Use of the Laryngeal Tube in the Difficult Airway and Routine Anesthesia Practice

Robin L. Alexander and James L. Ballentine Jr.

BryanLGH/University of Kansas Medical Center School of Nurse Anesthesia

Lincoln, Nebraska

Abstract

In the field of anesthesia airway management is one of the primary concerns for an anesthesia provider. A large majority of the patient population is easily intubated; however, there is a small portion of the population encountered that presents with a difficult airway. These patients pose a serious and potentially fatal challenge to anesthetists and anesthesiologists. The incidence of difficult intubation has been reported in up to 11% of patients requiring tracheal intubation in the prehospital setting, and intubation is not possible in about 1% (Genzwuerker, Finteis, Hinkelbein, & Krieter, 2003). Several devices and techniques are currently available to assist in achieving an adequate airway when traditional direct laryngoscopy and endotracheal tube placement is not possible. Two such devices are the laryngeal mask airway and the laryngeal tube. The eight studies reviewed demonstrated many facets of the laryngeal tube as compared to the laryngeal mask airway including the ease of insertion, the reliability to provide a patent airway, ability to produce significantly higher peak airway pressures, evidence of the ability to allow for the placement of an exchange catheter and the subsequent successful placement of an endotracheal tube, and superior prevention of pulmonary aspiration related to a greater storage capacity. At this point in time, the authors believe that there is an inadequate knowledge base to warrant a change in protocol or in the American Society of Anesthesiologists difficult airway algorithm, however, changes in personal practice may be justified. Preliminary studies have indicated appropriate use in patients without airway abnormalities or gastric regurgitation while providing ventilation at greater peak airway pressures.

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In the field of anesthesia airway management is one of the primary concerns for an anesthesia provider. A large majority of the patient population is easily intubated; however, there is a small portion of the population encountered that presents with a difficult airway. These patients pose a serious and potentially fatal challenge to anesthetists and anesthesiologists. The incidence of difficult intubation has been reported in up to 11% of patients requiring tracheal intubation in the prehospital setting, and intubation is not possible in about 1% (Genzwuerker, Finteis, Hinkelbein, & Krieter, 2003).

Several devices and techniques are currently available to assist in achieving an adequate airway when traditional direct laryngoscopy and endotracheal tube placement is not possible. Examples of such devices and techniques available to assist with a difficult intubation include an Eschmann stylet, fast track laryngeal mask airway, light wand, fiberoptic technique, and emergency cricothyroidotomy. Two additional devices, the laryngeal mask airway (LMA) and the laryngeal tube (LT), afford two less invasive forms of airway protection.

As nurse anesthesia students, difficult airway management is essential to the delivery of a safe anesthetic for each patient. The laryngeal mask airway is an established device that is familiar to most nurse anesthesia students, whereas the laryngeal tube is relatively new and therefore not as well investigated. The purpose of this paper is to analyze research on the use of the laryngeal tube in the difficult airway and in routine clinical practice as compared to the known standard of the laryngeal mask airway.

Research Utilization Model

The Iowa Model of Research in Practice was chosen to guide this project. This model revolves around problem-focused triggers and knowledge-focused triggers. The first step in the problem-focused triggers approach is to identify a clinical problem either during clinical practice or by Quality Improvement or Quality Assessments. The next step is to search for and identify appropriate literature. If no appropriate literature is identified, the problem is either abandoned or a research plan is developed. Granting appropriate literature is identified; it must be determined if the knowledge base is adequate. In the case the knowledge base is not adequate, then again either the problem is abandoned or a research plan is developed. Providing the knowledge base is adequate, an assessment must be made to decide whether the action can be implemented. This is done by comparing cost to benefit ratios and by the feasibility of its implementation. In the event it is appropriate for practice, protocols must be changed and implemented. Once implemented the outcomes must be evaluated, and decisions made about application of the intervention and findings must be shared (Polit & Hungler, 1999).

The knowledge-focused triggers method for beginning research utilization begins with a review of research literature. The next step is to determine if the research is clinically relevant, if so, then the process precedes the same as stated above beginning at the knowledge base step. If the research is not clinically relevant, then the review of research is continued (Polit & Hungler, 1999).

Literature Review

Table 1 summarizes the information obtained from the eight most relevant studies identified during the review of the literature.

Table 1: Summary of studies of the laryngeal tube

Authors	Purpose	Sample	Measures	Results
Asai, T., Kawashima, A., Hidaka, I., & Kawachi, C. (2002)	Comparison of the laryngeal tube (LT) with the laryngeal mask airway (LMA) in terms of the success of insertion, gas leak pressure, and the incidence of gastric insufflation	▪ Convenience, crossover sample ▪ 22 patients ▪ 18-78 yr. old ▪ Ht.: 148-180 cm ▪ Wt.: 45-81 kg ▪ ASA I or II, ▪ Mallampati Class I or II ▪ Excluded: abnormality of neck , upper respiratory or alimentary tract, and risk of regurgitation of gastric contents	▪ Adequacy of ventilation ▪ Airway pressure at which gas leak occurred ▪ Presence or absence, as determined by auscultation, of gastric insufflation at an inflation pressure of 20 cm H_2O	▪ LT provided a patent airway 95% of the time, as frequently as the LMA ▪ Significantly higher leak pressure for LT than LMA ▪ No incidence of gastric insufflation with LT compared to 3 with the LMA
Asai, T., Murao, K., & Shingu, K. (2000)	Assess the efficacy of the laryngeal tube (LT) during intermittent positive-pressure ventilation	▪ Convenience ▪ 50 patients ▪ Adult ▪ ASA I or II ▪ Undergoing elective surgery ▪ Neuromuscular blockade ▪ Excluded: pathology of neck, upper respiratory or upper alimentary tract, and risk for pulmonary aspiration of gastric contents	▪ Adequacy of ventilation ▪ Airway pressure at which gas leak occurred ▪ Mean tidal volume ▪ Time for insertion	▪ Able to ventilate at airway pressures ≥ 18 cmH_2O in 82% of patients ▪ Mean tidal volume of 587 ml ▪ Mean time of insertion was 26 sec ▪ Able to ventilate 94% of patients after first attempt of insertion

Authors	Purpose	Sample	Measures	Results
Cook, T. M., McCormick, B., & Asai, T. (2003)	Compare efficacy of the laryngeal tube (LT) with that of the classic laryngeal mask airway (LMA) in paralyzed patients and to compare the sealing effects of the LT and LMA	▪ Convenience, randomized sample ▪ 72 patients ▪ Adult ▪ ASA I or II ▪ Elective surgery in supine or lithotomy position with neuromuscular blockade ▪ Excluded: diseases of neck upper respiratory or upper alimentary tract, or at risk for pulmonary aspiration of gastric contents	▪ Success rate in establishing a patent airway without complication ▪ Airway leak pressures ▪ Time for insertion	▪ LT as effective as classic LMA at providing patent airway ▪ LT gave significantly greater sealing pressure than the classic LMA ▪ Similar postoperative complications ▪ Similar insertion times
Dorges, V., Ocker, H., Wenzel, V., & Schmucker, P. (2000)	Assess whether the laryngeal tube (LT) can provide sufficient ventilation and adequate oxygenation in patients undergoing routine induction of anesthesia	▪ Convenience ▪ 30 patients ▪ Adult ▪ ASA I or II ▪ 26-82 yr. old ▪ Mallampati Class I or II	▪ End-tidal CO_2 ▪ Expiratory tidal volume ▪ Peak Airway Pressure ▪ Capillary blood gas samples ▪ Time of insertion ▪ Oropharyngeal leak pressure	▪ Sufficient ventilation & oxygenation, similar to those reported by the laryngeal mask airway (LMA) and Combitube ▪ Similar insertion times to LMA ▪ Mean airway leak pressure 24-40 cm H_2O

Authors	Purpose	Sample	Measures	Results
Gaitini, L. A., Vaida, S. J., Somri, M., Kaplan, V., Yanovski, B., Markovits, R., & Hagberg, C. A. (2003)	Determine the effectiveness of the Laryngeal Tube (LT) for primary airway management during routine surgery with mechanical ventilation in adults	▪ Convenience ▪ 175 patients ▪ ASA I or II ▪ Ht.: 155-180 cm ▪ Wt.: 50-90 kg ▪ Elective surgery under general anesthesia ▪ Mallampati Class I or II ▪ Excluded: known esophageal disease, pulmonary disease, or cardiovascular disease	▪ Airway pressures ▪ End-expiratory pressure ▪ Lung volumes ▪ Gas leak ▪ Airway trauma ▪ Attempts and time of insertion	▪ LT is an efficient and reliable device for airway management for mechanical ventilation ▪ LT mean peak respiratory pressure close to values obtained with LMA ▪ Adequate insertion on first attempt in 94% of patients and in 100% of patients within three attempts
Genzwuerker, H. V., Vollmer, T. & Ellinger, K. (2002)	Assess the efficacy of a technique using a tube exchange catheter and laryngeal tube (LT)	▪ Convenience ▪ 10 patients ▪ ASA I or II ▪ Mallampati Class I or II ▪ $\geq$ 18 yr. Old ▪ Elective orthopedic surgery ▪ Exclusions: pregnancy, inability to consent, severe pulmonary disease	▪ Time of insertion for LT ▪ Correct positioning of LT confirmed by fiberoptic tube exchange ▪ Assessment of ventilation was completed by auscultation	▪ The LT was positioned without difficulty on the first attempt in all patients ▪ Exchange procedure with the tracheal tube was achieved easily in all patients by the second attempt

Authors	Purpose	Sample	Measures	Results
Miller, D. M., & Light, D. (2003)	Determine the useful storage capacity of the laryngeal tube (LT) and the laryngeal mask airway (LMA) and compare	▪ A silicone rubber pharynx designed to accommodate the insertion of supraglottic airways that will seal and allow for positive pressure ventilation	▪ The amount of contents injected via the esophagus that resulted in "regurgitation"	▪ The Storage capacity for the LT was 15 ml compared to 3.5 ml for the LMA ▪ More "stomach contents" can be regurgitated before aspiration
Ocker, H., Wenzel, V., Schmucker, P., Steinfath, M., Dorges, V. (2002)	Compare the laryngeal tube (LT) with the laryngeal mask airway (LMA) in routine clinical practice	▪ Convenience ▪ 50 patients ▪ ASA I or II ▪ 17-77 yr. old ▪ General anesthesia for minor routine procedures	▪ End-tidal CO_2 ▪ Expiratory tidal volume ▪ Peak Airway Pressure ▪ Capillary blood gas samples ▪ Time of insertion	▪ LT was similar to the LMA in terms of insertion time and attempts, adequacy of ventilation and oxygenation, and tidal volumes

Summary and Critique of Current Research Knowledge

All of the studies reviewed demonstrated the ease of insertion and the reliability of the laryngeal tube to provide a patent airway. All of the studies that measured the airway pressure at which a leak occurred determined that the laryngeal tube had significantly higher pressures than the laryngeal mask airway. The study by Genzwuerker, Vollmer, and Ellinger (2002) showed evidence of the ability of the laryngeal tube to allow for the placement of an exchange catheter and the subsequent successful placement of an endotracheal tube which is important when a more secure airway is required. The study by Miller and Light (2003) was the only study to directly focus on the aspect of prevention of pulmonary aspiration related to gastric regurgitation.

This study found that the laryngeal tube was superior to the laryngeal mask airway at aspiration prevention as evidenced by a greater storage capacity.

In light of the advantages presented upon analysis of these research studies, many questions arise concerning patients with abnormal airway anatomy and in situations of difficult intubations. An additional area that should be addressed would be the use of the laryngeal tube in emergency circumstances by paramedic and trauma personnel. With the growing epidemic of obesity in the United States further studies must be performed to evaluate the use of the laryngeal tube in the obese population. The obese population presents concerns of increased ventilatory resistance and an increased risk of gastric regurgitation.

The implicit framework implied throughout the studies analyzed was the search for a safe, easily inserted and manipulated device that provides the ability to ventilate adequately at greater peak airway pressures and provides protection against potential pulmonary aspiration of gastric contents. All of the research designs were prospective studies. Four of the studies (Asai, Kawashima, Hidaka, & Kawachi, 2002; Cook, McCormick, & Asai, 2003; Miller & Light, 2003; Ocker, Wenzel, Schmucker, Steinfath, Dorges, 2002) utilized a randomized, controlled design and four studies employed the single experimental group design (Asai, Murao, & Shingu, 2000; Dorges, Ocker, Wenzel, & Schmucker, 2000; Gaitini et al., 2003; Genzwuerker et al., 2002). The Miller and Light (2003), Genzwuerker et al. (2002), and Asai, Kawashima et al. (2002) studies were limited by small sample sizes. All studies were performed on human subjects with the exception of the Miller and Light (2003) study, which utilized a silicone mannequin. The studies' methods, analyses, and interpretations are logical and appropriate.

The practice implications reveal that the laryngeal tube is considered equal to and superior to the laryngeal mask airway in these research reports. The research indicated that the

laryngeal tube might be utilized as an alternative airway device in emergency use with minimally trained personnel due to ease of placement. The laryngeal tube should be considered appropriate to use as an additional airway device, not as a replacement of the LMA. Currently, reservations exist in the use of the LT until larger studies can be developed to confirm preliminary studies.

Evaluate Current Use of Research Findings

Upon consultation with anesthesia providers at BryanLGH Medical Center in Lincoln, Nebraska, a 300 bed hospital with 15 operating rooms, it was determined that many had never heard of the laryngeal tube. The few providers that had heard of the laryngeal tube have received no formal training in its use and even fewer providers have utilized the laryngeal tube in clinical practice. One anesthetist attempted placement of the laryngeal tube resulting in a puncture of the oropharyngeal cuff on the patient's tooth during insertion.

At the fall Nebraska Association of Nurse Anesthetist meeting, Wendell Spencer, CRNA, provided a presentation on the revisions to the King Systems Corporation's LT® supraglottic reusable and disposable airways as well as personal experiences with its use in clinical practice. This educational experience provided first time exposure and knowledge to many anesthetists in attendance including the authors of this paper. Many current anesthesia textbooks and references fail to address the laryngeal tube and its use. This may be correlated to the current lack of definitive studies available on the laryngeal tube.

Decision and Plan for Utilization of Research Findings

—Link to Iowa Model of Research Practice

According to the Iowa Model of Research Practice, the authors determined that the knowledge base from the research identified was not sufficient. According to this model, further original research is required. At this point in time, the authors believe that there is an inadequate

knowledge base to warrant a change in protocol or in the American Society of Anesthesiologists difficult airway algorithm, however, changes in personal practice may be justified. Preliminary studies have indicated appropriate use in patients without airway abnormalities or gastric regurgitation while providing ventilation at greater peak airway pressures.

After observation of anesthesia providers at the BryanLGH Medical Center, a slow acceptance of the use of the LMA due to unfamiliarity and resistance to change has been elicited. The authors believe that this same resistance and unfamiliarity will exist when the laryngeal tube is introduced and potentially incorporated into practice unless safety, reliability, and profound benefits are proven.

The plan for implementing the utilization of the laryngeal tube at the BryanLGH Medical Center would entail several steps. The major goal is to provide a dissemination of information to anesthesia providers in addition to respiratory therapist and physicians. The first step in achieving this goal is to provide a poster presentation with pamphlets describing the device, summarizing current research, and suggestions for use in clinical practice. Following this distribution of knowledge, an open-ended survey will be circulated to assess knowledge base, use, and level of confidence in personal ability to place the laryngeal tube.

Recommendations and Conclusions

After utilizing the Iowa Model of Research Practice to analyze current research on the laryngeal tube an insufficient knowledge base was identified due to the lack of sufficiently large controlled trial studies and lack of research in specific areas including but not limited to the obese population and emergency and trauma situations. Additional studies are needed to validate findings in the areas of storage capacities for gastric regurgitation and fiberoptic tube exchange

technique. Further research is warranted to assess the effects of the laryngeal tube's distal cuff pressure in the esophagus as it relates to tissue ischemia.

The authors concluded that despite highly positive research results from current studies changes to present protocols are not warranted until further research is conducted. In the future the laryngeal tube is believed to become a significant factor in routine anesthesia practice and in difficult airway management upon completion of further research validating preliminary findings.

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