LMA C Trach aided endotracheal intubation in simulated cases of cervical spine injury: A series of 30 cases

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ABSTRACT

Background: Laryngeal mask airway (LMA) C Trach is a novel device designed to intubate trachea without conventional laryngoscopy. The aim of the study was to evaluate the clinical efficacy of C trach in the simulated scenario of cervical spine injury where conventional laryngoscopy is not desirable. **Methods:** This prospective pilot study was carried out in 30 consenting adults of either gender, ASAPS I or II, scheduled for surgery requiring endotracheal intubation. An appropriate sized rigid cervical collar was positioned around the patient's neck to restrict the neck movements and simulate the scenario of cervical spine injury. After induction of anesthesia, various technical aspects of C Trach facilitated endotracheal intubation, changes in hemodynamic variables, and complications were recorded. **Results:** Mask ventilation was easy in all the patients. Successful insertion of C Trach was achieved in 27 patients at first attempt, while 3 patients required second attempt. Majority of patients required one of the adjusting maneuvers to obtain acceptable view of glottis (POGO score >50%). Intubation success rate was 100% with 26 patients intubated at first attempt and the rest required second attempt. Mean intubation time was 69.8 ± 27.40 sec. With experience, significant decrease in mean intubation time was observed in last 10 patients as compared to first 10 (46 ± 15.77 sec vs. 101.3 ± 22.91 sec). Minor mucosal injury was noted in four patients. **Conclusion:** LMA C Trach facilitates endotracheal intubation under direct vision and can be a useful technique in patients with cervical spine injury with cervical collar *in situ*.

Key words: *Cervical spine injury, cervical collar, laryngeal mask airway C Trach*

INTRODUCTION

Cervical spine (C-spine) injuries occur in 1.5-4% of all major trauma cases.[1] These patients require utmost care to minimize the movement of cervical spine to prevent the worst possible neurological outcome. According to Advanced Trauma Life Support (ATLS) guidelines, the simplest way of limiting neck movement is the application of a hard cervical collar (C Collar).[2] One third of C-spine injury patients require intubation at some time.[3] In this situation, conventional intubation with head extension and neck flexion is dangerous and intubation needs to be done with head and neck in neutral position.[2]

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Laryngeal mask airway C Trach (LMA C Trach, The laryngeal Mask Company Limited, Le Rocher, Victoria, Mahe, Seychelles) is a new device which avoids conventional laryngoscopy. Due to its unique design, it conforms to normal curvature of upper airway and can be inserted in neutral position of head and neck.[4] Thus, it may offer advantage in intubating the patients of C-spine injury stabilized on C Collar. But before applying this technique to the patients of C-spine injury, experience and expertise on the simulated category of patients is desirable where patients are not subjected to any undue risk. If found successful, results can be extrapolated in patients of C-spine injury.

Purpose of the study was to evaluate efficacy of LMA C Trach in simulated scenario of C-spine injury with C Collar *in situ*.

METHODS

After obtaining institutional review board approval and informed written consent, this prospective pilot study was carried out in 30 patients of either gender, aged 20-60 years of ASA physical status I and II, scheduled for elective surgery requiring tracheal intubation. Patients with body mass index >30, risk of regurgitation, anticipated difficult intubation, respiratory tract and pharyngeal pathology, and antenatal females were excluded from the study.

In preanaesthetic preparation room, monitoring consisting of heart rate (HR), non-invasive Mean Arterial Pressure (MAP), and peripheral oxygen saturation (SpO_2) was done and baseline vital parameters were recorded. The inter-incisor distance in centimeter was recorded before and after positioning of an appropriately sized rigid C Collar (VISSCO hard cervical collar) around the neck of the patients. After securing intravenous access, patients were premedicated with glycopyrrolate 0.004 mg/kg, tramadol 2 mg/kg, midazolam 0.02 mg/kg, and ranitidine 1 mg/kg intravenously, 15 min before induction.

In the operation theater, patient was placed supine without pillow. After preoxygenation, anesthesia was induced with sleep dose of 2.5% thiopentone sodium. After assessing ease of mask ventilation, rocuronium 0.9 mg/kg was given for muscle relaxation. When there was no response to train-of-four stimulation with peripheral nerve stimulator, appropriate sized LMA C Trach [Table 1] lubricated with 2% lignocaine jelly was inserted by anesthesiologist who had more than 3 years of experience in LMA C Trach insertion. All the intubation attempts were performed by the same anesthesiologist. Jaw elevation was the only movement permitted during insertion of LMA C Trach. Once the LMA C Trach was inserted, the cuff of the LMA was inflated with recommended volume of air to achieve air-tight seal. LCD viewer, which was focused in advance for the clarity of view, was attached to the C Trach and the best possible view of the glottis was obtained in the center of the LCD viewer and graded according to Percentage of glottic opening (POGO) score from 0 to 100% [Figure 1]. Time duration from starting of LMA C Trach insertion to getting of best possible view of larynx on LCD viewer was taken as T_1. If laryngeal view on the LCD viewer was not satisfactory, C Trach was adjusted to optimize the view of glottis by one of the following adjusting maneuvers: (1) Withdrawing the LMA C Trach by no more than 6 cm with cuff inflated, followed by reinsertion (up-down maneuver) and (2) pulling the handle of the LMA C Trach back toward the intubator (extension maneuver). After getting the best possible view of glottis, trachea was intubated with appropriate sized [Table 1], well-lubricated, cuffed wire reinforced silicone endotracheal tube (ETT) through C Trach channel. If a clear view of glottis was not obtainable, an attempt was still made to perform tracheal intubation using whatever view was obtained. Time duration from starting of LMA C Trach insertion to correct placement of tube as evidenced by visual confirmation on LCD viewer was taken as T_2. Tube was connected to the breathing circuit and additional confirmation of correct placement was done using end-tidal CO_2 measurement in expired breath. After successful intubation, viewer was detached from LMA C Trach, ETT connector was removed, cuff of the LMA was deflated, and LMA C Trach was removed over the ETT with the use of a stabilizer rod. The ETT was again connected to the breathing circuit. The time taken to withdraw the LMA was not included in the duration of intubation attempt. The number of attempts for successful C Trach insertion and intubation was noted, and if intubation could not be accomplished within 3 min or more than two attempts were required, it was considered a failure of the technique and intubation was done using conventional laryngoscopy without C Collar. Changes in hemodynamic variables, oxygen saturation, and complications, if any, were recorded during the procedure and 10 min post procedure [Figure 2]. At the time of extubation, oral cavity was inspected for any traumatic injury.

Table 1: Criteria for selecting size of LMA C Trach and endotracheal tube

Size of LMA C Trach	Weight (kg)	Size of ETT (mm ID)
Size 3	30-50	6.5
Size 4	50-60	7.0
Size 5	>60	7.5

LMA C Trach - Laryngeal mask airway C trach; ETT - Endotracheal tube

We also compared T_1 and T_2 in the first 10, second 10, and third 10 patients groups to evaluate the improvement in the technique with the increasing experience of the anesthesiologist in the simulated scenario of C-spine injury [Figure 3].

The primary endpoints were the POGO score obtained and time taken, number of attempts, and rate of successful C Trach insertion and intubation. The secondary endpoints were the number of adjusting maneuvers required for obtaining the best possible view of larynx, incidences of desaturation and trauma, and effect on hemodynamic variables during the procedure.

Statistical analysis

Assuming overall intubation success rate of 90% in patients with a difficult intubation,[5] minimum 26 patients would be necessary for the study with permitted alpha error of

0.05. We therefore enrolled 30 patients in this study. After allowing beta error of 0.2, power of the study stands out to be 80%.

Statistical analysis was performed on Jindal sigma statistical software version 2.0. Data were presented as mean±standard deviation (SD) and percentage, wherever applicable. $P<0.05$ was considered statistically significant.

RESULTS

All patients completed the study. Table 2 shows the characteristics of the patients. The average inter-incisor distance was smaller after application of collar than before the application of collar (4.06±0.58 cm vs. 4.62±0.59 cm; $P<0.05$)

Technical aspects of C Trach-facilitated endotracheal intubation with C Collar *in situ* are shown in Table 3. Mask ventilation was easy in all the patients. C Trach insertion was accomplished in first attempt in 90%, while 10% patients required second attempt. Twenty-five patients (83.33%) required one of the adjusting maneuvers to achieve the best possible view of larynx in the center of the LCD viewer [Figure 1]. POGO score was 75-100% in 22 patients and 50-75% in rest of the patients. Twenty-six patients were intubated at first attempt, while the rest required second attempt. The success rate of tracheal intubation was 100%.

There was significant increase in HR and MAP at the time of intubation, which returned to baseline within 10 min [Figure 2]. Except for the incidence of minor mucosal injury in four patients, three at upper lip and one at hard palate, no other severe complications like dental trauma or airway laceration were encountered.

Mean time for successful C Trach insertion (T^1) and successful intubation (T^2) was 42.83±15.50 sec and 69.80±27.40 sec, respectively. Figure 3 shows significant decrease in C Trach insertion and intubation time with increase in experience of anesthesiologist. There was no incidence of desaturation as evidenced by stable SpO^2 throughout the procedure.

DISCUSSION

Trauma victims, unless proved otherwise, should be suspected of having C-spine injury.[3] According to ATLS protocol, a rigid C Collar should be used to immobilize the neck in patients with suspected C-spine injury.[2] There are wide varieties of C Collar available in the market. Use of appropriate size is mandatory for proper immobilization of neck. We used rigid C Collar of appropriate size. Conventional laryngoscopy in patients restrained by a rigid C collar is usually difficult and impossible at times.[1,6,7] Fiber-optic intubation is ideal in these patients because neck mobilization and wide mouth opening are not required. However, accomplishing fiber-optic intubation needs time, expertise, secretion-free airway, and patient's cooperation, which make it not suitable in emergency situation.[7]

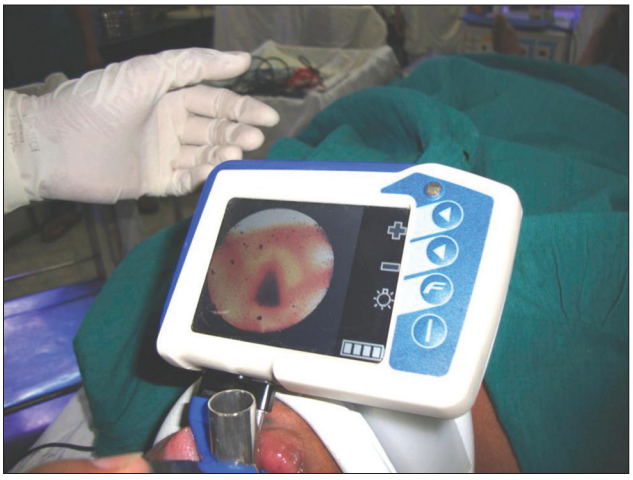

Figure 1: POGO score of 100% on LMAC Trach LCD viewer

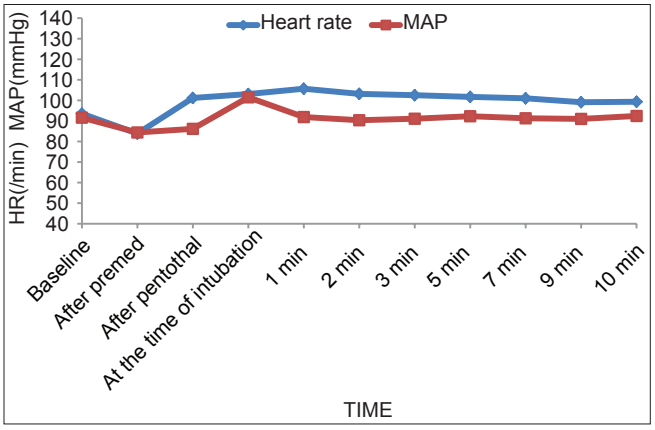

Figure 2: Hemodynamic response to LMA C Trach facilitated intubation

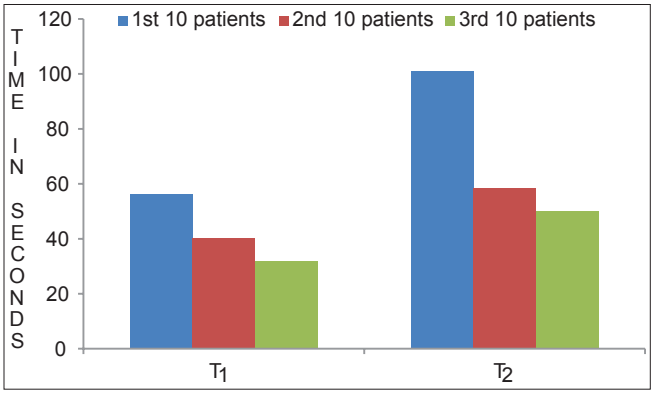

Figure 3: Time required for procedure in first 10, second 10 and third 10 patients' groups

Table 2: Patients' characteristics

Variables	Mean ± SD
Age (years)	29.16±12.70
Weight (kg)	48.3±7.67
Gender (M/F)	10/20
ASAPS (I/II)	14/16
Inter-incisor distance (cm)	
Before application of C Collar	4.62±0.59
After application of C Collar	4.06±0.58

*P<0.05 when inter-incisor distance is compared before and after the application of C Collar; n=30

Table 3: Technical measures of LMA C Trach aided endotracheal intubation

Technical measures	No. of patients	Percentage
Mask ventilation		
Easy	30	100
Difficult	00	00
No. of attempts for C Trach insertion		
First attempt	27	90
Second attempt	03	10
Adjusting maneuvers required		
Yes	25	83.34
No	05	16.66
POGO score after adjusting maneuvers		
75-100%	22	73.33
50-74%	08	26.67
<50%	00	00
No. of successful endotracheal intubation	30	100
No. of intubation attempts required		
First attempt	26	86.66
Second attempt	04	13.44

LMA C Trach - Laryngeal mask airway C trach; POGO – Percentage of glottic opening

There are various reports of use of the intubating laryngeal mask airway (ILMA) to facilitate endotracheal intubation in patients wearing a C Collar, with varied results.[8-10] One study[8] reported 100% success rate of blind intubation via the ILMA wearing rigid tracheostomy Philadelphia collar. However, this study was retrospective and investigators had cut out the chin portion of collar to facilitate the access to patient's mouth, a maneuver that surely reduces the efficacy of C Collar and would ease ILMA insertion. Another study[9] reported 100% success rate of blind intubation via ILMA in 17 patients wearing a stiff neck collar. However, using same type of collar with application of cricoid pressure, author of another study[10] reported only 20% success rate in blind intubation via ILMA. Whatever is the result, it is a blind technique with high potential for failed intubation in the first attempt.

To overcome this, use of a lighted stylet through the intubating laryngeal mask or fiber-optic devices is recommended.[4]

There are various videolaryngoscopic devices (Truview EVO2, Glidescope, Airtraq, C-MAC, and Pentax AWS) available in the market which are reported to improve endotracheal intubation success rate over Macintosh laryngoscope in patients with cervical spine immobilization.[11-14] The LMA C Trach is another such device designed to increase intubation success rates in both anticipated and unanticipated difficult airways. It is a modified ILMA with the addition of an LCD display and a light source to allow fiber-optic view of the glottis during ventilation and intubation. Because of its unique curvature which resembles Guedel's airway, it can be inserted in neutral position of head and neck, and hence may prove a valuable technique in patients with cervical spine injury.[4]

Most of the studies,[11-14] where different videolaryngoscopes were used in C-spine injuries, used manual-in-line stabilization to immobilize cervical spine, which cannot be equated with hard C Collar immobilization of cervical spine. Hence, we decided to undertake this pilot study to evaluate the efficacy of LMA C Trach for endotracheal intubation in simulated scenario of C-spine injury with rigid C Collar in place.

Data of present study proved it to be a real valuable technique as intubation success rate was 100% using C Trach. Successful insertion of LMA C Trach was achieved at first attempt in 90% of patients. It is a common experience that insertion of oropharyngeal airway is easier with concavity facing upward in patients with limited mouth opening with restricted head and neck movement (alternate method). This method was found to be more convenient as compared to the classical technique (one hand rotational movement in sagittal plane) of LMA C Trach insertion in this group of patients. In significant number of cases (83.33%), some kind of adjusting maneuvers was required to optimize the view of glottis. Once the acceptable view of the glottis was obtained in the center of LCD viewer, endotracheal intubation was successful in 100% of cases. Out of four patients where second attempt for intubation was required, in three patients further lubrication with good amount of jelly facilitated endotracheal intubation and one patient required smaller size ETT.

We used POGO score for the assessment of the laryngeal view, which is a measure of glottic opening seen from the anterior commissure to posterior cartilage on a numerical scale from 0 to 100%. This newer method has excellent inter-and intra-rater reliability, is simpler, and better suited for research purpose over Cormack–Lehane classification of laryngeal view, as Cormack–Lehane classification is poorly known among anesthesiologists, and its reproducibility, even in subjects well familiar with this classification, is limited.[15]

Statistics show that increasing experience in the technique improves the competency of anesthesiologist in intubating trachea. The mean intubation time 101.3±22.9 sec in the first 10 patient's group was significantly reduced to 46±15.77 sec in the last 10 patients' groups. This proves that the skill is gained in the technique over time. The results of the present study are comparable to the results of a study[16] in which mean intubation time was 41±15.8 sec with 100% success rate of intubation through LMA C Trach, although we could achieve comparable intubation time only after experience gained in 20 patients.

There was significant increase in HR and MAP at the time of intubation. We are not in a position to comment whether stress response observed in this study is comparable to conventional laryngoscopy and intubation, as we did not have control group.

Though there is no gold standard technique for airway management of a patient with C-spine injury, several techniques are being used. Conventional laryngoscopy being difficult, blind nasal intubation and intubating LMA being blind techniques, fiber-optic intubation being time consuming in emergency situation, the usefulness of LMA C Trach to intubate under direct vision with C Collar in place is evident in the scenario of C-spine injury. Further studies are needed to translate these results in the patients with actual C-spine instability.

The limitations of present study are the absence of a control group and simulated scenario which does not represent the true emergency scenario of C-spine injury.

CONCLUSION

It was concluded that with experience gained in the simulated scenario of C-spine injury, this technique can really be a boon for tracheal intubation in patients with actual C-spine injury.

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