

THE STUDY OF STRESS RESPONSE TO ENDOTRACHEAL INTUBATION BY MEASURING SERUM CORTISOL LEVEL

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Abstract

Background: Endotracheal intubation is a definitive method of securing the airway and is routinely done by the direct laryngoscopy and visualization of the vocal cords. Manipulation during advancement of endotracheal tube into the Laryngoscopy and intubation cause great stress to patients, not only due to physical stimulation of pharyngeal, laryngeal mucosa and tracheal receptors during the intubation but also psycho emotional due to fear of the procedure. The stress response to endotracheal intubation can lead to sudden change in hemodynamic status which may precipitate to myocardial ischemia, cerebrovascular accident. **Materials and Methods:** This prospective study was conducted in 33 patients in Dr. Susheela Tiwari Government Hospital, Haldwani, Uttarakhand, India. Serum Cortisol levels were assessed, at 30 minutes before transferring the patients to operating room (pre-operative sample) and 2 minutes, 5 minutes and 10 minutes after Endotracheal Intubation placement. **Result:** We observed that mean pre-operative serum cortisol level was 20.02 ± 13.15 mcg/dl, which increased to 41.35 ± 26.41 mcg/dl at 2 minutes after endotracheal intubation. The mean serum cortisol level at 5 minutes and 10 minutes after endotracheal intubation was 33.60 ± 25.62 mcg/dl and 26.91 ± 23.00 mcg/dl respectively. On statistical analysis, this was found to be significant ($p < 0.05$). **Conclusion:** The present study highlighted the change in serum cortisol levels of patients undergoing elective surgeries as a result of stress response to endotracheal intubation.

INTRODUCTION

Endotracheal intubation is a definitive method of securing the airway and is routinely done by the direct laryngoscopy and visualization of the vocal cords.^{[1][2]} Manipulation of the airway during endotracheal intubation leads to stimulation of pharyngeal and trachea-laryngeal nociceptors resulting in hemodynamic stress response (HDSR), which can be more deleterious in patients with poor cardiac reserves or having other comorbidities.^[3-5] The magnitude of the HDSR is variable and proportional to the amount of force applied during visualization of the glottis and the degree of trachea-laryngeal manipulation during advancement of ET into the trachea.^[6,7] Minimal desired duration for laryngoscopy and intubation to decrease stress response is less than 90 second, longer the duration

greater the stress response. Laryngoscopy and intubation cause great stress to patients, not only due to physical stimulation of pharyngeal, laryngeal mucosa and tracheal receptors during the intubation but also psycho emotional due to fear of the procedure.^[8] The stress response to endotracheal intubation can lead to sudden change in hemodynamic status which may precipitate to myocardial ischemia, cerebrovascular accident.

MATERIALS AND METHODS

This prospective study was conducted in 33 patient at Dr. Susheela Tiwari Government, Hospital under The Department of Anesthesiology, Critical care, Government Medical College, Haldwani. The study was undertaken after obtaining Institutional Ethical

Committee clearance as well as written informed consent from all patients.

Inclusion Criteria

- ASA Grade I and II
- Nonsmokers
- Mallampati Scoring I and II
- Elective Surgery requiring General anesthesia with Endotracheal intubation
- Age between 18 years to 60 years.
- Body mass index $\leq 30\text{kg/m}^2$

Exclusion criteria

- Patient refusal
- Age less than 18 years and >60 years
- Prior hypo or hypercortisolism (Pre-existing endocrine disorder, Cushing's syndrome, Pituitary tumor, Pseudo Cushing's syndrome, Addison diseases, Nelson syndrome).
- Patients with history of treatment with steroids in last 3 months.
- BMI $>30\text{kg/m}^2$
- MPS $>III$ and IV

Methodology

After approval from the institutional ethical committee, written informed consent was obtained from the patients, who fulfilled the inclusion criteria. Following receiving fitness from pre-anesthesia checkup clinic, these patients were enrolled in the study.

On the day of surgery, patients were kept fasted overnight, as per standard fasting guidelines. Venous blood samples were collected peripherally to measure serum cortisol levels, as follows: 30 minutes before transferring the patients to operating room (pre-operative sample), at 2 minutes after Endotracheal Intubation placement then 5 minutes and then after 10 minutes.

The samples were then transferred to the precooled tubes and soon centrifuged at -40°C and the plasma was stored at -80°C until analysis. All samples were analyzed together. Serum Cortisol levels were measured by commercially available radioimmunoassay kit.

On arrival of patient in operating room, wide bore intravenous catheter of appropriate size was secured and an infusion of ringer lactate was started as per standard peri-operative fluid replacement therapy. The patient was connected to multichannel non-invasive monitor to assess continuous heart rate (HR), electrocardiogram (ECG), hemoglobin oxygen saturation (SpO₂), End-tidal CO₂ (EtCO₂) and systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP). Baseline blood pressure, heart rate, SpO₂, ECG were noted. They were taken after an interval of 2 minutes, 5 minutes, 10 minutes after Endotracheal intubation and otherwise every 5 minutes from the attachment of non-invasive monitors till shifting of patient to PACU. Patients were given premedication in form of Injection ranitidine 1mg/kg, Injection metoclopramide 0.15 mg/kg, Injection glycopyrrolate 0.004mg/kg, Injection midazolam

0.05 mg/kg and injection nalbuphine 0.4 mg/kg. Following 3-5 minutes of pre-oxygenation with 100% oxygen, patients were induced with Injection propofol 1.5 - 2mg/kg and after confirming ability for mask ventilation, muscle relaxant Injection vecuronium 0.1mg/kg was given. Patients were intubated with a cuffed (high volume low pressure) ETT of inner diameter 7.5-8.0 mm for males, and 7.0-7.5 mm for females, under laryngoscopy. The cuff was inflated by the standard technique, with approx. 5 cc air, position in trachea was confirmed visually by chest rise and five point auscultation method, EtCO₂ value on monitor.

Patients were mechanically ventilated by volume-controlled ventilation with 50% of oxygen and 50% nitrous oxide with Sevoflurane (0.2-1.0), tidal volume and respiratory rate were set at 6 to 8 ml/kg and of 12-16 cycle/minutes, to maintain normocapnia with end-tidal carbon dioxide tension between 35 to 45 mmHg.

The following parameters were studied

Serum Cortisol levels at 30 minutes before transferring the patients to operating room (pre-op sample) and 2 minutes, 5 minutes and 10 minutes after Endotracheal Intubation placement.

Hemodynamic Parameter In all patients first Systolic blood pressure, diastolic blood pressure & mean blood pressure, heart rate, SpO₂, ECG were recorded baseline and then 2 minutes, 5 minutes, 10 minutes after Endotracheal Intubation.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp. Results on continuous measurements were presented on Mean $\pm$ SD (Minutes-Max) & categorical as Frequency (Percentage). Inferential statistics like Chi-square test/Fischer Exact test, independent t test was applied. The significance of level adopted was 5%.

RESULTS

The present study was a prospective study conducted on 33 ASA grade I/II patients for elective surgery in Department of Anesthesiology, Critical care, Government Medical College, Haldwani, to measure the change in serum cortisol levels as a result of stress response to endotracheal intubation.

We observed that mean pre-op serum cortisol level was 20.02 ± 13.15 mcg/dl, which increased to 41.35 ± 26.41 mcg/dl at 2 minutes after endotracheal intubation. The mean serum cortisol level at 5 minutes and 10 minutes after endotracheal intubation was 33.60 ± 25.62 mcg/dl and 26.91 ± 23.00 mcg/dl respectively. On statistical analysis, this was found to be significant ($p < 0.05$).

Table 1: Comparison of mean serum cortisol level of study participants at different time intervals

Time interval	Mean serum cortisol level (mcg/dl)
Pre-op	20.02 ± 13.15
2 minutes	41.35 ± 26.41
5 minutes	33.60 ± 25.62
10 minutes	26.91 ± 23.00

The f-ratio value is 5.35152. The p-value is .001667. The result is significant at $p < .05$.

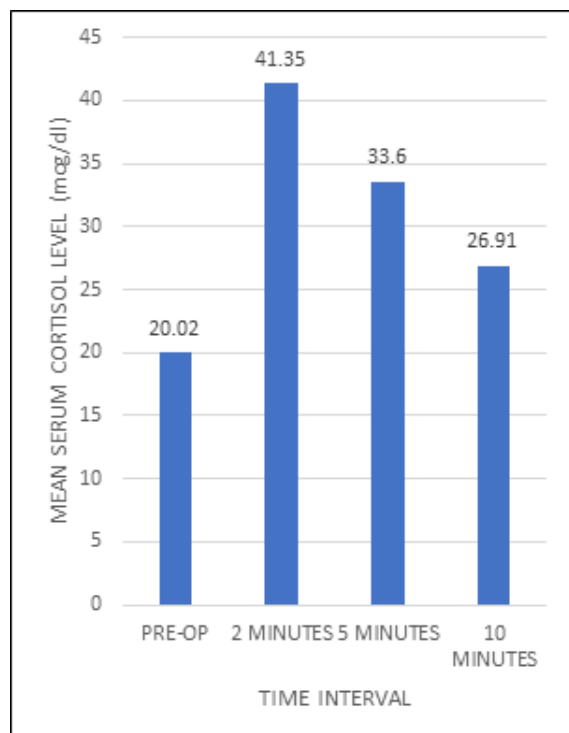


Figure 1: Comparison of mean serum cortisol level of study participants at different time intervals

DISCUSSION

Manipulation of the airway during endotracheal intubation leads to stimulation of pharyngeal and trachea-laryngeal nociceptors resulting in hemodynamic stress response. The magnitude of the stress response is variable and proportional to the amount of force applied during visualization of the glottis and the degree of trachea-laryngeal manipulation during advancement of endotracheal tube into the trachea.^[9] There are a limited number of studies that have assessed the stress response to endotracheal intubation, hence the present study was planned and conducted in Department of Anesthesiology, Critical care, Government Medical College, Haldwani to measure the change in serum cortisol levels as a result of stress response to endotracheal intubation on 33 ASA grade I/II patients admitted for elective surgeries. We also evaluated the hemodynamic parameters of these patients at different time intervals.

The glossopharyngeal and vagus nerves create hemodynamic responses as well as laryngospasm reflex to laryngoscopy and intubation. The irritation caused in the supraglottic area and cuff inflation in the trachea are the major causes of hemodynamic

response during intubation. Moreover, the intensity of the response is related to the duration and intensity of the stimuli applied to the base of the tongue.^[10] In the present study, we observed that the mean pre-op systolic. In the present study, the mean pre-op serum cortisol level was 20.02 ± 13.15 mcg/dl, which increased to 41.35 ± 26.41 mcg/dl at 2 minutes after endotracheal intubation. The mean serum cortisol level at 5 minutes and 10 minutes after endotracheal intubation was 33.60 ± 25.62 mcg/dl and 26.91 ± 23.00 mcg/dl respectively. On statistical analysis, this was found to be significant ($p < 0.05$). The stress hormone cortisol is a powerful promoter of gluconeogenesis in the liver, and acts on the glycogen storage in the liver as well as on the reduction of glucose utilization in peripheral tissues. Stress response will cause increase secretion of growth hormone and prolactin, this will increase their hyperglycemic action in the liver. Under surgical stress condition protein degradation in skeletal muscle, glycolysis, and gluconeogenesis are the prominent characteristics of intermediary metabolism. Promotion of gluconeogenesis by cortisol in the liver is caused primarily by the stimulation of protein catabolism. In stress condition the rate of the overall metabolism is increased, but the capacity of oxidative metabolism is limited. This is one of the main reasons why catabolic pathways begin to work un aerobically and to produce, among other metabolites, lactate. The evaluation of stress response becomes particularly important in comorbid patients. A sudden change in hemodynamics status may increase risk of myocardial ischemia, especially in high-risk patients. Laryngoscopy and intubation induce stress responses such as tachycardia and hypertension. Those are in association with the surge of plasma adrenaline concentration following intubation.

CONCLUSION

The present study highlighted the change in serum cortisol levels of patients undergoing elective surgeries as a result of stress response to endotracheal intubation. Laryngoscopy and intubation cause great stress to patients, either psycho emotional due to fear of the procedure, or physical due to nociceptive stimulation of pharyngeal, laryngeal mucosa and tracheal receptors during the intubation. Significant changes in hemodynamic parameters were also noted at different time intervals in the present study. All patients were operated in elective circumstances and depth of anaesthesia and volume were controlled

easily and we didn't notice any adverse event. The results may differ in emergency surgeries in terms of stress response and also in the cardiovascular or high risk comorbid patients. Further studies on larger scale are required to substantiate our findings.

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