

**Original Article**

# Hemodynamic changes during endotracheal intubation: A prospective randomised comparative study using fiberoptic bronchoscope and intubating laryngeal mask airway

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**ABSTRACT**

**Background:** Fiberoptic intubation and Intubating laryngeal mask airway are alternatives to conventional laryngoscopy. The objective of the study was to compare hemodynamic changes with the use of these two devices for tracheal intubation.

**Methods:** It was a randomized, comparative and prospective study of two groups comprising of 50 patients each. Tracheal intubations were performed using intubating fibroscope in group I and intubating laryngeal mask airway in Group II. Intubation time, heart rate, blood pressure and complications were compared.

**Results:** Heart rate response to tracheal intubation was comparable between the groups. Changes in mean arterial pressure were also comparable and returned to baseline after two minutes of tracheal intubation. The first attempt success rate was 80% and 92% respectively in Group I and Group II. The time taken for intubation was found to be significantly longer in Group II irrespective of the number of attempts. There were no major complications observed. However there was some desaturation at the time of intubation which was seen in three patients in Group I, and one patient in Group II. However the SpO<sub>2</sub> did not fall below 96% and was not considered to be clinically significant.

**Conclusions:** Endotracheal intubation using either an Intubating Laryngeal Mask Airway or a Fiberoptic Bronchoscope is comparable in terms of the haemodynamic responses.

**Keywords:** Endotracheal Intubations; Fiberoptic endoscope; haemodynamics; Laryngeal Mask Airways.

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## Introduction

Stimulation of the pharyngolaryngeal structures is an important factor in the haemodynamic stress response of laryngoscopy. Endotracheal intubation with the aid of a fibreoptic bronchoscope (FOB) and an Intubating Laryngeal Mask Airway (ILMA) are alternatives to conventional laryngoscopy. Previous studies have demonstrated decrease in haemodynamic stress response with the use of FOB or ILMA when compared to conventional laryngoscopy. However, a true comparison between these two modalities has not been performed. Therefore this prospective, randomized study was designed to compare the haemodynamic response to endotracheal intubation and associated complications with the use of FOB and ILMA.

## Methods

It was a randomized, comparative and prospective study. An ethical clearance was obtained from the institutional ethical committee. A written and informed consent obtained from all the patients. The study was conducted in a university hospital. This study was conducted in 100 patients of ASA physical status I and II of age between 18 to 60 years undergoing routine elective surgery under general anaesthesia requiring endotracheal intubation.

Adult patients of ASA physical status I and II, who were undergoing routine surgical procedure under general anaesthesia with endotracheal intubation, were included in the study. Patient taking drugs which may affect blood pressure and heart rate, having history of gastro oesophageal reflux, anticipated difficult airway, morbid obesity and patients undergoing oral surgery were excluded from the study.

Randomization was done using a computer generated random technique and were divided into two equal groups of 50 patients each. Group I comprised of patients in whom FOB was used for orotracheal intubation. Group II comprised of patients in whom ILMA was used for tracheal intubation. All the patients were premedicated with oral Diazepam 0.2mg/kg body weight administered the night before and two hours prior to surgery. On the day of surgery, in the operation theater, peripheral venous access was secured. ECG electrodes, non-invasive blood pressure cuff; pulse oxymeter was attached for monitoring. Patients of both the groups received injection glycopyrrolate 0.2 mg intravenously 15 minutes before the induction of anaesthesia.

After preoxygenation for three minutes, anesthetic induction was done with intravenous propofol 2mg/kg, pethidine 1mg/kg and vecuronium bromide 0.1mg/kg. Lungs were ventilated with positive pressure ventilation by mask with 100% oxygen and 1.0% halothane for three minutes. Then the endotracheal intubation was done using either of the technique, according to the group randomization.

## In group I

During FOB, patient's head was placed in the sniffing position over a four inch doughnut head rest. The operator stood on the left side of the patient to introduce FOB into the mouth. Jaw thrust maneuver which opens the mouth, displaces the mandible and tongue anteriorly, thereby cleaning the airway, was used to advance the tip of the fiberscope towards the vocal cords. After glottis was exposed, FOB was passed between the vocal cords and downwards into the middle of the trachea. The tip of the bronchoscope was not advanced too deep into the trachea to cause stimulation of the carina. An endotracheal tube (ETT) of appropriate size (7.5 mm for females and 8.0 mm for males) was then advanced over the FOB and appropriate position of the tube in the trachea was confirmed visually, its cuff was inflated and its appropriate position was confirmed both clinically and capnographically after removal of FOB.

## In ILMA intubation group

Patients head was placed in sniffing position over a four inch doughnut head rest. ILMA of size three for women and of size four for men was inserted according to the standard technique by rotating it in a capital plane and then cuff was inflated with air. Anesthesia circuit was attached to the ILMA with the capnography and then checked for adequate ventilation (clinically and by capnography). After the correct position of ILMA was confirmed, the position of ILMA was maintained by holding the handle firmly and specially developed wire enforced cuffed ETT supplied by the manufacturer sizes 7.5 mm internal diameter for females and 8.0 mm for males was passed 1.5 cm beyond the black transverse line, when no resistance felt, the tube was advanced further and the tracheal placement was confirmed by square shaped capnography tracing and the cuff of the ETT was inflated with the required amount of air preventing leak, then the ILMA was removed by removing the detachable universal connector from the ETT and with the help of the ETT stabilizer supplied with the ILMA and ETT was fixed.

The escape safe criteria was used in both the groups was that, when in any case saturation of oxygen fell below 90% and mean arterial pressure (MAP) varied more than 20% from the baseline, the attempt was abandoned and ventilation was done using mask and another attempt was tried upto a maximum of three attempts, after which the case was dealt by the difficult airway algorithm.

If the hypertensive response increased to dangerous level i.e., systolic blood pressure more than 180mmHg, it was treated by increasing the depth of anaesthesia, injection lignocaine hydrochloride 1.5mg/kg body weight. If still the response was not adequately controlled, it was treated with bolus injection of metoprolol 1 to 5 mg intravenously. Drug and dose required were noted.

External laryngeal manipulation was applied to facilitate intubation. When the initial attempt of intubation using ILMA failed then successive attempts were tried by 1) pulling the handle towards the intubator extensor manoeuvre, 2) withdrawing the ILMA by five centimeters with the cuff inflated followed by reinsertion (up and down manoeuvre), 3) ventilation commenced and the position of ILMA adjusted until the optimal seal was obtained (optimization manoeuvre) and 4) flexing the neck and extending the head (head neck manoeuvre).

Intubation time was defined as the time in seconds from the insertion of fiberoptic bronchoscope or ILMA to the confirmation of tracheal intubation by Capnograph. Number of attempts for intubation was defined as the number of times FOB or ILMA was removed out from the oral cavity for any reasons. Heart rate (HR), MAP, oxygen saturation ( $\text{SpO}_2$ ) were measured in the following manner. A base line reading in the pre-operative holding area (15 minutes before induction), a pre-induction value (just prior to induction of anesthesia), post-induction value, at intubation of trachea, then at every minute till 5 minutes and then at 10, 15, 20, 25, 30 minutes. The maximum values of the parameters during the procedure were also recorded. Complications like laryngospasm, desaturation, dental trauma, lip injury, oro-pharyngeal trauma and arrhythmias were also recorded. The observations of number of intubation attempts, time to intubation and the complications were done by an independent observer. The hemodynamic parameters were recorded from the recording monitor where all the data was stored automatically.

Statistical analysis: Sample size was calculated considering a 10% change in haemodynamics would result in significant difference with power of 80% and p-value < 0.05. Data was entered in SPSS version 11.0 for statistical analysis. Descriptive statistics were presented in proportion, percentage, mean, standard deviation etc. For inferential statistics, variables were compared in between the groups using Chi-square Test for grouped variables and T-test or U-test was used for ungrouped variables wherever necessary. P-value < 0.05 was considered statistically significant.

## Results

Demographic variables were comparable between the groups. (Table 1)

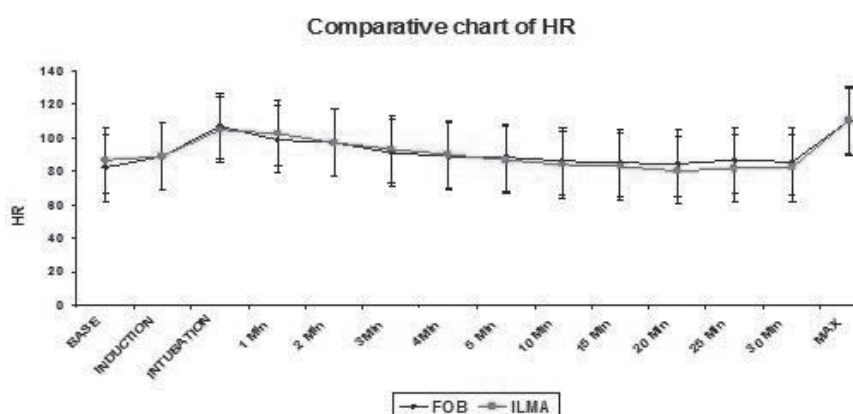
**Table 1: Comparison of demographic variables**

Variables	Category	Group I (n=50)	Group II (n=50)	p-value
Age (Yrs)	18-27	15	17	0.668
	28-37	16	19	0.529
	38-47	10	6	0.275
	48-60	9	8	0.790
Sex	Male	20	14	0.205
	Female	30	36	
ASA	I	45	47	
	II	5	3	0.461
Weight (Kg)		52.88±7.78	51.60 ±7.15	0.394

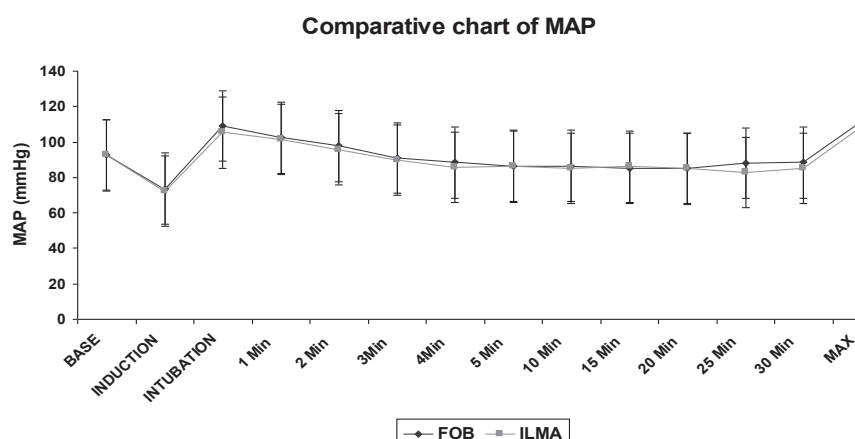
After the induction of anesthesia, HR increased in both the groups and further increase was seen at intubation but the difference was not significant between the groups. The maximum values recorded during the observation in both the groups were also comparable (Figure 1).

The MAP decreased than the baseline values after induction of anesthesia, then increased at intubation and there after throughout the observation in both the groups but was not statistically significant. The mean arterial pressure returned to the baseline after three minutes of intubation. The maximum value recorded during the observation between the groups was comparable (Figure 2).

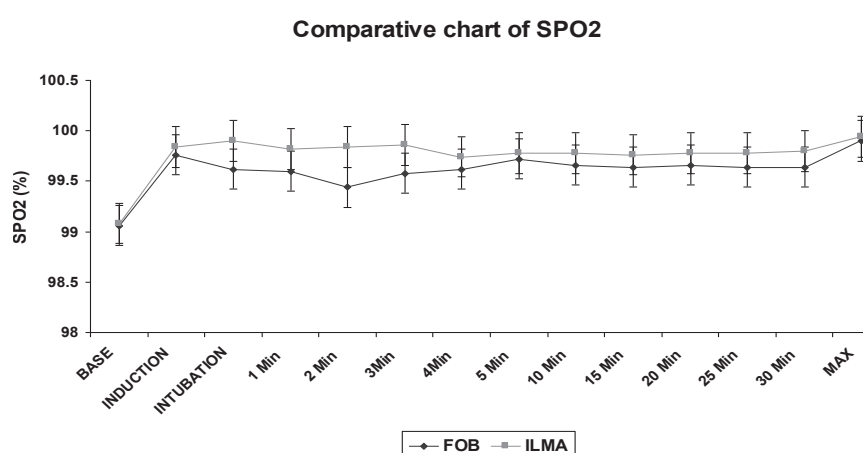
$\text{SpO}_2$  was insignificantly lower in group I after induction of anesthesia. There was a decrease in  $\text{SpO}_2$  in three patients in Group I, and one patient in Group II to 96% but it was statistically not significant (Figure 3).



**Figure 1: Comparison of changes in heart rate.**



**Figure 2: Comparison of changes in Mean arterial Pressure**



**Figure 3: Comparison of SPO2**

Other complications like laryngospasm, lip injury, dental trauma, oropharyngeal trauma, or arrhythmias were not recorded.

In both the groups, the time taken for intubation in second attempt was significantly longer than those in whom intubation succeeded in first attempt. Similarly when the time taken for intubation was compared between the two groups, it was found to be significantly longer in Group II irrespective of the number of attempts (Table 2).

**Table 2: Comparison of Number of attempts and time taken for intubation**

Attempt	Group I	Number of Attempts	Group II	Number of Attempts	
1	40		46		
2	10		4		0.084
Attempt	Group I		Group II		P-value
	Time taken (sec)		Time taken (sec)		
1	53.53±13.84		66.67±9.65		<0.001
2	82.20±10.17		97.75±9.11		0.021

## Discussion

Laryngoscopy and intubation is known to cause exaggerated hemodynamic response. This response manifests as tachycardia, hypertension and dysrhythmias and it may have deleterious respiratory, neurological and cardiovascular effects. These hemodynamic responses are due to reflex sympatho-adrenal discharge resulting in increased catecholamine level provoked by epiglaryngeal and laryngotracheal stimulation subsequent to laryngoscopy and tracheal intubation. Although these changes are only short lived, they may have detrimental effects on the coronary or cerebral circulation in already cardiac compromised patient.

Intubation with the aid of a FOB or an ILMA is an alternate to a conventional laryngoscope. Although both FOB and ILMA are important tools in the management of difficult airways, both have been found to cause less hemodynamic changes when compared with conventional laryngoscopy.<sup>2,3</sup> The rationale for conducting this study was to compare hemodynamic changes, intubation time, attempts for intubation of trachea and complications with the help of ILMA, an easily available and less expensive device, with FOB, an expensive device, which is not that easily available in a developing country.

In our study, patients with anticipated difficult airway were excluded. It is obvious that there would have been variation in the duration of procedure and extra manipulation to complete endotracheal intubation in patients with difficult airway. Hemodynamic responses vary according to the duration of the procedure and manipulations during tracheal intubation. Laryngoscopy and tracheal intubation contribute to these responses separately. The duration of laryngoscopy has a some effect on the magnitude of the pressor response. In a study, a 60-second laryngoscopy resulted in increased MAP until 45 seconds but no further increase was seen until tracheal intubation thereafter. To obtain reliable results, only patients without anticipated difficulties in airway management were included and the duration of intubation and number of attempts were recorded.

The main cause for the failure to intubate in the first attempt in FOB group was due to failure to thread the endotracheal tube over the fibroscope. Other causes were due to the obstruction of the visual field by secretions, disconnection of the electrical circuit and displacement of the tube while withdrawing the fibroscope. In ILMA group the main reason for failure to intubate in the first attempt was due to failure to pass the endotracheal tube into the trachea. The first attempt success rate of tracheal intubation in our study with ILMA was found to be higher than those found by other authors. Kirhara et al reported the first attempt success rate of 56%. Similarly Brain et al, Chan et al and Baskett et al reported first attempt success rate of 75%, 50% and 79.8% respectively. The number of patients who required either single or two attempts for

intubation between the groups was comparable (Table 2).

When the time taken for intubation was compared between the two groups, it was found to be significantly longer in Group II irrespective of the number of attempts (Table 2). Intubation of trachea with ILMA is a two-stage process: first the proper placement of the ILMA and secondly the intubation and removal of the device.

The heart rate increased after the induction of anaesthesia in both the groups and further increase was seen at intubation but there was no significant difference (Figure 1). The maximum values recorded during the observation in both the groups were also comparable (p-value=0.941) (Figure 1). Xue and colleagues also showed that both orotracheal and nasotracheal fiberoptic intubation resulted in increase of blood pressure and HR compared to the baseline and post induction values. In our study, the time required for the recovery of MAP to the post induction value (2 minutes after intubation) was not significantly different between the two groups.

The MAP decreased by 10% of the baseline value after induction of anesthesia in both the groups as the anesthetic technique used during induction was same. We used injection propofol 2mg/kg for induction and maintained with halothane 1%. Both of these are known to decrease the blood pressure: propofol by decreasing the systemic vascular resistance, cardiac contractility and preload and halothane by direct myocardial depression.

The MAP increased in both the groups from the baseline value at intubation but was comparable (p-value=0.114) between the two study groups (Figure 2). These hemodynamic responses are due to reflex sympatho-adrenal discharge.<sup>6</sup> Mechanical stimulation of upper respiratory tract results in the transient rise in HR and BP. Similar hemodynamic responses in the two groups would be explained by the fact that tracheal intubation is the strongest stimuli to produce hemodynamic response, though, ILMA mediated stimulation of the pharyngo-laryngeal structures has some role to play. In our study, both the groups finally received tracheal intubation, though the techniques used were different. Blood pressure at any other points of observation and maximum values did not differ. In our study, MAP returned to baseline value within two minutes of intubation in both the groups. In an anesthetized patient, muscle tone of soft palate, base of the tongue and epiglottis is reduced and approximate them to the posterior pharyngeal wall, leaving little air space in the pharynx for manoeuvring the tip of the fibroscope to locate the glottis. Extra manipulation of the palatopharyngeal structure is required for successful tracheal intubation in case of ILMA too. We used jaw thrust in both the groups to open the mouth which displaces the mandible and tongue anteriorly, thereby cleaning the airway, and also tend to direct the tip of the fibroscope towards the vocal cords. The recovery of hemodynamic changes is rapid.



The lower SPO<sub>2</sub> at intubation, though insignificant, in the Group I could probably be due to the fact that intubation with the ILMA is a two staged process, first the insertion of ILMA and second the intubation and we check for ventilation at each step with oxygen whereas, during intubation with FOB such provision was not used. Preoxygenation, use of escape safe criteria like commencement of ventilation with fall in SPO<sub>2</sub> below 90% would not let the difference in SPO<sub>2</sub> be significant between the groups and actually demonstrates the safety of the study.

No major complications were observed during our study like dental trauma, lip trauma, dysrhythmias, laryngospasm, or oropharyngeal trauma. All these complications are possible and have been reported. Takenaka et al reported a case of epiglottic oedema as a consequence of down folding of the epiglottis during blind intubation.

The limitation of the study is that we did not compare the hemodynamic changes with conventional laryngoscopy and intubation.

In conclusion, haemodynamic changes and complications during orotracheal intubation using FOB or ILMA were comparable. Therefore, ILMA, which has a better availability and is less expensive than FOB, can be used safely as an alternative method for securing airway in routine surgical patients.

**Conflict of Interest:** None

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