Hemodynamic response to endotracheal intubation using C-Trach assembly and direct laryngoscopy

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ABSTRACT

Purpose: Our objective was to study the pressor response to endotracheal intubation through laryngeal mask airway C-Trach and compare it to the hemodynamic response to intubation with direct laryngoscopy (DL). **Materials and Methods:** After obtained approval from institutional ethical committee, 100 patients of American Society of Anesthesiologists physical Status I, aged 14-65 years, posted for elective surgery were enrolled in the trial. They were randomly divided into two groups of each 50 patients. Anesthesia technique was standardized and patients of Group I were intubated using DL, while patients of Group II were intubated with the help of C-Trach assembly. Hemodynamic parameters, systemic blood pressure (systolic and diastolic) and heart rate were recorded before and after induction of anesthesia and every minute up to 5 min after intubation. **Results:** Patients of Group II recorded a minimal rise in peak systolic blood pressure (SBP) (1.8%) and diastolic blood pressure (10.6%). In comparison patients of Group I recorded a significant sustained rise in peak SBP (20.3%) and diastolic blood pressure (21.4%). However heart rate changes recorded in the two groups were of equal measure (peak rise of 22.9% in Group I vs. 22.4% in Group II). **Conclusion:** We conclude that intubation through C-Trach generates a lower pressor response to intubation in comparison to intubation using DL.

Key words: *C-Trach, direct laryngoscopy, endotracheal intubation, haemodynamic response*

INTRODUCTION

The pressor response to direct laryngoscopy (DL) and endotracheal intubation precipitating a significant increase in heart rate and systemic blood pressure is an established phenomenon and thus, a cause of concern for anesthesiologists all over. The majority of studies treat laryngoscopy and intubation as a single stimulus, which manifestly they are not. The mechanism of hemodynamic response to laryngoscopy and orotracheal intubation is proposed to be by somato-viseral reflexes. Stimulation of proprioceptors at the base of the tongue during laryngoscopy induces impulse dependent increases of systemic blood pressure, heart rate and plasma catecholamine concentrations. Subsequent orotracheal intubation recruits additional receptors that elicit augmented hemodynamic and epinephrine responses as well as some vagal inhibition of the heart.[1]

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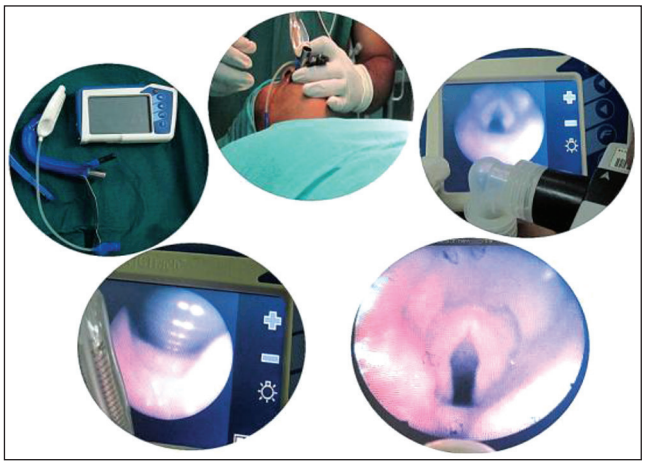
The C-Trach laryngeal mask airway (LMA) assembly, a secure airway in its own right, facilitates view of the laryngeal opening and guiding of the endotracheal tube under vision into the trachea without moving the patient's head and neck, while maintaining the ventilation of the patient. It has an anatomically curved rigid airway tube, an integrated guiding handle, an epiglottis elevating bar and a fiberoptic bundle, which provides direct view of the larynx on a cable free light weight portable viewer [Photograph 1]. Trials made to assess, analyze and compare the sympathetic and hemodynamic response to endotracheal intubation using DL and intubating LMA (ILMA) reported a significantly diminished response, while intubating through ILMA compared to endotracheal intubation using DL. We decided to study the autonomic response to endotracheal intubation facilitated under vision through C-Trach assembly and compare it to the hemodynamic response to intubation with DL.



Photograph 1: Intubation using C-Trach assembly

MATERIALS AND METHODS

The study was conducted in the Department of Anesthesia at JLN Hospital and Research Center, Bhilai, Chhattisgarh, India. Approval was obtained from the institutional scientific and ethical committee. After written informed consent, 100 patients of American Society of Anesthesiologists physical Status I, of either sex, in the age group 14-65 years, posted for planned surgery were enrolled in the trial. The sample size calculation was based on a previous study,[2] which indicated that at least 35 patients in each group will be required to compare means of difference between groups by confidence interval −95% and study power 80%. Patients with anticipated difficult airway were not included in the study. They were randomly divided into two groups using the sealed opaque envelope technique:

- Group I: Comprised 50 patients who were intubated using DL.
- Group II: Comprised 50 patients who were intubated with the help of C-Trach assembly.

Patients were premedicated with tablet alprazolam (0.5 mg) on the night before surgery.

On arrival in the operation theater patients were reassured and connected to multipara monitor.

Baseline hemodynamic parameters were recorded and labeled "basal." Intravenous access was achieved and injection fentanyl 2 mcg/kg was given. Anesthesia was induced with intravenous propofol 2.5 mg/kg. This was followed by muscle paralysis with 0.1 mg/kg of vecuronium bromide. Intermittent positive pressure ventilation (IPPV) was instituted with oxygen in nitrous oxide (1:1) during the period of apnea. Hemodynamic parameters were recorded at 3 min after administration of propofol and values were labeled as P3. IPPV was continued for 3 min after injection of vecuronium bromide when DL and orotracheal intubation was performed with 7.5 mm and 8.0 mm reinforced endotracheal tubes in female and male patients in Group I, respectively, whereas LMA C-Trach of appropriate size was introduced in patients of Group II. Hemodynamic parameters were recorded following the insertion of C-Trach LMA and labeled as LMA1. Chandy's maneuver, if required, was then used to achieve a direct central view of the vocal cords and orotracheal intubation was performed through the LMA under direct vision.

Correct placement of the endotracheal tube was confirmed in both groups by capnography. The C-Trach LMA was removed with the help stabilizing obturator rod. Hemodynamic parameters were recorded every minute up to 5 min after intubation in both groups and labeled as ET1, ET2, ET3, ET4 and ET5 respectively. All intubations were performed by the first author who has >10 years of anesthesia experience. SpO_2 and $EtCO_2$ were continuously monitored throughout the study period and any event of cardiac arrhythmia was recorded. At the end of 5 min after endotracheal intubation, inhalational anesthetic agent and/or intravenous propofol infusion was supplemented to the N_2O in O_2 (2:1) and surgery was allowed to commence. The observations were tabulated and statistically analyzed using paired and unpaired Student's *t*-test.

OBSERVATIONS

There was no significant difference between the two groups regarding age, weight, and sex ratio [Figure 1].

Systolic blood pressure

Mean baseline (basal) values of systolic blood pressure (SBP) were comparable, 128.48 ± 15.29 mm Hg in Group I and 132.96 ± 18.43 mm Hg in Group II. A significant fall in systolic blood pressure was recorded in both groups following administration of propofol, recording comparable mean SBP values of 102.26 ± 18.19 mm Hg in Group I and 103.32 ± 15.36 mm Hg in Group II 3 min after injection propofol (P3). In Group I, intubation after DL resulted in a steep rise in SBP with an average recording of 154.98 ± 29.32 mm of Hg (20.3% above mean basal value). This rise was highly significant compared with baseline and P3 values. In Group II, the mean SBP value immediately after insertion of the LMA was 114.08 ± 20.85 mm Hg, which was significantly lower than the basal value. The insertion of endotracheal tube through LMA C-Trach assembly precipitated a rise in systolic blood pressure with

a mean peak value of 135.02 ± 22.72 mmHg (1.8% above mean basal value).

However, this rise was not statistically significant when compared with baseline value. The increase in SBP following endotracheal intubation was more sustained in Group I as compared with Group II with average values touching baseline levels 5 min after intubation in Group I and 2 min after intubation in Group II. At all points of time following endotracheal intubation, the average values for SBP in Group I were significantly higher than corresponding values in Group II [Figure 2].

The distribution pattern of patients of the two groups according to the maximal rise recorded in SBPs revealed a peak rise of >20% of baseline values in 30 (60%) patients in Group I as opposed to only 9 (18%) patients in Group II. 4 (8%) patients in Group I when compared to 19 (38%) patients in Group II recorded no rise in SBPs compared to their baseline values during the entire study period [Figure 3].

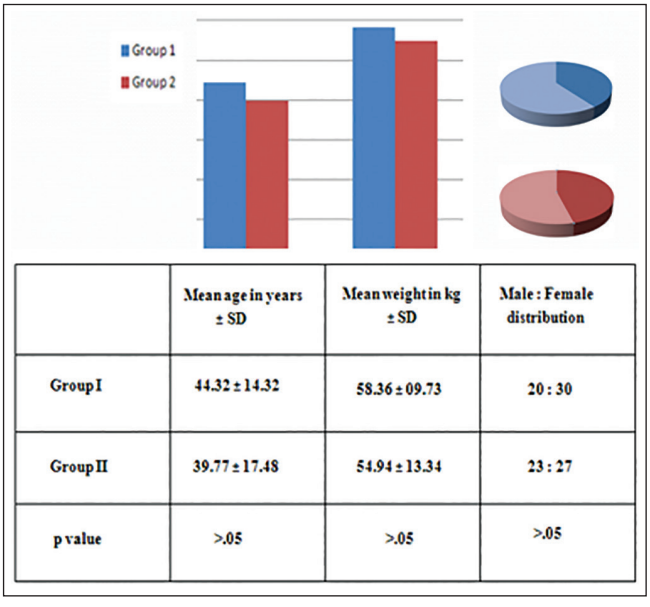
Diastolic blood pressure

Mean diastolic blood pressure (DPB) changes revealed a pattern similar to SBP recording significant fall following administration of propofol in both groups. In Group I, mean value of DBP, 95.54 ± 15.79 mm of Hg, following intubation after direct laryngoscopy was significantly higher than the basal (21.4% above mean basal value). And P3 values. In Group II, the mean DBP values immediately after insertion of the LMA was 75.32 ± 16.35 mm Hg which was statistically significantly lower than the baseline value. The insertion of endotracheal tube through LMA C-Trach assembly precipitated a rise in diastolic blood pressure with a mean value of 89.54 ± 17.06 mm Hg (10.6% above mean basal value). This rise was statistically significant when compared to basal value. At all-time intervals following endotracheal intubation, the average values for DBP in Group I and II were comparable [Figure 4].

The distribution pattern of patients of the two groups according to the maximal rise recorded in DBPs revealed a peak rise of >20% of baseline values in 28 (56%) patients in Group I as opposed to only 22 (44%) patients in Group II. 7 (14%) patients in Group I as compared with 13 (26%) patients in Group II recorded no rise in DBPs compared to their baseline values during the entire study period. Thus, an equal percentage of patients (30%) recorded a moderate rise of up to 20% in each group [Figure 3].

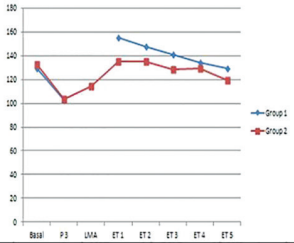
Heart rate

Mean heart rate variations were identical in the two groups. Intubation after DL resulted in a steep significant rise in heart rate with an average recording of 102.82 ± 15.45/min (22.9% above mean basal value) 1 min after intubation in Group I. This rise was statistically and clinically significant when compared to mean baseline and P3 values. In Group II, the mean heart rate immediately after insertion of the LMA was 95.2 ± 20.54/min which was a significant rise compared to the baseline value. The insertion of endotracheal tube through LMA C-Trach assembly precipitated a further rise in heart rate with average value increasing to 104.44 ± 21.65/min (22.4% above mean basal value) 1-min after intubation. This increase was statistically significant compared to baseline values. In both the groups average values of heart rate remained significantly higher than corresponding baseline values up to 5-min after endotracheal intubation. At all points of time following



	Mean age in years ± SD	Mean weight in kg ± SD	Male : Female distribution
Group I	44.32 ± 14.32	58.36 ± 09.73	20 : 30
Group II	39.77 ± 17.48	54.94 ± 13.34	23 : 27
p value	>.05	>.05	>.05

Figure 1: Mean values of age, weight and male female distribution in the two groups



	Basal	P_3	LMA	ET_1	ET_2	ET_3	ET_4	ET_5
Group I	128.8 ± 15.9	102.26* ± 18.19		154.98* ± 29.32	147.68* ± 25.59	141.14* ± 24.01	134.42* ± 22.57	*128.84** ± 20.17
Group II	132.6 ± 18.3	103.32* ± 15.36	114.08* ± 20.85	134.64 ± 23.98	135.02 ± 22.72	128.74 ± 19.78	122.98* ± 20.59	119.44* ± 20.01
P value intergroup	>.05	>.05		<.05	<.05	<.05	<.05	<.05

Figure 2: Mean values of systolic blood pressure recorded at various intervals in the two groups

endotracheal intubation, the average values for heart rate in Groups I and II were comparable [Figure 5].

36 (72%) patients in Group I and 33 (66%) patients in Group II recorded a peak rise of >20% of baseline values. 3 (6%) patients in Group I as compared to 9 (18%) patients in Group II recorded no rise in heart rate compared to their baseline values during the entire study period.

Rate pressure product

Individual and mean rate pressure product were calculated and percentage rise from the basal value was derived. The rise in rate pressure product from basal value at all-time intervals was consistently higher in Group I as compared to Group II [Figure 6].

SpO_2 and $EtCO_2$ values remained within acceptable limits throughout the study period in both the groups. No event of cardiac arrhythmia was recorded in any patient during the entire study period.

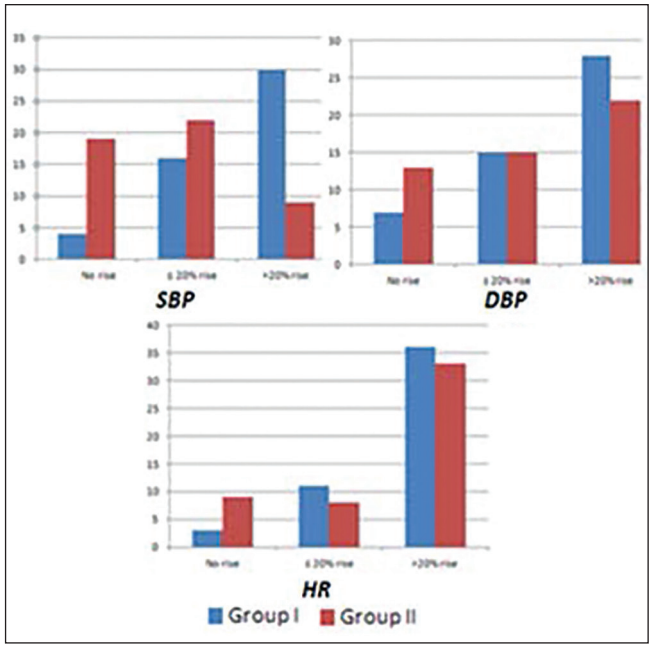
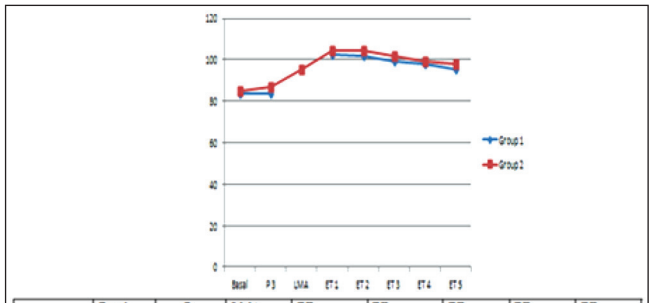


Figure 3: The distribution pattern of patients of the two groups according to the maximal rise recorded in systolic blood pressure, diastolic blood pressure and heart rate

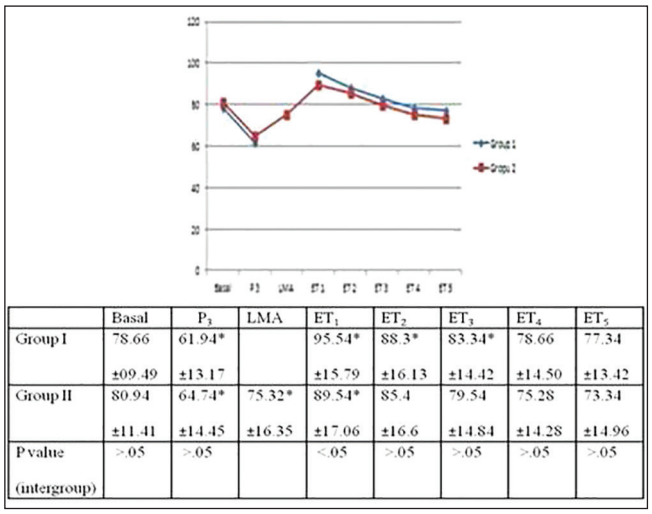


	Basal	P_3	LMA	ET_1	ET_2	ET_3	ET_4	ET_5
Group I	83.60 ±15.22	83.92 ±13.49		102.82* ±15.45	101.8* ±12.93	99.60* ±13.98	98.16* ±14.59	95.38* ±15.73
Group II	85.32 ±16.11	87.22 ±18.0	95.2* ±20.54	104.44* ±21.65	104.66* ±23.88	101.9* ±23.55	99.10* ±25.13	98.06* ±24.32
P value (intergroup)	>.05	>.05		>.05	>.05	>.05	>.05	>.05

Figure 5: Mean values of heart rate recorded at various intervals in the two groups. **P* value statistically significantly as compared to basal value

DISCUSSION

King *et al.*[3] in 1951 first described sympathetic hemodynamic response to laryngoscopy and endotracheal intubation. DL exerting a pressure over the base of the tongue by the laryngoscope blade stimulates proprioceptors, resulting in a significant proportionate increase in catecholamine and hemodynamic parameters. Passage of the tube through the trachea further



	Basal	P_3	LMA	ET_1	ET_2	ET_3	ET_4	ET_5
Group I	78.66 ±09.49	61.94* ±13.17		95.54* ±15.79	88.3* ±16.13	83.34* ±14.42	78.66 ±14.50	77.34 ±13.42
Group II	80.94 ±11.41	64.74* ±14.45	75.32* ±16.35	89.54* ±17.06	85.4 ±16.6	79.54 ±14.84	75.28 ±14.28	73.34 ±14.96
P value (intergroup)	>.05	>.05		<.05	>.05	>.05	>.05	>.05

Figure 4: Mean values of diastolic blood pressure recorded at various intervals in the two groups. **P* value statistically significantly as compared to basal value

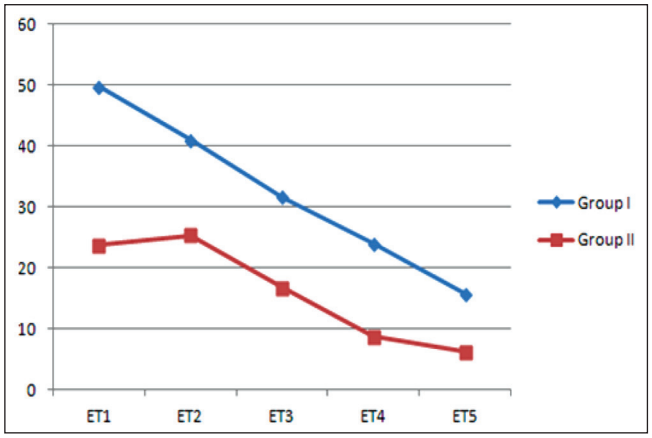


Figure 6: Percentage rise in rate pressure product recorded at various intervals in the two groups

exaggerates this response by somato-visceral reflex followed by rapid regression of SBP and heart rate whereas plasma catecholamine concentrations regress more slowly. Studies showing this enhanced sympathetic response to laryngoscopy and endotracheal intubation following induction with thiopentone or propofol and relaxation with succinylcholine or nondepolarisers, and its alteration, have been published time and again. Insertion of LMA generating lower sympathetic response has been reported by Akbar *et al.*[4] and Wood MLB and Forrest ETS.[5] Reports of hemodynamic response following intubation with ILMA vary from minimal cardiovascular response[6] to no different from intubation with DL[7,8] Li *et al.*[9] compared the hemodynamic response to orotracheal intubation with LMA C-Trach and direct laryngoscopy under general anesthesia in 60 adult patients scheduled for elective gynecological surgery. Their observations revealed that blood pressure and heart rate at and after intubation were not significantly different from basal values in C-Trach group whereas in laryngoscopy group only heart rate increased significantly at and after intubation.

In our study we used C-Trach assembly to intubate under vision, record the hemodynamic response to intubation and compare it to the response seen after intubation with direct laryngoscopy. Minimal or no clinical rise in SBP (1.8%), a modest rise in DBP (10.6%) was recorded, while intubating with the help of C-Trach. In comparison, statistically and clinically significant increases were recorded in systolic and DBP (20.3% and 21.4%) after intubation using DL. The rise recorded in systemic blood pressure was more sustained in DL group than CTrach group. However the heart rate increase recorded in the two groups (22.8% in Group I and 22.4% in Group II) was statistically and clinically significant and of equal magnitude. Higher findings of percentage rise in rate pressure product derived in Group I postintubation imply a greater hemodynamic stress and enhanced myocardial oxygen demand following intubation with DL.

Stimulation of supraglottic region by tissue tension is the major cause of sympathoadrenal response to tracheal intubation and placement of tube through cords contributes little additional stimulation. Laryngoscopy produces a balanced stimulation of vagal and cardiac accelerator fibers, whereas intubation produces less vagal stimulation.[10] Our study reveals that intubation using C-Trach generates low sympathetic stress response because the propioceptors at the base of the tongue are not stimulated. The response to the passage of tube through the trachea resulted in sympathetic stimulation, precipitating a profound increase in heart rate in both C-Trach and DL group. Easy insertion, secure airway and minimal side-effects are other benefits of C-Trach assembly. The subdued response could be more helpful in hypertensive patients where the variations of blood pressure are wide and thus may result in higher morbidity. The fact that no drug was used to suppress the stress response is an added advantage. Thus, we conclude that CTrach assembly is a useful technique of intubation as it generates low hemodynamic response.

However, further trials will help to assess the hemodynamic effects of intubation through CTrach assembly in patients with hypertension and cardiac disease.

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