Original Article

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Intubating Laryngeal Mask Airway Allows Tracheal Intubation When the Cervical Spine is Immobilized by a Rigid Collar

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Abstract

In trauma patients, an unstable cervical spine can render intubation dangerous. Also, immobilization of the cervical spine may hinder intubation. We tested the hypothesis that the ILMA would allow tracheal intubation in the presence of a rigid collar. *Methods:* One hundred patients of ASA I & II were divided into two groups; the Collar group of 50 had a cervical collar in place whereas the Control group of 50 did not have a collar.Tracheal intubation was performed with the help of ILMA and the results were noted. *Results:* The ILMA allowed tracheal intubation in the presence of cervical collar without any significant differences in the success rate, the number of attempts, the intubation time, and the frequency of complications as compared to patient without a collar.

Keywords: ILMA; Tracheal; Intubation; Cervical; Spine

Introduction

Few diseases or injuries have greater potential for causing death or devastating effects to the quality of life than cervical spine trauma. Cervical spine injuries occur in 1.5% - 3% of all major trauma cases [1]. Anaesthesiologists are often involved in the initial resuscitation and management of trauma victims with possible cervical spine injuries. In traumatized patients, 3% - 25% of spinal cord injuries occur during field stabilization, transit to the hospital, or early in the course of therapy [1]. The potential of cervical spine injury makes airway management more complex in the trauma patient. A cervical spine injury should be suspected in all injury mechanisms involving blunt trauma. Patients with injury above the clavicles are at increased risk, and this is increased 4-fold if there is a clinically significant head injury (Glasgow Coma Score < 9) [2].

Intubation involves positioning the head and neck in the sniffing position, resulting in the axial alignment of the month, oropharynx and larynx. To accomplish this, the lower cervical spine is placed in flexion and the occipitoatlantoaxial complex is extended. When the cervical spine is unstable, such a manipulation may result in fracture or subluxation of the osseous elements with resultant cord compression and injury.

According to the Advanced Trauma Life Support protocol, a rigid cervical collar should be used to immobilize the neck in patients with possible cervical spine injury [3]. Fibreoptic intubation is ideal in these patients because neck immobilization and wide mouth opening are unnecessary. However, patients with suspected cervical spine injuries often require urgent intubation under suboptimal conditions.

Direct laryngoscopy in patients restrained by a rigid cervical collar is usually difficult and sometimes impossible [4]. An Intubating Laryngeal Mask Airway can be inserted without manipulating head and neck [5]. Therefore, an ILMA is an alternative to direct laryngoscopy in patients stabilized by a cervical collar.

We tested the hypothesis that the Intubating Laryngeal Mask Airway would allow tracheal intubation in the presence of a rigid cervical collar.

Aims and Objectives

Aim

To evaluate the efficiency of Intubating Laryngeal Mask Airway for endotracheal intubation in patients when the cervical spine is immobilized by a rigid cervical collar.

Objectives

(a) To compare the time required for insertion of ILMA in patients with a cervical collar and in those without a cervical collar.

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(b) To compare the intubation time using an ILMA in patients with a cervical collar and in those without a cervical collar.

(c) To compare total intubation time using an ILMA in patients with a cervical collar and those without a cervical collar.

(d) To compare the number of attempts required for insertion of ILMA in patients with a cervical collar and in those without a cervical collar.

(e) To compare the ease of ventilation with an IMLA in patients with a cervical collar and in those without a cervical collar.

(f) To compare the number of attempts required for endotracheal intubation using an ILMA in patients with a cervical collar and in those without a cervical collar.

(g) To compare the success of endotracheal intubation using an ILMA in patients with a cervical collar and in those without a cervical collar.

(h) To compare the incidence of adverse events while using an ILMA for endotracheal intubation in patients with a cervical collar and in those without a cervical collar.

Materials and Methods

This study was conducted on hundred patients who were divided into two groups (collar and control) of 50 patients each. All patients belonged to ASA physical status 1 and 2 and were more than or equal to 18 years of age. All patients were posted for elective surgery under general anesthesia. Patients less than 18 years, those at increased risk for aspiration and those having an unstable cervical spine were excluded from the study.

Preoperative history, examination and intra-operative examination findings were documented in each case. In Collar Group, measurement of mallampati score and mouth opening were performed with cervical collar in place.

Patients included in the collar group were provided with an appropriate rigid cervical collar and they were placed supine without a pillow. Patients included in the Control Group were also placed supine but without collar and with the head elevated 7cm by a ring pillow. Patients in both the groups were preoxygenated with 100% oxygen for 3 minutes. Patients in both the groups were then given Inj. Midazolam 0.03mg/kg and Inj. Fentanyl 2 mcg/kg I.V. Patients were induced with Inj. Propofol 2mg/kg and after confirming ventilation were given Inj. Vecuronium 0.1mg/kg I.V.

In both the groups appropriate size intubating laryngeal mask airway lubricated with lignocaine jelly (2%) was inserted using one handed rotational technique. Cuff was inflated with air and breathing circuit was attached. The size of intubating laryngeal mask airway was decided according to the following criteria.

Height (cm)	IMLA size	Volume of air cuff inflation (ml)
<160	3	20
160-170	4	30
>170	5	40

Ventilation was graded as:

(1) Adequate – rectangular capnograph with no air leak.

(2) Possible – capnograph wave form with some air leak.

(3) Impossible – no capnograph wave form detected.

If ventilation by intubating laryngeal mask airway proved impossible, only one further attempt at intubating laryngeal mask airway insertion was made.

Once ventilation was confirmed, a lubricated silicone tracheal tube was inserted through intubating laryngeal mask airway by gently advancing the tube beyond the epiglottis elevation bar. Size 7.0mm internal diameter endotracheal tube was used in all the patients.

If resistance was felt during insertion of endotracheal tube through the IMLA, the attempt was deemed as a failure and following adjusting manoeuvres were performed before each additional attempt at intubation:

1. Withdrawing intubating laryngeal mask airway by no more than 6 cm with cuff inflated followed by reinsertion (up- down manoeuvre),
2. Adjusting the position of intubating laryngeal mask airway until optimal seal was obtained,
3. Pulling the handle of intubating laryngeal mask airway back towards the intubator. (Chandy's manoeuvre).

Intubating laryngeal mask airway was removed after successful tracheal intubation using a stabilizing rod. The silicone endotracheal tube was the replaced with a PVC endotracheal tube of appropriate size using a tube exchanger.

Tracheal intubation was considered to have failed if it could not be accomplished within 3 minutes or all the adjusting manoeuvres failed.

Observation and Results

The present study was carried out with 100 patients selected randomly.

The patients were divided into two groups–Collar group and Control group of 50 patients each.

Table 1: Demography of patients

Parameters	Control group	Collar group	P-value
No. of patients	50	50	-------
Mean Age (yrs)	41.780 +/- 15.072	37.580 +/-11.516	0.1206
Mean Weight (kg)	60.060 +/- 7.413	59.200 +/- 7.884	0.5755
Mean Height (cm)	164.92 +/- 3.036	165.78 +/- 2.985	0.1564
M:F proportion	64:36	68:32	0.8328

By using unpaired t-test * P < 0.05 significant
P > 0.05 not significant

Above data reveals that mean age of the patients in control group was 41.780 while mean age of the patients in collar group was 37.580 which was almost same and the difference was not significant. Mean weight, height and sex distribution of the patients in both the groups were also comparable.

Table 2: Comparison of airway parameters between both the groups

Parameter	Control group	Collar group	P-value
Mallampati score (1/2/3/4)	18/32/0/0	1/30/19/0	< 0.0001
Mean Interincisor distance (cm)	5.040 +/- 0.3620	4.080 +/- 0.3959	< 0.0001
Slux (-1/0/+1)	0/1/49	0/2/48	0.8573
Mean Mentohyoid distance (cm)	7.160 +/- 0.3703	7.250 +/- 0.2901	0.1793
Mean Mento thyroid distance(cm)	7.890 +/- 0.4320	7.940 +/- 0.3591	0.5306

Airway parameters were compared using unpaired t-test * P < 0.05 significant, P > 0.05 not significant

As seen in Table 2, in Control group, 18 patients were present with Mallampati score 1, while 32 patients had Mallampati score 2. But after application of cervical collar in Collar group there was only 1 patient with Mallampati score 1 while 30 patients had Mallampati score 2 and 19 patients had Mallampati score 3. Both the groups differed significantly from each other with respect to Mallampati score.

Interincisor distance in Control group was 5.040 cm while in Collar group; it was 4.080 cm, thus differing significantly from each other.

Slux, Mentohyoid distance and Mento thyroid distance were evaluated before application of collar in the Collar group unlike Mallampati score and Interincisor distance which were evaluated after application of collar in the collar group.

None of the patients in both the groups had -1 slux value. While 1 patient in the Collar group had 0 slux value, 2 patients in Control group had 0 slux value. Rest of the patients in both the groups had +1 slux value. Difference in slux value between both the groups was not statistically significant.

Similarly, the differences between the Mentohyoid distance and Mento-thyroid distance was not statistically significant in both the groups.

Table 3: Comparison of ILMA insertion and intubation times between both the groups

Parameter	Control group	Collar group	P-value
Mean ILMA insertion time (sec)	19.240 +/- 4.153	25.260 +/- 7.502	< 0.0001
Mean intubation time (sec)	22.800 +/- 11.526	23.563 +/- 13.462	0.7636
Mean total intubation time (sec)	42.040 +/- 13.822	48.750 +/- 20.358	0.0584

By using unpaired t-test * P < 0.05 significant
P > 0.05 not significant

Above data in Table 3 reveals that mean ILMA insertion time in Control group was 19.240 +/- 4.153 sec which prolonged to 25.260 +/- 7.502 sec on application of collar in Collar group. The increase in mean ILMA insertion time was *extremely significant* statistically with a p-value of < 0.0001.

Mean intubation time in Control group was 22.800 +/- 11.526 sec while in Collar group, it was 23.563 +/- 13.462 sec and it *did not differ significantly* between both the groups with a p-value of 0.7636.

Similarly Mean Total intubation time in Control group was 42.040 +/- 13.822 sec which was *not significantly different* from 48.750 +/- 20.358 sec observed in Collar group.

Table 4: Comparison of ILMA insertion attempts between both the groups

ILMA insertion attempts	Control group	Collar group
One	49	42
Two	1	8

Applying Fisher's Exact Test * P < 0.05 significant
P > 0.05 not significant

As seen in Table 4**,** ILMA could be inserted in first attempt in 49 patients in Control group, while in Collar group ILMA could be inserted in first attempt in only 42 patients. On applying Fisher's Exact Test, p-value was 0.0309 which *was statistically significant.*

Table 5: Comparison of Grades of ILMA ventilation between both the groups

Grade of ILMA ventilation	Control group	Collar group
Adequate	46	42
Possible	4	8
Impossible	-----	----

Applying Fisher's Exact Test * P < 0.05 significant
P > 0.05 not significant

As can be seen in Table 5**,** in Control group 46 patients could be adequatelyventilated while in Collar group 42 patients could be adequately ventilated while in none of the patients ventilation was impossible. On applying Fisher's Exact Test, p-value was 0.3567 and there *was no statistically significant difference* between the two groups.

Table 6: Comparison of intubation attempts between both the groups

Intubation attempts	Control group	Collar group
One	42	40
Two	7	6
Three	1	4

Applying Chi-squared Test * P < 0.05 significant
P > 0.05 not significant

The data in Table 6 reveals that intubation through ILMA could be performed in first attempt in 42 patients in Control group, while 7 patients required two and 1 patient required three attempts respectively for intubation. In Collar group, 40 patients could be intubated in first attempt while 6 patients required two and 4 patients required three attempts for intubation respectively. On applying Chi-squared Test, p-value was 0.3818 *which was not statistically significant.*

Table 7: Comparison of overall intubation success between both the groups

	Control group	Collar group	P-value
Overall intubation success	50	48	0.4949

Applying Fisher's Exact Test * P < 0.05 significant
P > 0.05 not significant

Overall, all 50 patients could be intubated by using ILMA in Control group while only 48 patients could be intubated by using ILMA in Collar group. On applying Fisher's Exact Test to the above data, *the difference is not statistically significant* as can be seen in Table 7.

Table 8: Comparison of adverse events between both the groups

Adverse event	Control group	Collar group	P-value
Hypoxia	------	------	------
Mucosal injury	6	12	0.1923
Lip or dental injury	1	3	0.6173

Applying Fisher's Exact Test * P < 0.05 significant
P > 0.05 not significant

As seen in Table 8, there was no hypoxia in any of the patients in any of the groups. Mucosal injury occurred in 6 patients in Control group and 12 patients in Collar group. Similarly lip or dental injury occurred in 1 patient in Control group and 3 patients in Collar group. The difference in adverse events in both the groups *was not statistically significant* on applying Fisher's Exact Test as can be seen from the p-value.

Discussion

Immediate management of the compromised or "at risk" airway is crucial in trauma patients. Complications arise as a result of emergency intubations [6], but failure or delay in securing an adequate airway appear to cause unacceptably high morbidity and mortality rates. Rapid intubation when appropriate will need to minimize any movement of the c-spine with consideration of associated risk of the procedure. Various methods have been used to secure the airway in patients with potential cervical spine injury. Fibre optic intubation is ideal in these patients because neck immobilization and wide mouth opening are unnecessary. But lack of easy availability of the equipment as also of medical personnel with sufficient experience in using fibre optic bronchoscope limits its use in emergency settings.

For adults with potential c-spine injury requiring emergency intubation, the optimal method of achieving a secure airway is Rapid Sequence Induction and Intubation (RSI) with Manual in-line stabilisation (MILS) ·But this requiresenough experienced personnel at the trauma site.A lack of assistants may increase the incidence of failed intubations and the risk of neurological complications with this technique.

Laryngeal mask airway was introduced in 1983 but was approved by FDA in 1991 only.The intubating laryngeal mask airway has been introduced as a prototype of the laryngeal mask airway for blind endotracheal intubation. It does not require head and neck manipulations on insertion. Therefore, the IMLA might be helpful for endotracheal intubation in patients with cervical spine disease. The purpose of this study was to investigate the utility of the IMLA for blind endotracheal intubation when cervical spine is immobilized by a rigid collar.

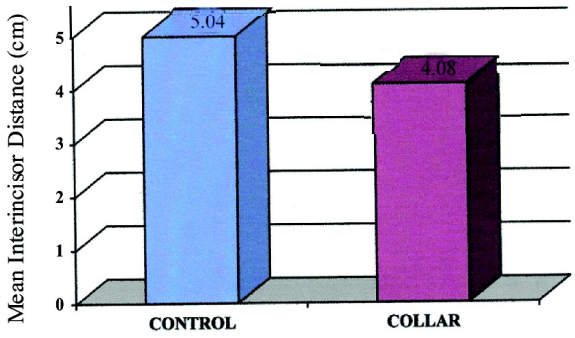
Demography of the Patients

The demographic data of the patients was similar in both the groups and there was no bias in any group.

In our study, application of collar significantly increased the Mallampati score and reduced the mean Interincisor distance in the Collar Group.

Heath et al have shown that the presence of a semi-rigid cervical collar results in a poorer view at laryngoscopy [4]. It has been suggested that a reduction in mouth opening is the major contributory factor for the deterioration in the view obtained. The maximum external diameter of the intubating laryngeal mask is 20 mm. Reduced mouth opening has been shown to contribute to either difficulty with insertion or failure of insertion of both the laryngeal

Fig. 1: Interincisor Distance Comparison



mask and the intubating laryngeal mask. But none of our patients had mouth opening less than 20 mm on application of collar.

Other airway parameters like Slux, Mento-hyoid distance and Mento-thyroid distance in both the groups were calculated without the application of a collar and the difference was not significant.

ILMA Insertion Time

Mean ILMA insertion time in Control Group was 19.240 sec while that in Collar Group was 25.260 sec and these were significantly different.

The difference in ILMA insertion time can be explained by reduced mouth opening and prevention of small movement of the head and neck that might have facilitated insertion of the device in Collar Group.

Intubation Time

It was the time from removal of the breathing circuit from the intubating laryngeal mask airway to the reappearance of capnographic trace through the tracheal tube with positive pressure ventilation and without any cuff leak.

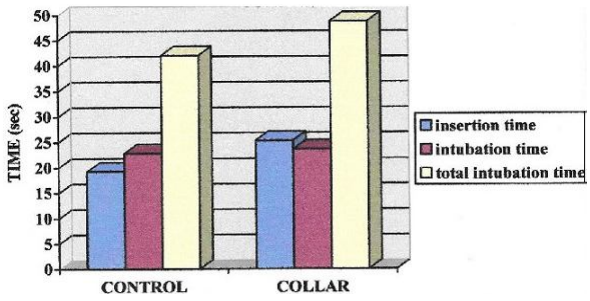
Mean intubation time in Control Group was 22.800 sec while that in Collar Group was 23.563 sec. On applying unpaired t-test this difference in the intubation time between both the groups was not statistically significant.

Total Intubation Time

It was the sum total of ILMA insertion time plus intubation time and indicated the total time that we took to secure the airway.

Mean total intubation time in Control Group was 42.040 sec as compared to 48.750 sec in Collar Group. This difference in the mean total intubation time between both the groups was not statistically significant on application of unpaired t-test. This has important implications as it indicates that ILMA with practice can be used by medical personnel to intubate patients with a rigid cervical collar in place at the site of trauma.

Fig. 2: Ila isertion time and intubation time comparison



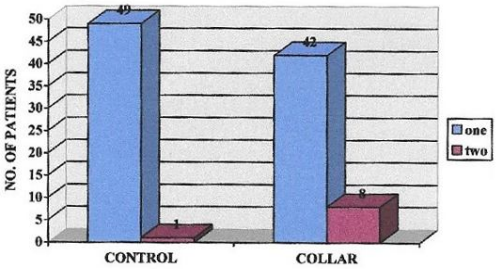
ILMA Insertion Attempts

In this study, ILMA could be inserted at first attempt in 49 patients in Control Group while in Collar Group; it could be inserted in only 42 patients at first attempt. On applying Fisher's Exact Test, this difference in the number of attempts was statistically significant.

This increase in the number of attempts could be attributed to reduced mouth opening on application of rigid cervical collar.

Some investigators have reported no difficulty in insertion of ILMA in the presence of a collar [7, 9, 10] while others have reported a significant increase in the number of attempts [8, 11].

Fig. 3: Ilma isertion Attempts comparison



Grades of ILMA Ventilation

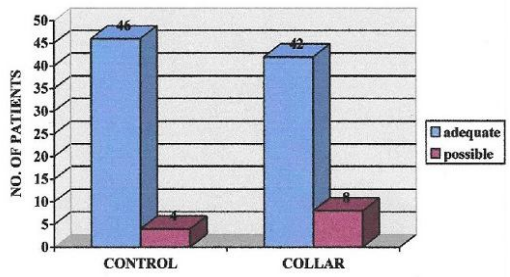
In our study, 46 to 50 patients in Control Group could be ventilated without any difficulty while in 4 patients in Control Group ventilation proved difficult but possible. In the Collar Group, 42 of 50 (i.e.84%) patients could be ventilated without any difficulty but in 8 patients ventilation was difficult but possible. In none of our patients was ventilation impossible. On applying Fisher's Exact Test, there was no statistically significant difference between the two groups.

In a retrospective study by Moller et al, in patients wearing a cervical collar, ventilation through ILMA was possible in only 10 out of 17 patients (i.e. 58.8%) at first attempt while 7 patients required 2-4 attempts [9]. This could have been due to inadequate depth of anesthesia as short lived laryngospasm occurred in 2 of their patients.

Wakeling and Nightingale also reported difficulty in ventilation in 4 of their 10 patients i.e. only 60% of their patients could be ventilated with ease with an ILMA [8].

In a prospective study by Komatsu *et al* in 50 patients wearing a cervical collar, 37 patients (i.e. 74%) could be ventilated without any difficulty while in 8 patients ventilation was difficult but possible. 5 patients in their study could not be ventilated [11].

Fig. 4: Grades of ILMA Ventilation Comparison

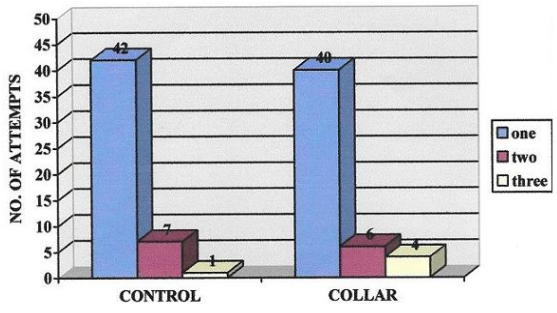


Intubation Attempts

It was the number of attempts required to blindly intubate the trachea through the ILMA. In our study, this difference in number of intubation attempts was not statistically significant on application of Chi-squared test. Several studies have shown that even on application of rigid cervical collar, there is no significant difference in the number of attempts required to blindly intubate the trachea through the ILMA [9, 12].

Komatsu *et al* in their study of 50 patients with cervical collar could intubate 33 patients in first attempt while 8 patients required two attempts, 5 patients required three attempts while 4 patients required four attempts and still 2 patients could not be intubated [11].

Fig. 5: Intubation Attempts Comparison



Intubation Success

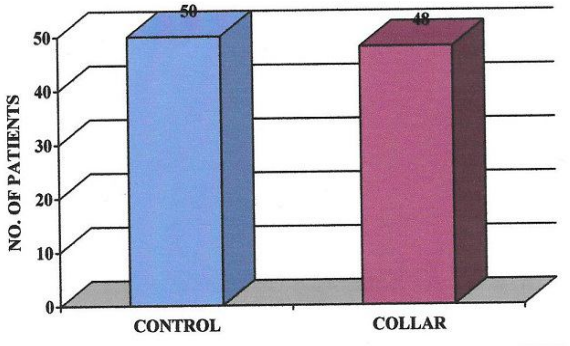
In our study all 50 patients in the Control Group could be blindly intubated through the ILMA while in the Collar Group, 48 patients could be blindly intubated through the ILMA. On applying Fisher's Exact Test, this difference in the two groups was not statistically significant.

Most investigators have reported 90 to 100% success rate of intubation in the presence of a rigid collar [7, 9, 12].

Komatsu el al reported 90% success rate of blind intubation via the ILMA in 50 patients wearing a rigid cervical collar [11].

Wakeling and Nightingale succeeded in intubating only two of 10 patients in their study [8]. The success rate of ventilation and intubation via ILMA in their study might have been altered by the application of cricoid pressure. Analyzing the literature, there are numerous hints that cricoid pressure impedes positioning and ventilation through an ILMA [13].

Fig. 6: Overall Intubation Success Comparison



Adverse Events

Mucosal injury was seen in 6 patients in Control Group while it was seen in 12 patients in the Collar Group. Lip or dental injury was seen in 1 patient in Control Group and 3 patients in the Collar Group. None of the patients in both the groups developed hypoxia in our study. The incidence of complications was not significantly different in between both the groups statistically.

Our study has several limitations. First, we only studied patients undergoing elective surgery without an unstable cervical spine. Oesophageal intubation occurred in 7% of our patients, and 18% of our patients required multiple intubation attempts. Significantly prolonged intubation time may not be acceptable in an emergency situation. This percentage of oesophageal intubation and multiple intubation attempts may increase significantly in an emergency scenario.

Komatsu et al have reported a 14% incidence of oesophageal intubation and 34% incidence of multiple intubation attempts in a similar study conducted by them [11].

The ILMA exerts considerable pressure against cervical vertebrae and possible neurological

deterioration must be considered before using the ILMA in patients with an unstable cervical spine.

Another limitation of our study was that we did not have a positive control (i.e. comparison of the ILMA with another intubation technique in the presence of a collar). Although fibreoptic intubation is ideal in these patients in elective settings, there is no gold standard technique for emergency airway management of a patient with possible cervical spine injury.

Compared with above-mentioned techniques, the ILMA does not need a secretion-free and blood-free airway, and even when the intubation is not possible, the ILMA acts as a ventilatory device with a high success rate.

Thus, it can be concluded that blind intubation through an ILMA is a reasonable strategy for controlling the airway in patients who are immobilized with a rigid cervical collar, especially when urgency precludes a fibreoptic approach.

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