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Evaluation of incidence and severity of postoperative hypoxemia in neurosurgical patients during transportation from operation theater to surgical intensive care unit in a tertiary care unit, Kashmir, India

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ABSTRACT

Background: Postoperative hypoxemia during transportation from operation theater to intensive care unit is common among neurosurgical patients. Methadology: Arterial oxygen saturation (Spo2) and arterial blood gas analysis was performed postoperatively before and after shifting a group of sixty patients with ASA I and ASA II status undergoing various elective neurosurgical procedures under general anesthesia at Sheri-Kashmir Institute of Medical Sciences Srinagar , Kashmir. Statistical analysis: The data was analyzed using SPSS version 13. The chi-square test was used for categorical variables and student's t test was used for continuous variables with normal distribution. The data was collected, compiled and statistically analyzed using analysis of variance (ANOVA). The values were expressed as mean±SD and a p value <0.05 was taken as statistically significant. Results: SpO2 before and after transporting the patients to SICU in group I was 98.90±0.45 and 86.70±3.85 respectively, whereas in group II, the SpO2 values were 98.80±0.52 and 93.95±3.99 respectively. In group III the mean SpO2 before and after transportation was 97.60±1.96 and 83.95±8.64 respectively .The difference in SpO2 in all the three groups before and after transportation was statistically significant ($p<0.05$). Conclusion: We recommend supplemental oxygen administration in all neurosurgical patients during transportation from operation theater to intensive care unit.

Key words: Postoperative hypoxemia, neurosurgical patients, Pulse oximetry ,oxygen tension

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Introduction

Postoperative hypoxia is a well-known phenomenon in neurosurgical patients due to multiple factors affecting the respiration in these patients. There are certain factors, which can be readily modified to circumvent these complications. Many complications are associated with anesthesia and surgery in the immediate postoperative period. The time taken during the transfer of the operated patient to the recovery room and to the surgical intensive care unit (SICU) is the most important period during which the patient is at the greatest risk of multiple complications. There is a high incidence of desaturation following routine surgery in previously healthy patients during transport to recovery area [1].

Studies have shown that transportation time determines the postoperative hypoxia in a given patient. In many institutions the transportation time is usually long, which may take 5-15 minutes. The usual complication during this period is hypoxemia. [2].

During transfer from operating room to the post anesthetic recovery room breathing room air, desaturation is greatest within first two minutes. [3]. There are various reasons to explain postoperative hypoxia like, right to left intrapulmonary shunting due to microatlectasis. [4]. General anesthesia (GA) is associated with 8-25% reduction in functional residual capacity (FRC [5]. Anesthetics and opiates depress the ventilatory response to CO_2 and may cause hypoxemia secondary to hypoventilation and hypercarbia in postoperative period [6].

Measurement of arterial oxygenation (SpO2) and arterial blood gas analysis (ABG) estimations can reliably detect and assess any hypoxic state. The present study was conducted to evaluate the incidence and severity of postoperative hypoxemia in neurosurgical patients during transportation from operation theatre to intensive care unit using pulse oximetry and arterial oxygen tension estimation.

Aims and objectives

To evaluate the incidence and severity of postoperative hypoxemia in neurosurgical patients during transportation from OR to intensive care unit. To find the predictive factors for development of postoperative hypoxemia in such patients.

Methadology

This prospective randomized study in neurosurgical patients during transportation form operation theater(OR) to surgical intensive care unit" was conducted in the Department of Anesthesiology and Critical Care of Sheri Kashmir Institute of Medical Sciences Srinagar ,Kashmir a tertiary care hospital facility in the north Indian state of India over a period of 3 years Sixty patients (35 males and 25 females)with ASA I and ASA II status undergoing various elective neurosurgical procedures under general anesthesia were enrolled in this study.

Exclusion criteria: Patients with pre-existing respiratory, cardiac, neuromuscular diseases and those who were hypothermic (temperature <35°c) and shivering at the end of surgery were excluded from the study.
The patients were divided into three groups according to age in years as follows:
Group I: 3-15 years
Group II: 16-49 years
Group III: 50 years and above.

All patients were clinically evaluated, assessed and investigated prior to surgery.Written informed consent was taken from all patients. All the patients were premedicated with glycopyrrolate (0.004mg/kg) one hour prior to surgery.

On arrival of the patient in the operating room (OR) an intravenous line was established and standard monitoring which included electrocardiography, heart rate,non invasive blood pressure monitoring, intra-arterial blood pressure monitoring. Arterial oxygen saturation was monitored by Pacetech pulse oximeter. Central venous pressure and Precardial Doppler Monitoring were done whenever indicated. Normothermia was ensured in every patient. At the end of the surgery residual neuromuscular block was antagonized by appropriate dosage of neostigmine and atropine. All the patients were extubated when awake and allowed to breathe 100% oxygen by facemask for three minutes. Duration of anesthesia was recorded and then the patients were shifted the operation table to the transfer trolley. Before shifting the patient to the surgical intensive care(SICU) arterial oxygen saturation (Spo2) and an arterial blood sample was taken for ABG analysis.

The transfer time to the SICU was recorded. Soon after stabilizing the patient on the SICU bed another reading of Spo2 and ABG were recorded. Patients were later allowed to breathe on oxygen through Hudson Mask with flow of 4-5l/min. Patient's hemodynamics were monitored over next 24 hours.

Statistical analysis: The data was analyzed using SPSS version 13. The Chi-square test was used for categorical variables and Student's t test was used for continuous variables with normal distribution. The data was collected, compiled and statistically analyzed using analysis of variance (ANOVA). The values were expressed as mean±SD and a p value <0.05 was taken as statistically significant.

Results

The results of the study are shown in table 1 .Duration of anesthesia in group I ranged between 78-230 minutes with a range of 160.45 ± 48.19 minutes, group II 123-330 minutes with a mean of 235.50±50.46 minutes and in group III between 175-270 minutes with a mean of 213.30±29.59. The difference between the duration of anesthesia between groups I and II was statistically significant (p<0.05) but between group II and III it was not significant (p>0.05).

Table I: SpO2 and PaO2 in the 3 groups

Age Group	SpO2	SpO2	PaO2	PaO2	Duration of anesthesia In minutes	Time of transportation	P value
	Before Surgery	After Surgery	Before Surgery	After Surgery			
Age (3-15)	98.90±0.45	86.70±3.85	138.36±16.92	79.95±15.05	160±48.19	9.15±1.39	<0.05
Age(16-49)	98.80±0.52	93.95±3.99	144.63±28.12	92.22±26.04	235.50±50.46	8.40±1.57	<0.05
Age(>50years)	97.60±1.96	83.95±8.64	129.46±22.83	70.36±17.40	213.30±29.59	9.10±1.25	<0.05

In group I , minimum and maximum transportation time ranged between 6 and 11 minutes with a mean of 9.15±1.39.In group II it ranged between 6 and 12 minutes with a mean of 8.40±1.57. In-group III minimum transportation time was 7 minutes and maximum 11 minutes with a mean of 9.10±1.25.The difference in transportation time between the three groups was statistically insignificant (p value>0.05). SpO2 (%) in groups I and II before transportation in comparison between the groups was not statistically significant (p value>0.05).

The mean SpO2 before transporting the patients to SICU in group I was 98.90±0.45 which decreased to 86.70±3.85 . In group II, the SpO2 values decreased from 98.80±0.52 to 93.95±3.99. Similarly in group III the mean SpO2 decreased from 97.60±1.96 to 83.95±8.64 respectively. The difference in SpO2 in all the three groups before an after transportation was statistically significant(p<0.05).

When comparing the mean PaO2 before and after the transportation to SICU, it was observed that group 1 had PaO2 of 138.36±16.92 and 79.95±15.05 after surgery . whereas, in group II, the PaO2 values were 144.63±28.12 before surgery and 92.22±26.04 after surgery. In transportation was it decreased to 70.36±17.40. There was a statistically significant difference in PaO2 before and after the surgery among all the three groups (p value<0.05).

Discussion

Postoperative hypoxia is an important cause of morbidity among neurosurgical patients and it is often multifactorial. It most often results from atelectasis leading to right to left intrapulmonary shunting. Besides there is a reduction in functional residual capacity (FRC), following general anesthesia, drug overdosage, residual neuromuscular blockade, airway closure, diffusion hypoxia and increased oxygen consumption lead to postoperative hypoxemia. Anesthetics and opiates depress the ventilatory response to carbon dioxide which may cause hypoxemia secondary to hypoventilation and hypercapnia [7].We conducted this prospective study among neurosurgical patients undergoing various neurosurgical procedures and observed that there is a significant difference between oxygen saturation during transportation of these patients from OR to ICU warranting a careful monitoring and supplemental oxygen therapy to circumvent any hypoxic damage .There are multiple reasons which lead to these postoperative oxygen saturation changes and studies have shown that supplemental oxygen therapy is essential .It is quite possible that residual anesthetic effect of inhalational anesthetics on hypoxic pulmonary vasoconstriction may persist and cause hypoxemia in postanaesthetic recovery room. Situations such as extremes of age, postanesthetic shivering, low cardiac output and increased transportation time may worsen the degree of hypoxemia in postsurgical patients. Gloria et al also observed that during transportation from operation theater to the recovery room , postoperative hypoxemia is common in both adult as well as pediatric patients[7].

We performed the current study among three groups and we tried to correlate any difference in pre procedure and post procedure oxygen saturation among three groups .we observed a statistically significant difference among three groups based on age of the patient. Elderly people were more prone to hypoxia compared to young as shown in table 1

In our study the transportation time was similar in all the three study groups and there were no reasons to account for hypoxia due to any prolonged shifting of patients post operatively .We observed a statistically significant difference among group 1 and group 3 patients. After shifting the patients to intensive care unit Spo2 was lower in I and the III study groups. This could be because of a lower respiratory reserve in the extremes of age(Group I included pediatric patients and Group III included elderly patients).

This difference was reflected in intra group analysis as well. Our results are consistent with Anna Dylczyk-Sommer et al.(8) Authors in their study showed a mean drop in Spo2 from 96.9±10.55% in operating room to 93±6.35 in the post anesthesia care unit (PACU). Authors were of the opinion that additional oxygen via facemask is mandatory during transportation from OR to ICU . In another study Bruns et al [9] studied incidence of hypoxemia in postoperative patients in the recovery room and observed that hypoxia was observed in 32.6% of patients prior to oxygen administration. In this study also authors concluded that there is necessity of oxygen administration during transport and in the early postoperative .

It has been uniformly agreed by all workers[9,10]. that oxygen saturation monitoring is mandatory after all surgical procedures to prevent hypoxia We observed hypoxia during transportation among children. In our study we observed that maximum arterial oxygen tension (Pao2) fall was found in older age group (Group III) followed by group I and group II. This could be due to a lower respiratory reserve in elderly patients, as their closing volume encroaches upon the tidal volume once they lie down flat especially under anesthesia [11]. Our observed results are similar to the conclusions derived by Niraj Vishnoi et al [12].These authors also reported significant fall in arterial oxygen tension in neurosurgical patients following transportation from operation theater to neuro-intensive care unit. They found that desaturation occurs in early post anesthetic period in pediatric neurosurgical patients upto 15 years of age while it occurs late in elderly patients above 50 years. Hypoxemia, leading to decreased oxygen supply to body organs, may be an amplifying or precipitating factor in postoperative morbidity parameters. It is important to ensure that patients are not taken off oxygen too soon after major surgery.

We conclude that the desaturation occurs in all the neurosurgical patients during transportation in the postoperative period, with higher incidence among extremes of age. Both pulse oximetry and arterial oxygen tension estimation are reliable methods of detection of postoperative hypoxemia. Further we recommend routine oxygen in all the neurosurgical patients during transportation from operation theater to the intensive care unit.

Limitations : 1.As we used Pulse oximetry as a measure of oxygen saturation although it is an accurate,safe and non invasive modality but several factors can alter its accuracy and may cause some harm to the patients.These factors include: Change in strength of arterial pulse, body movements, dyshaemoglobinemia, venous pulsations.Finger pulsations can be lost due hypothermia of few degrees and also by hypotension.
2.The sample size of our study is small and further studies with bigger smple size are needed to confirm our results.

Strengths: 1. Our results are comparable to all the literature available and we used the arterial oxygen tension as a measure of Hypoxemia in our study which is the most accurate and reliable modality besides the pulse oximetry.

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