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Review Article

Strengthening anaesthesia training: The role of wet lab anatomy in resident education

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ABSTRACT

Wet lab anatomy plays a vital role in enhancing the clinical proficiency of anaesthesiology residents by providing a hands-on learning experience that complements theoretical knowledge. Anaesthesiologists rely heavily on an accurate understanding of anatomical relationships for critical procedures such as airway management, regional anaesthesia, and vascular access. Conventional teaching methods often fail to convey the complexity and variability of human anatomy, leaving trainees less confident in applying their knowledge to real-life situations. Wet lab sessions, utilizing cadavers and preserved specimens, allow residents to explore anatomical structures in a realistic and tactile setting, significantly improving their procedural accuracy and understanding. Recent developments, such as the use of virtual reality (VR) and augmented reality (AR) tools alongside traditional cadaveric studies, have made learning more interactive and effective. These tools enable residents to visualize anatomical structures dynamically and practice techniques repeatedly without patient risk. However, challenges such as ethical concerns, limited availability of cadavers, and high costs associated with wet lab facilities limit its widespread use. This review examines the importance of wet lab anatomy in anaesthesia training, discusses modern advancements that enhance its value, and explores strategies for overcoming barriers to its implementation. Through structured application and innovative approaches, wet lab anatomy has the potential to significantly improve the competency and confidence of anaesthesia residents, ultimately leading to better patient outcomes.

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1. Introduction

Anaesthesiology is a highly specialized field that requires both theoretical knowledge and precise practical skills to ensure patient safety during surgical and diagnostic procedures. Central to this practice is a thorough understanding of human anatomy, particularly the complex relationships between nerves, blood vessels, and other critical structures. Procedures such as regional anaesthesia, airway management, and vascular access demand precision,

as errors can lead to complications such as nerve injury, accidental arterial punctures, or inadequate anaesthesia. While theoretical education forms the foundation of medical training, practical exposure to anatomical structures is essential for mastering these skills.¹⁻⁴

Traditionally, anatomy education has relied on lectures, textbooks, and plastic models. While these methods provide a basic understanding, they often fall short in conveying the three-dimensional complexity and variability of human anatomy. For anaesthesiology residents, this gap becomes particularly evident when transitioning to clinical practice, where they must adapt to real-world challenges such

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as anatomical variations and unforeseen complications.^{5,6} This shortfall underscores the importance of incorporating hands-on experiences into training programs. Wet lab anatomy, involving cadaveric dissection and the study of preserved specimens, provides an invaluable opportunity for residents to interact with human tissues and observe anatomical structures in their natural context. This practical exposure enhances understanding, improves procedural accuracy, and builds confidence in performing critical techniques. In recent years, innovations such as AR, VR, and high-fidelity simulators have further enriched the learning experience, enabling residents to visualize and practice procedures dynamically.

Despite its evident advantages, incorporating wet lab anatomy into anaesthesia training is not without challenges. These include limited access to cadaveric specimens, logistical constraints, and ethical considerations. In resource-constrained settings, these barriers are further exacerbated, creating disparities in training quality across institutions. Addressing these challenges requires collaboration among educators, policymakers, and technology developers to create sustainable and effective training models.^{7,8}

This article explores the significance of wet lab anatomy in anaesthesiology training, discusses the challenges associated with its use, and highlights recent advancements that have expanded its utility. By examining these aspects, this review aims to provide insights into how hands-on anatomical education can enhance the skillset and confidence of anaesthesia residents, ultimately improving patient care outcomes.

2. Discussion

2.1. The importance of anatomy in anaesthesia practice

The practice of anaesthesiology revolves around accurate identification and management of anatomical structures. For instance, regional anaesthesia techniques such as brachial plexus blocks or epidurals require precise needle placement, often guided by anatomical landmarks. Similarly, successful airway management hinges on an in-depth understanding of the laryngeal and tracheal anatomy to prevent complications such as intubation failure or airway trauma. Anaesthesia residents must also navigate anatomical variations, which can complicate even routine procedures.⁹

Wet lab anatomy offers a unique opportunity to develop these critical skills. By working with cadavers, residents can observe the natural relationships between nerves, vessels, and tissues, gaining a realistic understanding that is difficult to achieve through models or diagrams alone. Additionally, wet lab sessions allow residents to practice invasive procedures in a controlled environment, enabling them to refine their techniques before applying them in clinical settings.

2.2. Advancements in wet lab anatomy for anaesthesia training

Recent technological advancements have significantly enhanced the utility of wet lab anatomy in medical education. For instance, AR and VR tools have been developed to complement traditional cadaveric studies, allowing residents to visualize and interact with anatomical structures in three dimensions. These tools can overlay digital images onto cadavers, providing detailed insights into complex regions such as the brachial plexus or the lumbar spine.^{10–12}

High-fidelity simulation models are another important advancement. These models incorporate anatomical features derived from real patient data, offering a lifelike experience for practicing procedures such as intubation, central line placement, and nerve blocks. When combined with wet lab anatomy, these simulations allow for repetitive practice, helping residents build muscle memory and procedural confidence.

Hybrid models that blend cadaveric dissection with advanced imaging techniques, such as ultrasound-guided procedures, have also gained traction. These approaches help residents correlate anatomical landmarks with real-time imaging, a skill that is critical for modern anaesthesia practice.

2.3. Challenges in implementing wet lab anatomy in residency programs

Despite its benefits, several challenges limit the widespread use of wet lab anatomy in anaesthesiology training. Access to cadavers remains a significant barrier, particularly in countries where body donation programs are underdeveloped. Even when cadavers are available, maintaining them requires specialized facilities, preservation techniques, and trained personnel, all of which involve substantial costs. Ethical considerations also play a role, as cultural and religious beliefs can affect the acceptance of cadaver use in medical training. These concerns often lead to restrictions on the availability of specimens or the methods used in dissection.^{13,14}

Logistical challenges, such as scheduling wet lab sessions and ensuring adequate supervision, further complicate implementation. Many residency programs face constraints related to time and faculty availability, making it difficult to incorporate comprehensive wet lab training into already packed curricula.

2.4. Strategies to overcome barriers

Overcoming these challenges requires innovative and collaborative approaches. One potential solution is the development of body donation awareness programs to increase the availability of cadavers for educational use. Establishing regional wet lab centres that serve multiple

institutions can also help optimize resources and reduce costs. Investing in technology-driven solutions, such as VR and AR tools, can supplement cadaveric training and make hands-on education more accessible. These tools can be particularly valuable in resource-limited settings, where traditional wet lab facilities may not be feasible. Additionally, adopting cost-effective preservation methods, such as plastination, can help reduce the logistical burden associated with cadaver maintenance. Faculty development programs are equally important. Training educators to effectively facilitate wet lab sessions and integrate modern tools into the curriculum can enhance the overall learning experience for residents.¹⁵

2.5. Best practices for incorporating wet lab anatomy into anaesthesia training

To maximize the benefits of wet lab anatomy, residency programs should adopt structured and standardized approaches. This includes designing curricula that incorporate regular wet lab sessions, complemented by simulation-based training and imaging-guided techniques.¹⁶ Collaborative efforts between anatomy and anaesthesiology departments can further enhance the quality of training by fostering knowledge exchange and resource sharing. Regular assessments and feedback mechanisms should be implemented to evaluate the effectiveness of wet lab sessions and identify areas for improvement.

2.6. The future of anatomical training in anaesthesiology

The future of anatomical education in anaesthesiology lies in the integration of advanced technologies and collaborative strategies. Portable AR and VR devices are likely to become more affordable and widely available, making interactive learning accessible to a broader audience. Research into innovative preservation techniques and synthetic cadaver alternatives may also help address the challenges associated with traditional wet labs.¹⁷

Global collaboration among medical institutions can play a key role in advancing anatomical training. By sharing resources, best practices, and research findings, educators can create more effective and equitable training models.

The National Medical Commission (NMC) should consider incorporating anaesthesia resident training in the wet lab of anatomy departments as a formal part of the curriculum to enhance the procedural skills and anatomical knowledge of future anaesthesiologists. Such training would provide residents with a hands-on, practical understanding of complex anatomical structures essential for critical procedures, including regional anaesthesia, airway management, and vascular access. The use of cadaveric specimens in wet labs allows for a realistic and

tactile exploration of anatomical relationships, bridging the gap between textbook learning and clinical application. Additionally, integrating this concept with modern tools like ultrasound guidance and simulation could further enrich the learning experience, fostering greater accuracy and confidence among trainees. By introducing this innovative approach, the NMC would align anaesthesia education in India with global best practices, ensuring residents are better equipped to handle the demands of contemporary clinical practice while prioritizing patient safety.^{18,19}

3. Conclusion

Wet lab anatomy provides an essential foundation for enhancing the skills and confidence of anaesthesia residents. By offering a hands-on approach to understanding human anatomy, it bridges the gap between theoretical learning and clinical application. Recent technological advancements have further enriched this training method, making it more dynamic and effective. Addressing challenges such as resource constraints and ethical concerns will require innovative solutions and collaborative efforts. With its proven benefits, wet lab anatomy has the potential to revolutionize anaesthesiology education, ensuring that residents are well-prepared to deliver safe and effective patient care.

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5. Conflict of Interest

None.

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