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Research article

HYPOXIC STATUS AND ITS PROGNOSIS IN PATIENTS WITH HEAD INJURY

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ABSTRACT

Objectives: The study was undertaken to investigate the effect of decreased oxygenation status in a patient of head injury and its outcome in terms of prognosis of patients with regards to neurological damage. The objective was to find out a co-relation between the SpO2 levels in a patient on admission and the severity of head injury. **Methods:** Prospective observational study was carried out after the approval of Institutional ethical committee. Patient with head injury coming to the emergency department of Pravara Rural hospital were assessed for the severity using Glasgow Coma scale (GCS) and hypoxic status by using pulse oximeter with bedside monitors. The SpO2 levels were monitored at 2hrs, 4hrs, 8hrs, 24hrs and 48hrs by pulse oximeter. At the time of discharge outcome was assessed again by Glasgow Outcome Scale (GOS) and the treatment that followed it. **Results & Conclusions:** Oxygenation status of patient on admission affects the prognosis of the patient in terms of residual neurological deficit as assessed by the Glasgow Outcome scale. There is significant co-relation between the Oxygen saturation at the time of admission and the outcome at the time of discharge. Therefore the SpO2 values are significant in patients with head injury as a prognostic factor.

Keywords: Hypoxia, Glasgow Outcome Scale, Glasgow Coma scale, SpO2, pulse oximeter.

INTRODUCTION

Traumatic brain injury (TBI) is the result of an external mechanical force applied to the cranium and the intracranial contents, leading to temporary or permanent impairments, functional disability, or psychosocial maladjustment.[1,2]

TBI is the major cause of death related to injury. The risk of TBI peaks when individuals are aged 15-30 years. The risk is highest for individuals aged 15-24 years. Men are approximately twice as likely as women to sustain a TBI.[3]Among children aged 0-14 years. An estimated 475,000 TBIs occur each year.[4]

TBI is usually classified based on severity, anatomical features of the injury, and the mechanism (the causative forces).[5] Mechanism-related classification divides TBI into closed and penetrating head injury. [6] A closed (also called non-penetrating, or blunt) [7] injury occurs when the brain is not exposed[8]. A penetrating, or open, head injury occurs when an object pierces the skull and breaches the dura mater, the outermost membrane surrounding the brain[8].

Medical complications like hypotension (low blood pressure), hypoxia (low blood oxygen saturation), lower cerebral perfusion pressures and longer times spent with high intracranial pressures are associated with a bad prognosis[9,10]. Prognosis worsens with the severity of injury[11]. Most TBIs are mild and do not cause permanent or long-term disability; however, all severity levels of TBI have the potential to cause significant, long-lasting disability[12]. Permanent

disability is thought to occur in 10% of mild injuries, 66% of moderate injuries, and 100% of severe injuries[13].

The brain needs a continuous supply of oxygen to survive. About 20% of the body's oxygen intake is utilized by the brain, more than any other organ. Metabolism in the brain relies on glucose as the main energy source and oxygen is required for the metabolic process. Interruption of the oxygen supply can lead to the impairment of the functioning of the brain and can cause irreversible injury. A complete interruption of the supply of oxygen to the brain is referred to as cerebral anoxia. Partial or inadequate supply of oxygen to the brain is known as cerebral hypoxia.

SpO_2 stands for Peripheral capillary oxygen saturation. It is an estimation of the oxygen saturation level of the blood. Oxygen saturation is a term referring to the concentration of oxygen in the blood. It measures the percentage of hemoglobin binding sites in the bloodstream occupied by oxygen. The range for normal oxygen saturation in the blood is 95-100 percent.

In assessment of severity of brain injury the Glasgow Coma Scale (GCS) is the most common scoring system used whereas Glasgow Outcome Scale (GOS) is used for assessing global outcome following a brain injury.

Various studies have shown the effects of multiple factors on the prognosis of patients of severe traumatic brain injury. The prognostic outcomes were strongly correlated with GCS score, age, pupillary response and size, hypoxia, hyperthermia, and high intracranial pressure (ICP). These findings indicate that prevention of hypoxia may be useful means for improving the outcome of patients with severe head injury[14].

In view of the aforementioned use of assessment scales it was thought prudent to evaluate the traumatic brain injury patients coming to the PRH for their hypoxic status and the final outcome.

OBJECTIVES:

1. To study severity of head injury and SpO_2 levels at the time of admission.
2. To observe the outcome of head injury in the patients in relation to SpO_2 status at discharge.
3. To study the oxygen saturation level at admission and the outcome at discharge.

MATERIALS AND METHOD

Study design: This was a prospective observational study done in collaboration with Department of Surgery.

Ethics approval: The Institutional ethical committee approval was obtained before the initiation of the study, inform consent was obtained from each patient

Inclusion criteria: 1. Patients with Traumatic Brain Injury, above 18 years of age of Patients of either sex, Patients in whom assessments feasible.

Exclusion criteria: Pregnancy or breast feeding, Patients with history of cerebro-vascular accident, epilepsy, psychological illness, Patients addicted to alcohol, drugs or on any other medication, Patients receiving cardio – pulmonary resuscitation.

Study period: 6 months

Sample size: 25 patients were included according to inclusion and exclusion criteria.

Methodology: Patients satisfying the inclusion criteria were assessed till discharge. Total of 25 patients admitted in the ICU following RTA/Head Injury were monitored for SpO_2 levels at the time of admission and at the intervals of 2hrs, 4hrs, 8hrs, 24hrs, 48hrs and at discharge with regards to the vital status of the patient.

1. The severity of head injury was evaluated by Glasgow Coma Scale (GCS) at the time of admission.[15]
2. Regular follow up of the patient condition was monitored up to the discharge of the patient from hospital.
3. CNS assessment of the patient was done on discharge to assess for residual disease.
4. Vitals of patients were monitored during treatment to assess the prognosis of the patient.
5. Glasgow Outcome Scale (GOS) was used to exam the outcome of patients at the time of discharge.
6. Outcome of patients with score <5 on the GOS was considered not favorable.

Evaluation of severity of head injury:

The severity of head injury was assessed by Glasgow coma scale.[15]

Glasgow Coma Scale (GCS)						
	1	2	3	4	5	6
Eye	Does not open eyes	Opens eyes in response to painful stimuli	Opens eyes in response to voice	Opens eyes spontaneously	N/A	N/A
Verbal	Makes no sounds	Incomprehensible sounds	Utters inappropriate words	Confused, disoriented	Oriented, converses normally	N/A
Motor	Makes no movements	Extension to painful stimuli (decerebrate response)	Abnormal flexion to painful stimuli (decorticate response)	Flexion / Withdrawal to painful stimuli	Localizes painful stimuli	Obeys commands

Evaluation of outcome of the treatment with regard to residual neurological deficit:

Outcome of patients was assessed by Glasgow Outcome Scale (GOS).[16]

Glasgow Outcome Scale (GOS)	
Scale	**Description**
5 (Good outcome)	Resumption of normal life; there may be minor neurological and/or psychological deficits.
4 (Moderately disabled)	Able to work in a sheltered environment and travel by public transportation.
3 (Severely disabled)	Dependant for daily support by reason of mental or physical disability or both.
2 (Persistent vegetative state)	Unresponsiveness and speechless for weeks or months until death.
1 (Death)	Not applicable.

Statistical analysis: The data was collected, pooled, subjected to appropriate statistical analysis and conclusions were drawn.

RESULTS:

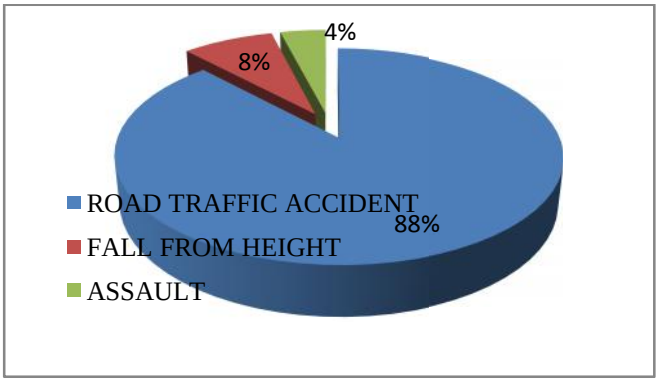

Fig 1: Distribution of patients according to the cause of head injury.

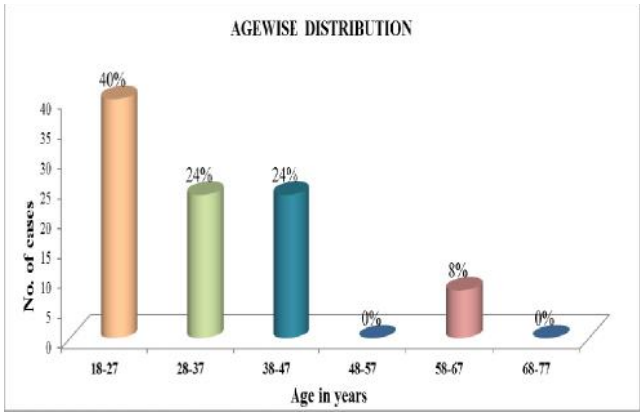

Fig 2: Age wise distribution of patients with head injury.

Table 1: Distribution of patients according to their gcs score at the time of admission.

GCS SCORE	NO. OF PATIENTS	%
3/15	0	0
4/15	0	0
5/15	0	0
6/16	1	4
7/15	2	8
8/15	1	4
9/15	1	4
10/15	0	0
11/15	1	4
12/15	0	0
13/15	4	16
14/15	4	16
15/15	11	44
Total	**25**	**100**

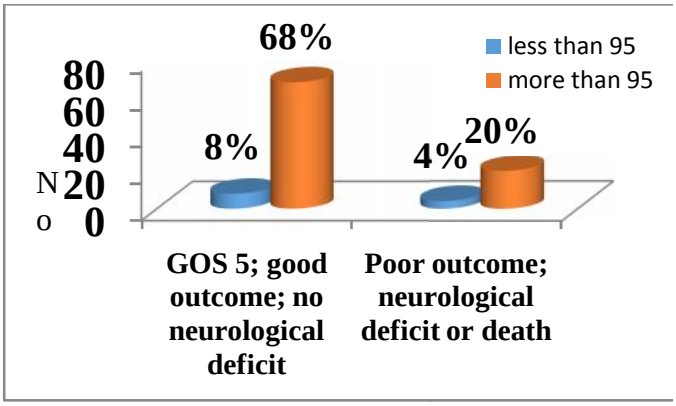

Fig 3: Distribution of patients according to their spo2 level at the time of admission.

By applying Z test of difference between two proportions there is a significant difference between proportions of SpO2 level at the time of admission less than 95 and more than 95 in GOS 5 and poor outcome (i.e. $p<0.05$).

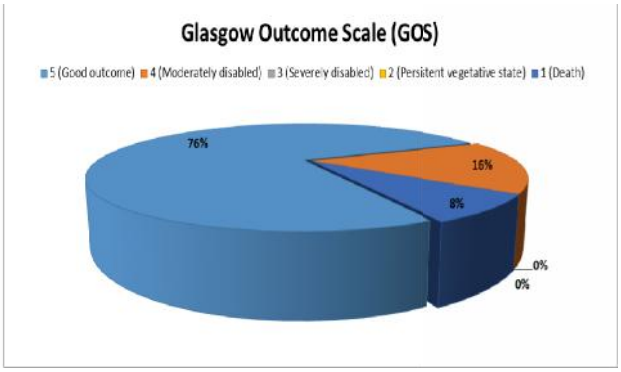

Fig 4: Distribution of patients according to their glasgow outcome scale score

DISCUSSION

This study was undertaken to investigate the effect of decreased oxygenation status in a patient of head injury and its outcome, and examines the prognosis of patients with regards to neurological damage. Maximum cause of head injury that is 88% is due to road traffic accident whereas it is 8% due to fall from height and only 4% due to assault (graph 1). The age wise distribution of patients with head injury shows about 40% of the patients belong to age group of 18-27yrs. The total of 4% patients belonged to age group of 78-87yrs. 24% patients belonged to both age groups of 28-37yrs and 38-47yrs. Total of 8% patients were in age group of 58-67yrs (graph 2). Distribution of patients according to their Glasgow coma scale (GCS) score at the time of admission shows maximum of 44% patients had GCS score of 15/15; while each 13/15 and 14/15 GCS score had 16% patients at the time of admission (table 1). Distribution of patients according to their SpO_2 level at the time of admission showed 68% patients with SpO2 level more than 95 and GOS 5 while 8% showed SpO2 level less than 95. 20% patients with poor outcome, neurological deficit or death GOS <5 had SpO2 more than 95 while 4% had less than 95. Z test applied on the observed data proved the significance of co-relation between the SpO2 levels and the prognosis (graph 3). Outcome of patients with head injury at the time of discharge evaluated by the Glasgow outcome scale (GOS) shows 76% of the patients had a good outcome with a GOS score of 5 while 16% of total were moderately disabled and needed assistance and 8% of patients died during the course of treatment even though oxygenation saturation was ensured and further hypoxia was prevented (graph 4).

This study showed that in spite of high GCS score and near normal SpO_2 levels, mortality in patients was observed. The study sample was male dominated. The results of the study are in accordance with the studies conducted previously although there are differences to the experimental design. Firstly, in this study, hypoxia was measured with pulse oximetry and was not validated with arterial blood gas analysis. Thus, it is possible that episodes of hypoxia were not detected. Secondly, the study populations were different. Here the sample population, whose median age was 40 years, was older than those from the Chestnut et al study in Traumatic Coma Data Bank with (median age, 25 years) and the average admission GCS was higher (14 Vs 3). Further investigation into the effects of hypotension and hypoxia on patients with head injury is warranted since the physiological effects of these secondary insults may be different in different population age groups. Consideration of other insults and other parameters simultaneously could be considered to have a better reliable prognosis as all such variables are not independent of each other. The study concludes that the oxygenation status of the patient at the time of admission affects the prognosis in a patient with head injury and that early oxygen support and maintenance of SpO2 levels could ensure a good prognosis in patients.

CONCLUSION

This study arrives at a conclusion that oxygenation status of patient on admission affects the prognosis of the patient in terms of residual neurological deficit as assessed by the Glasgow Outcome scale. There is significant co-relation between the Oxygen saturation at the time of admission and the outcome at the time of discharge. Therefore the SpO_2 values are significant in patients with head injury as a prognostic factor.

Limitations: Consideration of other parameters simultaneously with SpO_2 levels could be a better and more reliable prognostic factor as all such variables may not be independent of each other. O_2 levels could be monitored by ABG analysis with provide a more accurate value than oximetry and episodic hypoxia could also be noted.

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