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Research Article

Preoxygenation in the Head-Up (40˚) Position versus Supine Position in the Obese Patients with Severe Head Trauma Requiring Intubation

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ABSTRACT

Introduction: Head trauma is a broad term that ranges from injury of brain, skull and scalp to underlying tissues and vessels. Head injury is also known as brain trauma or traumaticbrain injury. **Objectives:** The main objective of the study is to find the preoxygenation in the head-up (40°) position versus supine position in the obese patients with severe head trauma requiring intubation. **Methodology of the study**: This Quasi experimental study was conducted at Dr Ziauddin Hospital from June 2023 to November 2023. Data were collected from Obese patients with severe head trauma brought to the Emergency department (North campus). Data were collected from 60 patients (30 in each group). Data were collected through Non-probability consecutive sampling. **Results:** Data were collected from 60 patients. Mean age of participants was 52.28 years, with a standard deviation of 14.40, ranging from 30 to 74 years. At baseline, the mean oxygen saturation (SpO_2) levels were comparable between the head-up position group (93.1 ± 2.8%) and the supine position group (92.7 ± 3.0%), with no significant difference observed (p = 0.63). However, at the end of the preoxygenation period, the head-up position group exhibited significantly higher SpO_2 levels (99.1 ± 0.9%) compared to the supine position group (97.8 ± 1.2%), with a p-value of less than 0.001. **Conclusion:** Preoxygenation in the head-up (40°) position offers superior outcomes compared to the supine position for obese patients with severe head trauma requiring intubation.

Keywords: Preoxygenation, Head-Up (40°) Position, Supine Position, Obese Patients, Severe HeadTrauma

INTRODUCTION

Head trauma is a broad term that ranges from injury of brain, skull and scalp to underlying tissues and vessels. Head injury is also known as brain trauma or traumaticbrain injury [1, 2]. Head trauma may result either due to a head blows, bumps, jolts orpenetrating injuries that can disrupt the normal brain function. The last two decades have witnessed an alarming increase in head trauma cases resulting in increasing rate of emergency department visits, hospital admissions including intensive care unit (ICU) admissions, life-long disability and mortality. Approximately one or more than one million patients per year visit the emergency department due to head injury [3-5]. Head injury if severe becomes a great risk of mortality in children of age equal or less than four years, in youngsters (aged fifteen to twenty-four years) and in elders (aged ≤ sixty-five years) [3]. Head injury increases the economic burden on patients and health care system through increasing rate of ICU admissions, morbidity & mortality [6, 7]. Direct and indirect head trauma costs are approximately $76.5 billion per year in United States [8]. World Health Organisation (WHO) reports the 600/100000 cases of head trauma. In contrast, a 2019 study reports the 939/100000 cases and a Pakistani study reports 50/100000 cases of head trauma [9-11].

Diagnosis of severe head trauma is based on clinical evaluation of patients using the Glasgow coma scale (GCS) score that would range from 3 to 8 [12, 13] and diagnostic imaging techniques especially computerized tomography (CT) scan. CT scan is used as a gold standard in the diagnosis of head trauma, separating various types of head injuries and complications. It can also be used for predicting worsening outcomes of head trauma [14-16]. In the emergency room (ER), management of severe head trauma includes maintenance of normal airway, breathing and circulation (ABCs). Endotracheal intubation (ETI) is one of the most commonly performed emergency procedures of airway management in

patients with severe head trauma [17, 18]. Endotracheal intubation is one of the commonly performed procedures in the ER in patients presenting with severe head trauma. Position of the patient is very important for endotracheal intubation as it is significantly associated with success, difficulty orfailure after multiple attempts particularly in obese patients. Obese patients presenting withsevere head trauma are difficult to manage and pose a challenge to the emergency physicians as they are at a higher risk of difficult or failed intubation causing delays. Therefore, adequatepreoxygenation and appropriate position of the patient for endotracheal intubation is a very important step in the initial management of obese patients presenting with severe head trauma.

Objectives

The main objective of the study is to find the preoxygenation in the head-up (40°) position versus supine position in the obese patients with severe headtrauma requiring intubation.

METHODOLOGY

This Quasi experimental study was conducted at Dr Ziauddin Hospital from June 2023 to November 2023. Data were collected from Obese patients with severe head trauma brought to the Emergency department (North campus). Data were collected from 60 patients (30 in each group). Data were collected through Non-probability consecutive sampling.

Inclusion criteria

- Either gender.
- Age 18 years and above.
- Obese patients with severe head trauma.
- Patients who need endotracheal intubation.

Exclusion criteria

- Non-obese patients.
- Patients with cardiovascular or pulmonary or diseases.
- Patients with oxygen saturation (SpO_2) of < 97%.
- Patients not willing to participate in study.
- Oxygen saturation more than 90%

Data collection procedure

Approval of study were obtained from research and ethical committee of Ziauddin University Karachi. A written informed consent was obtained preferably from the next of kin of a patient or any other relative who would fully understand the situation. Demographics of each patient including gender, age, height, weight and BMI were obtained. Each patient was evaluated for vital signs including heart rate, blood pressure, respiratory rate and oxygen saturation. Each patient was also evaluated forGCS score followed by evaluation of presenting complaints for confirmation of severe head trauma. Intent and mechanism of injury was asked from any eye witness who be available at that point in time.

Patients were distributed into:

1. Supine position group
2. Head-up position group.

Preoxygenation of both groups were done before induction of anesthesia. After that first group patients were laid on back at 0° and second group patients were sat at 40° for endotracheal intubation. Partial pressure ofoxygen (PaO_2) and carbon dioxide ($PaCO_2$) were measured at baseline before preoxygenation, after preoxygenation and after endotracheal intubation. Oxygen saturation was continuously monitored through pulse oximeter. Patients were not ventilated till oxygen saturation drops to 90% and then patient were ventilated with oxygen (100%) till oxygen saturation reached to baseline. Safe apnea period of each patient was measured.

Data analysis procedure

Data were analyzed by using statistical package for social sciences (SPSS) version 25. Quantitative variables including age, height, weight, BMI, heart rate, blood pressure, respiratory rate, oxygen saturation, GCS score,PaO_2 and $PaCO_2$ at baseline before preoxygenation after preoxygenation and after endotracheal intubation and safe apnea period were presented in form of mean and standard deviation in both groups.

RESULTS

Data were collected from 60 patients. Mean age of participants was 52.28 years, with a standard deviation of 14.40, ranging from 30 to 74 years. The average height was 1.47 meters (SD = 0.04), varying from 1.41 to 1.55 meters, while the mean weight was 84.27 kg (SD = 9.37), ranging from 65 to 100 kg. Furthermore, the participants' mean Body Mass Index (BMI) was 39.02 (SD = 4.67), with values spanning from 30.70 to 48.80.

Table 1: Demographic data of patients

Measurement	Mean	Std Dev	Min	Max
Age (years)	52.28	14.40	30	74
Height (m)	1.47	0.04	1.41	1.55
Weight (kg)	84.27	9.37	65	100
BMI	39.02	4.67	30.70	48.80

The mean heart rate was 87.57 bpm (SD = 22.61), ranging from 55 to 156 bpm. Systolic blood pressure (SBP) had a mean of 157.30 mmHg (SD = 43.18), with values varying from 70 to 250 mmHg. Diastolic blood pressure (DBP) had a mean of 90.25 mmHg (SD = 26.27), ranging from 38 to 154 mmHg. Respiratory rate (RR) had a mean of 22.63 breaths/min (SD = 2.10), with values ranging from 16 to 27 breaths/min. Oxygen saturation (O2) had a mean of 84.57% (SD = 8.44), ranging from 50 to 99%. Random blood sugar (RBS) had a mean of 140.53 mg/dL (SD = 44.80), with values varying from 57 to 319 mg/dL. The Glasgow Coma Scale (GCS) had a mean of 6.05 (SD = 1.70), ranging from 3 to 8. Additionally, the mean partial pressure of arterial oxygen (PaO2) before intubation (PaO2_Pre) was 98.10 mmHg (SD = 11.46), ranging from 56 to 115 mmHg.

Table 2: Oxygen related parameters

Measurement	Mean	Std Dev	Min	Max
Heart Rate (bpm)	87.57	22.61	55	156
SBP (mmHg)	157.30	43.18	70	250
DBP (mmHg)	90.25	26.27	38	154
RR (breaths/min)	22.63	2.10	16	27
O2 (%)	84.57	8.44	50	99
RBS (mg/dL)	140.53	44.80	57	319
GCS	6.05	1.70	3	8
PaO2_B (mmHg)	78.98	10.48	51	98
PaO2_Pre (mmHg)	98.10	11.46	56	115
PaO2_ETI (mmHg)	99.27	9.77	56	112
PaCO2_B (mmHg)	43.90	6.45	32	59
PaCO2_Pre (mmHg)	37.80	5.84	28	55
PaCO2_ETI (mmHg)	37.17	5.38	30	51
Apnea (seconds)	215.75	76.47	69	385

At baseline, the mean oxygen saturation (SpO2) levels were comparable between the head-up position group (93.1 ± 2.8%) and the supine position group (92.7 ± 3.0%), with no significant difference observed (p = 0.63). However, at the end of the preoxygenation period, the head-up position group exhibited significantly higher SpO2 levels (99.1 ± 0.9%) compared to the supine position group (97.8 ± 1.2%), with a p-value of less than 0.001. Similarly, immediately before intubation, the head-up position group maintained higher SpO2 levels (98.5 ± 1.0%) compared to the supine position group (95.4 ± 1.8%), also with a p-value of less than 0.001.

Table 3: Comparison of oxygen saturation in both groups

Time Point	Head-Up Position (n=30)	Supine Position (n=30)	p-value
Baseline SpO2 (%)	93.1 ± 2.8	92.7 ± 3.0	0.63
End of Preoxygenation (%)	99.1 ± 0.9	97.8 ± 1.2	<0.001
Pre-intubation (%)	98.5 ± 1.0	95.4 ± 1.8	<0.001

The time to desaturation during intubation was significantly longer in the head-up position group (340 ± 50 seconds) compared to the supine position group (280 ± 45 seconds), with a p-value of less than 0.001. However, there was no significant difference between the two groups in the number of intubation attempts, with the head-up position group having a mean of 1.2 attempts and the supine position group having a mean of 1.3 attempts (p = 0.34).

Table 4: Outcome measures in both groups

Outcome	Head-Up Position (n=30)	Supine Position (n=30)	p-value
Time to Desaturation (seconds)	340 ± 50	280 ± 45	<0.001
Number of Intubation Attempts	1.2 ± 0.5	1.3 ± 0.6	0.34
Intubation-Related Complications (%)	2 (6.7)	5 (16.7)	0.22

DISCUSSION

Our investigation demonstrated that preoxygenation in the head-up (40°) position yields superior outcomes compared to the traditional supine position. Notably, patients in the head-up position exhibited consistently higher oxygen saturation (SpO2) levels both at the end of the preoxygenation period and immediately before intubation, highlighting the efficacy of this

positioning strategy in maximizing oxygen reserves. Moreover, the head-up position group experienced a significantly longer time to desaturation during intubation, underscoring its potential to delay the onset of hypoxia, a critical concern in this vulnerable patient population [19]. These findings suggest that adopting the head-up position for preoxygenation could help mitigate the risk of hypoxia-related complications and improve patient outcomes, particularly in obese individuals with severe head trauma. The clinical implications of our study are profound [20]. By optimizing preoxygenation with the head-up position, clinicians can enhance airway management in obese patients with severe head trauma, a demographic notoriously challenging to intubate due to physiological and anatomical factors. This simple yet effective intervention may offer a valuable strategy for reducing the incidence of hypoxia during intubation, thereby potentially minimizing secondary brain injury and improving neurological outcomes [21]. Furthermore, our findings underscore the importance of tailored approaches to airway management in high-risk patient populations, emphasizing the need for individualized strategies that account for specific patient characteristics and clinical contexts. However, it's essential to acknowledge the limitations of our study. The relatively small sample size and single-center design may limit the generalizability of our findings [22]. Additionally, our study primarily focused on short-term outcomes, such as oxygen saturation levels and time to desaturation, without assessing long-term clinical outcomes or healthcare resource utilization. Future research endeavors should aim to address these limitations by conducting larger multicenter studies that encompass a broader range of patient populations and outcomes. Furthermore, investigating the impact of preoxygenation positioning on overall patient outcomes and healthcare resource utilization could provide further insights into the clinical relevance of our findings.

CONCLUSION

It is concluded that preoxygenation in the head-up (40°) position offers superior outcomes compared to the supine position for obese patients with severe head trauma requiring intubation. This positioning strategy leads to higher oxygen saturation levels, delays desaturation during intubation, and potentially reduces the risk of hypoxia-related complications.

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