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Comparative Evaluation of Physiological Stress Responses During Endotracheal Intubation Using BPL VL-01 Video Laryngoscope and Macintosh Laryngoscope in Elective Surgeries

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ABSTRACT

Background

Endotracheal intubation during general anesthesia provokes a sympathetic stress response characterized by changes in heart rate and blood pressure. Minimizing this response is crucial, especially in vulnerable patients. Video laryngoscopes may reduce airway manipulation and thereby attenuate these responses compared to conventional techniques.

Objectives

To compare the physiological stress response (heart rate, systolic and diastolic blood pressure, mean arterial pressure, and oxygen saturation) associated with the BPL VL-01 video laryngoscope and Macintosh laryngoscope.

Methods

A prospective randomized comparative study was conducted on 44 adult patients (ASA I–II) undergoing elective surgery under general anesthesia. Patients were divided into two groups: BPL VL-01 and Macintosh laryngoscope. Hemodynamic parameters were recorded at baseline, pre-laryngoscopy, and at 1, 3, and 5 minutes post-intubation.

Results

The BPL VL-01 group demonstrated significantly attenuated increases in heart rate and blood pressure at 1 minute post-intubation compared to the Macintosh group. Mean arterial pressure and oxygen saturation also showed more stable trends with the video laryngoscope. No significant differences were observed at later time intervals.

Conclusion

The BPL VL-01 video laryngoscope provides better attenuation of physiological stress response compared to the Macintosh laryngoscope and may be a safer alternative for routine airway management.

Keywords

Video laryngoscope, Macintosh laryngoscope, hemodynamic response, intubation, airway management

Introduction

Airway management is a part of the anesthetic practice that is one of the most critical, and the gold standard of managing the airway when administering general anesthesia is endotracheal intubation. It provides sufficient ventilation and oxygenation and prevents aspiration. Nevertheless, the laryngoscopy and intubation, despite their regular use, entail a thoroughly recorded physiological imbalance referred to as the hemodynamic stress response (HDSR) [1,2]. This reaction is mediated by the stimulation of the sympathetic nervous system as a result of stimulating the nociceptors in the oropharyngeal, laryngopharyngeal, and tracheal areas, leading to tachycardia, hypertension and release of catecholamines [3,4].

Hemodynamic alterations during intubation are usually short-term and can have serious clinical consequences especially in those patients who are already affected by cardiovascular or neurological conditions. Such reactions are capable of augmenting the myocardial oxygen requirement and can trigger myocardial ischemia, arrhythmias, or cerebrovascular accident in individuals with predispositions [5,6]. The severity of the response depends on various factors such as the duration and intensity of laryngoscopy, level of anesthesia, comorbidity of the patient, and the skills of the operator [7].

Direct laryngoscopy has been using the traditional Macintosh laryngoscope, which was first introduced in 1943. It involves the coordination of the axes of the mouth, pharynx, and larynx to look at the glottis, and therefore involves significant movement of airway structures and cervical extension. This manipulation is also added to the further rise in sympathetic stimulation and consequent hemodynamic instability [6,8].

Video laryngoscopes have become a significant development in airway management in the last few years. These equipment have a camera and source of light on the tip of the blade, with the benefit of indirect observation of the glottis without the necessity to align axes of airways. This causes less manipulation of the airways and even lessening the physiological stress response of intubation [9,10].

BPL VL-01 video laryngoscope is one of the relatively new video laryngoscopes. It should give high-resolution visualization of the glottis with an aim of reducing tissue trauma. Although it has the potential benefits, there is limited literature comparing its performance to the Macintosh laryngoscope, especially regarding its physiological stress response [11,12].

Therefore, the present study was undertaken to compare the physiological stress responses during endotracheal intubation using the BPL VL-01 video laryngoscope and the Macintosh laryngoscope in patients undergoing elective surgeries under general anesthesia.

Materials and Methods

This was a prospective randomised comparative study carried out in the Department of Anaesthesiology in a tertiary care teaching hospital during 18 months time span. The sample size of the study was 44 adult patients between 20-50 years of age and of American Society of Anesthesiologists (ASA) physical status I and II who were to receive elective surgeries done under general anesthesia with endotracheal intubation.

Patients were enrolled based on predefined inclusion and exclusion criteria. The inclusion criteria comprised patients aged 20–50 years, ASA physical status I and II, those undergoing elective surgeries requiring endotracheal intubation, and those who provided written informed

consent. Patients with an anticipated difficult airway, a history of allergy to anesthetic drugs, pregnant patients, and those unwilling to participate were excluded from the study.

The sample size consisted of 44 patients, who were randomly allocated into two equal groups of 22 each using a computer-generated randomization sequence. Allocation concealment was ensured prior to group assignment. Group A patients underwent endotracheal intubation using the BPL VL-01 video laryngoscope, whereas Group B patients were intubated using the Macintosh laryngoscope.

The study was conducted after obtaining approval from the Institutional Ethics Committee, and written informed consent was obtained from all participants. Patient confidentiality was maintained throughout the study in accordance with ethical guidelines.

A thorough preoperative assessment was done to all patients and they were kept nil orally as per normal fasting guidelines. When the patient arrived in the operating room, the usual monitoring was provided, namely, electrocardiography, non-invasive blood pressure measurement, pulse oximetry, and capnography. Before induction of anesthesia, baseline physiological parameters were measured including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation (SpO 2).

General anesthesia was induced using a standardized anesthetic protocol. Laryngoscopy and endotracheal intubation were performed by an experienced anesthesiologist according to the group allocation using either the BPL VL-01 video laryngoscope or the Macintosh laryngoscope.

The main measures of the research were the physiological signs of stress reaction, such as heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and oxygen saturation. Data on these parameters were noted at certain time intervals: baseline prior to induction (T0), pre-laryngoscopy after induction (T1), 1-minute after intubation (T2), 3-minute after intubation (T3), and 5-minute after intubation (T4). The use of this structured assessment has enabled the assessment of the immediate and short-term hemodynamic response to endotracheal intubation.

The collected data were compiled and analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation and compared using the independent t-test, while categorical variables were analyzed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1: Baseline Demographic Characteristics

Parameter	Group A (BPL VL-01)	Group B (Macintosh)	p-value
Age (years)	38.2 ± 8.5	35.9 ± 9.1	0.421
Sex (M/F)	14 / 8	12 / 10	0.543
Weight (kg)	65.3 ± 11.4	68.1 ± 10.8	0.387
ASA (I/II)	16 / 6	14 / 8	0.527
Mallampati Grade (I/II/III)	10 / 9 / 3	11 / 8 / 3	0.924

The baseline characteristics were comparable between the two groups, indicating homogeneity.

Table 2: Physiological Stress Response

Parameter	Time	Group A	Group B	p-value
HR	T2	91.5 ± 8.9	98.2 ± 9.5	0.023*
SBP	T2	142.8 ± 12.1	154.3 ± 13.8	0.009*
DBP	T2	89.7 ± 8.4	96.5 ± 9.1	0.017*
MAP	T2	107.4 ± 9.1	115.8 ± 10.0	0.011*

A significant increase in all hemodynamic parameters was observed following intubation in both groups. However, the increase was significantly lower in the BPL VL-01 group at 1 minute post-intubation.

At 3 and 5 minutes post-intubation, parameters gradually returned toward baseline levels, with no statistically significant differences.

Table 3: Oxygen Saturation

Time	Group A	Group B	p-value
T0	99.1 ± 0.7	98.9 ± 0.8	0.451
T1	99.0 ± 0.8	98.8 ± 0.9	0.512
T2	98.8 ± 1.1	97.9 ± 1.6	0.048*
T3	99.0 ± 0.9	98.7 ± 1.2	0.385
T4	99.2 ± 0.6	99.0 ± 0.7	0.334

Oxygen saturation remained within normal limits in both groups.

Discussion

The current research has shown that endotracheal intubation is linked with a considerable hemodynamic stress response that is manifested by the elevation of heart rate and blood pressure. Such results are in line with other past research that has recorded comparable sympathetic reactions after airway control [13,14].

This study demonstrates that the BPL VL-01 laryngoscope is specifically related to a substantially lower increment in heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure, 1 minute following intubation as compared to Macintosh

laryngoscope. This indicates that video laryngoscopy could argue the physiological response to stress during intubation.

It is possible to explain the decreased stress response to video laryngoscopy by decreased airway manipulation and the lifting force during laryngoscopy. Video laryngoscopy, in contrast to direct laryngoscopy, does not necessitate a positioning of axes of airways, and thus the airway structures stimulation is reduced to a minimum [8,9].

These results are consistent with the data of Zaki et al., which demonstrated better glottic visualization and increased first-pass rates with video laryngoscopes and decreased physiological stress response [10]. On the same note, Lee et al. established that video laryngoscopes are more visualized and have superior safety profiles in comparison to traditional laryngoscopes [12].

The benefits of video laryngoscopy in enhancing the state of intubation and decreasing complications associated with the airways have also been supported by other researches [15,16]. The benefits apply specifically to patients whose airways have a challenging structure or have little neck mobility.

Nonetheless, there are conflicting studies that have been reported. Nair et al. did not report any significant difference in hemodynamic reaction between video laryngoscope and Macintosh laryngoscope, although with video laryngoscopy, glottic visualization is better than in the Macintosh laryngoscope [17]. This variation can be explained by the difference in the study design, population of patients, and experience of the operators.

Kumar et al. also showed better ease of intubation by using video laryngoscope with BPL but did not observe statistically significant change in hemodynamic parameters [11]. Conversely, the current investigation shows that there is a considerable reduction of stress response by using the BPL VL-01 device.

The oxygen saturation levels were constant in both groups during the study and this demonstrates that both machines are safe in ensuring adequate oxygenation which is not new given that there are past researches comparing the video and direct laryngoscopy [10,15].

In general, the results indicate that BPL VL-01 video laryngoscope is superior to the Macintosh laryngoscope in terms of alleviation of physiological stress during the intubation process and the improvement of the state of intubation.

The strengths of the study are that the study is prospective, randomized, standardized anesthetic protocol, and measured hemodynamic parameters at various time intervals, which are reliable to compare. Nevertheless, drawbacks are a limited sample size, the consideration of only ASA I-2 patients, and the analysis of only short-term physiological reactions, which can impact the generalization.

Conclusion

BPL VL-01 video laryngoscope has superior attenuation of physiological stress response than the Macintosh laryngoscope as shown by much lower heart rate and blood pressure rise after intubation.It can thus be assumed as a safer and more efficient method of managing airways especially on patients whose hemodynamic stability is paramount.

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Data Access : The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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