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The Evaluation of Endotracheal Intubation Effect on Blood Flow Stability Parameters in Baghdad and Gazzi AL-Harriri Hospitals

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Abstract

Endotracheal intubation and laryngoscopy have become necessary to provide sufficient airway management, deliver anesthesia and avoid aspiration in anesthetized individuals. Laryngoscopy and intubation have been shown to induce a broad spectrum of stress responses e.g. hypertension and tachycardia. The current study aimed to assess the impact of endotracheal intubation on the pulse rate (P.R) and blood pressure (B.P) during different time intervals of general anesthesia. This study was performed in Baghdad teaching and Gazzi AL-Harriri hospitals during 2019-2020. A total of fifty (50) patients were included in the study; twenty-five (25) were females and twenty-five (25) males with American society of anesthesiologist (ASA) physical status (I & II). The ages of patients ranged between (16-60) years. All patients were administrated (I.V.) Dexamethasone (0.11 mg/kg), Metoclopramide (0.14mg/kg), Ranitidine (0.71mg/kg) & Ketamine (0.5 mg/kg) as premedication. At the induction of anesthesia, patients were administrated (2-3 mg/kg) Propofol as a hypnotic drug and succinylcholine 1 mg/kg as a muscle relaxant. The results revealed a significant increase ($p \leq 0.05$) in systolic/ diastolic blood pressure (B.p) at- intubation (135.58 ± 10.29 / 91.74 ± 10.91) and also at 1 minute (132.34 ± 10.08 / 88.58 ± 13.06). There was also a significant increase ($p \leq 0.05$) in pulse rate (P.R) at-intubation (103.00 ± 18.59).

Keywords: Blood Pressure; Endotracheal Intubation; Hemodynamic Status; Pulse Rate.

1. Introduction

The lower pharynx, larynx, and epiglottis have many sensory receptors that are responsive to mechanical, chemical & thermal stimuli. The mechanoreceptors are located in large amounts, particularly in lower pharyngeal walls, vocal cord, and epiglottis. When the mechanoreceptors are stimulated, reflex motor responses such as hiccup, cough as well as reflex sympathetic stimulations and cardiovascular press or responses can be produced [1].

During emergency conditions, the major indications for tracheal intubations include inadequate ventilation or oxygenation, acute respiratory failures, and airway protection in patients with depressed mental conditions. During perioperative settings, endotracheal tubes can be put in different clinical conditions such as patients who receive general anesthesia, surgery involving or close to the airways, unconscious patients who need airway protection, or surgery involving unusual positionings [2]. Less frequently, intubations are done for short-term hyperventilations for managing high intracranial pressures or managing copious bleedings or secretions from the airways [3].

Patients with high-risk groups such as cerebral aneurysms or coronary artery diseases may be administered further pharmacological treatments for providing hemodynamic stability. Various methods, agents, and equipment can be used. It is necessary to insert an endotracheal tube inside the trachea. An anesthetic agent is not required for patients below GCS 4 and with cardiac arrests [4].

The homeostatic mechanism controls the circulatory system, for example, the control system controls the hydraulic circuits and the hemodynamic responses adjust and monitor the body conditions and environment. Therefore, hemodynamics explains the physical rules which govern blood flow in a blood vessel [5]. Echocardiography can evaluate the hemodynamic state and provides higher diagnosis levels than the conventional pressure and flow-based monitoring so that hypotensions alert the practitioners about the presence of hemodynamic abnormalities but it provides no adequate information for identification of the reason behind the hemodynamic states [6].

Nomenclature & Symbols			
P.R	Pulse Rate	B.p	Blood Pressure
ASA	American Society of Anesthesiologist	I.V.	Intravenous
ECG	Electrocardiography	b.p.m or (b/m)	Beat Per Minute
ETT	Endotracheal Tube	mm Hg	Millimeters of Mercury
LMA	Laryngeal mask	H.R	Heart Rate
SBP	Systolic Blood Pressure	DBP	Diastolic Blood Pressure
MAP	Mean Arterial Pressure	N.S	Non-Significant

Heart rate is defined as the heartbeat speed calculated from the heart's contraction (beat) number per minute (b/m). The heart rate may differ by the body's physical requirements, such as absorption of oxygen requirement and carbon dioxide excretion. It often equals or is close to the pulse calculated at any peripheral point. Activities that may induce changes are physical exercises, anxieties, sleep, stresses, illnesses, and drug ingestions [7]. The American heart association reported that (60–100) b.p.m is the normal resting adult human heart rate [8].

The circulatory blood pressure is mainly because of the heart's pumping action [9]. The heart's pumping action generates pulsatile blood flow, which conducts in the arteries, across the microcirculation, and finally, back through the veins to the heart. Within each heartbeat, systemic arterial blood pressures vary between the minimum (diastolic) and maximum (systolic) pressures [10]. Several factors may influence blood pressures including stress, hormone, sitting, standing, exercise and eating, so that the size of blood vessels regulates the blood flow, from the actions of gastric muscles, of one-way valves, and the fluid pressures of the blood [11].

Endotracheal intubation is an important invention in general anesthesia or respiratory failure, but the resulting hemodynamic responses and complications can lead to severe complications for the patients [12]. Among other factors, the force exerted by the laryngoscope during endotracheal intubations and the irritations caused on the tube's entrance into the trachea, the cuff's expansion and pressure on the ring cartilages may cause stimulation of the autonomic nervous systems, leading to hemodynamic alterations to the patients, and may also result in cerebral bleedings or aneurysm ruptures to cerebrovascular disease patients [13].

The tracheal intubation and reflex circulatory response to direct laryngoscopy were also explained, and it was observed that tracheal intubations and laryngoscopy in anesthetized patients resulted in tachycardia despite the systemic arterial pressure elevation [14]. It was then found that laryngotracheal stimulation can result in sympathoadrenal stimulations, and can lead to a sudden blood pressure elevation causing left ventricular failures, cerebral bleeding, and myocardial ischemia [15].

In patients with normal blood pressure, laryngoscopy with insertion of the endotracheal tube is directly followed by an average mean arterial pressure rise of 25 mm Hg [16].

2. Patients and Methods

The current study was performed in Baghdad teaching hospital, and Gazzi AL-Harriri hospital during the year 2019-2020. All patients submitted to the American Society of Anaesthesiologists (ASA) stage (I and II), undergoing elective surgeries. The study recruited fifty (50) adult patients, twenty-five (25) females, and twenty-five (25) males, with their ages ranging from (16 to 60) years.

Heart rate readings and initial blood pressures were recorded by using Non- an invasive blood pressure cuff, pulse oximeter probe, and ECG. Then, the patients were premeditated with the injection of Midazolam (0.05mgs/kg) for 3 min. before induction.

Pre-oxygenations were performed during the 3 min. then, anesthesia was induced using I.V. Propofol (2-3 mg/kg). To the ETT group, succinylcholine (1mg/kg) was injected to facilitate muscle relaxation for intubations.

Halothane and oxygen were used to maintain anesthesia. The intubation/insertion is defined as the time of the starting of a laryngoscopy. Surgery or any other procedure did not begin until the completion of the study (for 10 minutes following intubation/insertion).

In this study, instruments used were a non-invasive BP machine for measuring blood pressure, pulse oximeter probe, and ECG electrode to measure oxygen saturation and ECG respectively. In addition, the endotracheal tube with laryngoscope for the ETT group. I.V. cannula, drugs like propofol, midazolam, suxamethonium, isoflurane, and oxygen to induce and maintain anesthesia. For delivery of anesthesia, Drager Fabius anesthetic machine was applied. Stopwatches were utilized for the timing of the insertion length of LMA or intubations. The Drager infinity gamma XL monitor was used for monitoring heart rate (HR), SBP systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) of the patients.

The non-invasive diastolic, systolic & mean arterial pressure pre-induction, post-induction, were performed immediately following laryngoscopy with intubations 1, 5, and 10 minutes after intubation. Datasheets also included insertion time information as well as any complication that occurred.

Statistical analysis: The study used a T-test for statistical analysis of data.

3. Results

Higher hemodynamic changes were found when performing laryngoscopy and endotracheal intubation together than when just lifting by laryngoscopy, which was reported to be due to the higher irritation effects on the respiratory system by the tube than irritation by the laryngoscopy [17].

Table (1) demonstrated that the blood pressure status of studied patients was different under the different periods of endotracheal intubation starting from pre-induction, at-induction, at-1, after-3, after -5 mint. and after-10 mint. of endotracheal intubation which was indicated by mean and Std. deviation ratio of systolic/ diastolic blood pressure (mm/Hg), when compared with normal BP status (Elevated blood pressure, high blood pressure, high blood pressure, elevated blood pressure, normal blood pressure, and normal blood pressure respectively).

Table 1 Mean distribution of systolic and diastolic blood pressure of the study patients

Period of intubation/ Patient No.=50	Systolic/ diastolic (mm/Hg)	Minimum	Maximum	Mean ± Std. Deviation
Pre-induction	systolic	101.00	139.00	124.98 ± 8.66
	diastolic	68.00	114.00	84.28 ± 9.57
At- intubation	systolic	92.00	153.00	135.58± 10.29
	diastolic	57.00	114.00	91.74± 10.91
At-1min.	systolic	92.00	152.00	132.34± 10.08
	diastolic	54.00	122.00	88.58 ± 13.06
At-3min.	Systolic	91.00	149.00	123.24± 10.93
	Diastolic	55.00	111.00	84.06± 11.30
At-5min.	Systolic	81.00	137.00	119.20±10.44
	Diastolic	52.00	107.00	81.86 ± 12.42
At-10min.	Systolic	100.00	141.00	120.86 ± 9.57
	Diastolic	60.00	107.00	80.80 ± 11.47

Table (2) demonstrated that the heart rate status of most studied patients was of normal reading under different periods of endotracheal intubation starting from pre-induction, at-induction, at 1 min and after-3, 5 and 10 mint. of endotracheal intubation which is indicated by values mean, and Std. deviation of pulse rate /min when compared with normal levels. Only the patients' group at endotracheal intubation showed tachycardia status (103±18.59120).

Table 2 Distribution of mean pulse rate of study patients

Patients status	Pulse Rate (PR/minute)		
Patient N.=50	Minimum	Maximum	Mean ± Std. Deviation
Pre-induction PR	68.00	127.00	94.62 ±13.15
At-intubation	11.00	134.00	103.00 ± 18.59
At-1 min. PR	70.00	120.00	100.84 ± 9.53
At-3 min. PR	71.00	118.00	95.04 ± 10.59
At -5 min. PR	71.00	125.00	93.82 ± 10.75
At-10 min. PR	67.00	114.00	92.08 ± 9.72

Results are shown in table (3) revealed that the correlation age with systolic readings has moderate negative correlation before induction of endotracheal intubation (r = -.048, P=0.74), but this correlation was declined at the time of endotracheal intubation (r= -.128, P=0.37). Also, the results showed that this correlation was declined to a weak negative correlation at (10 min.) of endotracheal intubation (r= .021, P= 0.88), which indicated that the reading of systolic value reached normal rage after (10 min.) of intubation during the time of operation. Statistically this correlation was non-significant (p = 0.88).

Table 3 Correlation between age with systolic reading at different times of endotracheal intubation

Types of induction Patient N=50	Pearson Correlation (r)	p. value
Pre-induction systolic	-.048	0.74 (N.S)
At-induction systolic	-.128	0.37 (N.S)
At-1min. systolic	-.182	0.20 (N.S)
At-3min. systolic	-.170	0.23 (N.S)
At-5min. systolic	-.288	0.04 (N.S)
At-10min. systolic	.021	0.88 (N.S)

*The correlation is significant at 0.05 level (2-tailed)

In table (4), it was revealed that the correlation age with diastolic reading has a weak positive correlation before induction of endotracheal intubation (r=.163, P= 0.128), while this correlation was moderately positively increased (r=0.51, P=0.36) at a time on endotracheal intubation which indicated that the reading of diastolic was increased at this time, but this correlation was declined to weak positive correlation at (1 mint) of endotracheal intubation till (10 mint) on induction showing that the reading of diastolic was decreased (r=0.218, P=0.64). Statistically this correlation was non-significant (p = 0.06).

Table 4 Correlation between age and systolic reading at a different time of endotracheal intubation

Types of induction Patient N=50	Pearson Correlation (r)	p. value
Pre-induction diastolic	.163	0.12 (N.S)
At-induction diastolic	.051	0.36 (N.S)
At-1min. diastolic	.023	0.43 (N.S)
At-3min. diastolic	.066	0.32 (N.S)
At-5min. diastolic	.010	0.47 (N.S)
At-10min. diastolic	.218	0.06 (N.S)

* The correlation is significant at 0.05 level (2-tailed).

Table (5) the results revealed that the correlation of age with pulse rate has a strong positive significant correlation before induction of endotracheal intubation (r=.054, P=0. 354), which indicated that the heart rate value was increased at this time. But this correlation was weakly negatively correlated at the time of intubation (r=-0.176-, P=0.111), which was referred to decrease in the heart rate value of studied patients at the time of intubation under different operation surgery. Also, this table showed that this correlation was moderately negative significant correlation at the time (5 min) of intubation and (10 min) of intubation during the time of operation surgery (r=-0.451, -0.451, P=0.001, P=0.001 respectively) with a significant correlation which indicated that the pulse rate value was decreased at these times of endotracheal intubation.

Table 5 Correlation of age with pulse rate readings at different time intervals of endotracheal intubation

Types of induction	Pearson Correlation(r)	p. value
Pre-induction PR	.054	0.354 (N.S)
At-induction PR	-.176	0.111 (N.S)
At-1mint PR	-.403**	0.002 (S)
At-3mint PR	-.383**	0.003 (S)
At-5mint PR	-.451**	0.001 (S)
At-10mint PR	-.451**	0.001 (S)

* The correlation is significant at 0.05 level (2-tailed).

4. Discussion

Further pressures by the laryngoscope are implemented in endotracheal intubations in difficult airways, and hemodynamic change because of laryngoscopy could be more observable in difficult airways [18]. Larger hemodynamic changes were found on performing laryngoscopy and endotracheal intubation together than when the application of just lifting with the laryngoscopy, and it was shown that this was attributed to the high impact of irritations on the respiratory system by the tube than irritations by laryngoscopy [19].

Our findings disagreed with the findings of Syed Altaf Bukhari et. al, (2003) who investigated intraocular pressure and pressor response changes after laryngeal mask airway insertion and endotracheal tube, and they detected significant rises in diastolic and systolic blood pressures, heart rates in addition to in intraocular pressures in endotracheal tube group in comparison with the laryngeal mask airway group [20].

On the other hand, our results agreed with Akhondzadeh, R. et. al, (2018) They found that heart rate and systolic and diastolic blood pressure increased significantly in all groups immediately before inserting ETT or LMA [21].

In general anesthesia, L-I causes noxious stimulations which lead to significant MAP and HR elevations. This is a result of sympathetic stimulations with increased circulating catecholamine concentrations [22]. Though a variety of anesthetic techniques and drugs are available to control the hemodynamic response to endotracheal intubation [23]. For the prevention of sympathetic stimulations, an appropriate sympatholytic agent is essential. Different pharmacological agents such as opioid (fentanyl), adrenergic blocking agent (esmolol), vasodilating agent (sodium nitroprusside), or local anesthetic drugs (IV lidocaine) were examined for attenuation of such hemodynamic impacts, however, none of these agents can attenuate such responses [24,25].

Yperglycemia is a distinguishing feature of diabetes, defined as an elevated blood glucose level caused by the body's inability to correctly use or produce the hormone insulin. Glucose is obtained from the foods that consume. Fruit, milk, potatoes, bread, and rice are the most common sources of glucose in a normal diet. Carbohydrates are broken down into glucose by the liver, which is then transformed into the small intestine, then transported to the cells by the bloodstream.

Our findings may align with those of Öner et al., who stated that the level of the blood group type AB was highly significant in type 1 diabetes mellitus, but that blood type A was highly significant in type 2diabetes mellitus [14]. In contrast to the findings of this study, Meo et al. claim that blood group type (B) is related with a high occurrence of type 2 diabetes mellitus and, blood group type O is associated with a low incidence of type 2 diabetes mellitus. Both diabetic and non-diabetic populations have almost identical distributions of blood group-types A and AB [4]. People with blood type O, on the other hand, have the lowest risk of type 2 DM, while those with blood type B have the highest risk, preceded by type AB and type A; nevertheless, the risk for type AB persons was not statistically significant [15, 16]. According to a major study conducted in Bangladesh, there is no connection between ABO blood types and type 2 diabetes mellitus. Type 2 diabetes mellitus risk is also lower in blood types A and O, according to a Malaysian study (Kamil et al. 2010). Other studies revealed mixed results: an analysis in Yemen found that blood type A had the highest subjective blood sugar levels, whereas blood type AB had a protective effect [17, 18].

Since one's kidneys do not effectively remove uric acid, will develop a high uric acid level. Rich diets, being overweight, developing diabetes, consuming some diuretics, and consuming too much alcohol are all these possible causes that may slow down the removal of uric acid. A diet rich in purine-containing foods or the body releasing too much uric acid is another two less common reasons.

Our results showed the possibility that blood group type AB is the most affected one by diseases, the incidence of hyperglycemia, and hyperuricemia. And no significant differences in age groups, which contrast with Gillum who revealed that age-adjusted serum uric acid, differed significantly among blood groups in white males. Serum uric acid was significantly lower in group AB than in group O. Examination of age-specific data revealed lower serum uric acid levels in group AB at ages 12 through 16 but not at age 17 when group AB had the highest level of serum uric acid. The overall difference in white males was no longer significant after controlling for weight and age although the AB versus O contrast remained significant. Among black males, there was non-significant difference among blood groups and non-significant interaction with age. Age-adjusted serum uric acid did not differ significantly among blood groups in either white or black females [19].

5. Conclusion

The study concludes that endotracheal intubation causes an elevated blood pressure level in most time intervals specifically after intubation. Also, a significantly increased pulse rate resulted in most time intervals, especially at intubation intervals.

6. Recommendation

The current study recommends to use of premedication for reducing the risk of hemodynamic instability, or anxiolytics, injection pre-induction drugs to prevent induction and post-induction blood pressure elevations as well as pulse rate inducing, and the technique should be combined with fluid preloading for optimal effect, also using other anesthetic drugs at induction period like Propofol to counteract the increment in the heart rate.

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