of technology utilization.

### **6.3 Challenges of Quantifying Educational Effects**

Quantifying the educational effects of simulation teaching is a challenge. It requires setting clear learning objectives and assessment criteria and adopting diverse assessment methods, such as observation

assessments, exams, and simulated scenario assessments. These methods can comprehensively evaluate students' practical operational abilities, decision-making abilities, and teamwork skills, resulting in more accurate assessments of educational effects.

### **6.4 Strategies for Improving Acceptance by Teachers and Students**

The acceptance of simulation teaching by teachers and students is a key factor. To improve acceptance, providing education and training for teachers to enhance their teaching abilities and technical skills is important. Additionally, showcasing the effectiveness and learning outcomes of simulation teaching helps teachers and students better understand the value and role of simulation teaching. Furthermore, encouraging teachers and students to participate in the design process of simulation teaching activities increases their sense of involvement and ownership, resulting in higher satisfaction and acceptance.

## **7. Discussion**

### **7.1 Role of Simulation Teaching in Anesthesia Education Reform**

Simulation teaching plays a significant role in anesthesia education reform. Traditional anesthesia education relies mainly on classroom teaching and practical clinical internships, which are often limited by time, resources, and associated risks. Simulation teaching addresses the limitations of traditional teaching by providing realistic clinical simulation environments, offering students more learning and training opportunities, and improving learning outcomes and teaching quality. In anesthesia education reform, simulation teaching can better cultivate students' clinical skills, decision-making abilities, teamwork, and communication skills, enabling them to better adapt to and excel in clinical practice.

### **7.2 Advantages and Disadvantages of Simulation Teaching Compared to Traditional Teaching**

Traditional teaching and simulation teaching each have their advantages and disadvantages. Traditional teaching emphasizes the transmission of theoretical knowledge and practical internships, which can convey basic

theoretical knowledge and skills. However, traditional teaching is constrained by limited time and opportunities for students' practical operations, as well as higher risks associated with actual procedures. Simulation teaching provides a safer and more realistic learning environment, allowing students to engage in extensive repetitive practice, enhancing their skills and decision-making abilities. Additionally, simulation teaching can promote students' teamwork and communication skills. However, simulation teaching also faces challenges related to costs, technology updates, and maintenance, requiring significant resource and funding investments.

### 7.3. Trends and Prospects for the Future Development of Simulation Teaching

In the future, simulation teaching in anesthesia education will continue to develop and achieve better outcomes. Firstly, as technology continues to advance, simulation teaching equipment and technology will become more advanced and accessible, providing more realistic and comprehensive simulation environments. Secondly, simulation teaching will be combined with other teaching methods, such as online education and virtual reality technology, to form diversified teaching models, offering personalized and flexible learning experiences. Furthermore, as simulation teaching becomes more widely applied in anesthesia education, the assessment of teaching effectiveness and quality assurance will receive more attention, driving continuous improvement and innovation in simulation teaching.

### 8. Conclusion

Simulation teaching holds an important position and plays a significant role in anesthesia comprehensive teaching. By providing realistic clinical simulation environments, simulation teaching effectively cultivates students' clinical skills, decision-making abilities, and improves learning outcomes and teaching quality. Students can gain proficiency and apply their knowledge and skills in actual clinical practice through extensive practice and repetition within simulated environments.

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### Reference

- [1] Dong Jun, Min Su, Li Ping, Tang Xiaoning, & Cheng Bo. (2012). Application of medical simulation teaching in anesthesiology teaching course for international medical students. *Journal of Exploration in Medical Education*, 11(2), 3.
- [2] LinJingyan, YangLina, HeJian, LinJingyan, YangLina, & HeJian. (2015). Application of Cbl combined with medical simulation teaching in clinical anesthesiology teaching. *Chinese Cases* (3), 3.
- [3] Ye J R, Ma Y, & Zheng H. (2017). Application of Pbl combined with situational simulation teaching method in the teaching of Clinical Anesthesiology. *Journal of Xinjiang Medical University*, 40(12), 3.
- [4] Wang Xianyu, Liu Juying, Qin Mingsheng, & Zhu Tao. (2008). Study on the application of intraspinal anesthesia simulation teaching to the probation teaching of anesthesiology. *Chinese Journal of Medical Education*, 028(003), 97-99.
- [5] Lu M L, & Shao J L. (2022). Application and development of intelligent scene simulation teaching in anesthesiology undergraduate teaching. *Chinese Science and Technology Journal Database (Full text) Medicine and Health* (3), 3.
- [6] Zhang S M, Su N, Yun L T, Zhao Z H, & Li N. (2023). Application of Cbl situational simulation training model to undergraduate anesthesiology interns. *Inner Mongolia Medical Journal*, 55(3), 357-358.
- [7] Pei S L. (2020). Observation on the effect of micro-lesson embedded case teaching combined with situational simulation teaching in anesthesiology teaching. *World Latest Medical Information Abstracts (Electronic edition)*, 020(046), 183-184.

- [8] Shi X Y, & Du B. (2020). Application of Pbl combined situational simulation teaching method in Clinical Anesthesiology teaching. *Famous Doctor*, 000(003), P. 289-289.
- [9] Wang Li, Li Yanhua, Liu Xingling, Zhao Yanhua, Li Yujin, & Li Yun. (2020). Simulation teaching and participatory feedback method in anesthesiology practice teaching research. *Friends of Health*, 000(006), 6.
- [10] Wang X R. (2009). Medical simulation teaching and critical care medicine. *Proceedings of the first International Anesthesiology Simulation Education Summit 2009 in China*.
- [11] Lin Hai, & PI Zhibing. the application of simulation teaching in pain outpatient training. *Zhejiang Anesthesiology Conference*, 2009.
- [12] Sun Changyi. Discussion on cardiopulmonary resuscitation training mode -- "problem-centered teaching method" supported by high simulation technology. *2006 West China Hospital Anesthesia and Critical Care Medicine Annual Meeting of Anesthesiologists Branch of Chinese Medical Doctor Association*.
- [13] Yuan Qing, Fei Yuda, Zhang, Ruan Xia, Cui Xulei, & Tan Gang et al. (2019). Investigation and analysis of the status quo of epidural puncture technique and training needs of anesthesiology residents in China. *Chinese Journal of Anesthesiology*, 39(5), 4.
- [14] Ma X D, Yan L J, Yao Y Y, Li X F, & Li P P. (2020). Effect analysis of Cbl teaching model combined with simulation training in clinical anesthesiology teaching. *Electronic Journal of Clinical Medicine Literature 2020*, Volume 7, Issue 39, page 75, 77.
- [15] Zou L, Yuan, Liu D Y. (2015). Application of situational simulation teaching in clinical teaching of anesthesiology. *Chinese health industry*.
- [16] Huang Z H, & Wei Z L. (2016). Application of medical simulation teaching in anesthesiology education. *Curriculum Education Research* (32), 2.