

Effectual Postoperative Airway Management as the Product of Pre- Anaesthetic Assessment and Monitoring: A Narrative Review of Current Trends

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Abstract

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Pre-anaesthetic assessment and monitoring are critical, lifesaving components of perioperative care, particularly for patients with acute respiratory compromise in whom swift and effective securing of the airway is paramount. Although airway management is routine, tracheal intubation still carries a significant risk of complications, and effectual postoperative airway management depends substantially on the quality of pre-anaesthetic assessment and the continuity of monitoring. This review examines effectual postoperative airway management as the product of pre-anaesthetic assessment and monitoring, clarifying the underlying concepts, appraising current technological trends, and considering the implications for nursing practice. A narrative review methodology was adopted, in which peer-reviewed articles and reports were systematically retrieved and critically analysed. Telemedicine, artificial intelligence, point-of-care ultrasound, genetic testing, and wearable devices are emerging trends that enhance pre-anaesthetic assessment and monitoring and, in turn, postoperative airway outcomes. These innovations should be integrated into the nursing curriculum and supported by continuous professional training to strengthen nurses' service delivery and improve perioperative outcomes. Health system administrators should also formulate user-friendly, cost-effective policies that promote optimal uptake of these technologies among nurses, patients, and other members of the healthcare team.

Keywords: effectual airway management, pre-anaesthetic assessment, monitoring, artificial intelligence, point-of-care ultrasound, perioperative nursing,

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Introduction

Pre-anaesthetic assessment and monitoring of the patient's airway are crucial to the delivery of quality postoperative airway care. Airway management is a lifesaving skill in emergency situations where the airway needs to be secured quickly and effectively in patients with acute conditions where prompt and efficient airway management is essential (Olatunji et al., 2024). Intubation and other airway management procedures are performed in large numbers every year, and they are the cornerstone of patient care in emergency rooms, operating rooms, and intensive care units, all of which require adequate monitoring (Riveros-Perez et al., 2025).

Although routine, airway management, in particular intubation of the trachea, is associated with a high risk of complications, of the order of 5–8% (Riveros-Perez et al., 2025). In recent decades, the mortality rate for any kind of surgery, including anaesthetic-related mortality, has significantly reduced, which can be attributed to improved airway management, monitoring and training (Kristoffersen et al., 2022). However, the morbidity and mortality rates in non-surgical room anaesthetic such as after anaesthetic period have been reported higher (Herman et al., 2021). Good pre-assessment of the patient and careful and constant monitoring are important to the success of any anaesthetic episode.

An assessment of the patient prior to anaesthetic is a vital aspect of patient care which helps to optimise the management of the patient perioperatively. To minimise potential hazards, guide the use of anaesthetic approach and direct postoperative airway outcome, a thorough assessment of anaesthesia is required (Herman et al., 2021). Traditional pre-anaesthetic evaluation includes a comprehensive medical history, physical examination, airway examination which includes the Mallampati classification and LEMON method and radiological assessment of the airway (Kristoffersen et al., 2022). But, as pointed out by Heidegger and Pandit (2025), there are drawbacks to current clinical airway difficulty predictors, like the Mallampati or the Wilson risk assessment, as they are poorly sensitive and specific and so may fail to capture relevant information regarding the risk of airway challenges. This restriction highlights the necessity of discussion on effective postoperative airway management because of pre-anaesthetic evaluation and monitoring in this technologic era. This review therefore looks at the current trends of pre-anaesthetic assessment and monitoring for effective airway management.

Methods

A narrative review methodology was used to gather and critically analyse literature available on pre-anaesthetic assessment and monitoring and the correlation of the same to effective postoperative airway management. Peer-reviewed journal articles, reviews, and relevant reports were obtained from electronic databases and professional sources, focusing on recent literature on airway assessment, perioperative monitoring and new digital and technological innovations in anaesthesia. Relevant sources were identified and the results were categorised according to the main concepts of pre-anaesthetic assessment and monitoring, current technological trends, implications for nursing practice and recommendations for the way forward. Ethical approval was not required as this review did not involve human participants.

The Concept of Pre-Anaesthetic Assessment and Monitoring

Pre-Anaesthetic Assessment

Pre-anaesthetic evaluation is the initial of the number of anaesthetic actions taken with a patient. It aims at ascertaining the physical status of the patient before the surgery, analysing the type of surgery, predicting the complications that may occur before, during and after anaesthetic and preparing the relevant drugs and anaesthetic tools (Kulsum, 2020; Aderibigbe et al., 2024).

Optimising the patient involves obtaining a history that includes past and present medical and surgical history, family and social history and anaesthetic history to ensure safe and efficient anaesthetic practice. This type of history examines the entire body system to find

undiagnosed illnesses, especially those of the cardiovascular and respiratory systems. Physical examination and physical-status classification must not be overlooked and the assessment should include specific assessment of the airway, lungs and heart with the addition of laboratory examination. The type of operation, the operator's skill, the equipment available, the patient's age, sex, physical status, and the patient's needs are important factors to consider when administering anaesthesia and analgesia, as well as the skills and ability of the doctor providing the service (Kulsum, 2020).

In this regard, Kulsum (2020) stated the following points that should be examined at the time of physical examination before anaesthetic: Consciousness, respiratory frequency, blood pressure, pulse, body temperature, nutritional status or body mass index (BMI) considering the height and weight. Evaluation of teeth (including dentures, loose teeth, protruding teeth), mouth opening and the tongue is also part of it and can be done by calculating Mallampati score. These are useful to consider when predicting the difficulty of laryngoscopy and intubation, as a short, stiff neck may also pose challenges in laryngoscopy. After this, a detailed physical examination is carried out in a systematic manner throughout all the organ systems by inspection, palpation, percussion and auscultation.

Mallampati assessment. In the Mallampati assessment, the patient is asked to open the mouth and maximally protrude the tongue. The view of the pharyngeal structures is noted and graded from I to IV, with grades III and IV suggesting difficult intubation.

Monitoring

Peri-anaesthetic monitoring is traditionally done following a few patterns as described below. Vital signs monitoring: A proper pre-anaesthetic assessment and monitoring of the patient's airway allow the practitioner to ensure that the airway is patent and that the patient can protect their airway with an effective cough and gag reflex after anaesthetic. Basic vital signs monitoring involves checking the chest wall rises and falls normally, that there is any movement of the chest wall, or the signs of respiratory distress; listening for air entry/exit on both sides and hearing any added sounds; and feeling for breath at the nose or mouth (Resuscitation Council UK, 2021). Further, monitoring arterial blood oxygen saturation (usually by pulse oximetry), in combination with blood gas analysis, gives indications of respiratory dysfunction with hypoxia. The parameters for close peri-anaesthetic monitoring are oxygen saturation less than 90%, PaO₂ less than 60 mmHg (on 40% oxygen), respiratory rate more than 35 per minute, PaCO₂ more than 55 mmHg and VC less than 15 mL/kg.

Pulse oximetry: The pulse oximeter is a basic and reliable instrument for estimating arterial blood oxygen saturation and is routinely used by nurses to assess patients after surgery. The probe contains two components; the light emitting diodes and a light detector and will detect both saturation and pulse as the light beam passes through the tissue from one side of the probe to the other. Bright lights (e.g. operating theatre lights directly on the probe) can interfere with the correct functioning of the pulse oximeter; shivering may prevent the probe from acquiring the signal; low blood pressure (hypovolaemic shock, low cardiac output, arrhythmia) may make it harder to detect the signal. Vasoconstriction (which decreases peripheral blood flow) and hypothermia can also interfere with good signal detection, as can carbon monoxide and nail polish (World Health Organization, 2011). Therefore, it is important for the nurse to be careful in positioning the probe and in reading the results from it to get an accurate reading of the oxygen saturation level.

Capnography: Capnography is used in the peri-anaesthetic phase to help monitor the airway to assess respiratory function and ventilation. It quantifies the amount of carbon dioxide in every cycle of expiration and is a good indicator of acute respiratory acidosis. Capnography can be used either by a portable handheld device in intubated or non-intubated patients (Barbara, 2019). Other devices that are used for close monitoring include the multiparameter

monitor and the electrocardiogram machine, which can show early signs of respiratory deterioration that accompany cardiac deterioration.

Current Trends in Pre-Anaesthetic Assessment and Monitoring

The introduction of digital health technologies, such as telemedicine, health apps, and AI has transformed the entire pre-op assessment and monitoring process, including pre-anaesthetic care, that play a crucial role in determining the outcome of airway management (Viteri Hinojosa, 2024).

Telemedicine

Through telemedicine, patients can be examined and consulted with before surgery without having to travel to the physician's office (Viteri Hinojosa, 2024). Health applications also allow patients to evaluate themselves and comprehend their symptoms without needing to go to a health centre, helping them to be actively involved in every phase of their health care, including the pre-operative phase, rather than feeling lost or abandoned (Viteri Hinojosa, 2024).

Artificial Intelligence

With the advent of artificial intelligence, anaesthetic safety has been improved, with equipment efficiency, assessment of perioperative risk, monitoring, pain management, and drug-administration systems being among the areas where AI has had a positive impact (Hashimoto et al., 2020). AI has been identified to offer solutions to the challenges faced in airway management, including facemask ventilation and intubation of an artificial airway (Song et al., 2023; Tubić et al., 2025). Artificial Intelligence comprises of machine learning, deep learning, natural language processing, speech identification, and image identification. Although there are clear guidelines and protocols, failed airway management can still result in life-threatening complications (Naik et al., 2024), and the use of AI might be able to overcome perceived difficulties during airway management (Xia, 2023).

Artificial Intelligence algorithms can analyze a wide range of patient data, including electronic health records, facial appearance, investigations and genetic information, to stratify and predict complications, and to tailor anaesthetic techniques based on individual patient characteristics for improved post-anaesthetic airway outcomes. AI can also be used for data-processing and decision-making support, and to give recommendations to clinicians based on high-level evidence (Kristoffersen et al., 2022). In addition, a new non-invasive positive pressure system with a pair of snake arms and a mask-fixing mechanism that raises the patient's jaw has been developed: This assists in opening the upper airway and allows the smooth transmission of air through the facemask, thereby aiding in the management of the airway in the trachea and improving the surgical results.

In anaesthetic practice, various studies have tried to integrate artificial-intelligence algorithms into existing video-laryngoscopes, to enhance the visualization of upper-airway structures in real time (Naik et al., 2024). To overcome the manual quantification of the vocal-fold movement from previously recorded video laryngoscopy examinations, Adamian et al. (2021) developed a user-friendly software tool, which was called automated glottic action tracking using artificial intelligence. These tools might be useful in challenging airway situations (Adamian et al., 2021; De Rosa et al., 2025).

Wearable Devices

Other emerging trends in pre-anaesthetic assessment that can improve outcomes related to the airway are wearable devices like point-of-care testing devices and wearable biosensors that can monitor physiological parameters in real-time. They help to identify early post-op issues and intervene in a timely fashion. Wearable biosensors can be used to investigate a patient's physical state, including symptoms of sleep disturbance and vital signs, before anaesthesia, which can improve the evaluation of risk factors for airway challenges and airway management planning before anaesthesia (Le Guen et al., 2020). Eddahchouri et al.

(2022) found that one wearable device worn on the wrist tracked the patient's ventilatory frequency, heart rate, blood pressure, and oxygen saturation every minute and the data was continuously transferred to the electronic health record.

Genetic Testing

The idea of genetics relates to the changes in the DNA sequence that can lead to changes in the expression of genes and therefore to particular conditions or predispose the person to such conditions (Maritska et al., 2022). The recent introduction of genetic testing as part of pre-op assessment allows the identification of inherited traits, characteristics, and predisposing factors which impact drug metabolism, sensitivity to anaesthetic agents, and risk of developing airway complications during and following anaesthetic. This information enhances the anaesthetist's ability to plan for individualised care (Kahl et al., 2024).

Care of patients with unusual genetic disease that may be associated with a congenital anomaly should start at the pre-op stage with thorough analysis and identification of the co-existing disease, as many of the congenital anomalies are interconnected including airway abnormalities. Difficult facemask ventilation and intubation have been noted to be more likely in patients with airway abnormalities. These abnormalities can be due to bronchopulmonary hypoplasia, abnormalities in the respiratory drive, gastroesophageal reflux and skeletal abnormalities, including vertebral and craniofacial abnormalities, of genetic origin. In these circumstances, the anaesthesiologist should evaluate the airway for difficult intubation or ventilation prior to the use of neuromuscular blocking agents, be vigilant to monitor the airway before and after anaesthesia, have equipment ready for difficult airway and should take precaution in positioning and care during intubation (Oliveira & Degrandi, 2019).

In addition, anaesthesiologists need to carefully choose a muscle relaxant in patients with genetic defects of the neuromuscular junction. Non-depolarising muscle relaxants may have a prolonged and exaggerated effect on hypotonic patients with central nervous system disorders and may impair breathing; on the other hand, succinylcholine may cause prolonged muscle relaxation and cardiac arrhythmias, increase potassium, cause muscle fasciculation, malignant hyperthermia and joint stiffness (Oliveira & Degrandi, 2019).

Pre-Anaesthesia Assessment Clinic

With the growing number of patients who need surgery, the use of the pre-anaesthesia assessment clinic is growing as a way of managing the increased numbers (Sarkis-Onofre et al., 2021). This clinic identifies risk factors for anaesthesia and high-risk patients, enhances patient outcomes, and prepares the patient physically and psychologically for anaesthesia (Manjit et al., 2022; Metterlein et al., 2021). It emphasizes interviewing and examination of the patient, history of previous medical, surgical and anaesthetic problems, enquiry of current medications and assessment of all laboratory and radiological investigations which may influence airway management during and after surgery (Kristoffersen et al., 2022). The pre-anaesthesia assessment clinic also prepares health care workers for intraoperative and postoperative airway emergencies, with effective communication and coordination (Kristoffersen et al., 2022).

Airway Ultrasound and Point-of-Care Ultrasound

Ultrasound imaging is the use of high frequency sound waves to create real-time images of anatomy. Wave reflection at tissue interfaces depends on the acoustic impedance of the medium, which is related to tissue density (Riveros-Perez et al., 2025). This acoustic property when used for airway evaluation can differentiate between soft tissue, cartilage, bone, and conductive airways, providing a dynamic assessment of the airway, which can help identify a difficult airway and potential postoperative airway emergencies (Riveros-Perez et al., 2025). Linear and curvilinear transducers provide the image resolution required to assess the superficial structures including the cricothyroid membrane, vocal cords, epiglottis, base of the tongue and the hyomental distance (Lin et al., 2023). This examination helps the anaesthetist

predict the potential postoperative airway problems. For example, postoperative airway oedema is a major concern in patients with prolonged intubation, airway trauma, and/or intraoperative fluid shifts, and airway ultrasound improves clinical decision making and objectively evaluates airway oedema to optimize extubation outcomes (Kwon et al., 2019). Point of care ultrasound is an inexpensive, readily available, portable and convenient diagnostic modality which complements assessment and decreases the number of imaging tests required by a patient (Courteney et al., 2024). It is performed at the bedside with a portable ultrasonography machine or handheld device to aid with clinical diagnosis (Courteney et al., 2024). A recent study has shown that POCUS can be used to detect postoperative increase in parapharyngeal thickness, lateral pharyngeal wall thickness, and neck circumference, which are related to intraoperative fluid administration, indicating that POCUS is useful for detecting airway oedema (Aytac & Soyal, 2023).

Implications for Nursing

The use of genomic data is becoming more integrated into patient care plans and is used to guide interventions specific to a patient's genetic profile. This personalised approach enhances the precision of treatments, medication management, and preventive measures. Additionally, nurses work with other health care professionals to integrate genomic information into comprehensive care for their patients; in this capacity, it is important that they inform their patients of the implications of genetic testing, the possible outcomes, and the benefits and risks. The informed-consent processes should be thorough, with consideration for the sensitive nature of genomic information and its impact on patients and families. Given the sensitivity of genomic information, nurses must maintain confidentiality in the storage and sharing of genetic information with other entities to ensure patient privacy, support policies that protect genetic information, and educate patients about considerations for disclosure within the family.

Furthermore, AI can significantly minimize administrative workloads, enhance clinical decisions, and aid in remote patient monitoring. It also offers a significant potential for enhancing work-life balance for nurses; thus, by recognizing the potential of AI in airway management, nurses can shape a brighter future for themselves and their patients. Nurses should therefore be informed about the latest trend of Artificial Intelligence and always improve themselves.

As for wearable devices, these can enable a pro-active approach to monitoring patients; increase engagement between nurse and patient; offer a more personalised approach to care; and enable early intervention in the provision of effective airway management.

The Way Forward

In the light of the current trend of healthcare technology, the concepts and applications of Artificial Intelligence (AI) should be taught in the nursing curriculum to improve the quality of care delivered by nurses and better outcomes of the surgical interventions. Nurse education programs in this area need to be ongoing and awareness of new technologies for peri-operative care should be generated to ensure that they stay up to date on new norms and practices. Lastly, healthcare system administrators should develop policies that are easy to follow and affordable for both patients and healthcare staff, including nurses, to encourage the best use of these current trends in the perioperative care of patients.

Conclusion

Pre-anaesthetic evaluation is an important initial step in the series of anaesthetic procedures which are carried out on patients who are slated for surgery. Effective airway management involves pre-anaesthetic assessment and close monitoring, including history taking, physical examination and physical-status classification and involves preparations at the clinic or at home (outpatients), in the treatment room and in the operating room. Anaesthesia does not depend on the extent of operation performed, and indeed the choice of anaesthetic technique

is comprehensive and complex, with all types of anaesthetic having risk factors for complications which could threaten the life of the patient, particularly relating to the airway. Innovations like artificial intelligence, genetic testing, point-of-care ultrasound and wearable monitoring devices will allow efficient pre-anaesthetic assessment and continuous monitoring of vital signs, then wirelessly transfer the data to the electronic health record, and ultimately help to keep the airway safer, without unplanned airway events.

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