Simulated rescue airway use by laypersons with scripted telephonic instruction.

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Simulation and education

Simulated rescue airway use by laypersons with scripted telephonic instruction☆

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ABSTRACT

Background: The King LT-D is a supraglottic airway with the potential for use by trained first responders in settings where access to advanced life support interventions by a physician or Emergency Medical Services may be delayed.
Objectives: To determine the success rate of novice users in the telephone-directed placement of the King LT-D airway during a simulated respiratory arrest in order to establish the feasibility of conducting further study into use of the device by first responders after minimal training.
Methods: We conducted a prospective study using 30 undergraduate students without medical training and a high-fidelity simulator. Subjects were instructed using a telephone-directed protocol to assess the airway, place the King LT-D and ventilate the simulator. Subjects were assessed on the successful placement of the King LT-D, time to placement, and perceived ease of use of the device. A Likert scale was used to identify the participant's perceptions. Subjects with CPR/AED certification were compared to those without such training. Data were analyzed using descriptive statistics and a *t*-test.
Results: The King airway was successfully placed in 80% (95% CI: 65; 95) of attempts. Success rate did not differ with prior CPR training. The median time to successful placement was 1 min 50 s (95% CI: 1 min 6 s; 2 min 39 s). The participants perceived the King LT-D to be easy to place in 90% (27/30) of cases.
Conclusion: The King LT-D is simple enough to use, that it can be successfully placed by novice users with minimal telephonic instruction. This suggests that further studies could be conducted to determine the effect of King LT-D use on quality of airway management in scenarios depicting management of cardiac arrest by first responders in areas with delayed access to ALS interventions.

1. Introduction

The King Laryngeal Tube Disposable (King LT-D; King Systems Corporation, Noblesville, IN) is a supraglottic airway device with the potential for use by the trained first responder in situations where access to medical interventions by a physician or Advanced Life Support (ALS) Emergency Medical Services may be delayed. The device can be inserted blindly into the airway using a jaw lift and consists of a transparent tube with a proximal pharyngeal cuff, distal esophageal cuff and ventilation apertures that allow air to pass from the oropharynx into the trachea. Prior studies have shown the efficacy of the King LT-D in the operating room,[1,2] in a human simulator[3] and in the prehospital setting.[4] The King LT-D has potential for use by minimally trained first responders such as police officers, firefighters and flight attendants as well as EMS personnel in conjunction with bag-valve-mask and CPR/AED interventions, particularly in the context of online medical control verbal instructions.

Airway management protocols during CPR by the basic prehospital provider have recently been brought into question.[5] In most states, airway management by the first responder or basic emergency medical technician (EMT-B) remains limited to use pocket mask or bag-valve-mask facilitated rescue breathing. During cardiac or respiratory arrest, ventilation performed by EMS personnel is commonly performed using a bag-valve-mask prior to the insertion of another device designed to provide definitive airway security. The use of the conventional definitive airway, the cuffed endotracheal tube (ETT), requires training and competence beyond the level of the first responder.[6] Since neither pocket mask nor bag-valve-mask interventions ensure direct ventilation into the trachea and do not reduce aspiration risk, alternative airways such as the King LT-D have been studied to assess their effectiveness.[3,4] The use of the King LT-D by a first responder represents an alternative to the

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use of the pocket mask or bag-valve-mask or indeed lack of airway management in respiratory or cardiac arrest occurring in the pre-hospital setting where access to more invasive interventions may be delayed. These areas include rural settings, austere environments and in-flight airline emergencies where the providers on a scene may be minimally trained first responders working with pre-arrival instructions or online medical command. Investigations of alternative airways such as the LMA have shown a reduction in the risk of aspiration in comparison to the bag-valve-mask.[7] It is possible that the use of the King LT-D could provide this same benefit when used by a first responder as an alternative to the bag-valve-mask for securing a patent airway. In addition, direct bag-valve-mask ventilation is a complex and difficult skill requiring maintenance of a secure seal, which is most adequately provided by two rescuers.[8–11] The two-rescuer method may not always be feasible in the out-of-hospital prioritize CPR compressions and AED use.

The objective of this study was to determine the success rate of novice users in the placement of the King LT-D during a simulation directed by telephone instruction. The scenario used simulated the simplest of conditions—a respiratory arrest in the absence of complicating airway reflexes or indications to begin CPR or AED use. This scenario provided the opportunity to isolate the skill of King LT-D placement by novice users in order to determine the feasibility of use of this device with simple verbal instructions. As there is no data describing the use of the King LT-D by untrained rescuers, the investigation involved use of human simulators, thus compromising neither patient nor subject safety. We hypothesized that novice users can successfully place the King LT-D and ventilate a human simulator in respiratory arrest with verbal instructions provided via a mock 911 call.

2. Methods

2.1. Type of study

Feasibility study.

2.2. Setting

Study scenarios took place at the Peter M. Winter Institute for Simulation, Education and Research (WISER) at the University of Pittsburgh.

2.3. Subjects

Subjects participating in this study consisted of 30 University of Pittsburgh undergraduate students with no training beyond CPR/AED certification. Students were recruited via a verbal request made during several undergraduate summer course lectures at the University of Pittsburgh. Interested subjects were then contacted via an emailed recruitment letter. Subjects were given a $5 gift card upon completion of the study.

2.4. Equipment

The King LT device used for this study was a size 4 King LT Supraglottic Airway Device (King Systems, Noblesville, IN). The bag-valve device used for this study was an AMBU (Ambu Inc., Glen Burnie, MD). The simulator used for the study was a Laerdal SimMan (Laerdal, Stavanger, Norway).

2.5. Protocol

All subjects gave informed consent prior to participation in the study. Subjects were then asked to enter the room to help a person who had 'stopped breathing' and were given a prop phone with which to contact 911 for instructions. Subjects then entered the room where a mannequin in simulated respiratory arrest was lying on the floor. The King LT-D with connected syringe and bag-valve was lying next to the mannequin. Subjects were instructed to place the King LT-D with instructions given by telephone as described in Fig. 1.

3. Measurements

Subjects were asked prior to participation whether or not they had ever been trained in CPR/AED interventions. Those with any prior CPR training were analyzed separately from the CPR-naive subjects. Subjects were assessed on the successful placement of the device, time to placement and perceived ease of use of the device. Time to placement was measured from time the subject picked up the device to completion of first successful ventilation. Subjects were only given one attempt to place the device but were directed to make adjustments in device positioning up to two times if ventilation was not successful following initial placement. Ease of use was evaluated using a 5-point Likert scale administered following the scenario. Given the written statement, 'This device was easy to use', subjects were asked to select one response from the following list; Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree. Strongly Agree was given a score of 5 points and Strongly Disagree a score of 1 point. Each scenario was videotaped for data collection purposes. For each scenario, one study investigator ran the simulation software (FXG) and a second investigator provided verbal instructions out of sight of the subject via a telephone script modeled after a 911 call (GB). This was done to eliminate variation in presentation of the scenario. In order to eliminate the possibility of imposing investigator bias on the scenario, the study investigator providing instructions did not observe subjects during the actual scenarios. The following data were retrieved from review of video footage of each simulation: (1) Time (in seconds) for airway assessment and opening. (2) Time from picking up the King LT-D to first successful ventilation. (3) Total scenario time. Subjects were blinded to the outcome measures being evaluated. Successful ventilation was defined as the presence of chest rise during positive pressure ventilation with a bag-valve attached to the King LT-D. Subjects were asked to identify presence or absence of chest rise. Adequate ventilation was verified by the investigator running the simulation software (FXG). Data were entered into a personal computer and analyzed with descriptive statistics and a two sample *t*-test with unequal variances to compare groups with and without prior CPR/AED training. Data were analyzed with Stata 9.0 (Stata Inc., College Station, TX). The University of Pittsburgh Institutional Review Board approved this study.

4. Results

Thirty subjects completed the study. Nine subjects (30%) had prior CPR training. No subjects had any medical training beyond CPR/AED certification. The King LT-D was successfully placed by 80% (24/30) of subjects (Fig. 2). The median time to successful placement was 1 min 50 s (95% C I: 1 min 6 s; 2 min 39 s), (Table 1). Time to assess airway with no prior CPR/AED training was 54 s (95% CI: 48.8–59.2) and with prior CPR/AED training was 47.1 s (95% CI: 38.5–55.7), ($p = 0.25$). Time to 1st ventilation with no prior CPR/AED training was 115.5 s (95% CI: 102.7–128.3) and with prior CPR/AED training was 99 s (95% CI: 70.2–127.8), ($p = 0.15$).

Subjects perceived the device to be easy to use in 27 of 30 cases (90%). Most subjects agreed that the King was easy to use, with a median of 4 (IQR 4–5). Two of the subjects failing to ventilate the simulator indicated *Neutral* in response to the Likert scale prompt. One of these two subjects failed due to inability to disconnect the

1. **Subject enters scenario room and contacts 911 dispatch using a mock cellular phone.**
2. **Subject is asked to indicate patient location.**
3. **Subject is informed that their 'cellular phone' has been placed in the speaker phone setting and that subsequent instructions will be given over the speaker system within the scenario room. Subject places 'cellular phone' on ground.**
4. **Subject is asked to ensure patient is lying on their back.**
5. **Subject is asked to assess consciousness, airway and breathing.**
6. **Subject is asked to perform jaw thrust and reassess airway and breathing.**
7. **Subject is asked to pick up the King LT and to insert the device into the patient's mouth until the red valve on the end of the device reaches the patient's teeth.**
8. **Subject is instructed to inflate the King LT using the attached syringe and to remove the syringe once the device is inflated.**
9. **Subject is instructed to attach the bag-valve device to the King LT.**
10. **Subject is instructed to squeeze the bag every 5 seconds.**
11. **Subject is asked to assess the rise and fall of the chest with ventilation.**
12. **If subject states chest is rising with ventilations, subject is informed that EMS is on the way and scenario is terminated.**
13. **If subject states chest is not rising, subject is instructed to adjust the device by pulling it out of the patient's mouth 1 inch. Subject makes second attempt at ventilation with subsequent assessment of chest rise. If no chest rise, subject is instructed to adjust the device a second time and to re-attempt ventilation. If no chest rise, scenario is terminated.**

Fig. 1. Sequence of voice prompts and participant actions during mock respiratory arrest scenario.

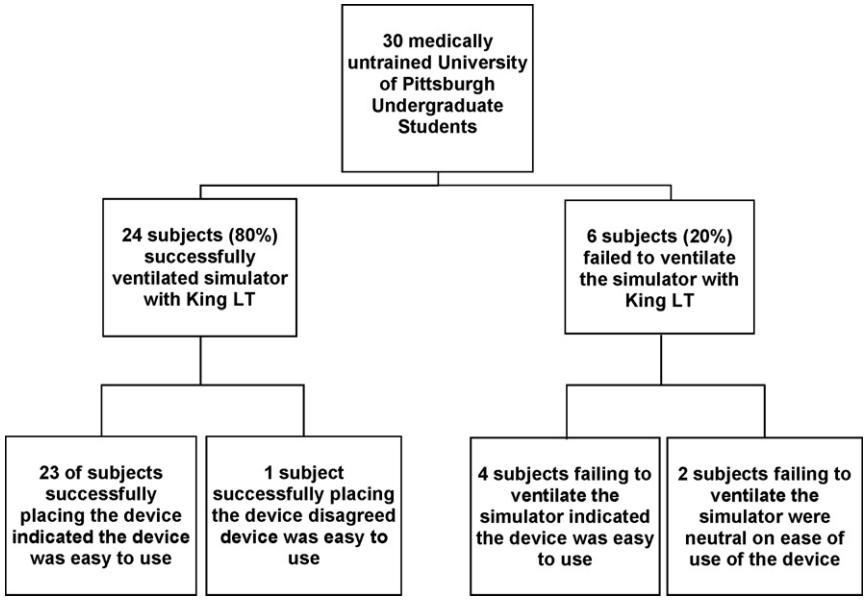

Fig. 2. Success rate and ease of use of the King LT-D™ by untrained rescuers. Subjects indicating device was easy to use selected a Likert scale response of 'Strongly Agree' or 'Agree' to the prompt: 'This device was easy to use.'

Table 1
Times and perceived ease of use for placement of King LT by laypersons. Median time to successful placement: 110 s (95% confidence interval: 66; 159).

Subject	Sex	Prior CPR	Time for assessment and airway opening (s)	Time to successfully place King LT (s)	Device easy to use
1	F	N	46	124	Strongly Agree
2	F	N	40	137	Agree
3	F	N	46	110	Agree
4	F	N	51	134	Agree
5	F	N	45	Failed to ventilate	Agree
6	F	N	54	151	Disagree
7	M	N	66	129	Agree
8	F	N	55	159	Agree
9	M	Y	61	89	Strongly Agree
10	F	N	40	Failed to ventilate	Neutral
11	F	Y	40	94	Strongly Agree
12	F	N	38	95	Strongly Agree
13	M	Y	41	91	Agree
14	F	Y	45	66	Strongly Agree
15	M	N	43	115	Strongly Agree
16	M	N	60	85	Strongly Agree
17	M	N	44	90	Agree
18	F	Y	29	170	Strongly Agree
19	F	N	72	81	Agree
20	M	Y	40	63	Strongly Agree
21	M	N	62	Failed to ventilate	Neutral
22	F	N	74	107	Strongly Agree
23	F	N	59	135	Agree
24	M	N		90	Agree
25	F	N	55	106	Agree
26	M	Y	54	94	Strongly Agree
27	F	Y	64	Failed to ventilate	Strongly Agree
28	F	Y	50	125	Strongly Agree
29	F	N	68	Failed to ventilate	Strongly Agree
30	F	N	62	Failed to ventilate	Agree

syringe from the King LT-D while the other was unable to adequately re-position the device once inserted. Only one subject in the study indicated *Disagree* that the device was easy to use. Interestingly, this subject was successful in ventilating the simulator with the King LT-D.

One video file of a successful placement was inadvertently deleted, preventing the investigators from determining time for airway assessment and opening (Subject 24). Of six subjects who failed to place the device, two were unable to remove the syringe from the tubing on the device. In these two cases, the scenario was halted. The other four subjects failing to successfully ventilate the simulator were unable to adequately re-position the device in the mannequin's airway in order to achieve chest rise with ventilation.

5. Discussion

In this study, simple instructions provided in a simulated 911 call enabled novice users to successfully ventilate a high-fidelity simulator in 80% of cases. 27 of 30 subjects perceived the device to be easy to use (90%). Our data suggest that use of this device by minimally trained first responders such as EMT-basics, firefighters, police officers, lifeguards or flight attendants could be further studied in more clinically realistic rescue scenarios simulating King LT-D use in the pre-hospital setting with verbal instructions provided by 911 operator or online medical control.

Airway management by the first responder is limited by both level of training and the inadequacy of face mask or bag-valve-mask techniques in ensuring adequate ventilation. In instances where access to ALS Emergency Medical Services or the intervention of a physician may be delayed, use by a minimally trained first responder of the King LT-D may represent an alternative to non-invasive bag-valve -mask ventilation which is most adequately provided by two rescuers. The solo management of the airway by a minimally trained second rescuer using this simple airway device would provide the opportunity for a primary first-responder to prioritize continuous management of CPR/AED interventions. In a two-rescuer scenario, the King LT-D can be placed without stopping compressions and allows for continuous compressions once the device has been placed. Use of this device by a minimally trained first responder may free up providers with more extensive training, allowing for placement of emphasis on quality CPR/AED interventions within a rescue scenario. This may both reduce no-flow time and minimize interruption of compressions for airway management, possibly improving the quality of CPR provided by first responders.

The use of a supraglottic airway device such as the King LT-D provides a number of advantages to rescuers lacking advanced airway skills. It is simple to use. In this study, users with no previous advanced airway training or exposure to the device were able to successfully ventilate a simulator 80% of the time. By using this device, the difficulty of maintaining a sufficient seal over the patient's face when using a pocket mask or bag-valve-mask is eliminated, thus reducing the need for two-rescuer management of the airway. Furthermore, the reliance on patient head, neck and jaw positioning maneuvers to increase likelihood of tracheal vs. esophageal ventilation is reduced. It was possible in this study to direct a non-medically trained individual to use the King LT-D with simple verbal instructions. Further studies are needed to assess the ability of first responders to successfully use the device in conjunction with CPR and AED. It should be noted that minor modifications to the device itself could potentially eliminate barriers to use of the device by individuals with limited training. Of six subjects who failed to place the device, two were unable to remove the syringe from the tubing on the device. It is possible that color coding specific attachment points of device components would facilitate removal of the syringe from the device tubing as well as assembly of the King LT-D tube and bag-valve.

There were a number of limitations to this feasibility study. In an attempt to assess the skill of King LT-D placement in an isolated

fashion, the scenario used simulated only the simplest of conditions of respiratory arrest and thus did not investigate the effect of airway complications or management of cardiac arrest on use of the device. We did not evaluate the clinical translation of these skills, nor did we assess these skills in medically trained individuals—such areas require further study. Additional studies assessing the ease of use of the King LT-D by first responders in conjunction with CPR/AED in scenarios simulating out-of-hospital cardiac arrest are needed to determine the feasibility of the use of the device by such rescuers with online medical control. Translation of simulated study activity to real-life experience would not be advisable without further investigation. The study was subject to the limits of a human simulator. We used one size King LT-D and one adult size simulator. Therefore, our results may not be applicable to all sizes of the device or to all patients.

6. Conclusions

The King LT-D was successfully placed by novice users in 80% of simulations. These findings warrant further exploration of the potential use of this device by minimally trained first responders. In instances where access to the EMS system may be delayed, the King LT-D may represent an alternative to non-invasive ventilation by a minimally trained first responder in conjunction with priority management of CPR/AED interventions.

Conflict of interest statement

The authors have no conflicts of interest to report.

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