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RESEARCH

Evaluation of the Intubating Laryngeal Mask Airway (ILMA) as an intubation conduit in patients with a cervical collar simulating fixed cervical spine

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Background: Cervical spine immobilisation with a semi-rigid cervical collar imposes difficulty in tracheal intubation. There is increasing use of the Intubating Laryngeal Mask Airway (LMA- Fastrach™) for intubation in patients with difficult airways. The present study was conducted to assess its potential role for tracheal intubation in simulated fixed cervical spine patients.
Method: After obtaining approval from the ethics committee and patients' consent, this observational study was performed on 35 adult patients of either sex of ASA physical status I and II scheduled to undergo surgery under general anaesthesia requiring tracheal intubation. A two-piece semi-rigid cervical collar of appropriate size was positioned around the neck of patients. A standard anaesthesia protocol comprising glycopyrrolate, propofol and vecuronium was used for induction of anaesthesia. ILMA placement and blind tracheal intubation through this was attempted by using dedicated silicone tube provided with the ILMA set. Success rate, number of attempts required, time taken, difficulties encountered and any complication that occurred were noted. Anaesthesia was maintained with isoflurane in oxygen and nitrous oxide, pethidine and vecuronium. Following completion of surgery, neuromuscular blockade was reversed with glycopyrrolate and neostigmine.
Results: The overall success rate was 85.7% and the success rate for ILMA placement at first attempt was 57.1%. Tracheal intubation was successful at first attempt in 70.5% of patients. The time taken for ILMA placement and tracheal intubation through this was 31.76 ± 9.74 and 34.04 ± 12.68 seconds respectively. Decreased mouth opening due to presence of the collar led to difficulty in ILMA placement.
Conclusions: Blind tracheal intubation through ILMA is a possible option for airway management in patients with a semi-rigid cervical collar.

Keywords: cervical collar, difficult airway, ILMA, intubation

Introduction

A semi-rigid collar is usually applied for stabilisation of the cervical spine.[1,2] Such patients may require airway management. The presence of a collar renders intubation difficult and sometimes impossible, even for the most experienced anaesthesiologists. The restriction of neck movements precludes a sniffing position, which leads to poor glottic visualisation.[3] Moreover, there is decreased mouth opening, which further compounds a difficult airway.[4,5] Various techniques have been described in these patients, such as awake fibre-optic intubation,[6] blind nasal intubation,[7] McCoy laryngoscope,[8] left molar approach of direct laryngoscopy,[9] glidescope,[10] and C-trach[8] but the best technique continues to be debated. Though awake fibre-optic intubation is considered as the gold standard, it has several limitations such as its cost, availability, requirement for operator's experience and patient's cooperation, and blood and secretions.[2,11]

The Intubating Laryngeal Mask Airway (ILMA) has proved to be a revolutionary development in the management of difficult airways.[12] The difficulties in viewing the larynx on direct laryngoscopy, which is a cause of failed intubation, are irrelevant to ILMA placement and subsequent intubation. Furthermore, cervical spine movements are not required for these procedures.[13] Although the majority of studies support its use, there are a few studies which do not support its use in patients with a cervical collar.[14,15] In the light of these controversies, the present observational study was planned to test the hypothesis that the ILMA would facilitate tracheal intubation in patients wearing a cervical collar simulating fixed cervical spine. The primary objective was to assess the success rate of intubation and secondary objectives were to know the time required for intubation and difficulties encountered.

Method

After obtaining approval from the institutional ethics committee, the present observational study was carried out in the Department of Anaesthesiology and Critical Care. Thirty-five adult patients of either sex classified as American Society of Anesthesiologists (ASA) physical status I and II, scheduled to undergo surgery under general anaesthesia requiring tracheal intubation, were enrolled for the study. Informed written consent was taken from all the patients. Exclusion criteria included those with anticipated difficult airway, risks of aspiration, low pulmonary compliance such as obesity and an inter-incisor gap of less than 2.5 cm.

On preanaesthetic rounds, a detailed clinical history was obtained and thorough general and systemic examination was carried out. Routine haematological and biochemical investigations were checked. Fasting for six hours prior to surgery and premedication in the form of oral diazepam 5 mg at bedtime and 2 h prior to surgery with a sip of water was prescribed.

Figure 1: Intubation through an ILMA in a patient wearing a semi-rigid cervical collar.

In the operating room patients were positioned supine with the head and neck in neutral position. A two-piece semi-rigid cervical collar (MGRM™, New Delhi, India) of appropriate size was applied around the neck of patients as per the manufacturer's instructions. Mouth opening was assessed before and after application of the collar using a ruler with centimetre scale. Routine monitors such as heart rate, ECG, noninvasive blood pressure, oximetry (SpO_2) and end-tidal carbon dioxide ($EtCO_2$) were attached. Anaesthesia was induced with glycopyrrolate 0.2 mg and propofol 2–3 mg/kg until loss of eyelash reflex. Mask ventilation was checked and vecuronium 0.1 mg/kg was administered. Bag-mask ventilation was continued for 3 min with 1% isoflurane in oxygen. An appropriate sized ILMA (size 3 for females and size 4 for males) well lubricated with water soluble jelly was introduced as per the manufacturer's guidelines. Correct placement was judged by chest movements and $EtCO_2$ curve on manual ventilation after connecting an anaesthesia breathing system to the ILMA. If adequate ventilation was not possible the ILMA was manipulated in situ or reintroduced. A total of three attempts/adjusting manoeuvres were made. If the ILMA was still not placed correctly, it was considered as a failure and conventional direct laryngoscopy and intubation were done after removing the collar. The total number of attempts taken to achieve ILMA placement, time taken (from removal of face mask till appearance of carbon dioxide trace) and difficulties encountered were noted.

A straight silicone wire-reinforced tracheal tube provided with the ILMA set (LMA-Fastrach™, Laryngeal Mask Company, UK) of size 7 or 7.5 mm, was well lubricated and made to pass through the ILMA (Figure 1). Successful placement of the tracheal tube was judged by visualising chest movements, chest auscultation and $EtCO_2$ trace when manual ventilation was performed. If oesophageal intubation occurred, the tube was withdrawn and reinserted. If the tube faced any resistance, various adjusting manoeuvres were attempted as per the manufacturer's instruction manual.[16] After confirmation of tracheal tube position, the ILMA was removed while the tube was retained in place by a stabilising rod. The number of attempts required, time taken (from holding of tracheal tube in hand until correct placement confirmed) and difficulties encountered were noted.

Throughout the procedure, the patient's vital signs were monitored continuously and recorded at regular intervals. Anaesthesia was maintained with isoflurane in oxygen and nitrous oxide. Intravenous pethidine was administered for intraoperative analgesia and vecuronium for muscle relaxation. Following completion of surgery, neuromuscular blockade was reversed with injection of glycopyrrolate (0.01 mg/kg) and neostigmine (0.05 mg/kg). Any postoperative problem such as coughing, laryngospasm, hoarseness of voice or trauma to oropharyngeal structures was noted.

The entire data were entered into a Microsoft Excel® (Microsoft Corp, Redmond, WA, USA) file. The parametric data were expressed in range, mean and standard deviation. The categorical data were expressed in number and percentage. The mouth opening prior and after application of collar was analysed using a paired t-test. The haemodynamic variations over time were analysed using a repeated measures ANOVA test. The entire statistical analysis was carried out using SPSS® software version 16 (SPSS Inc, Chicago, IL, USA) and a *p*-value less than 0.05 was taken as significant.

Results

The demographic profile of the patients is shown in Table 1. The size of collar used was small, medium and large in 18 (51.4%), 15

Table 1: Demographic profile of patients (n = 35)

Age (years)	Mean ± SD	30.6 ± 9.07
	Range	16–53
Height (cm)	Mean± SD	161 ± 8.50
	Range	150–180
Weight (kg)	Mean ± SD	55.8 ± 7.82
	Range	41–75
Gender	Male	15 (42.8%)
	Female	20 (57.2%)
ASA	I	35 (100%)
	II	–
Mallampati grade	1	28 (80%)
	2	7 (20%)

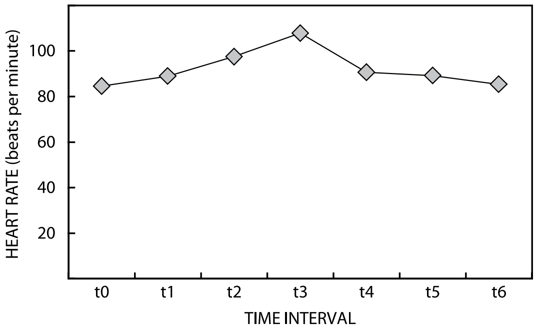

Figure 2: Changes in heart rate in beats per minute at various time intervals (t0 = baseline, t1 = after induction of anaesthesia, t2 = after ILMA insertion, t3 = after intubation through ILMA, t4 = 3 min after intubation, t5 = 5 min after intubation, t6 = 10 min after intubation).

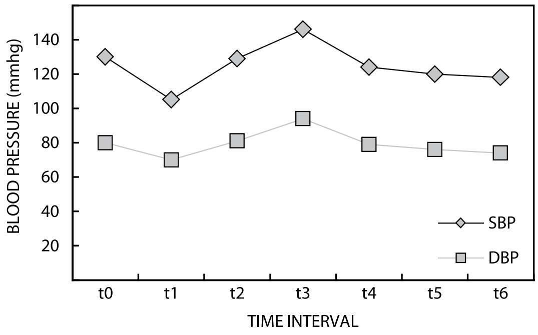

Figure 3: Changes in blood pressure (systolic and diastolic) in mmHg at various time intervals (t0 = baseline, t1 = after induction of anaesthesia, t2 = after ILMA insertion, t3 = after intubation through ILMA, t4 = 3 min after intubation, t5 = 5 min after intubation, t6 = 10 min after intubation).

Table 2: Distribution of patients according to surgery performed.

Type of surgery	No. of patients (percentage)
Cholecystectomy	10 (28.5%)
Pyelolithotomy	4 (11.4%)
Hysterectomy	4 (11.4%)
Rhinoplasty	2 (5.7%)
Squint surgery	2 (5.7%)
Other	13 (37.1%)

Table 3: ILMA placement and intubation (number of attempts and time taken).

Time taken for ILMA placement (in seconds)	Mean ± SD	31.76 ± 9.74
	Range	15–50
Time taken for intubation (in seconds)	Mean ± SD	34.04 ± 12.68
	Range	10–63
Number of attempts at ILMA placement (*n* = 35)	1	20 (57.1%)
	2	7 (20.0%)
	3	7 (20.0%)
	Failure	1 (2.8%)
Number of attempts for intubation (n = 34)	1	24 (70.5%)
	2	5 (14.7%)
	3	1 (2.9%)
	Failure	4 (11.7%)

(42.8%) and 2 (5.7%) patients respectively. The inter-incisor gap decreased from 4.59 ± 0.18 cm to 4.17 ± 0.17 cm after application of the collar ($p < 0.0001$). Table 2 shows the distribution of patients as per surgical procedures performed.

Placement of the ILMA was successful at first attempt in the majority of patients (57.1%); however, in one patient there was failure of placement (Table 3). In all patients, a second person was required to open the mouth in order to introduce the ILMA. Endotracheal intubation was carried out successfully in the majority of patients at first attempt (70.5%). Additional manoeuvres were required in six patients; flexion of the ILMA in three, extension of the ILMA in one and up-and-down manoeuvre in two patients. In four patients intubation through the ILMA failed despite three attempts. The overall success rate was 85.7% (30 patients were successfully intubated through the ILMA). We encountered oesophageal intubation in five patients.

The haemodynamic changes at various time intervals are shown in Figures 2 and 3. At the time of ILMA insertion and intubation through this, there was an increase in heart rate and blood pressure as compared with basal values ($p < 0.05$). None of the patients desaturated. Postoperatively one patient had coughing, which resolved within six hours of surgery, two patients had trauma to oropharyngeal structures, and sore throat was present in five patients.

Discussion

We used a semi-rigid cervical collar to immobilise the patient's neck to simulate a fixed cervical spine. Semi-rigid collars restrict the following degrees of movements: flexion (70%), extension (60%), lateral flexion (35%) and rotation (60%).[17] Macintyre *et al.* observed no limitation of cervical movements during intubation in patients wearing a collar.[18] Moreover, in a cadaveric study, it was found that a collar can actually increase cervical motion by acting as a lever.[19] Despite this, probably for lack of a convenient and suitable alternative, semi-rigid collars are still commonly used.[20] Advanced Trauma Life Support (ATLS) still recommends their use in patients with suspected cervical spine injury.[1] Removal of the front portion of the collar before intubation and application of manual in-line stabilisation (MILS) is a better method for immobilisation of the cervical spine.[2] However, it requires an additional person who should be expert in this manoeuvre since inadvertent application of traction can displace the cervical segments and cause more damage.[2,21]

The ILMA was bioengineered by A.I.J. Brain in 1997 to overcome limitations of the Laryngeal Mask Airway (LMA).[22] Since then it has established its role in the management of difficult airways. The first-attempt success rate for ventilation through an ILMA in our study is in agreement with those mentioned previously in the literature.[6] We faced problems in initial introduction of ILMA in the oral cavity due to impaired mouth opening. The decrease in mouth opening was significant statistically but seemed clinically irrelevant. There was a definite difficulty in jaw lifting single-handedly while holding the ILMA in one hand. Thus in all the cases a second person was required to open the mouth to make room for placement of the device. Similar problems have previously been encountered by others.[5,10]

The principal factor that determines the success rate of adequate ventilation and intubation via the ILMA is appropriate alignment of the ILMA aperture and glottis.[23] In our study, we were able to achieve endotracheal intubation blindly through the ILMA in the majority of patients. The literature also describes studies where it has proved successful in patients with a fixed cervical spine. The immobility of the neck was due either to pathology or to stabilising aids such as a halo-vest, cervical collar or manual in-line stabilisation (MILS).[24] Ferson reported 100% success rate in patients wearing a collar but that study was retrospective.[12] Moller too reported 100% success rate in these patients[25] but in the same year Wakeling found it successful in only 3 patients out of 10.[15] Removal of the collar helped in achieving intubation in four more patients. He planned to enrol 50 patients but had to terminate the study prematurely. The results of our study are in agreement with those by Belgin *et al.*, but they removed the front portion of the collar and applied manual in-line stabilisation.[8]

Blind intubation through the ILMA can cause oesophageal intubation, with a reported incidence of around 18%.[26] In our study it was slightly less (14.2%). To avoid this problem, fibre-optic bronchoscope-guided intubation via the ILMA is recommended by a few.[27] Lightwand-guided intubation and gum-elastic bougies have also been used in the past to aid intubation.[24,28]

In our study, all the procedures were carried out by a single person who had experience of intubation through an ILMA in more than 20 patients with normal as well as difficult airways. Hence, we cannot comment on its use by novices. Haemodynamic perturbations were encountered in our patients in response to ILMA placement and subsequent intubation. These most likely occurred due to stimulation of oral structures and it is difficult to comment on whether they were equivalent or less than those with direct laryngoscopy and intubation. Damage to pharyngolaryngeal structures is a potential problem of blind intubation through the ILMA. Sore throat incidence may be as high as 67%. The most likely cause is manipulation of the device in situ.[29] In our study the incidence of sore throat was somewhat less, probably because the procedure was performed by experienced person and we performed it in anaesthetised patients.

There were a few limitations of our study. First, we used a semi-rigid cervical collar as the immobilisation device, which is criticised by many for not limiting neck movements adequately. Nevertheless, our aim was to simulate a difficult airway and use of this supraglottic device in the presence of different stabilisation devices could form a separate study. Second, we had a single group and did not compare it with other intubation methods. Intubation via a supraglottic airway device is a unique method and cannot be compared with direct laryngoscopy or with a video laryngoscope. Recently, Air-Q,[30] another sibling of ILMA meant for intubation, has become available, which can be compared with the ILMA. Third, the study was conducted in patients with normal airways and the same results may not be reproduced in patients who have actual cervical spine pathology. Furthermore, its use in patients with difficult airways due to other causes such as increased body weight cannot be commented on. Finally, the sample size was small.

Conclusions

Our study suggests that the ILMA is a possible technique for intubation in patients with a semi-rigid cervical collar. However, alternative options should also be available since it carries a high failure rate even in experienced hands. Further studies comprising a large number of cases are warranted to assess its utility in the presence of other stabilisation devices and compared with other intubation techniques proposed for difficult airways.

References

1. American College of Surgeons. Advanced trauma life support. Chicago, Il: Author; 2008. 157–9 p. ISBN 978-1-880696-31-6
2. Crosby ET. Airway management in adults after cervical spine trauma. Anesthesiology 2006;104:1293–318. http://dx.doi.org/10.1097/00000542-200606000-00026
3. Heath KJ. The effect on laryngoscopy of different cervical spine immobilization techniques. Anaesthesia 1994;49:843–5. http://dx.doi.org/10.1111/ana.1994.49.issue-10
4. Goutcher CM, Lochhead V. Reduction in mouth opening with semi-rigid cervical collars. Br J Anaesth. 2005;95:344–8. http://dx.doi.org/10.1093/bja/aei190
5. Komatsu R, Nagata O, Kamata K, et al. Intubating laryngeal mask airway allows tracheal intubation when the cervical spine is immobilized by a rigid collar. Br J Anaesth. 2004;93(5):655–9. http://dx.doi.org/10.1093/bja/aeh248
6. Fuchs G, Schwarz G, Baumgartner A, et al. Fiberoptic intubation in 327 neurosurgical patients with lesions of the cervical spine. J Neurosurg Anesthesiol. 1999;11:11–6. http://dx.doi.org/10.1097/00008506-199901000-00003
7. Grande CM, Barton CR, Stene JK. Appropriate technique for airway management of emergency patients with suspected spinal cord injury. Anesth Anal. 1988;67:714–5.
8. Bilgin H, Bozkurt M. Tracheal intubation using the ILMA, C-TrachTM or McCoy laryngoscope in patients with simulated cervical spine injury. Anaesthesia. 2006;61:685–91. http://dx.doi.org/10.1111/ana.2006.61.issue-7
9. Saini S, Bala R, Singh R. Left molar approach improves laryngeal view in patients with simulated limitation of cervical movements. Acta Anaesthesiologica Scand. 2008;52(6):821–8.
10. Bathory I, Frascarolo P, Kern C, et al. Evaluation of the Glidescope for tracheal intubation in patients with cervical spine immobilization by a semirigid collar. Anaesthesia. 2009;64:1337–41. http://dx.doi.org/10.1111/ana.2009.64.issue-12
11. Joo HS, Kapoor S, Rose DK, et al. The intubating laryngeal mask airway after induction of general anesthesia versus awake fiberoptic intubation in patients with difficult airways. Anesth Analg. 2001;92:1342–46. http://dx.doi.org/10.1097/00000539-200105000-00050
12. Ferson DZ, Rosenblatt WH, Johansen MJ, et al. Use of the intubating LMA-Fastrach™ in 254 patients with difficult-to-manage airways. Anesthesiology. 2001;95:1175–81. http://dx.doi.org/10.1097/00000542-200111000-00022
13. Caponas G. Intubating laryngeal mask airway. Anaesth Intensive care. 2002;30:551–69.
14. Keller C, Brimacombe J, Keller K. Pressures exerted against the cervical vertebrae by the standard and intubating laryngeal mask airways: a randomized, controlled, cross-over study in fresh cadavers. Anesth Analg. 1999;89:1296–300. http://dx.doi.org/10.1213/00000539-199911000-00042
15. Wakeling HG, Nightingale J. The intubating laryngeal mask airway does not facilitate tracheal intubation in the presence of a neck collar in simulated trauma. Br J Anaeth. 2000;84:254–6. http://dx.doi.org/10.1093/oxfordjournals.bja.a013414
16. Brain AIJ, Verghese C. LMA-FastrachTM Instruction manual. San Diego, The Laryngeal Mask Company; 1998.
17. Stewart JDM, Hallett JP editors. Traction and orthopaedic appliances. Spinal orthoses. 2nd ed. Edinburgh: BI Churchill Livingstone Pvt; 1993. 129–51 p.
18. MacIntyre PA, McLeod ADM, Hurley R, et al. Cervical spine movements during laryngoscopyComparison of the Macintosh and McCoy laryngoscope blades. Anaesthesia. 1999;54:413–8. http://dx.doi.org/10.1046/j.1365-2044.1999.00804.x
19. Bednar DA. Efficacy of orthotic immobilization of the unstable subaxial cervical spine of the elderly patient: Investigation in a cadaver model. Can J Surg. 2004;47:251–6.
20. Austin N, Krishnamoorthy V, Dagal A. Airway management in cervical spine injury. International J Critical Illness & Injury Science. 2014;4(1):50–6.
21. Manoach S, Paladino L. Manual in-line stabilization for acute airway management of suspected cervical spine injury: historical review and current questions. Ann Emerg Med. 2007;50:236–45. http://dx.doi.org/10.1016/j.annemergmed.2007.01.009

22. Brain AIJ, Verghese C, Addy EV, et al. The intubating laryngeal mask. I: development of a new device for intubation of the trachea. Br J Anaesth. 1997;79:699–703. http://dx.doi.org/10.1093/bja/79.6.699
23. Khan MU. Endotracheal intubation in patients with unstable cervical spine using LMA-Fastrach and gum elastic bougie. J Coll Physicians Surg Pak. 2014;24(1):4–7.
24. Gerstein NS, Braude DA, Hung O, et al. The Fastrach intubating laryngeal mask airway:an overview and update. Can J Anesth. 2010;57:588–601. http://dx.doi.org/10.1007/s12630-010-9272-x
25. Moller F, Andres AH, Langenstein H. Intubating laryngeal mask airway(ILMA) seems to be an ideal device for blind intubation in case of immobile spine. Br J Anaesth. 2000;85:493–4.
26. Dimitriou V, Voyagis GS. Blind intubation via the ILMA: what about accidental oesophageal intubation? Br J Anaesth. 1999;82:478–9. http://dx.doi.org/10.1093/bja/82.3.478
27. Joo HS, Rose DK. The intubating laryngeal mask airway with and without fibreoptic guidance. Anesth Analg. 1999;88:662–6. http://dx.doi.org/10.1213/00000539-199903000-00036
28. Chan PL, Lee TW, Lam KK, et al. Intubation through intubating laryngeal mask with and without a lightwand:a randomized comparison. Anaesth Intensive Care. 2001;29:255–9.
29. Shung J, Avidan MS, Ing R, et al. Awake intubation of the difficult airway with the intubating laryngeal mask airway. Anaesthesia. 1998;53:645–9. http://dx.doi.org/10.1046/j.1365-2044.1998.429-az0533.x
30. Garzón Sánchez JC, López Correa T. Sastre RJA. Blind tracheal intubation with the Air Q (ILA-Cookgas) mask. A comparison with the ILMA- FastrachTM laryngeal intubation mask. Rev Esp Anestesiol Reanim. 2014;61(4):190–5. http://dx.doi.org/10.1016/j.redar.2013.11.002

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