Use of the LMA Supreme in the Special Operations Environment: A Retrospective Comparison of the LMA Supreme and King LT-D

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Introduction

Supraglottic airway devices have proved to be effective emergency airway adjuncts through many years of use by prehospital providers. These devices have provided a means to secure emergent airways when endotracheal intubation is impractical, impossible, or challenging beyond the skill of the provider. One such device, the King LT-D® (King Systems; http://www.kingsystems.com/), is currently in use by United States Army Special Operations Command (USASOC) forces and provides adequate airway support. It has been used successfully for several years during the conflicts in Iraq and Afghanistan. It is, without doubt, an effective airway; however, it is certainly worthwhile to evaluate new airway devices that may offer practical advantages over the current system. The airway device that we have chosen to compare with the King LT-D is the LMA Supreme® (LAM; http://www.lmana.com/). This device was developed as an improvement on the original laryngeal mask airway, a device so successful and effective that the American Society of Anesthesiologists included its use in the ASA Difficult Airway Algorithm for "cannot intubate, cannot ventilate" scenarios. There are several variations of the LMA on the market today to meet various requirements for airway control. At least two of these variants, the LMA Classic and LMA Fastrach, also known as the Intubating LMA (ILMA), have been evaluated for use in the Special Operations environment. Both airways have design features that limit their utility for combat use. The LMA Supreme has, until now, not been evaluated for this purpose. It is the opinion of the authors that the LMA Supreme has several unique features that warrant its evaluation as a viable airway device for Special Operations use. It has numerous enhancements that make it superior to both previous LMA designs and other supraglottic airway devices. As such, it is the purpose of this project to compare the King LT-D with the LMA Supreme to determine which device is superior in the hands of the Special Operations medic.

Military Relevance

Airway management in combat can prove to be difficult for even the most experienced providers. Direct laryngoscopy under such conditions can be difficult and extremely dangerous, as an intubating provider will often have no assistance, will be in a less-than-ideal position to intubate, and will have to use the white light of a laryngoscope to visualize the airway, thereby making himself or his patient a target for enemy fire. In addition, there is a low likelihood that a Special Operations medic would be maximally proficient with laryngoscopic skills. Expert laryngoscopic skills develop only with continual and prolonged experience with actual human airways—a time-consuming and costly training endeavor. Due to the massive skillset that these providers must maintain, laryngoscopic experience, understandably, is often deficient. To circumvent these challenges, alternative methods of airway establishment are often preferentially used in combat. Supraglottic airway devices have become the method of choice for airway protection in the Special Operations environment. The ability to quickly insert these devices under combat conditions without the need for direct laryngoscopy and, thus, without the need for white light, makes them very useful for tactical airway management. The ease with which these devices are placed allows them to be used successfully in dangerous and stressful environments, such as during low-visibility periods, while under hostile fire, or when the medical personnel themselves are wounded. These devices require little to no training, and the insertions are repeatable without frequent practice, unlike direct laryngoscopy.

Research Design and Methods

During regularly scheduled predeployment trauma training, the authors conducted a performance improvement project using a standardized airway model to determine the success rates and average times to insertion for both the King LT-D and the LMA Supreme by SOF medics. In addition, any complications experienced were to be recorded for further evaluation. All participants were Special Operations Combat Medic (SOCM) qualified. All participants had recently received refresher training on the use of the King LT-D. A short tutorial was provided to demonstrate the features and operation of the LMA Supreme as well as provide instruction for the proper employment of the device, although no handson training was conducted before the airway exercise. Devices were available for familiarization during the tutorial. A Laerdal® (http://www.laerdal.com/us/) airway manikin was used as the patient model for this study. The project was conducted over the course of 3 days and involved a total of 22 SOF medics, although, due to training requirements, not all individuals were present for all aspects of the exercise. Supervision of the trauma lanes was provided by the unit battalion surgeon and two physician assistants. Days 1 and 2 consisted of daylight trauma lanes. An airway station was incorporated into the trauma lanes for the purpose of this project and was positioned as the final event before completion of the lane.

All SOF medics were required to wear full combat kit, which consisted of the Army Combat Uniform, a ballistic helmet, appropriate body armor vest, individual equipment, M4 or Mk16 carbine with six magazines, and a complete medical aid bag. Each SOF medic approached the airway station and was asked to place each individual airway into the manikin. Insertions were conducted from the kneeling and prone positions. Each device was prelubricated with manikin lubricant spray before each insertion. Each insertion was timed using a digital stopwatch. End points for this project were successful insertion of the airway or failure after 1 minute. Successful airway placement was determined by visualization of bilateral lung inflation during hand ventilation. For consistency, the station was configured with a supine airway manikin next to a closed medical aid bag. On the aid bag was placed a prelubricated airway device and an appropriately sized syringe for cuff inflation. An identical setup was repeated for each medic.

At the end of days 1 and 2, the medics were asked to secure the King LT-D and LMA Supreme to their patient using 1-inch silk tape. Improvised methods of airway device securement were also discussed and tested, to include the use of intravenous tubing. Resultant airway stability was assessed by each medic to determine which airway they thought was more secure for patient transport. The results of this portion of the study would be reflected in the postproject surveys. Day 3 consisted of low-light, night vision–assisted insertions of the airway devices. For this portion of the study, an airway station was placed inside a large, darkened room within the SOF compound. The airway station configuration was identical to that used during the day iterations. Again, a supine airway manikin was placed next to a closed medical aid bag with the specific airway device placed on top of the aid bag. Each device was prelubricated with manikin lubricant spray before each insertion. Each individual SOF medic was brought into the room in full kit with a PVS-14 night vision monocle used for visualization. The room was darkened to prevent visualization with the naked eye. Each medic was allowed to position himself at the head of the manikin and the trial was begun. End points for this portion of the study were successful insertion of the airway or failure after 1 minute. Successful airway placement was determined by visualization of bilateral lung inflation during hand ventilation.

Results

A total of 22 SOF medics completed the initial survey. Of these, 14 had as their highest level of medical training an EMT-Basic certification, four were EMT-Basic qualified with Advanced Tactical Practitioner certification, and four were Paramedics. All 22 respondents had experience with the King LT-D. One of the 22 respondents had experience with the LMA Supreme. Fifteen of the 22 had prior experience with the LMA Classic or Unique (single-use version of the LMA Classic). Three of the 22 had experience with the LMA Fastrach (LMA). In regard to experience with placement of supraglottic airways, six medics reported placing one to five airways in the previous 18 months, seven reported placing six to 10 airways, four reported having placed 11 to 15, and five reported placing 16 or more. Most airway experience involved the use of airway manikins; however, approximately half (10 of 22) of the medics reported at least some human airway experience within the past 18 months. Table 1 is the preexercise questionnaire that was provided to all SOF personnel participating in the performance improvement project. This questionnaire was answered before participation in any airway tasks. Results are given in Table 2. For the first iteration of this exercise (daytime insertion of the LMA Supreme and King LT-D in the kneeling position), there was a success rate of 100% on the initial attempt with both airways. For the LMA Supreme, the average time to successful airway placement was 9.99 seconds with the shortest time recorded at 7.98 seconds and the longest time at 13.41 seconds. For the King LT-D, the average time to successful placement was 11.59 seconds. The shortest time recorded for insertion was 7.70 seconds and the longest was 17.74 seconds. For the second iteration of the exercise (daytime insertion of the LMA Supreme and King LT-D in the prone position) there was a success rate of 100% on the initial attempt with both airways. For the LMA Supreme, the average time to successful airway placement was 10.16 seconds with the shortest time recorded at 6.27 seconds and the longest time 15.08 seconds. For the King LT-D, the average time to successful placement was 10.92 seconds. The shortest time recorded for insertion was 6.82 seconds and the longest was 16.76 seconds. For the third iteration of the exercise (insertion of the LMA Supreme and King LT-D under night vision), there was a success rate of 100% on the initial attempt with both airways. For the LMA Supreme, the average time to successful airway placement was 10.89 seconds with the shortest time recorded at 7.87 seconds and the longest time 13.06 seconds. For the King LT-D, the average time to successful placement was 12.32 seconds. The shortest time recorded for insertion was 7.49 seconds and the longest was 22.45 seconds. The questionnaire in Table 3 was provided to all SOF personnel participating in the performance improvement project. This questionnaire was answered following completion of all airway tasks, and the answers are given in Table 4.

A total of 14 SOF medics completed the postexercise survey. Due to operational obligations, not all medics were present for this portion of the exercise.

- When surveyed as to which airway they felt most confident with when securing an airway, one medic chose the King LT-D, four medics chose the LMA Supreme, and nine medics stated that they were equally confident with both airways.
- When asked about which airway they found most reliable in establishing a patent airway on the first attempt, two medics chose the King LT-D, eight medics chose the LMA Supreme, and four believed both airways to be equally reliable.

When asked which device is easier to properly insert in controlled conditions, two chose the King LT-D, nine chose the LMA Supreme, and one believed the airway devices to be equal.

- When asked which device was easier to place during periods of limited or no visibility, two medics chose the King LT-D, 11 chose the LMA Supreme, and one thought that the two were equal.
- When asked which device was easier to place while using night vision, two medics chose the King LT-D, eight chose the LMA Supreme, and four thought that the two were equal.
- When asked which device was easier to place in the prone position, no medics chose the King LT-D, eight chose the LMA Supreme, and six thought that the two were equal.
- When asked which device was easier to secure to the patient, no medics chose the King LT-D, 10 chose the LMA Supreme, and four thought that the two were equal.
- When asked which device they thought was most stable for patient transport, one medics chose the King LT-D, seven chose the LMA Supreme, and six thought that the two were equal. In general, the SOF medics thought that the LMA Supreme was superior to or equal to the King LT-D in every category of the survey. In seven of the eight areas of questioning, the medics thought that the LMA Supreme was superior and in only one of eight did the majority feel the LMA Supreme and King LT-D were equivalent. In regard to securing the airway and stability in transport, the medics thought that the LMA Supreme was superior. This likely has to do with the shape of the LMA Supreme, as it has a plastic tab molded into the proximal portion of the tube for taping as well as a "Y" formed by the separation of the breathing tube and gastric access tube. Both of these features allow easy attachment of this device to the patient for transport. In contrast, the King LT-D is a simple tube that requires tape to prevent slippage of a tether wrapped around the tube. The LMA Supreme was considered to be more easily and reliably placed while using night vision and in no visibility scenarios. This may have to do with the lack of a requirement to note the depth of insertion with the LMA Supreme. In this device, a provider simply inserts the airway until it seats in the posterior oropharynx. It may be successfully completed by feel alone, if necessary, as the LMA Supreme essentially positions itself. In contrast, the King LT-D requires one to position the device with the teeth of the patient between two lines located near the proximal end of the tube. Appropriate positioning can be difficult with visibility limited and improper positioning may result in the inability to ventilate. Positioning must be done visually as there are no tactile clues to indicate tube position.

Discussion

The Laryngeal Mask Airway (LMA) was invented and designed by Dr. A.I.J. Brain in London in 1981. He identified the need for better safety, reliability and ease of insertion of airway management devices. The LMA was introduced to the U.S. anesthesia market in 1992 and to the emergency market in 1996. It is currently included in and supported by the American Heart Association Resuscitation Guidelines. It is also included in the American Society of Anesthesiologists Difficult Airway Algorithm. It has more than 300 million uses worldwide and is currently used in approximately 40% of all surgeries conducted in the United States. Its use is currently supported by over 3,000 published references. The LMA Supreme is a supraglottic, noninvasive airway management device that is composed of three main components: an airway tube, the hypopharyngeal mask, and an inflation line. The mask is designed to conform to the contours of the hypopharynx with its lumen facing the laryngeal opening. It is designed to maintain or temporize an airway in patients with an immediate need for airway support, patients with failed tracheal intubation or in whom tracheal intubation is not an option, and patients in whom the benefit of establishing an airway outweighs the risk of regurgitation and/or aspiration. It incorporates an integrated bite block and a gastric access port to allow evacuation of gastric contents or passive venting in the event of vomiting. Its semirigid structure allows easy and reliable insertion and increases the stability of the device once in place. Its cuff is small in comparison to those of other supraglottic airways, making it feasible to carry a smaller syringe to fill the cuff once seated.

This allows not only less overall weight but also a smaller footprint in the medical aid bag. The LMA Supreme is currently indicated by the manufacturer for several emergent scenarios, including cardiac arrest, trauma (including patients with serious facial or head trauma), for rescue ventilation after failed intubation and for the inability to maintain an airway or oxygenation, especially where rapid control is essential. The LMA Supreme has several advantages over other rescue airways. Insertions are fast, relatively easy, and repeatable. It is less invasive and traumatic for the patient, as it does not pass through the vocal cords. It has a high first-time placement rate and a reliable seal for successful ventilation. In addition, it is extremely stable in transport due to its semirigid structure and multiple tether points. Ultimately, the LMA Supreme and the King LT-D are each effective airways in the hands of the Special Operations medic. In this test, both airways were reliably placed with an insertion success rate of 100%. The SOF medics inserted the LMA Supreme slightly faster than the King LT-D, despite the lack of prior training or practice with the airway. In addition, the LMA Supreme was generally preferred by the medics, based on their experiences during this exercise. Several issues must be addressed, however, prior to the use of the LMA Supreme in combat. To improve the LMA Supreme's utility in combat, several modifications to packaging and markings would be recommended. First, the device would need to be prepackaged in a durable, waterproof enclosure that would be easily accessed while wearing gloves. A textured and perforated corner, similar to that used on the King LT-D military packaging from North American Rescue, LLC, would allow effective purchase with any type of glove and would also provide a tactile indicator for opening without direct visualization. Within this package, there should be included a 20ml syringe for cuff inflation as well as a small package of water-soluble lubricant. To minimize the overall size of the airway package, folding of the device may be considered. In our informal tests, several LMA Supreme devices were folded and wrapped tightly for several days while being carried in the lower leg pocket of the Army Combat Uniform. After several days, the device was easily unfolded and tested without any apparent degradation of the materials. The cuff continued to function well and the breathing conduit remained completely patent. Further study of the effects of folding these devices for extended periods of time would be warranted to guarantee the integrity of the system when deployed for use. Vacuum-sealing the airway package could further decrease the footprint of the device and accessories but would also need to be evaluated to ensure that no damage would occur to the device as a result of extended time in a collapsed state. In regard to device markings, it was noted that the red tab used to keep open the cuff's pilot balloon was nearly impossible to visualize when viewed through night observation devices. Some type of indicator, perhaps a black or reflective stripe across both sides of the tab, would make it easier to locate and remove before insertion at night. In addition, adding a textured surface to the tab would improve purchase when manipulating with gloves or wet hands.

Conclusion

The LMA Supreme is a viable supraglottic airway device for use by special operations medical providers in combat. The highly intuitive method of insertion, ease of repeatability, security of the device once inserted, and durability of the materials make this a good choice for use by medical personnel with limited training time on the device. With only minor modifications to packaging and device markings, the LMA Supreme would be ready for use in a tactical environment. Continued trial use by special operations medical personnel, to include human airway insertions in a controlled surgical environment, would be useful in continuing to build confidence and gain experience with this airway device.

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