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Original article

Assessment of Airway Management Knowledge among Final-Year Anesthesia Students and Anesthesia Internship Trainees

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Abstract
Airway management is a cornerstone of anesthesia practice, essential for ensuring patient safety during surgical procedures, emergencies, and critical care interventions. This study assessed the knowledge, confidence, and educational experiences of final-year anesthesia students and internship trainees in Libyan universities. Using a descriptive cross-sectional survey, data were collected from multiple institutions through a structured questionnaire addressing theoretical understanding, practical skills, and sources of training. Results revealed satisfactory knowledge in basic principles such as pre-oxygenation and patient positioning, but significant deficiencies in applied areas including the ASA difficult airway algorithm and complication management. Confidence levels were highest in basic procedures like bag-mask ventilation, while advanced tasks such as intubation and emergency airway interventions elicited lower confidence. The findings highlighted systemic gaps in training, with overreliance on lectures and limited access to simulation-based education. Students strongly advocated for early practical exposure, structured hospital training, and competency-based assessments. The study concludes that airway management education in Libya requires reform, emphasizing simulation, mentorship, and modern educational tools to bridge the gap between theory and practice, thereby aligning local curricula with international standards and improving patient safety outcomes.
Keywords. Airway, Anesthesia, Students, Knowledge.

Introduction

Airway management is a fundamental component of anesthesia practice and plays a crucial role in maintaining patient safety during surgical procedures, emergencies, and critical care interventions. The primary objective of airway management is to ensure adequate oxygenation and ventilation by maintaining a patent airway throughout patient care. Failure to establish or maintain an airway may result in severe complications such as hypoxia, aspiration, cardiac arrest, neurological damage, and death [1].

The ability to assess, secure, and manage the airway is considered one of the most important competencies required of anesthesia providers. Airway management includes a range of skills and procedures such as airway assessment, bag-mask ventilation, insertion of supraglottic airway devices, endotracheal intubation, and management of difficult airways. These skills require both theoretical knowledge and practical experience to ensure safe and effective patient care [2].

Despite major advances in airway management techniques and equipment, airway-related complications remain a significant cause of anesthesia-related morbidity and mortality worldwide. Research has shown that inadequate training, insufficient clinical experience, and poor adherence to airway management guidelines contribute substantially to adverse patient outcomes. Consequently, airway management education has become a major focus of anesthesia training programs internationally [3].

In recent years, anesthesia education has increasingly emphasized competency-based learning, which focuses on the development of practical skills in addition to theoretical understanding. Simulation-based education has become an important training strategy because it allows students to practice airway management techniques in a safe environment without risking patient safety. Numerous studies have demonstrated that simulation training improves technical competence, confidence, decision-making skills, and overall clinical performance among anesthesia trainees [4].

However, access to simulation facilities and advanced airway training resources remains limited in many low- and middle-income countries. In such settings, anesthesia education often depends heavily on traditional classroom teaching and hospital-based clinical exposure. Although these methods provide valuable knowledge, they may not always offer sufficient opportunities for repeated practice and skill development, particularly in managing difficult airway situations and emergencies [5].

In Libya, anesthesia students receive theoretical and clinical training through universities and healthcare institutions. Nevertheless, differences in available resources, clinical exposure, supervision, and educational facilities may influence the quality of airway

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management training received by students. Furthermore, limited local research has been conducted to evaluate the effectiveness of current educational approaches and the level of preparedness of anesthesia trainees [6].

Assessing students' knowledge and confidence in airway management is essential for identifying strengths and weaknesses within existing educational programs. Such evaluation can provide valuable information for educators and policymakers seeking to improve training quality and align anesthesia curricula with international standards. Therefore, this study aims to assess airway management knowledge among final-year anesthesia students and anesthesia internship trainees in Libyan universities and to identify potential areas for educational improvement [7].

Methods

Study Design

This study employed a descriptive cross-sectional survey design to assess airway management knowledge, practical skills, and self-perceived confidence among final-year anesthesia students and anesthesia internship trainees in Libya.

Study Setting

The study was conducted among final-year anesthesia students and anesthesia internship trainees from several Libyan universities offering anesthesia and intensive care programs. These institutions represent different geographical regions of Libya and contribute significantly to the education and training of future anesthesia providers.

The participating universities included the University of Tripoli, University of Benghazi, University of Misurata, University of Sabha, University of Al-Zawiya, University of Al-Zaytuna, University of Sirte, and the Faculty of Applied Technology – Al-Awat. Inclusion of multiple institutions was intended to improve the diversity of the sample and provide a broader understanding of airway management education across Libya.

Study Population

The study population consisted of final-year anesthesia students and anesthesia internship trainees enrolled in participating Libyan universities during the academic year 2025–2026.

These participants were selected because they represent the final stages of anesthesia education and are expected to possess sufficient theoretical knowledge and varying degrees of clinical experience in airway management. Their perspectives are particularly valuable because they are approaching independent clinical practice and can provide meaningful insight into the strengths and limitations of their educational experiences.

Eligibility Criteria

Participants were eligible to participate if they were final-year anesthesia students or anesthesia internship trainees currently enrolled in one of the selected Libyan universities. In addition, participants were required to provide informed consent and complete the questionnaire voluntarily.

Certain individuals were excluded from participation to maintain the accuracy and relevance of the collected data. Students enrolled in academic years below the final year were excluded because they may not yet have received sufficient airway management training. Individuals from disciplines other than anesthesia were also excluded. Furthermore, questionnaires that were incomplete or contained significant missing data were excluded from the final analysis. Participants who declined to provide consent or withdrew from the study at any stage were also excluded.

Sampling Technique and Sample Size

A convenience sampling technique was used to recruit participants from the selected universities. This method was chosen because it allowed efficient access to students and internship trainees from different institutions within the available timeframe.

The questionnaire was distributed electronically through academic groups, social media platforms, and communication channels commonly used by anesthesia students. The use of online distribution facilitated broader participation and increased accessibility for students located in different geographical regions.

The sample comprised all eligible participants who completed the questionnaire during the data collection period. Efforts were made to maximize participation by encouraging students and trainees to share the survey with their colleagues.

Data Collection Tool

Data were collected using a structured questionnaire developed after reviewing relevant literature and international airway management guidelines. The questionnaire was designed to assess participants' demographic characteristics, theoretical knowledge, practical confidence, and educational experiences related to airway management.

The questionnaire consisted of four major sections. The first section was for general information about participants, including age, gender, university affiliation, and academic level. These variables were included to describe the study population and allow comparison between different participant groups. The second section contained multiple questions evaluating participants' understanding of important airway management concepts. Areas assessed included airway assessment methods, difficult airway predictors, airway devices, patient positioning, pre-oxygenation, rapid sequence

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intubation, difficult airway algorithms, and common complications associated with airway management.

The questions were developed to measure the extent of participants' theoretical understanding of fundamental airway management principles.

Participants were asked to evaluate their confidence in performing various airway management procedures using a five-point Likert scale. Skills assessed included bag-mask ventilation, insertion of supraglottic airway devices, endotracheal intubation, airway assessment, management of difficult airways, and emergency airway interventions. The confidence scale ranged from: 1 = Not confident at all, 2 = Slightly confident, 3 = Moderately confident, 4 = Confident, 5 = Very confident.

The final section explored participants' educational experiences and sources of airway management knowledge. Participants were asked about the role of lectures, clinical training, simulation laboratories, online learning resources, textbooks, and workshops in developing their airway management skills.

In addition, open-ended questions were included to allow participants to provide suggestions regarding improvements in anesthesia education and airway management training.

Data Collection Procedure

Data collection was conducted using an electronic questionnaire distributed through online platforms. Prior to participation, students were provided with a brief explanation of the study objectives, procedures, and expected duration of questionnaire completion.

Participants who agreed to participate provided informed consent electronically before proceeding to the survey questions. The questionnaire was designed to be anonymous, ensuring that no personally identifiable information was collected.

Data collection took place during the academic year 2025–2026. Responses were collected and stored securely for analysis.

Data Analysis

After completion of data collection, responses were reviewed for completeness and accuracy. The collected data were entered into a computerized database for analysis.

Descriptive statistical methods were used to summarize participant characteristics and questionnaire responses. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were used where appropriate.

Ethical Considerations

Ethical approval for the study was obtained from the appropriate academic authority before the commencement of data collection. All participants were informed about the purpose of the study and their right to participate voluntarily.

Confidentiality and anonymity were maintained throughout the research process. No personal identifiers were collected, and all responses were treated as strictly confidential. Participants were informed that they could withdraw from the study at any time without any consequences.

The study was conducted in accordance with ethical principles governing research involving human participants, including respect for autonomy, confidentiality, voluntary participation, and protection of participant information.

Results

Figure 1 illustrates the distribution of participants according to university. The highest proportion of participants was from the University of Tripoli (46.8%), followed by the University of Benghazi (11.9%), while both the University of Sabha and the University of Al-Zawiya represented 10.1% each. The University of Misurata and the University of Al-Zaytuna each accounted for 6.4% of participants. A small number of participants were recruited from other Libyan institutions, including El-Mergib University, the University of Sirte, and Sabratha University.

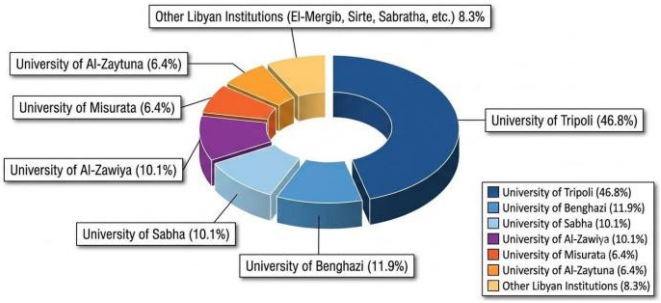

Figure (1): Distribution of Participants by University

Figure (2) presents the educational status of the study participants. Most respondents were Final-Year Anesthesia Students (59.6%), whereas 40.4% were Anesthesia Internship Trainees. This distribution provided representation from both senior undergraduate students and recent graduates undergoing internship training.

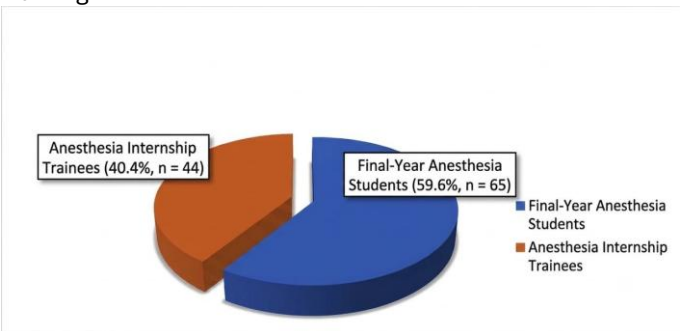

Figure (2): Educational Level / Status

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Figure (3) shows the gender distribution of participants. Females constituted the majority of the study sample (80.7%, n = 88), while males represented 19.3% (n = 21). This indicates a predominance of female students within the participating anesthesia programs.

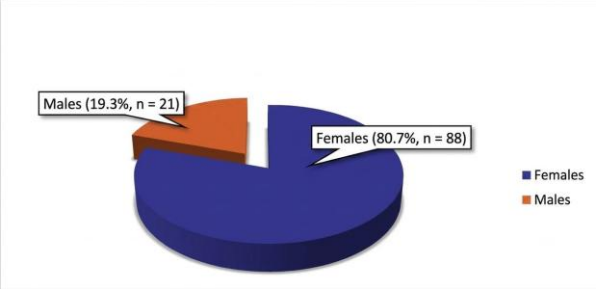

Figure (3): Gender Distribution

Table 1 demonstrates that theoretical understanding among Libyan anesthesia students and trainees is generally satisfactory, particularly regarding pre-oxygenation and patient positioning. However, the low accuracy in identifying the ASA difficult airway algorithm and common complications indicates a gap in applied clinical reasoning. The pattern suggests that while memorization of basic principles is strong, integration of algorithmic decision-making remains limited.

Table 1. Theoretical Knowledge of Airway Management

Knowledge Area	Correct Responses (%)	Common Errors
Indicators of a difficult airway	72% (mostly "All of the above")	Limited neck mobility, small mouth opening
Goal of pre-oxygenation	85% ("Increase oxygen reserve")	"Prevent vomiting"
Device for an unconscious patient	40% (Oropharyngeal Airway most frequent)	Confusion between LMA, ETT, NPA
Rapid Sequence Intubation (RSI)	60% ("All of the above")	Misidentification of the induction agent only
ASA difficult airway algorithm	35% correct ("Attempt → alternative → surgical airway")	"I do not know" frequently
A common complication of intubation	55% (Hypoxia, trauma to vocal cords)	Bronchospasm, vomiting
Ideal patient position	78% ("Head-elevated, sniffing")	Supine flat, lateral

The data in Table 2 reveal a pronounced imbalance between theoretical and practical learning. Over two-thirds of respondents reported inadequate hands-on exposure, and 70% emphasized excessive theoretical focus. This highlights a systemic issue in curriculum design, where simulation and clinical immersion are underutilized. The findings underscore the need for competency-based education rather than purely didactic instruction.

Table 2. Theoretical Knowledge of Airway Management

Knowledge Area	Correct Responses (%)	Common Errors
Indicators of difficult airway	72% (mostly "All of the above")	Limited neck mobility, small mouth opening
Goal of pre-oxygenation	85% ("Increase oxygen reserve")	"Prevent vomiting"
Device for unconscious patient	40% (Oropharyngeal Airway most frequent)	Confusion between LMA, ETT, NPA
Rapid Sequence Intubation (RSI)	60% ("All of the above")	Misidentification of induction agent only
ASA difficult airway algorithm	35% correct ("Attempt → alternative → surgical airway")	"I do not know" frequent
Common complication of intubation	55% (Hypoxia, trauma to vocal cords)	Bronchospasm, vomiting
Ideal patient position	78% ("Head-elevated, sniffing")	Supine flat, lateral

The pie chart shows that university lectures remain the dominant source of knowledge (65%), followed by hospital training (58%). Simulation labs and external courses contribute minimally, reflecting limited access to modern educational tools. This imbalance suggests that experiential learning opportunities are insufficiently integrated into the academic framework, reducing skill retention and confidence.

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Table 3. Deficiencies in Education & Training

Training Aspect	Reported Deficiency (%)
Lack of practical/hands-on training	68%
Limited simulation exposure	55%
Insufficient clinical exposure	60%
Weak integration of DAS/ASA algorithms	40%
Overemphasis on theory vs practice	70%

Confidence levels vary significantly across procedures. Students feel most assured in-patient positioning and bag-mask ventilation, yet less confident in advanced tasks such as intubation and emergency airway management. The inverse relationship between theoretical knowledge and procedural confidence implies that exposure and repetition are key determinants of competence. Structured supervision during clinical rotations could mitigate this gap.

Table 4. Adequacy of Clinical Exposure

Source of Knowledge	% of Students Reporting
University lectures	65%
Hospital clinical training	58%
Online courses/videos	40%
Simulation labs	20%
Textbooks/articles	25%
External courses	15%

Respondents consistently advocate for simulation-based learning (70%) and hands-on workshops (65%), emphasizing early practical exposure and structured hospital training. These recommendations align with global best practices in anesthesia education. The emphasis on competency assessment and team-based protocols reflects awareness of patient safety culture and multidisciplinary collaboration.

Table 5. Recommendations for Improvement

Recommendation	Frequency (%)
Simulation-based training	70%
Hands-on workshops	65%
Early practical exposure (from 5th–6th semester)	55%
Structured hospital training	60%
Regular competency assessments	45%
Team-based training & protocols	40%
Use of modern devices (video laryngoscopes, endoscopes)	35%

Discussion

The survey results reveal a consistent imbalance between theoretical knowledge and practical competence. While students demonstrate strong recall of basic principles such as pre-oxygenation and patient positioning, their limited mastery of structured algorithms and complication management reflects a lack of experiential reinforcement. This is consistent with international findings that theoretical instruction alone cannot ensure competence in high-risk procedures like airway management [8,9].

The confidence gradient observed—high in basic tasks, low in advanced procedures—underscores the importance of repeated supervised practice. Evidence shows that confidence is not merely a psychological construct but a predictor of performance under stress [10]. Inadequate exposure to real or simulated emergencies leaves trainees vulnerable to hesitation and error, particularly in time-critical scenarios such as failed intubation.

The deficiencies in training highlight systemic curricular gaps. Overemphasis on lectures (65%) and underutilization of simulation (20%) suggest a traditional model that prioritizes knowledge transmission over skill acquisition. This imbalance is particularly concerning given that airway emergencies are rare but catastrophic events, requiring preparedness beyond theoretical familiarity [11]. In low-resource settings, where access to advanced simulation tools is limited, structured mentorship and low-cost simulation alternatives have been recommended as viable strategies [11].

The clinical exposure data further emphasize the reliance on hospital rotations, which, while valuable, are often inconsistent and dependent on case availability. Without structured competency assessments, students may complete training with significant variability in skill acquisition. Literature supports the integration of standardized checklists and competency-based evaluations to ensure uniform proficiency across cohorts [12].

The student recommendations—simulation, workshops, early exposure, and structured hospital training—reflect an awareness of global best practices. Their emphasis on team-based training and modern devices (video laryngoscopes, flexible endoscopes) aligns with contemporary approaches that prioritize both technical and non-technical skills. Team-based simulation, in particular, has been shown to improve communication, reduce cognitive overload, and enhance patient safety during airway crises [13].

From a broader perspective, these findings highlight the need for curricular reform in Libyan anesthesia education. The integration of high-fidelity simulation, competency-based assessments, and structured mentorship would bridge the gap between theory and practice. Moreover, fostering a culture of continuous

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learning—through external courses, interdisciplinary workshops, and modern educational tools—would align local training with international standards. Such reforms are not merely academic but directly linked to patient safety outcomes, as inadequate airway management remains a leading cause of anesthesia-related morbidity and mortality [13].

Conclusion

In conclusion, the findings call for a paradigm shift in airway management education in Libya—from a predominantly theoretical model to a competency-driven, practice-oriented framework. By embracing simulation, structured mentorship, and continuous assessment, Libyan universities can ensure that their graduates are not only knowledgeable but also clinically competent, confident, and prepared to manage airway emergencies effectively. This transformation is essential to safeguard patients, empower trainees, and advance anesthesia education in line with international benchmarks.

Conflict of interest. Nil

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