Original Article

ISSN (0): 2347-3398; ISSN (P): 2277-7253

Correlation Between the Serum Sodium and Serum Magnesium Levels with Morbidity and Mortality in Case of Traumatic Brain Injuries

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Abstract

Background: Traumatic brain injury (TBI) occurs when outside force traumatically injures the brain. Traumatic brain injury is a major cause of mortality and morbidity worldwide. The aim of present study is to establish the relationship between the serum levels of sodium & magnesium and prognosis of patients of head injury in terms of mortality and morbidity. **Subjects and Methods:** This study compromise of all those cases who were admitted as a case of head injury through Neurosurgery outpatient department or through causality department of S.V.B.P hospital attached to LLRM medical college, Meerut during one year. All the factors producing mortality were found. Patients were followed-up and asked to come periodically. Outcome was recorded. **Results:** Patients who are admitted with poor GCS & those having higher Serum Sodium levels (More than 160 meq/ L) in posttraumatic period have poor prognosis and longer hospital stay. Patients who are admitted with poor GCS & those having lower serum Magnesium levels (less than 1.3 meq/L) have poor prognosis and longer hospital stay. In patients who have GCS of 13-15 serum sodium level is not increased much and there prognosis is better than those patients with GCS of 3-8 or 9-12. In patients who have GCS of 13-15 serum Magnesium level is not decreased much and there prognosis is better than those patients with GCS of 3-8 or 9-12. **Conclusion:** Serum sodium and magnesium levels are good prognostic markers for morbidity and mortality in case of traumatic brain injuries.

Keywords: Sodium, magnesium, morbidity, mortality, traumatic brain injuries.

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Received: August 2018
Accepted: October 2018

Introduction

Trauma is defined as damage to the body caused by an exchange with environmental energy that is beyond the body resilience. Trauma is the leading cause of death for people from 1-45 years of age and is third most common cause of death regardless of age.[1]

Brain Trauma: Also known as traumatic brain injury (TBI) occurs when outside force traumatically injures the brain. Traumatic brain injury is a major cause of mortality and morbidity worldwide.[2-6]

The modern management of TBI in not restricted to neurosurgery but has also fallen into the domains of many other specialized branches including specialized trauma surgeons, neuroanaesthetists, neurointensivists, neuroradiologists, and is based on management of primary injury like management of shock, management of airway and circulation, care and treatment of scalp and facial injuries, accurate management of bony injures by orthopedic surgeon, evaluation of chest and abdomen for any occult injury by surgeon on duty as well as avoiding secondary injuries to brain, maintaining cerebral perfusion pressure (CPP), maintaining intracranial pressure within normal range and optimizing the cerebral milieu for recovery of injured cells and prevention of further injury.[3,9,10]

Severe TBI is associated with 30-70% mortality rate and recovery of survivors is marked by severe neurological sequels and by a very impaired quality of life.[11]

Severity of TBI is in general established using the Glasgow Coma Scale (GCS). This scale is achieved by observation of 3 parameters: Eye opening, motor response and verbal response. TBI is ranked as severe with a GCS score of 3 to 8; as moderate from 9-12 and as mild from.[4,12-15]

The GCS score has been used as one of the most important predictors of outcome of TBI but exact prognosis of patient with TBI is cannot be commented upon with GCS Score only.[13,14] To make GCS more reliable and precise other variables like age, abnormal motor response,

CT scan findings, pupillary abnormalities, have been subsequently introduced.[5,15,16]

Another limitations of GCS evaluation is that at times it is often difficult to determine the GCS of patient in emergency room either due to intubation, sedation, due to effect of some drugs or any intoxication especially alcohol intoxication.[6]

Secondly the assessment of GCS score is dependent on subject and may vary from person to person due to difference in judgment.

Glasgow Outcome Scale (GOS) is another scale that is used for assessment of functional prognosis after TBI. It has 5 levels starting from death to good positive prognosis and is obtained at,[3,6,12] months after trauma. It presents important short comings and early assessment of brain damage may be very difficult during the patients stay in ICU.

CT Scan is imaging modality of choice in management of TBI, in the emergency room with CT scan, hematomas can be rapidly diagnosed and as required early surgical treatment.[7]

Recovery after TBI is related to severity of initial damage (primary lesion) and presence of secondary injuries. An important cause of secondary injury is development of intracranial hypertension which may be due to intracranial hematoma or cerebral edema. The traditional goal of management of patients with TBI is to limit the secondary injuries by manipulation of intracranial pressure and cerebral perfusion pressure as well as avoiding age related factors like hypoxemia & hypotension.[8]

The aim of present study is to establish the relationship between the serum levels of sodium & magnesium and prognosis of patients of head injury in terms of mortality and morbidity.

Subjects and Methods

This study compromise of all those cases who were admitted as a case of head injury through Neurosurgery outpatient department or through causality department of S.V.B.P hospital attached to LLRM medical college, Meerut during the last one year (July 2011 to august 2012). These cases were shifted to well establish ISU in department of surgery, and were managed by Neurosurgery Department.

Inclusion criteria

Patients of all age groups admitted to SVBP hospital emergency and having head injury.

Exclusion criteria

Those patients who are admitted after 24 hours of sustaining head injury

Patients who were discharged on request.

Patients who were left hospital against medical advice.

Patients who were referred to higher centre.

Clinical Examination

Detailed history was taken; examination was done and compiled on the following Proforma.

History

Age, sex, residential address, dates of admission and discharge were recorded in every case. Other points noted in history were:

Mode of injury e.g. Acceleration or deceleration injury, fall from height, assault, associated injuries and any medical co morbidities like alcohol intoxication or any drug addiction

Time from injury to admission.

History of unconsciousness, vomiting, ENT bleed and seizures was recorded.

Personal history

Physical examination General Examination

Pulse

Blood pressure

Respiratory rate

Temperature

Neurological examination

1. GCS
2. Pupillary reflexes
3. Planters examination
4. Sensory and motor examination

Systemic Examination

Cardiovascular, respiratory, abdominal and skeletal systems were examined in every case especially to rule out other associated injury.

Local examination

Examination of scalp and extent of external injury noted

Glasgow coma scale

All patients were assessed on Glasgow coma scale Any other associated injuries.

Investigations

Hematological: Hemoglobin, TLC, DLC, PCV, BT, CT, RBS S.Creatinine, Blood urea.

CT-scan: In as many as possible patients of head injury admitted to emergency department, CT scan of the head with bone window was performed. From that, it was decided whether to treat patient conservatively or operatively.

Ultrasound Abdomen: It was ordered when there was suspicion of any intra-abdominal visceral injury.

X-ray spine as indicated.

MRI(if indicated)

Management

From investigations it was decided whether to treat patient conservatively or operatively.

Conservative: Patients were kept on various modalities of treatment according to the need of the patients. Importance was given to airway, breathing, circulation according to ATLS (Advanced Trauma Life Support) system of trauma management. Tracheostomy and intubation if required were done.

Fluid and electrolyte balance was done with strict intake and output charting two hourly and vitals were recorded at one hourly interval. Initially in comatose patients it was given by intravenous route, later on it was given by naso-gastric tube provided that abdominal viscera was normal and bowel was functioning.

Broad spectrum antibiotics having much more affinity to cross blood brain barrier were given to all the patients with intra-cranial injury, suspected fracture base of skull and with other associated injuries.

Dehydration therapy was given in the form of mannitol, frusemide, restriction of sodium and only required amount of intravenous fluids. Hyperthermia was controlled by cold sponging and drugs to maintain temperature at or below body temperature.

Patients having unconsciousness for more than six hours, history of convulsions, and intra-dural involvement were given anticonvulsant therapy. These were given in the form of benzodiazepines, carbamazepine, phenobarbitone, sodium valproate and phenytoin.

Surgical management: Patients requiring any neurosurgery were admitted in neurosurgery unit. Different modalities of surgical treatment were:

Compound depressed fractures required either elevation of segments or removal of multiple segments with repair of duramatar if required

Craniotomy to evacuate the Extradural, Subdural or Intracerebral hematoma and removal of foreign body inside the brain matter.

Craniotomy was done for removal of multiple segments of bone in comminuted fractures

Loss of duramatar was repaired by temporal fascia or dural patch.

Injury to the frontal sinus was treated by exteriorization of the sinus

Lacerated brain matter was removed

All the factors producing mortality were found. Patients were followed-up and asked to come periodically. Outcome was recorded according to Jennet and Bond (1975).

Death: May be due to extra or intra-cranial cause

Vegetative: Sleep wake cycles but no mental activity

Severely disabled: Dependent physically or intellectually on another person at some point of every day

Moderately disabled: Is not dependent but is handicapped that prevents full restitution to activity.

Results & Discussion

From [Table 1] it is shown that seven patients have serum sodium more than 160 meq/l and their GCS score was in the range of 3-8 and 9-12V [Table 1].

From [Table 2] it is shown that total 9 patients were operated and out of 9 patient 5 patients serum sodium was in the range of 155-160 meq/l. At 24 hrs, 4 patients had serum sodium >160 meq/L.with GCS between 13-15 and out of these 4 patients 3 patients serum sodium decreased and become <155 meq/l. and 1 patient deteorated to moderate GCS level i.e. 9-12 [Table 2].

From [Table 3] it is shown that 3 patients expired and out of 3 patients 2 patients have serum sodium above 160 meq/l and one patient have serum sodium in the range of 155-160 meq/l and for remaining patients their GCS level improving with decreasing in serum sodium level [Table 3].

From [Table 4] it is shown that maximum number of patients improved and discharged and at the time of discharge their serum sodium level was less than 155 meq/l.

From above tables (24-27) it is clearly evidenced that hypernatremia (serum Na >155meq/l) is associated with higher mortality and morbidity in TBI patients [Table 4].

From [Table 5] we find that 5 patient have serum magnesium less than 1.3 and their GCS level are in the range of 3-8 and 9-12 [Table 5].

From [Table 6] it is shown that total 9 patients were operated and out of 9 patient 5 patients serum magnesium was in the range of 1.3-1.6meq/l. and there was no expiry.

From [Table 7] it is evident that 3 patients expired and out 3 patient one patient has serum magnesium less than 1.3 meq/l and for remaining two patients it was in the range of 1.3-1.6 meq/l . other patients improved in GCS and their serum magnesium levels coming toward normal ie. >1.6 meq/l. At 24 hrs total 4 patients serum Magnesium was <1.3meq/l, out of these 4 patients 1 patients expired and for 1 patient serum magnesium level become in the range of 1.3-1.6 meq/l.

Table 1: Correlation between the different levels of serum sodium and GCS with outcome in TBI adult patient (>12yrs) (Within 24hrs of Admission n-43).

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Sodium levels in meq/I	>160	-	-	2	-	-	-	5	-	-	-	-	-
	155-160	-	-	2	-	-	-	6	-	-	-	8	-
	<155	-	-	-	-	-	-	8	-	-	-	12	-
	Total	4				19				20			

I = Improve, E = Expired

Table 2: Correlation between the different levels of serum sodium and GCS with outcome in TBI adult patient (>12yrs) (After 24 hours n-43).

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Sodium levels in meq/I	>160	-	-	2	-	-	-	4	-	-	-	4	-
	155-160	1	-	1	-	4	-	5	-	-	-	3	-
	<155	-	-	-	-	4	-	5	-	-	-	10	-
	Total	4				22				17			

I = Improve, E = Expired

Table 3: Correlation between the different levels of serum sodium and GCS with outcome in TBI adult patient (>12yrs) (After 48 hours n-43)

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Sodium levels in meq/I	>160	-	-	-	1	-	-	1	1	3	-	-	-
	155-160	-	1	1	-	-	-	5	-	-	-	5	-
	<155	-	-	-	-	2	-	4	-	-	-	19	-
	Total	3				13				27			

I = Improve, E = Expired

Table 4: Correlation between the different levels of serum sodium and GCS with outcome in TBI adult patient (>12yrs) (At the time of Discharge n-40)

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Sodium levels in meq/I	>160	-	-	-	-	-	-	-	-	-	-	-	-
	155-160	-	-	-	-	-	-	-	-	-	-	5	-
	<155	-	-	-	-	-	-	10	-	-	-	25	-
	Total					10				30			

I = Improve, E = Expired

Table 5: Correlation between the different levels of serum magnesium and GCS with outcome in TBI adult patient (>12yrs) (Within 24hrs Admission n-43)

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Magnesium levels in meq/I	<1.3	-	-	3	-	-	-	3	-	-	-	-	-
	1.3- 1.6	-	-	1	-	-	-	8	-	-	-	9	-
	>1.6	-	-	-	-	-	-	8	-	-	-	11	-
	Total	4				19				20			

I = Improve, E = Expired

Table 6: Correlation between the different levels of serum magnesium and GCS with outcome in TBI adult patient (>12yrs) (After 24 hours n-43).

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Magnesium levels in meq/I	<1.3	-	-	2	-	-	-	2	-	-	-	-	-
	1.3- 1.6	1	-	1	-	4	-	5	-	-	-	4	-
	>1.6	-	-	-	-	4	-	7	-	-	-	13	-
	Total	4				22				17			

I = Improve, E = Expired

Table 7: Correlation between the different levels of serum magnesium and GCS with outcome in TBI adult patient (>12yrs) (After 48 hours n-43)

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Magnesium levels in meq/I	<1.3	-	1	-	-	-	-	-	-	1	-	-	-
	1.3- 1.6	-	-	1	1	-	-	5	-	-	-	6	-
	>1.6	-	-	-	-	-	-	8	-	-	-	20	-
	Total	3				13				27			

I = Improve, E = Expired

At the time of discharge nearly all patients have serum magnesium above 1.6 meq/l with GCS 13-15. So from above tables 19 and 24-31 it is clearly found that hypernatremia and hypomagnesaemia is associated with higher mortality and poor outcome in adult patients [Table 8].

Serum sodium and serum magnesium levels are also found to be superior to other triage tools like base deficit; SIRS Score, t-RTS in predicting outcome and prognosis of trauma patients.[8,15,16]

Table 8: Correlation between the different levels of serum magnesium and GCS with outcome in TBI adult patient (>12yrs) (At the time of Discharge n = 40).

		GCS Score											
		3-8				9-12				13-15			
		operative		conservative		operative		conservative		operative		conservative	
		I	E	I	E	I	E	I	E	I	E	I	E
Magnesium levels in meq/I	<1.3	-	-	-	-	-	-	-	-	-	-	-	-
	1.3- 1.6	-	-	-	-	-	-	-	-	-	-	4	-
	>1.6	-	-	-	-	-	-	10	-	-	-	26	-
	Total					10				30			

I = Improve, E = Expired

Conclusion

The present study was conducted in department of Neurosurgery of SVBP Hospital, Meerut during July 2010 to August 2011.

- Patients who are admitted with poor GCS & those having higher Serum Sodium levels (More than 160 meq/ L) in posttraumatic period have poor prognosis and longer hospital stay.
- Patients who are admitted with poor GCS & those having lower serum Magnesium levels (less than 1.3 meq/L) have poor prognosis and longer hospital stay.
- In patients who have GCS of 13-15 serum sodium level is not increased much and there prognosis is better than those patients with GCS of 3-8 or 9-12.
- In patients who have GCS of 13-15 serum Magnesium level is not decreased much and there prognosis is better than those patients with GCS of 3-8 or 9-1.

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How to cite this article: Mittal R, Mumtaz F, Faisal S, Gupta S. Correlation Between the Serum Sodium and Serum Magnesium Levels with Morbidity and Mortality in Case of Traumatic Brain Injuries. Asian J. Med. Res. 2018;7(3):SG08-SG12.
DOI: dx.doi.org/10.21276/ajmr.2018.7.3.SG3

Source of Support: Nil, **Conflict of Interest:** None declared.