Basic Airway Management For Non-Anesthesia Operating Room Personnel: Education Implementation

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Abstract

A review of basic airway management for non-anesthesia personnel is presented. Included is a literature review of 20 articles surrounding the most current literature on preoperative airway assessment, cricoid pressure, video laryngoscopy, adjuncts for airway management, and airway management education for non-anesthesia health-care personnel. Following the review, an in-service style education presentation was developed and implemented at two sites in Maine. A pre- and post-test evaluation of the participants demonstrated an overall increase in test scores of 22%.

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Introduction

The goals of this literature review are to further explore the research surrounding airway management, and education for non-anesthesia operating room personnel, including circulating and scrub nurses, and technicians. Using the findings from this review I will develop a basic airway management in-service for this population, implement it, and evaluate its efficacy.

Methods

The articles for this literature review were obtained through online databases including the Cumulative Index of Nursing and Allied Health Literature (CINAHL), MEDLINE complete, MEDLINE with full text, and the Cochrane Collection Plus. All databases were searched using the keyword phrases: airway assessment efficacy, airway management education, cricoid pressure education, video laryngoscope, face mask ventilation, and airway adjuncts. A total of 701 articles were found with the initial search. Articles were selected based on their relevance to the stated goal, resulting in 20 articles being included in this review.

Section 1.01 Preoperative Airway Assessment

The fundamentals of airway management begin with the ability to predict a difficult airway. Prediction of a difficult airway allows the provider to be better prepared for the interventions that may be necessary to secure said airway. The incidence of a cannot intubate situation in elective surgery cases is 1 in 1000; this rate of failed intubation rises in the incidence of rapid sequence intubation and intubations attempted in emergencies (Popovici & Mitre, 2018). One of the most common scoring tools for airway evaluation is the L-E-M-O-N scoring system, an acronym for look, evaluate, Mallampati, obstruction, and neck mobility (Mshelia et al., 2018).

Employing the tool, providers must first look for four things: facial trauma, large incisors, facial hair, and tongue size relative to the oral cavity. Second, evaluation includes inter-incisor, hyomental, and thyromental distances. The inter-incisor distance should ideally be greater than three finger breadths, while the hyomental distance should be greater than three finger breadths, and finally, the distance from the floor of the mouth to the thyroid cartilage should be at least two finger breadths. This second step is known as the "3-3-2 rule". Third, Mallampati quantifies visualization of the uvula, and soft and hard palates (see *Figure 1*).

Fourth, obstruction covers anything that may occlude the airway, including but not limited to tumors, foreign bodies, and obstructive sleep apnea (OSA). Finally, neck mobility assesses the patient's ability to extend the neck into the sniffing position for intubation (Mshelia et al., 2018).

The efficacy of the anesthesia provider's ability to predict a difficult airway is a topic that has been studied at length. Most results are underwhelming, and an argument could be made that many individual methods of airway evaluation are ineffective or have poor predictive value. The prospective observational study by Mshelia et al. (2018) demonstrated that when the L-E-M-O-N criteria are used individually their positive predictive value (PPV) is not ideal. The highest PPV was 66% in the large tongue category, the next highest dropping significantly to 31.25% in the inter-incisor distance category. However, the same study concludes that when used together instead of individually, the L-E-M-O-N criteria demonstrated a statistically significant correlation between a high score and difficult intubation.

One test not included in the L-E-M-O-N criteria is the upper lip bite test (ULBT). The ULBT is an assessment of the patient's ability to protrude the mandible, measured by the relation of the lower incisors with the upper lip. There are three classes of the ULBT scoring system: Class I, lower incisors can bite the upper lip above the vermilion line; Class II, lower incisors can bite the upper lip but not cross the vermilion line; Class III, the lower incisors cannot bite the upper lip at all. By utilizing this scale, a patient with a Class III result is predicted to have a difficult airway (ULBT).

A study evaluating the PPV of the ULBT was performed by Bukhari et al. (2018). They concluded that the PPV of the ULBT was statistically significant. However, the study only included 283 patients, with nine of those patients having a difficult airway. The authors concluded that the PPV was 69.2%, only 3.2% greater than the large tongue category researched by Mshelia et al (2018) which was found to not be statistically significant.

In a much larger study of 3,383 patients undergoing mask ventilation and attempted endotracheal intubation, Norskov et al. (2014) found that 93% of difficult airways were unpredicted by anesthesia providers. Of those airways predicted to be difficult, only 25% proved to qualify as difficult intubations.

A Cochrane systematic review performed in 2019 by Roth et al. with a total of 844,206 cases, concluded that bedside screening tests were not a good predictor of difficult intubation. They described a success rate of prediction for difficult direct laryngoscopy (DL) of 22-63% and the prediction of tube placement of 24-51%. These findings correlate with Norskov et al. (2014) and the predictive values of the L-E-M-O-N screening tool when used individually studied by Mshelia et al. (2018).

Another major factor in airway management is the ability to mask ventilate a patient. In the event of a cannot intubate situation, the ability to mask ventilate is vital for the patient's survival. Two of the studies included in the review assessed the anesthesia provider's ability to predict difficult mask ventilation using preoperative bedside assessment. In the study by Norskov et al. (2014) discussed previously 94% of difficult mask ventilation cases were unpredicted and the positive predictive value for difficult mask ventilation was 22%. Roth et al. (2019) found that difficult mask ventilation was only successfully predicted 17% of the time.

The research surrounding the PPV of bedside airway exams demonstrates that there is poor efficacy of these tests. One study found that by using the multiple criteria included in the L-E-M-O-N evaluation tool providers could better predict a difficult airway (Mshelia et al., 2018). Another study found that the single ULBT could successfully predict a difficult airway 69.2% of the time (Bukhari et al., 2018). Further research is required on these two specific bedside tests as the number of participants was small relative to the studies that demonstrated poor efficacy of anesthesia provider's ability to predict difficult intubation. The two studies that addressed the PPV of preoperative assessments for difficult mask ventilation found that the value ranged from 17% by Norskov et al (2014) and 22% by Roth et al. (2018).

It could be concluded that, overall, bedside tests have poor PPV for a difficult airway; however, the tests with the best PPV according to current research include the L-E-M-O-N scoring system as well as the upper-lip bite test. The positive predictive value of bedside assessments for difficult mask ventilation is poor, and the overwhelming majority of difficult mask ventilation cases are not predicted.

Cricoid Pressure Knowledge and Education

The practice of providing cricoid pressure during rapid sequence induction (RSI) has been taught and implemented for many years. The theory behind the maneuver is that it can displace the cricoid cartilage posteriorly enough to occlude the esophagus and prevent aspiration of gastric contents (See Figure 2). Proper implementation requires the ability to locate the cricoid cartilage, a knowledge of the appropriate amount of pressure to apply before and after induction (10 Newtons and 20-30 Newtons respectively). Providers must also know to only release the pressure after successful intubation has been verified (Parry, 2009). However, a lack of proper education and working knowledge among providers has led many to question if the maneuver is effective or even necessary.

Multiple studies have found a lack of knowledge among health-care providers on how to properly apply cricoid pressure. A systematic review and meta-analysis of nine studies was performed by Beckford et al. in 2018. In eight out of the nine studies reviewed, knowledge regarding the proper technique for cricoid pressure was lacking among providers. A 2009 literature review by Parry also found that there was a lack of knowledge among health-care professionals regarding cricoid pressure.

A Pakistani national survey by Butt and Hoda (2019) found that although cricoid pressure was commonly used among providers, knowledge regarding its proper implementation was lacking. Their survey of 212 anesthesia providers found that 197 out of 210 participants routinely used cricoid pressure. However, the same sample group correctly answered only 17% of knowledge-based questions. When asked about their education surrounding the subject, 9% had manikin training alone, 35.4% had only book knowledge of the maneuver, and 55% had supervised instruction on an actual patient.

Due to this lapse in knowledge, Beckford et al. (2018) and Parry (2009) both reference a need for further education on the topic for healthcare personnel. Beckford et al. (2018) went on to evaluate the effectiveness of simulation-based training. The review found that simulation was indeed an effective form of education regarding cricoid pressure.

A small cohort study by Weimer et al. (2017) explored the efficacy of teaching pre-clinical medical students about cricoid pressure via a workshop-style education session using laryngeal models. There were 34 participants in the study, and although three stated they had familiarity with the maneuver, none were able to properly demonstrate the technique on the laryngeal models prior to the workshop. A post-education assessment of the participants found that all 34 were able to demonstrate proper cricoid pressure on the laryngeal models on the first attempt. Although small, this study demonstrates the effectiveness of cricoid pressure education for healthcare personnel.

Although cricoid pressure is routinely performed, its efficacy has yet to be properly evaluated in practice. In 2015 a Cochrane Review was published by Algie et al. regarding the efficacy of cricoid pressure during RSI. The review identified 493 studies, however only one of those studies met the inclusion criteria put forth by the authors. It was determined that there was inadequate information provided by the current randomized controlled trials (RCTs) to extrapolate any outcomes. Although the RCTs were lacking, the review did find that among the non-RCT studies, cricoid pressure may not be necessary to successfully perform RSI. The lack of evidence found by the review prevented the authors from making a recommendation of whether the continued use of cricoid pressure for RSI should be recommended. A review of this magnitude not being able to include more than one article in their review demonstrates the apparent lack of quality research surrounding the topic.

The author concludes that there is a blatant lack of evidence supporting, nor disproving the efficacy of cricoid pressure. Based on the findings here, it is clear that more research is warranted. Despite this lack of evidence, the maneuver continues to be used in everyday practice. If cricoid pressure is to be implemented, then the proper technique should be used. There is a well-documented lack of knowledge among health-care providers on how to properly perform cricoid pressure for an RSI. Although this knowledge deficit exists, teaching methods such as hands-on workshops using laryngeal models, and simulation have proven to be an effective means of education.

Video Laryngoscopy

The implementation of video laryngoscopy (VL) has had a far-reaching impact, from anesthesia personnel to emergency room, and out-of-hospital emergency medical personnel. It is frequently used in all of these areas in place of direct laryngoscopy (DL).

In the critical care transport population, the implementation of VL has been shown to have a statistically significant improvement in intubation success rates. This statement is supported by a comparative data analysis of a critical care flight crew consisting of paramedics and nurses by Boehringer et al. (2015). The review consisted of an analysis of 790 patient care records that required intubation by the transport crew. After the implementation of the C-MAC VL, the crew's overall intubation success rate increased from 94.9% to 99%. The first pass success rates among the crew increased from 75.4% to 94.9%. Combined first and second pass success rates increased from 89.2% to 97.4%. When analyzing the ratio of successful to total attempts at intubation there was an improvement from 71.4% to 91.9%.

A systematic review and meta-analysis by Rombey et al. (2018) evaluated the effectiveness of VL in the inpatient emergency intubations. The review analyzed evidence from eight randomized controlled trials and found that there was no difference in first-pass intubation success rates between VL and DL in this setting. Although there was no difference found in first-pass success rates, the overall number of intubation attempts was found to be lower with VL. In contrast to this previous finding, there was no difference found in time to successful intubation between the two methods.

The largest review found in the last five years on this topic was a Cochrane review authored by Lewis et al. in 2016. The review encompassed 64 studies, 61 of which included patients undergoing elective surgery and the remaining three analyzed the emergency setting. This large, Level I evidence review found that there were fewer failed intubations reported with VL, in both the general population and those predicted to have a difficult airway. However, there was no difference in first attempt success rates or the incidence of hypoxemia between the two groups studied. The authors did find there was a statistically significant decrease in the amount of laryngeal trauma when VL was used over DL. The incidence of trauma during intubation was also evaluated by Scholtis et al. (2017). The authors compared the frequency of trauma during intubation between

DL and the GlideScope video laryngoscope. Of the 155 subjects in the study, 27 sustained injuries during intubation. Sixteen injuries were sustained with the use of VL and 11 were sustained during DL for intubation. The authors determined that there was no statistical significance to these findings, although the basic results of this Level III evidence study contrast the findings of Lewis et al. (2016) in their review.

While reviews such as those put forward by Lewis et al. (2016) have shown that the use of VL can improve the view of the glottis for intubation, their review did not touch on the different adjuncts that can be used with VL to aid in intubating the trachea once a glottic view is obtained. A literature review of 25 articles by Nemec et al. (2015) published in the AANA Journal addressed the different adjuncts that can be used with the GlideScope VL for intubation. Specifically, they looked at the use of the GlideScope Rigid Stylet (GRS) versus a malleable stylet or the use of an endotracheal tube exchanger with vascular forceps. The authors of the review found that the GRS was superior to the other two adjuncts for GlideScope intubation.

Implementation of VL has made a statistically significant impact on intubation success rates, especially in the critical care transport setting. The Level I evidence included in this review demonstrates a clear superiority of VL over DL for intubation success rates in the hospital setting as well. However, the first pass success rates do not differ between the two methods of intubation, except in the out-of-hospital setting. Level I evidence also demonstrates that the use of VL also decreases the incidence of laryngeal trauma with intubation. The adjunct that can be used with GlideScope intubation that has shown the greatest success is the GRS.

Adjuncts for Airway Management

The ability to manage the airway to ventilate the patient without intubation, or as an adjunct to intubation is crucial in anesthesia. Mask ventilation has been used for years before the implementation of the laryngeal mask airway (LMA) to aid in general anesthetic cases not requiring tracheal intubation. Mask ventilation continues to be used today for shorter, minor cases that do not require intubation. The ability to mask ventilate is crucial to patient safety and allows for a greater apneic period to achieve successful intubation (Casey et al. 2019). LMAs have taken the place of mask ventilation in many general anesthetic cases not requiring tracheal intubation. Although not a definitive airway, the LMA frees up the anesthesia provider's hands and helps in maintaining a patent airway by bypassing many oropharyngeal structures.

Mask ventilation during induction of general anesthesia to maintain oxygen saturation and prolong the apneic period during tracheal intubation is a common practice in anesthesia. However, in 2019, Casey et al. investigated the efficacy of this method by studying intubations of critically ill patients in the hospital. The randomized trial compared intubating patients using mask ventilation after induction and prior to laryngoscopy, with not using mask ventilation during this period. There were 401 patients involved in the trial from multiple critical care units. The main outcomes were the incidence of hypoxemia and aspiration of gastric contents. Oxygen saturation was documented by a trained nurse or physician who was not involved in the intubation process, while the incidence of gastric content aspiration was self-reported by the provider performing the intubation. It is important to note that patients considered to be at high risk of aspiration were excluded from the trial. For those included in the trial, the bag-mask ventilation (BMV) group was found to have no difference in aspiration from the non-ventilation group. As for the incidence of hypoxemia, the mean lowest oxygen saturation of the BMV group was 96%, while the non-ventilation mean was 93%. Severe hypoxemia in this trial was classified as an oxygen saturation of less than 80%. Using this criterion, 21 patients in the BMV group experienced severe hypoxemia, compared to 45 patients in the non-ventilation group. The researchers concluded that bag-mask ventilation during the period between induction and laryngoscopy results in an over-all higher oxygen saturation and a decreased incidence of severe hypoxemia.

There are two types of LMAs commonly used in general practice, the classic LMA and the ProSeal LMA (See Figure 3). The ProSeal is claimed to have a better fit and seal for ventilation, as well as a lower risk for aspiration of stomach contents. A Cochrane review by Qamarul et al. (2017) set out to compare these two devices in clinical practice.

Qamarul et al. (2017) included eight studies in their review, totaling 829 patients undergoing elective surgery. The researchers set out to compare the incidence of failed ventilation, time of insertion, peak airway pressures, and the amount of pressure required to cause a leak between the classic and ProSeal groups. Of the eight studies included in the review, none of them reported a significant difference in the incidence of failure to ventilate. It was found that the ProSeal generally took longer to place than the classic with a mean difference of 10.12 seconds. Peak airway pressures were lower in the classic group, while oropharyngeal leak pressure was noted to be higher in the ProSeal group.

The authors of this Level I evidence review concluded that while the ProSeal takes longer to insert, this finding was of little clinical relevance. They found that the

ProSeal may be better suited for positive pressure ventilation due to its superior seal. There were insufficient incidences of inability to ventilate to determine the superiority of one device of the other in this aspect of use.

The data collected here demonstrates that mask ventilation in the period between induction of anesthesia and laryngoscopy lessens the incidence of hypoxemia and is an effective way to increase the apneic period. The ProSeal laryngeal mask airway cannot be determined to lessen the incidence of failure to ventilate versus the Classic laryngeal mask airway. However, the ProSeal may be a better choice for positive pressure ventilation due to its superior seal.

Airway Management Education for Non-Anesthesia Health-Care Personnel

Those proficient in the practice of anesthesia are very familiar with the importance of proper airway management. However, the ability to ventilate a patient is crucial to patient survival in all aspects of health-care. Therefore, educating those health-care personnel that do not manage patient airways every day becomes very important in providing safe care. Popular methods of providing airway management education include both hands-on practice with actual patients, as well as simulated practice.

Trimmel et al. (2017) set out to explore the efficacy of an in-hospital airway management training program for non-anesthesiologist emergency medical services (EMS) transport physicians. Five physicians at a time participated in the training program, which consisted of both full operating room (OR) shifts under the supervision of an anesthesiologist, along with multiple simulation sessions done in conjunction with paramedics.

The researchers performed a retrospective evaluation of every case the EMS physicians managed that required airway intervention. Over the 11 years evaluated by the study, 32 EMS physicians participated in the training program. Out of 963 out of hospital transports requiring airway intervention, 877 required intubation. The EMS physicians were found to have an overall intubation success rate of 95.3%. The authors of the study concluded that the training program was successful and that a fixed number of working days in anesthesia is an effective way to maintain airway proficiency.

Hassan et al. (2011) also investigated the efficacy of an in-operating room anesthesia program. However, the participants of their study were emergency room residents who were one-year post-graduate. The residents received traditional simulated training before participating in the in-operating room anesthesia rotation. The rotation consisted of a one-month training in which the participants received additional training in airway management.

Thirty-six residents participated in the training program, and their success rates for both intubation and bag-mask ventilation were evaluated before and after participation. Each participant was asked to mask ventilate and intubate 36 individuals as part of their evaluation process both pre- and post-intervention. Success rates for bag-mask ventilation rose from 10:36 to 30:36 after completion of the training program. The Intubation success rates rose from 6:36 to 32:36 pre- and post-training. The authors concluded that the participant's airway management skills were notably improved by the educational rotation.

The effectiveness of simulation-based training has been explored by multiple studies in varying hospital-based specialties. One such study put forth by Han et al.

(2017) investigated the efficacy of a simulation-based training program for critical care nurses. The program focused on airway management emergencies that the nurses may encounter in the intensive care unit including, rapid sequence intubation, types of medications used, and difficult airway assessment. The self-efficacy, among the 35 participants selected to be evaluated in the study was noted to have a statistically significant increase through pre- and post-questioners. The researchers concluded that the simulation-based training program improved self-efficacy and clinical performance of the participating nurses.

A systematic review published in the AANA Journal by Lucisano and Talbot (2012) sought to determine the efficacy of simulation-based training for anesthesia and other health-care providers. The review focused specifically on advanced airway management studies involving this population. Fifteen articles were included in the review and the authors determined that simulation-based training is indeed an effective means of teaching advanced airway management to health-care providers. The authors also noted that many of the studies did not provide an appropriate means of quantifying the effectiveness of the training sessions. Due to the lack of quantifiable evidence, the authors recommend that further research be done on the topic in the future.

One may conclude that in-hospital, hands-on, training sessions for non-anesthesia personnel with real patients is an effective means of providing this population with airway management education. However, the time and resources required for a program of that magnitude hinder its practicality. While more research is needed on the efficacy of simulation-based training programs for airway management, current research suggests these programs may be effective in providing education.

Conclusion

The positive predictive value (PPV) of many preoperative airway assessment methods is poor, and many difficult intubations and mask ventilations are unpredicted. The exams with the highest PPV include the L-E-M-O-N assessment tool and the upper lip bite test.

There is a lack of sufficient evidence, supporting or disproving the efficacy of cricoid pressure. However, its use in everyday practice continues. There is a documented lack of proper education and technique regarding the maneuver and this may contribute to improper implementation in practice. Education programs for providers would help to increase knowledge and implementation of cricoid pressure. Effective means of education include simulation and workshops. Further research on the efficacy of cricoid pressure when implemented properly is warranted.

The implementation of video laryngoscopy (VL) has had a significant impact on the success rates of out of hospital intubation attempts. The use of VL has also been shown to decrease the incidence of airway trauma as compared to direct laryngoscopy (DL). The adjunct that has been shown to further improve intubation success rates with GlideScope VL is the GlideScope rigid stylet.

Mask ventilation in the period between induction of anesthesia and laryngoscopy has been shown to decrease the incidence of hypoxemia. The ProSeal laryngeal mask airway has been shown to be more effective for positive pressure ventilation when compared to the classic laryngeal mask airway. Further research with larger sample sizes is required to determine the superiority between the two devices regarding cannot ventilate scenarios.

Hands-on airway management programs in the operating room with patients has been shown to be a very effective means of providing education to non-anesthesia health-care personnel. However, the practicality of implementing a program such as this is limited by cost and time. A more accessible educational approach is the use of simulation and workshops. This method has also been proven to be successful in increasing knowledge of airway management skills.

Discussion

The main goal of this literature review was to evaluate the current literature surrounding airway management and the education of non-anesthesia personnel. Using these findings, I will develop an educational in-service that will be implemented, and its efficacy evaluated.

By reviewing the current literature, it has become apparent that preoperative airway assessments may not be as predictive as originally believed. However, teaching the L-E-M-O-N and upper lip bite test is still an important point in basic airway management education. These tests do not take long to complete and provide some predictive value of difficult intubation or bag-mask ventilation situation.

The efficacy of cricoid pressure remains in question, however, the lack of proper technique and education about the maneuver has become apparent throughout this review. Education must be developed to increase knowledge on the subject for proper implementation. Simulation and workshops may be the most cost-effective and practical way to provide education on this subject.

The implementation of video laryngoscopy has increased successful intubation attempts, especially in out-of-hospital airway management scenarios. Education on this topic including the use of the GlideScope rigid stylet will allow non-anesthesia personnel to better assist the provider performing the intubation.

The use of airway adjuncts including both classic and ProSeal laryngeal mask airways has become common practice. Educating non-anesthesia personnel on the subject will allow them to better understand how and why these devices are utilized. An increased understanding of the subject will lead to an improved provider comfort in caring for patients with these devices in use.

The most effective means of providing airway management education to non-anesthesia personnel is in hospital training programs that involve actual patients. This method is limited by financial and time constraints. A more practical alternative is the use of workshops, in-services, and simulation to provide airway management education.

Based on the results of this literature review, I will develop an education in-service presentation for non-anesthesia personnel regarding airway management. The presentation will include basic anatomy for reference followed by education on the L-E-M-O-N and upper lip bite tests including their efficacy. Also, an overview of cricoid pressure, its purpose, and simulation of proper technique. I will provide education on both direct and video laryngoscopy, followed by an overview of airway adjuncts that may be used in the clinical setting. Evaluation of the efficacy of the education provided will be completed using a pre- and post-test method administered to those in attendance.

A thorough understanding of airway management is fundamental to the practice of anesthesia. Nurse anesthetists receive extensive training on how to safely manage a patient's airway and provide a safe anesthetic during surgery.

Other healthcare personnel who are present during critical airway management times throughout the perioperative period, including induction and emergence, do not receive as much training in airway management. These healthcare personnel include Registered Nurses (RN) and Certified Surgical Technologists (CST). Although these personnel receive little education in airway management, they are expected to assist the anesthesia provider during these critical times. A lack of education about the importance of the actions the anesthesia provider is taking makes it difficult for these non-anesthesia personnel to properly assist, especially in times of emergency.

Methods

I developed and implemented an in-service to evaluate and mitigate non-anesthesia personnel's knowledge deficit surrounding airway management. The in-service consisted of a 40-minute slideshow presentation and included a pre and post-test which included ten questions each. I delivered the in-service at two facilities in Maine that will be designated Site A and Site B.

The non-anesthesia personnel that participated in this informal study included both Registered Nurses (RN) and Certified Surgical Technologists (CST). Upon commencement of the in-service, participants were asked to complete a ten-question pre-test that evaluated their knowledge of basic airway management. They were allotted ten minutes to complete the exam. Participants were given the option to select a random number from a strip of paper to use in place of their name to remain anonymous. Participants were also informed that by completing the test they agreed to be included in the data set for this study.

Upon completion of the exam period, I began the slideshow presentation I had prepared regarding basic airway management. Topics included basic airway anatomy, predictors of difficult mask ventilation, how to mask ventilate, head-tilt and chin-lift, jaw thrust maneuver, oropharyngeal airways, nasopharyngeal airways, laryngeal mask airways, predictors of difficult intubation, positioning for intubation, commonly used laryngoscope blades, standard inductions, rapid sequence inductions, cricoid pressure, gum-elastic bougie, video laryngoscopes, fiberoptic and video bronchoscopes, and a brief overview of awake fiberoptic intubation.

As part of the presentation, I brought in samples of several airway adjuncts that are used in the operating room. These adjuncts included a mask used for bag-mask ventilation, oropharyngeal airway, nasopharyngeal airway, laryngeal mask airways both classic and Supreme, gum-elastic bougie, and a disposable fiberoptic videoscope. Participants were encouraged to interact with the airway adjuncts after the presentation was completed. Also included in the presentation was a cricoid pressure simulator I made using a 60 mL syringe to mark the appropriate pressures before and after induction of anesthesia.

Upon completion of the presentation, participants were asked to complete a post-test that consisted of ten questions regarding basic airway management. Questions that were left unanswered or were not answered clearly by the participants were considered incorrect. All material in both the pre and post-tests was covered in the presentation delivered that day.

Results

There were 48 participants in total that completed a minimum of one test and were present for the presentation. Participants included both Registered Nurses (RNs) and Certified Surgical Technologists (CSTs). Also included were those who neglected to write in their position of employment, these individuals were classified as “unspecified.”

Of the 48 participants, 28 completed both a pre- and post-test. All were included in overall results even though they may have only completed a pre-test. This group demonstrated mean average pre- and post-test scores of 54.4% and 76.4% respectively. The group of 26 participants from Site A all completed a pre- and post-test, lending to the validity of their results. The Site A results were 59.6% for the pre-test and 76.9% for the post-test. There were 28 RNs that participated from both campuses, 15 of whom completed both a pre- and post-test. The RN group’s mean average scores were 61.1% and 76.7% for the pre- and post-tests. Overall, 11 CSTs participated and ten of whom completed a pre- and post-test. The mean average of the CST group test score was 54.5% and 80%. Seven individuals fell into the unspecified category, three of whom completed both a pre- and post-test. The mean average for the unspecified group test results were 42.3% and 60%. Pre- and post-test results were further broken down by place of employment, see *Tables 1 and 2* for details.

A question analysis was performed of both the pre- and post-tests to evaluate areas that require further education and areas that demonstrated a strong knowledge base. In the overall category, the questions answered incorrectly on the pre-test with the highest frequency (greater than 50%) were Questions 1, 5, 7, and 8. The percent of participants that answered these questions incorrectly was 73%, 85%, 60%, and 71%, respectively. Fewer than 20% of the participants answered Questions 4 (13%) and 6 (17%) incorrectly. The post-test question analysis of the overall group revealed that Question 1 was the only question answered incorrectly by over 50% of the participants (54%). The next greatest number of incorrect answers being on Questions 4 (43%) and 3 (39%). See *Figures 4 and 5* for a full question analysis by group. Also, see *pre-test and post-test* to read the questions that were asked of the participants.

Discussion

There were multiple limitations to the study that should be addressed in future implementation. Technical issues delayed the start of the presentation at Site B by 20 minutes, resulting in inadequate time for the participants to participate in the post-test. Upon correcting the pre-tests, I realized that many individuals had either changed their answers or self-corrected their tests during the presentation. These actions made it difficult to determine what the participant's initial pre-presentation answer was. I would suggest collecting the pre-tests prior to beginning the presentation in the future to avoid this confusion. Finally, it was found that multiple people forgot to write in their position of employment either on the pre or post-test. This made it difficult to get an accurate metric of the test scores by position of employment.

The overall increase in pre to post-test scores was 22%, however, 48 individuals completed a pre-test and only 28 that completed a post-test which may alter the data. The most accurate representation of a comparison between pre and post-tests came from Site A, since all 26 participants at this site completed both tests. The increase from pre to post-test for Site A was 17.3%, reflecting a positive outcome from the education session.

When evaluating the results by position of employment, Registered Nurses (RNs) demonstrated an increase of 15.6% from pre to post-test, while Certified Surgical Technologists (CSTs) showed an increase of 25.5%. This greater increase by CSTs is partially attributed to their lower pre-test scores 54.5% compared to the RNs 61.1%. However, the CSTs demonstrated a higher post-test average of 80% than the RNs 76.7% (*see Table 1*). These results suggest that although CSTs had less knowledge on the subject at the start of the education session, they were able to not only match but surpass the RNs knowledge of the topic through the educational in-service provided. These results were supported by the Site A group in which the pre- and post-tests where completed by all in attendance (*see Table 2)*.

A question analysis revealed that Question 1 on the pre-test was answered incorrectly by 73% of all participants. These results demonstrate a low understanding of basic anatomy and physiology regarding the airway. Question 5 on the pre-test evaluated the participants knowledge of overall difficult airway assessment mnemonics, 85% answered this question incorrectly. Furthermore, 60% of participants selected the wrong answer to Question 7 of the pre-test. This question was used to evaluate their knowledge of patient positioning for intubation. Question 8 of the pre-test combined basic airway anatomy and the use of different blades for direct laryngoscopy, 71% of participants answered this question incorrectly. The pre-test analysis also revealed that only 13% of participants incorrectly answered Question 4 about case specific airway management. Question 6, which covered Mallampati classification, was answered incorrectly by only 17% of individuals.

The results of the pre-test question analysis suggest a low understanding of overall difficult airway assessment mnemonics, but a good understanding of the Mallampati classification system. Participants also demonstrated a good understanding of case-specific use of an endotracheal tube versus a laryngeal mask airway. However, they had difficulty in basic airway anatomy and physiology, the use of different laryngeal blades, and patient positioning for intubation.

The post-test analysis revealed that Question 1 had the highest percentage of wrong answers (54%) and was once again regarding difficult airway assessment mnemonics. Although this question mirrors the question answered incorrectly the most on the pre-test, the percentage of participants that answered it incorrectly decreased by 31%. Question 4 was found to be the second question most frequently answered wrong, with 43% answering it incorrectly. This question was focused on evaluating the participant's knowledge of preoperative airway assessment tests. Question 3 was answered incorrectly by 39% of participants and evaluated the individual's knowledge of laryngeal mask airways. Of note, is that not a single participant answered Question 5 incorrectly. This question was regarding the most common types of laryngeal blades.

The results of the post-test analysis suggest a continued low understanding of preoperative difficult airway assessment tools and mnemonics. However, there was an improvement in these areas seen in the pre- to post-test comparison. The poor scores on the question regarding laryngeal mask airways suggest that the educational presentation could use a better explanation in this area and more time spent on the subject.

Conclusion

Although airway management is a specialty of anesthesia, a basic understanding of the subject can be beneficial to all operating room personnel. By having a better understanding of the subject, these non-anesthesia personnel can better assist in critical times of airway management including induction and emergence. An in-service style presentation on basic airway management is an effective means of providing this population with education on the topic of basic airway management. The pre- and post-test evaluation tools allow the educator to evaluate the knowledge of the audience before and after the presentation, as well as better understand areas of the educational topic that need to be addressed more thoroughly in the future. It is my recommendation that more research be done on the effectiveness of this style presentation and possibly the integration of simulation-style education if means are available.

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Tables

Table 1

Overall Pre and Post-Test Scores

	Overall Pre n= 48 Post n= 28	Registered Nurses Overall Pre n= 28 Post n= 15	Certified Scrub Technicians Overall Pre n= 11 Post n= 10	Unspecified Position Overall Pre n= 7 Post n= 3
Pre-Test	54.4%	61.1%	54.5%	42.3%
Post-Test	76.4%	76.7%	80%	60%

Note: This table shows the comparison of pre to post-test scores in the listed categories. The number of participants is listed to allow the reader to evaluate the validity of the data.

Table 2

Pre and Post Test-Scores by site

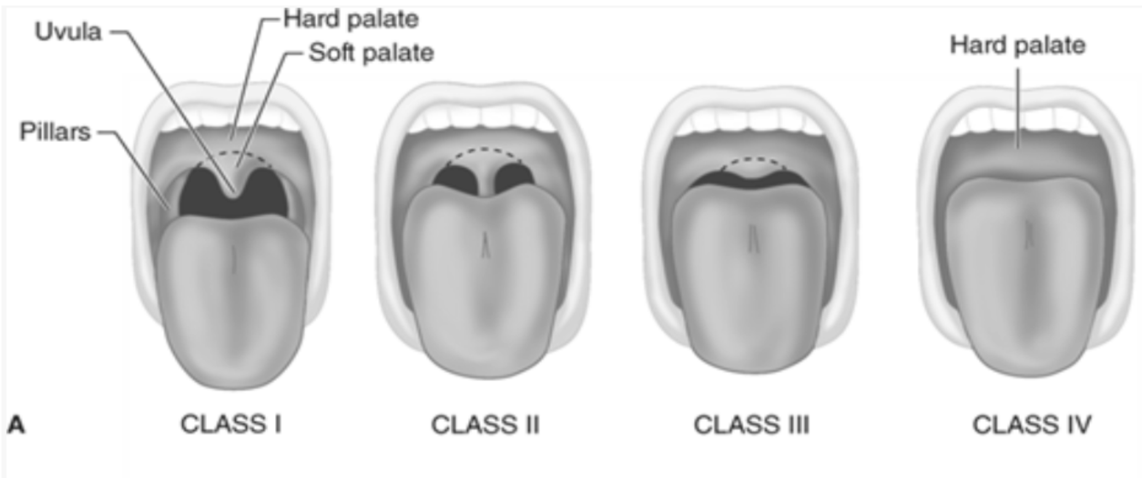
	Site A: Overall Pre n= 26 Post n= 26	Site B: Overall Pre n= 22 Post n= 2	Site A: Registered Nurses Pre n= 15 Post n= 14	Site A: Certified Surgical Technologist Pre n= 10 Post n= 10	Site A: Position Unspecified Pre n= 1 Post n= 2	Site B: Registered Nurses Pre n= 13 Post n= 1	Site B: Certified Surgical Technologist Pre n= 1 Post n= 0	Site B: Position Unspecified Pre n= 6 Post n= 1
Pre-Test	59.6%	48.2%	64%	55%	40%	57.7%	50%	43.3%
Post-Test	76.9%	70%	75.7%	80%	65%	90%	N/A	50%

Note: This table shows the comparison of pre to post-test scores in the listed categories. The number of participants is listed to allow the reader to evaluate the validity of the data. The Site A Overall group was found to be the only overall group with full participation in both pre and post-tests.

Figures

Figure 1

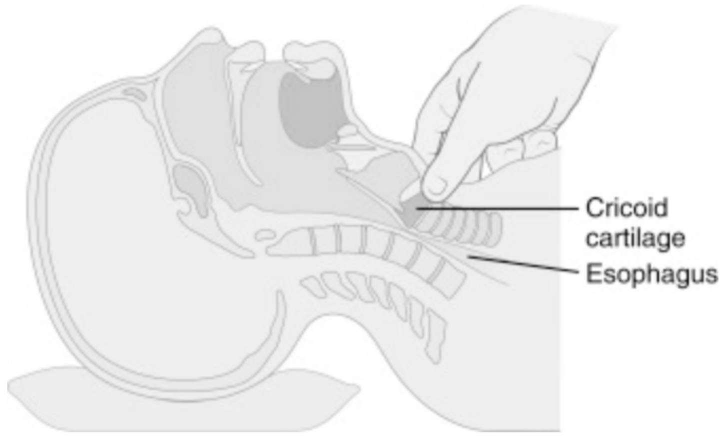
Mallampati classification system



Note: This figure demonstrates the different classes included in the Mallampati classification system. Adapted from Butterworth IV JF, Mackey DC, Wasnick JD. eds. *Morgan & Mikhail's Clinical Anesthesiology, 6e* New York, NY:

Figure 2

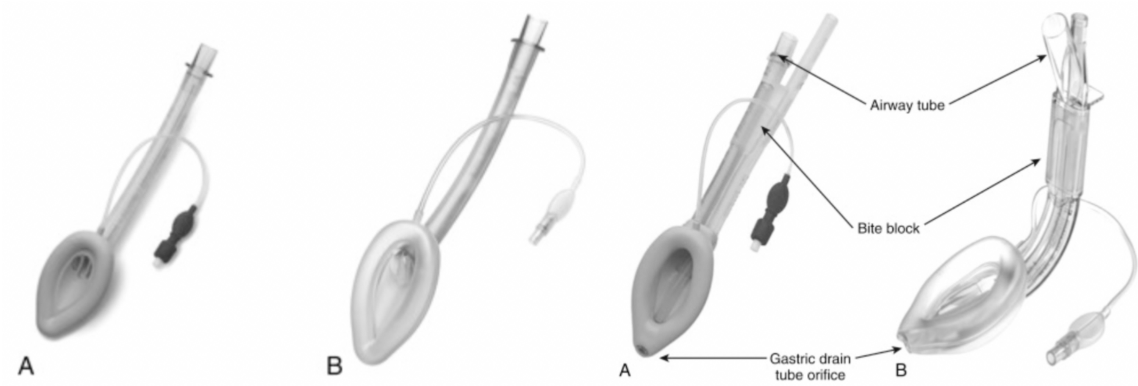
Cricoid pressure



Note: This figure demonstrates how the cricoid cartilage can be used to occlude the esophagus. Adapted from Miller, R. D., & Pardo, M. (2017). Basics of anesthesia Elsevier Health Sciences.

Figure 3

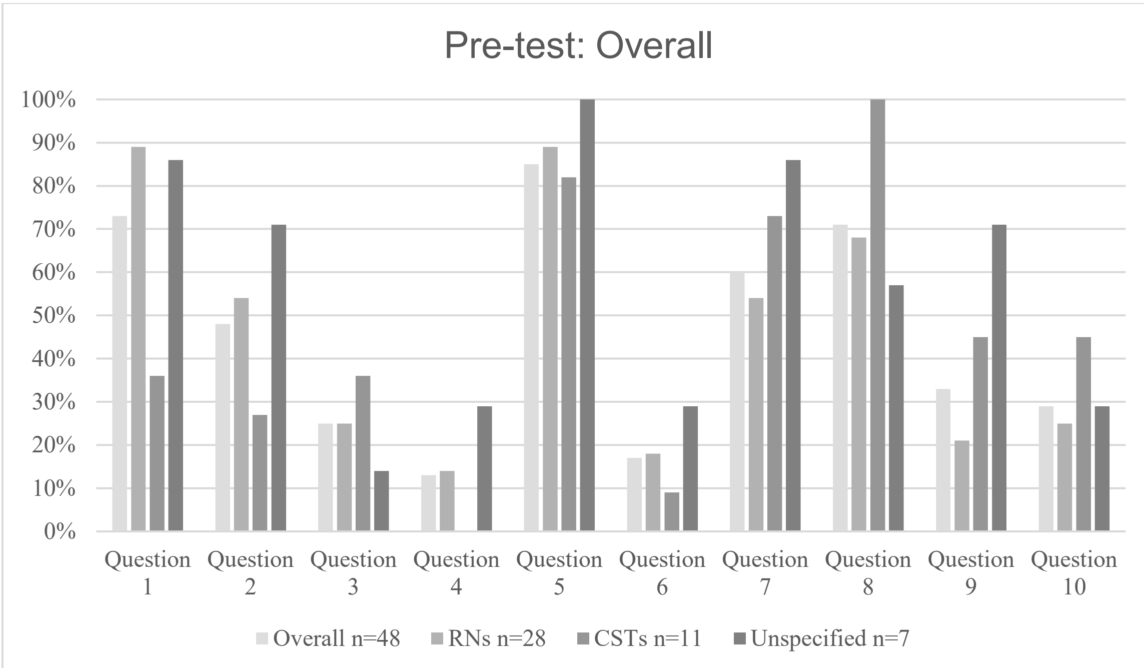
Types of LMAs commonly used in practice



Note: This figure depicts classic LMAs on the left and ProSeal LMAs on the right. Reusable devices are labeled with an “A” while single-use devices are denoted with a “B”. Adapted from Miller, R. D., & Pardo, M. (2017). Basics of anesthesia Elsevier Health Sciences.

Figure 4

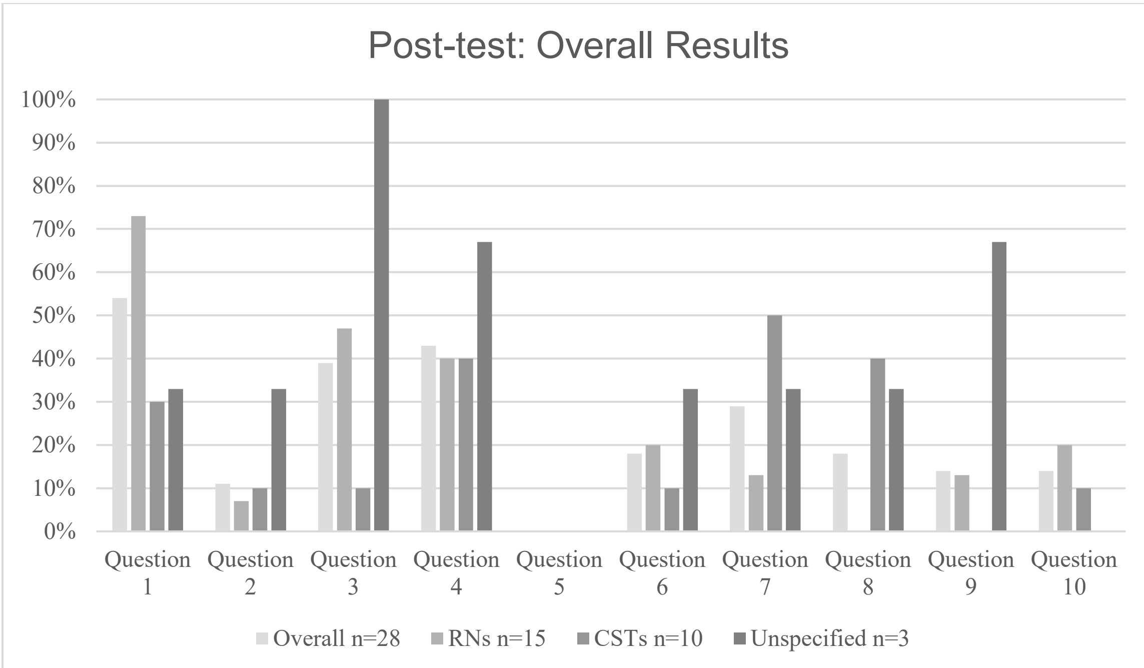
Percentage of participants that answered incorrectly



Note: This graph demonstrates the percentage of participants that answered each question of the pre-test incorrectly. The analysis is further broken down by position of employment.

Figure 5

Percentage of participants that answered incorrectly



Note: This graph demonstrates the percentage of participants that answered each question of the post-test incorrectly. The analysis is further broken down by position of employment.

Pre-test

Basic Airway Management **Pre-test** Evaluation

By completing this optional evaluation, you agree to have the results used for the purpose of educational research. The results will remain anonymous.

Assigned Number____________________

Position of employment_____________________

1. Which cartilage of the Larynx is responsible for preventing aspiration during swallowing?
   a. Arytenoid
   b. Cricoid
   c. Epiglottis
   d. Thyroid

2. What is the **maximum** peak inspiratory pressure for bag-mask ventilation to prevent insufflation of the stomach?
   a. 10 cmH2O
   b. 20 cmH2O
   c. 30 cmH2O
   d. 40 cmH2O

3. How can one estimate the appropriate size for an oropharyngeal airway?
   a. Measure from the mouth to the angle of the mandible
   b. Measure from the nares to the angle of the mandible
   c. Measure from the mouth to the Thyroid Cartilage
   d. Measure from the mouth to the Hyoid

4. Which procedure would require an Endotracheal tube over a Laryngeal Mask Airway if performed under general anesthesia?
   a. Abdominal cyst removal
   b. ORIF of distal Radius
   c. Laparoscopic Cholecystectomy
   d. Debridement of left heel

5. Select the Mnemonic for prediction of difficult intubation.
   a. MOANS
   b. LEMON
   c. RODS
   d. SHORT

6. What Mallampati Class is associated with the highest incidence of difficult intubation?
    a. Class 1
    b. Class 2
    c. Class 3
    d. Class 4

7. What is the **optimal** patient position for a standard intubation?
    a. Supine with head on table
    b. Supine with head elevated on a pillow
    c. Lateral decubitus
    d. Sniffing Position

8. Which laryngeal cartilage is not visible with conventional use of a Miller blade?
    a. Cuneiforms
    b. Arytenoids
    c. Epiglottis
    d. Corniculates

9. All of the following are reasons to perform a Rapid Sequence Induction **EXCEPT**. *(**Select one**)*
    a. Severe Gastroesophageal reflux disease (GERD)
    b. Full Stomach
    c. Pregnancy
    d. History of any abdominal surgery

10. What is the purpose of Cricoid pressure?
    a. To prevent the patient from vomiting
    b. To prevent aspiration of stomach contents
    c. To occlude the Trachea
    d. To displace the Epiglottis

Post-test

Basic Airway Management **Post-test** Evaluation

By completing this optional evaluation, you agree to have the results used for the purpose of educational research. The results will remain anonymous.

Assigned Number____________________

Position of employment_____________________

1. Select the Mnemonic for prediction of difficult mask ventilation.
   a. MOANS
   b. LEMON
   c. RODS
   d. SHORT

2. Which type of airway is better tolerated in the awake patient?
   a. Oropharyngeal
   b. Laryngeal mask
   c. Hypopharyngeal
   d. Nasopharyngeal

3. All of the following are benefits of the Proseal/Supreme LMA **EXCEPT**. *(**Select one**)*
   a. Faster insertion time
   b. Built-in bite block
   c. Gastric drain port
   d. Increased positive pressure limit of 30 cmH_2O

4. What is the single most predictive preoperative airway assessment test for difficult intubation?
   a. Mallampati
   b. Hyoid mentum distance
   c. Upper lip bite test
   d. Hyoid thyroid distance

5. What are the **two** most commonly used blades for direct laryngoscopy? *(**Select two**)*
   a. Mac
   b. Wis-Hipple
   c. Miller
   d. Phillips

6. Which type of induction would **<u>not</u>** include mask ventilation?
    a. Modified Rapid Sequence Induction
    b. Standard Induction
    c. Rapid Sequence Induction
    d. Mask Induction of a child

7. When should Cricoid pressure be initiated?
    a. Immediately before induction
    b. Immediately following induction
    c. On the way into the operating room
    d. Immediately before intubation

8. When should Cricoid pressure be released?
    a. When the Endotracheal tube is being placed
    b. After the Endotracheal tube is placed
    c. After Endotracheal tube placement has been verified by the anesthesia provider
    d. Immediately after induction of anesthesia

9. Which intubation technique is a “blind technique” that relies on tactile feedback?
    a. Direct Laryngoscopy
    b. Intubating Bougie
    c. GlideScope Intubation
    d. Fiberoptic Intubation

10. Which technique is the gold standard for predicted difficult intubation?
    a. Awake Fiberoptic Intubation
    b. Asleep Fiberoptic Intubation
    c. GlideScope Intubation
    d. Direct Laryngoscopy

Comments/Recommendations: