ORIGINAL ARTICLE

Outcome of Partial Application of Non-operative Tools in Management of Severe Traumatic Brain Injury in a Developing Country

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ABSTRACT:

Objective: *To see the outcome of partial application of non-operative tools like endotracheal intubation and early enteral nutrition on mortality in severe traumatic brain injury.*

Introduction: *Severe Traumatic Brain Injury (TBI) is the leading cause of death in children and young adults*[1]*. Mainstay in management of severe head injury is based on the concept that little can be done about primary brain injury but a lot can be done to minimize secondary brain injury because its severity and duration influences the outcome. Several non operative tools can prevent this secondary brain injury and can improve outcome but from these tools only some can be applied in developing countries. These are Endotracheal Intubation, Ventilatory Support, Sedation & Paralysis, Analgesia, Normothermia, Normovolemia, Electrolyte Balance, Enteral Nutrition, Head Elevation and Mannitol.*

Material and Methods: *It was a descriptive case series conducted in Department of Neurosurgery, Jinnah Hospital Lahore from January 2015 to December 2015 with a sample size of 150 cases estimated using 95% confidence level and 8% margin of error as expected percentage of mortality was 37.4%.*[13] *The sampling technique was non-probability/consecutive. All patients of both genders presenting with severe traumatic brain injury within 48 hours were included with age ranging from 10 to 60 years. While patients with co-morbid condition, chest/ abdomen trauma and patients requiring surgical intervention for head injury were also excluded from study.*

Data Collection and Analysis: *A total of 150 patients fulfilling the inclusion criteria were recruited for study and informed consent was taken. A proforma was used for data collection. The data collected was time since injury, gender, age, initial Glasgow Coma scale. Patient outcome (mortality) in hospital was measured. Data was entered and analyzed in SPSS version 20. Mean ± standard deviation was calculated for quantitative variables like age, duration of injury. Frequency and percentage was calculated for qualitative variables i.e. outcome in terms of mortality within 4 weeks. Data was stratified for age, gender, time since injury, initial GCS to address effect modifiers. Chi square test was applied post stratification with P- value ≤ 0.05 considered as significant.*

Results: *There were total 150 patients who were enrolled in this study. The mean age of the patients was 31.66 ± 12.07. Male patients were 112(74.7%) while 38(25.3%) were female patients. Mean time of injury was 50 ± 6.64. Initial GCS score was 4 in 15 (10%), 5 in 24 (16%), 6 in 30 (20%), 7 in 36 (24%) and 8 in 45 (30%). When outcome that is mortality was evaluated, it was noted that mortality rate in patients with partial application of non operative tools was 80 (53.3%) while 70 (46.7%) survive. On stratification difference in mortality was found with respect to gender as mortality in males was 55.3% and females 63.1% and also there was difference in frequency of mortality as 62 male and 24 female. Mortality was high in patients with GCS score 4 as 73% patients died in this score while with GCS score 8 46.7% patients died. Similarly no significant difference in mortality was found with respect to ages and time of injury as p-values were 0.888 and 0.781.*

Conclusion: *It is concluded that application of non operative tools results in the decrease in frequency of mortality in patients who had traumatic brain injury.*

Outcome: *Outcome was measured in terms of mortality during 4 weeks after presentation.*

Abbreviations: *ICP: Intra Cranial Pressure. GCS: Glagow Coma Scale. CPP: Cerebral Perfusion Pressure. PEG: Percutaneous Gastrostomy. ETT: Endotracheal Intubation. TBI: Severe Traumatic Brain Injury.*

INTRODUCTION

Severe Traumatic Brain Injury (TBI) is the leading cause of death in children and young adults.[1]

In United States alone, more than 53000 individual die annually because of TBI contributing to 30.5% of all injury related deaths.[2] Severe TBI is defined as head trauma associated with Glasgow Coma Scale (GCS) 3 to 8.

Mainstay in management of severe head injury is based on the concept that little can be done about primary brain injury which is physical damage to brain parenchyma, occurring during traumatic event, resulting in shearing and compression of brain; but a lot can be done to minimize secondary brain injury because its severity and duration influences the outcome. It may include hypoxemia, hypotension, hypercapnia, hypocapnia, hypothermia, hyperthermia, hyperglycemia, hypoglycemia hyponatremia and anemia.[3]

Several non operative tools can prevent this secondary brain injury and can improve outcome but from these tools only some can be applied in developing countries. These are Endotracheal Intubation, Ventilatory Support, Sedation and Paralysis, Analgesia, Normothermia, Normovolemia, Electrolyte Balance, Enteral Nutrition, Head Elevation and Mannitol. But generally the facility of Intra Cranial Pressure (ICP) monitoring, Cerebral Perfusion Pressure (CPP) monitoring, Juglar Venous Oxygen monitoring, monitoring of Regional Blood Flow[4] is not available in developing countries.

Early Enteral Nutrition started within 48 hours post injury reduces clinical malnutrition, prevents bacterial translocation from the gastrointestinal tract and improves outcome in TBI patients sustaining hypermetabolism and hyper-catabolism[5]. Stein et al (2010) compared mortality in severe traumatic brain injury with or without endotracheal intubation and concluded that mortality rate was 17% lower in treatment group (41.5% vs. 58.5%).[6] Kurt RD et al (2008) found impact of endotracheal intubation as non operative tools on mortality in severe traumatic brain injury statistically significant (41.5% vs. 58.5%) [7]. Another study by Efstathios K et al (2013) and Karamanos E et al (2013) showed controversial results from prior studies, found that mortality was significantly higher in endotracheal intubation (ETT) group (69.1% vs. 55.2%) respectively.[8,9] A further study by Mazin Tuma et al (2014) found mortality rate was higher in early intubation group as compared to non intubation group (54% vs. 31%).[10]

Improvements in mortality and neurological outcome have been suggested, 67% for early feeding as compared to not feeding resulting in 75% for deaths and disability (Perel et al, 2008).[11] Yung-Hsiao C et al (2012) examined the effect of early enteral nutrition on mortality rate during first 7 ICU days. It significantly improved outcome among enteral nutrition group compared with non enteral nutrition group (26.9% than 92.1%). Another randomized study examined that early nutrition significantly reduces mortality (36%).[12] Helen Webb concluded that the early endotracheal intubation and nutritional support were not associated with improved outcome following severe traumatic brain injury as high mortality rate was noted in patients who received endotracheal intubation and nutritional support 37.4% respectively.[13]

There is controversy about the mortality in patients of severe head injury using or not using application of non operative tools. We can prove from this study that application of these non operative tools can improve the outcome in patients of severe traumatic brain injury so available resources should be vigorously used in developing countries and more ICUs should be organized in this pattern for effective care of severe traumatic brain injury.

Pakistan, being a developing country has limited resources and only 0.7% of GDP is currently spent on health system. Due to the limited financial support, we have to use the available tools in an organized manner to get better outcomes for the management of severe traumatic brain injury. In this study we use the available resources in an aggressive and organized manner so that in developing countries best outcome can be obtained from STBI.

It is important to begin emergency treatment within the so-called “golden hour” following the injury.

People with moderate to severe injuries are likely to receive treatment in an intensive care unit followed by a neurosurgical ward. Treatment depends on the recovery stage of the patient. In the acute stage the primary aim of the medical personnel is to stabilize the patient and focus on preventing further injury because little can be done to reverse the initial damage caused by trauma. Rehabilitation is the main treatment for the subacute and chronic stages of recovery. International clinical guidelines have been proposed with the aim of guiding decisions in TBI treatment, as defined by an authoritative examination of current evidence.

Certain facilities are equipped to handle TBI better than others; initial measures include transporting patients to an appropriate treatment center. Both during transport and in hospital the primary concerns are ensuring proper oxygen supply, maintaining adequate cerebral blood flow, and controlling raised intracranial pressure (ICP),[3] since high ICP deprives the brain of badly needed blood flow and can cause deadly brain herniation. Other methods to prevent damage include management of other injuries and prevention of seizures.

Airway management and the prevention of hypoxia is a priority. All patients should receive supplemental O_2 to maintain saturations > 90%. In the prehospital setting, intubation has been a mainstay procedure in the treatment of patients with severe TBI and GCS scores ≤ 8, both for maintenance of good oxygenation and prevention of aspiration.

Endotracheal intubation and mechanical ventilation may be used to ensure proper oxygen supply and provide a secure airway. Hypotension (low blood pressure), which has a devastating outcome in TBI, can be prevented by giving intravenous fluids to maintain a normal blood pressure. Failing to maintain blood pressure can result in inadequate blood flow to the brain. Blood pressure may be kept at an artificially high level under controlled conditions by infusion of norepinephrine or similar drugs; this helps maintain cerebral perfusion. Body temperature is carefully regulated because increased temperature raises the brain's metabolic needs, potentially depriving it of nutrients.

Surgery can be performed on mass lesions or to eliminate objects that have penetrated the brain. Mass lesions such as contusions or hematomas causing a significant mass effect (shift of intracranial structures) are considered emergencies and are removed surgically.

Numerous studies have shown a significant association between hypotension and poor outcome in patients with head injuries. Low CBFs are frequent in the early hours following head injury, and even in the absence of blood loss a brief hypotensive episode can initiate irreversible cell death mechanisms in injured neurons.

In the setting of signs of cerebral herniation, urgent measures are needed to lower ICP. These measures should include acute hyperventilation and mannitol administration. In addition, good outcomes for patients with traumatic intracerebral mass lesions correlate strongly with prompt surgical evacuation.

Mannitol Administration

The mechanisms underlying the therapeutic benefits of mannitol are not thoroughly understood. By increasing the osmotic gradient between blood and the brain, water is drawn from normal and edematous brain into the vascular compartment, leading to prompt osmotic diuresis and a reduction in ICP There is evidence to suggest that mannitol also acts through vasoconstriction in response to these changes in blood viscosity.

Hypertonic Saline

Hypertonic saline has been shown to be as effective as mannitol in treating raised ICP in patients with head trauma. Concentrations ranging from 7.5% (2 mg/Kg) to 23% (1 ampule, 30 ml) are effective. Hypertonic saline acts through osmotic, vasodilatory, hemodynamic, antiinflammatory, and neurochemical mechanisms.

Hyperventilation Therapy

Moderate hyperventilation therapy is indicated as a temporizing, life-saving intervention for the comatose patient with impending cerebral herniation.

Increased aspiration risk due to reduced consciousness and/or the need for intubation to maintain respiration frequently prevent oral nutrition in severe HT cases. Therefore, only two options are available for early enteral nutrition: gastric and jejunal.

Data Collection Procedure

A total number of 150 patients fulfilling the inclusion criteria was recruited for study. Research purpose was explained to patient and informed consent was taken. A proforma was used for data collection. Patients of severe head injury presenting in emergency were included who will have presenting GCS 8 or < 8. Detailed history, physical examination, baseline investigations like complete blood count, renal function test, liver function test and CT scan brain was done. Nutritional support consisting of about 52% carbohydrates, 31% fat, 17% protein was started within 48 hours with total of 25kcal/Kg/day to each patient. All patients were intubated using laryngoscope and mechanically ventilated. The data collected included time since injury, gender, age, initial Glasgow Coma scale. Patient outcome (mortality) in hospital was measured.

Data Analysis

Data was entered and analyzed in SPSS version 20. Mean ± standard deviation was calculated for quantitative variables like age, duration of injury. Frequency and percentage was calculated for qualitative variables i.e. outcome in terms of mortality within 4 weeks. Data was stratified for age, gender, time since injury, initial GCS to address effect modifiers. Chi square test was applied post stratification with P- value ≤ 0.05 was considered as significant.

RESULTS

There were total of 150 patients who were enrolled in this study. The mean age of the patients was 31.66 ± 12.07. Male patients were 112 (74.7%) while 38 (25.3%) were female patients. Mean time of injury was 50 ± 6.64. Initial GCS score was 4 in 15 (10%), 5 in 24 (16%), 6 in 30 (20%), 7 in 36 (24%) and 8 in 45 (30%). When outcome that is mortality was evaluated, it was noted that mortality rate in patients with partial application of non operative tools was 80 (53.3%) while 70 (46.7%) did not die. On stratification difference in mortality was found with respect to gender as mortality in males was 55.3% and females 63.1% and also there was difference in frequency of mortality as 62 male and 24 female. Mortality was high in patients with GCS score 4 as 73% patients died in this score while with GCS score 8 46.7% patients died. Similarly no significant difference in mortality was found with respect to ages and time of injury as p-values were 0.888 and 0.781.

Table 1: *Distribution According to Age (Years).*

N	150
Mean	31.6600
Std. Deviation	12.0774

Table 2: *Distribution According to Gender.*

	Frequency	Percent
Male	112	74.7
Female	38	25.3
Total	150	100.0

Table 3: *Distribution According to Time of Injury (Minutes).*

N	150
Mean	50.0400
Std. Deviation	06.6448

Table 4: *Distribution According to Initial GCS Score.*

Score	Frequency	Percent
4.00	15	10
5.00	24	16
6.00	30	20
7.00	36	24
8.00	45	30
Total	150	100.0

Table 5: *Distribution According to Outcome (Mortality).*

	Frequency	Percent
Yes	80	53.3
No	70	46.7
Total	150	100.0

Table 6: *Mortality* Gender of Patients Crosstabulation.*

		Gender of Patients		Total
		Male	Female	
Mortality	Yes	62	24	86
	No	50	14	64
Total		112	38	150

P-value = 0.401

Table 7: *GCS scale * Mortality Crosstabulation.*

			Mortality		Total
			Yes	**No**	
GCS scale	4		11	4	15
		% within GCS scale	73.3%	26.7%	100.0%
	5	Count	13	11	24
		% within GCS scale	54.2%	45.8%	100.0%
	6	Count	16	14	30
		% within GCS scale	53.3%	46.7%	100.0%
	7	Count	19	17	36
		% within GCS scale	52.8%	47.2%	100.0%
	8	Count	21	24	45
		% within GCS scale	46.7%	53.3%	100.0%
Total		Count	80	70	150
		% within GCS scale	53.3%	46.7%	100.0%

Table 8: *Mortality* Age Cat Crosstabulation.*

		Age (years)					Total
		11 – 20	**21 – 30**	**31 – 40**	**41 – 50**	**51 – 60**	
Mortality	Yes	17	35	19	8	7	86
	No	10	25	15	9	5	64
Total		27	60	34	17	12	150

P-value = 0.888

Table 9: *Mortality* Time since injury 2 Crosstabulation.*

		Time since Injury (minutes)					
		10 – 20	**21 – 30**	**31 – 40**	**41 – 50**	**> 51**	
Mortality	Yes	17	28	22	12	7	86
	No	14	19	15	9	7	64
Total		31	47	37	21	14	150

p-value = 0.781

DISCUSSION

The major goal of mechanical ventilation was avoidance of hypoxemia and hypercarbia. In addition, ventilator strategies should comprise of low tidal volume (6 – 8 ml/kg ideal body weight) with application of 5 – 10 cm H_2O of positive end expiratory pressure (PEEP). Plateau pressure should be kept below 30 cm H_2O. This low tidal volume strategy aimed to reduce secondary, ventilator induced lung injury. In cases with acute lung injury/acute respiretory distress syndrome, application of moderate PEEP can be applied[14]; however, increases in intrathoracic pressure can impair cerebral venous drainage and result in increases in ICP.

Therefore, particular attention needs to be paid when PEEP or intrathoracic pressures are increased, for the resultant effect on ICP. To avoid or minimize chest complications prop up position, early chest physiotherapy, nebulization, change of posture was frequently applied.

Prolonged ventilation is often required in severe head injury patients. There is a considerable debate about the optimal timing for tracheostomy in critically ill-patients. Much improvement in outcome has been seen in our study with early tracheostomy that is within 72 hours. It has been shown that an early tracheostomy in trauma patients in general is associated with shorter duration of mechanical ventilation and intensive care unit (ICU) length of stay without an adverse effect on ICU or hospital mortality. Early tracheostomy is advocated in patients with persistently low GCS < 5 as patient cannot localize and therefore cannot self extubate and need prolonged ventilation. We did tracheostomy of all such patients. Early tracheostomy is also indicated in chest infections, conditions requiring frequent endotracheal suctioning or signs of very slow recovery.[15,16]

Early nutritional support is recommended, aiming to meet full nutritional requirements once hemodynamic stability is achieved. Furthermore, early aggressive nutritional support enhances immunologic function by increasing CD4 cells, CD4 – CD8 ratios and T-lymphocyte responsiveness. Early enteral nutrition has also been found to be associated with better hormonal profile; therefore related to a better outcome.[17] The route of administration may differ according to the overall clinical condition of patient, but there is no difference in the outcome after severe TBI between enteral or parenteral nutrition.[18] It has been recommended that 140% of resting metabolic expenditure in non-paralyzed patients and 100% in paralyzed patients should be replaced. At least 15% of calories should be protein. Study on patients with moderate TBI showed nitrogen balance was similar with both types of therapy. In other multicenter cohort study, Enteral Nutrition (145 patients) within 48 h post-injury compared to non Enteral Nutrition (152 patients) was found to be associated with better survival, GCS recovery and outcome among TBI patients, particularly in those with a GCS score of 6 – 8.[5] We used nasogastric tube for early enteral feeding and a nutrition consisting of 52% carbohydrates, 31% fats and 17% proteins was used. Formula milk, honey, egg, soup, fruit milk shakes, olive oil, dates, was used for composition of our nutrition. Each feed was given at interval of four hours. Vitamin supplements and Prokinetics were also given. Each feed constituted of about 300 to 400 ml that also fulfilled the major portion of daily fluid requirement. Daily serum electrolytes, serum albumin on alternate day was done to monitor any adverse affect or under nutrition. Early mobilization was encouraged to increase gastric motility. Few patients who were in vegetative state needed per cutaneous gastrostomy (PEG) for long term enteral feeding. The mortality in our study was similar as was evaluated by Stein, Kurt RD and Perel who showed that mortality was lower in endotracheal intubation group and early nutrition group as they also used these non operative tools in management of severe traumatic brain injury.[6,7,11]

CONCLUSION

In a developing country the application of non operative tools reduces the mortality in patients of traumatic brain injury.

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