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Assessment of Serum Level of Copper, Magnesium, Zinc and Chromium and Its Association with Severity of Head Injury in Trauma Patients

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Abstract
Introduction: *Head injury is a recognized as a major public health problem that is a frequent cause of death and disability in young people and makes considerable demands on health services. Alteration of the trace elements such as Zinc and copper has great importance in head injury patients.*
Objective: *To Study the serum level of Copper, Magnesium, Zinc and Chromium in trauma patients and its association between these trace elements and severity of head injury in terms of GCS.*
Methods: *Special designed performa was used to collect data of Trauma patients. The data were expressed in percentage.*
Results: *The Total of 34 head injury patients were enrolled in the study. Majority of patients (41.2%) in present Study were aged between 21-30 years. Majority of patients (67.6%) were males. Majority of patients were skilled/unskilled labour (41.2%) followed by 29.4% were in service/shopkeeper, 26.6% students and 8.8% were housewives.Majority of Patients were from rural (76.5%) areas followed by 23.5% were from rural areas. Road traffic accident was the most common mode of injury. There were 50% patents who reported between 5-6 hrs followed by 23.5% reported between 7 -8 hrs. None of the patients enrolled in the study reported after 8 hrs of injury. 8.8% patients had the assault as the mode of injury.Mean copper levels were 0.029 mg/dlamong patients with severe category of head injury while mean copper level among patients with moderate GCS score were 0.061mg/dl, thus showing difference between two to be statistical significant (P<0.001). The other trace elements like Zinc, Magnesium and Chromium does not showed statically significant among different severity categories of trauma, however mean Cu and Zn levels were found to be significantly higher among those with moderate group as compared to severe group.*
Conclusion: *Mean copper and magnesium levels among patients of head injury at the time of enrolment were lower than the normal range for healthy subjects. Mean copper and zinc levels were found to be significantly higher among patients with moderate GCS score as compared to those with severe GCS scores.*
Kewwords: *Head injury, Trauma Patients, GCS Score, Copper, zinc, Magnesium, Chromium*

I. Introduction

The American trauma Society defines trauma as an injury caused by a physical force. More often, trauma is the consequences of motor vehicle crashes, falls, drowning, gunshots, fires and burns, stabbings or blunt assaults. The traumatic event is an event which threatens injury, death or the physical body of a person while also causing shock, terror or helplessness. Trauma refers to both the experience of being harmed by an external agents as well as the response to that experience[1].

Head injury is a recognized as a major public health problem that is a frequent cause of death and disability in young people and makes considerable demands on health services. Epidemiological data are required to initiate appropriate preventive measures and to plan necessary services. However, reliable statistics are difficult to extract from routinely collected data. International Statistics for accidental death and road accidents deaths do not identify head injuries, but they do indicate difference in accident rates between countries and over time. For example, road traffic accident (RTA) death are more than twice as frequent in France, Australia and the USA as in the UK or the Netherlands, but in developed countries they are steadily decreasing each year[2]. Traumatic head injury often end up in traumatic brain injuries which are associated with an alteration in brain function which are manifested as confusion, alerted level of consciousness, seizure, coma or focal or sensory or motor neurological deficit resulting from blunt or penetrating force to the head. Traumatic brain injury (TBI) constitutes a major health and socioeconomic problem throughout the world. It is the Leading cause of mortality and disability among young individual in high- income countries and globally, the incidence of TBI is rising sharply, mainly due to increasing motor vehicle use in low-income and middle income countries. WHO has projected that, by 2020, traffic accidents will be the third greatest cause of the global burden of disease and injury. In higher income countries, traffic safety laws and preventive measures have reduced the incidence of

TBI due to traffic accidents, whereas the incidence of TBI caused by falls is increasing population ages, leading to a rise in the median age of TBI populations which ranges from 25 yrs to 48 yrs[3].

Four elements (Oxygen, Carbon, Hydrogen and nitrogen) account for 96% of living matter. About 50 of the known elements occur in measurable concentration in the living system. In humans and other mammals, 23 elements have known physiological activities. From these elements, 11 can be classified as trace elements (TE) because of their essentiality and very limited quantity in humans. Out of these 11 trace elements, eight are in the period 4 of the periodic table, suggesting an optimal relationship of nuclei size/electron availability of the elements in this period to interact with organic molecules present in biological system[4].

The mineral copper, zinc, iron, magnesium and chromium are directly involved in maintaining and regulating many of physiological process, especially those involved in normal carbohydrate, fat and protein metabolism and the ultimate formation of usable energy[5]. Trauma or severe injury leads to increased level of plasma catecholamine, cortisol, growth hormone and glucagon and inhibition of insulin secretion. The acute response to injury and infection is manifested as altered serum mineral levels (Zinc, Iron, Copper)[6] . Alteration of the trace elements such as Zinc and copper have been studied in head injury patients[7,8]. Many trace elements act as antioxidant or help such function that not only regulate immune response of the host, but also may alter the genome of the viruses[9]. Isolated head injury constitutes an homogenous model to study the impact of trauma in relation to trace elements because it is not lost from the body unlike other organs which might result in amputation. With this background, the present study was carried out to assess the serum level and a relationship trace element in head injury evaluates association with severity with trauma patients.

Objective:

- To Study the serum level of Copper, Magnesium, Zinc and Chromium in trauma patients
- To find out an association between these trace elements (cu, Mg, Zn and Cr) levels and severity of head injury in terms of GCS.

II. Material And Methods

Necessary approval from the Institutional Ethics Committee was obtained before initiating the study.

i. **Study site :** The Study conducted at the departments of Surgery, King George's Medical University, Lucknow.

ii. **Study design :** Prospective Cohort study

iii. **Sample size:** Total 34 patients were recruited for the study

iv. **Patient selection**

- **Inclusion criteria:**
  - Isolated Head Injury patients managed conservatively
  - BMI between 18.5 to 23.5 (Normal)
  - Injury within eight hours of admission

- **Exclusion criteria**:
  - Presence of Co-morbid disease like Diabetes, Hypertension, cardiovascular disease. Liver disorders
  - Alcoholics
  - Workers exposed to metal industry

Study Methods: All the patients fulfilling the inclusion criteria were enrolled in the study. At the time of admission, after noting down the detail related with age, gender, occupation, place of living, mode of injury, time gap between injury and admission to hospital were noted. Severity of injury was measured in terms of scores on Glasgow coma scale. Blood sample were collected and subjected to biochemical assessment for trace elements. Estimation of trace elements was done using atomic absorption spectrophotometer model Perkin Elmer analyst 600.

III. Results

The Present study was carried out to study serum level of trace elements (Copper, magnesium, zinc and Chromium) levels.

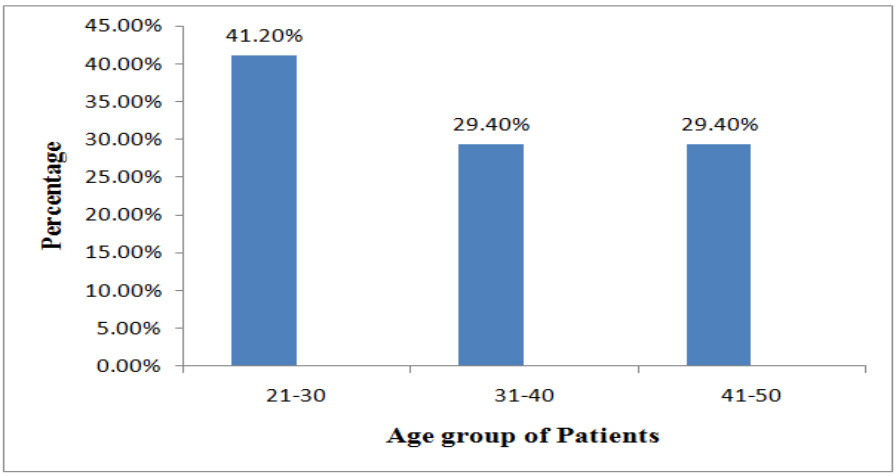

Fig 1 shows: Age wise distribution of Patients

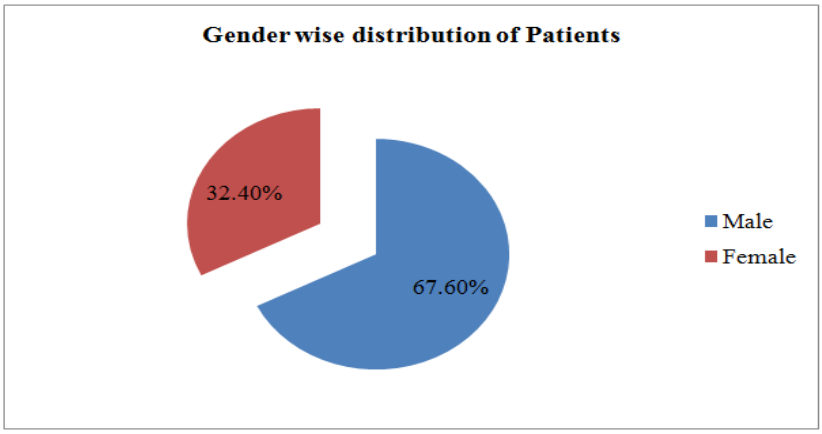

Fig 2 shows: Gender wise distribution of Patients

For this purpose, a total of 34 head injury patients were enrolled in the study. Majority of patients (41.2%) in present Study were aged between 21-30 years. Majority of patients (67.6%) were males. There were only 4 females. Male to female ratio of the study subjects was 5.75:1.

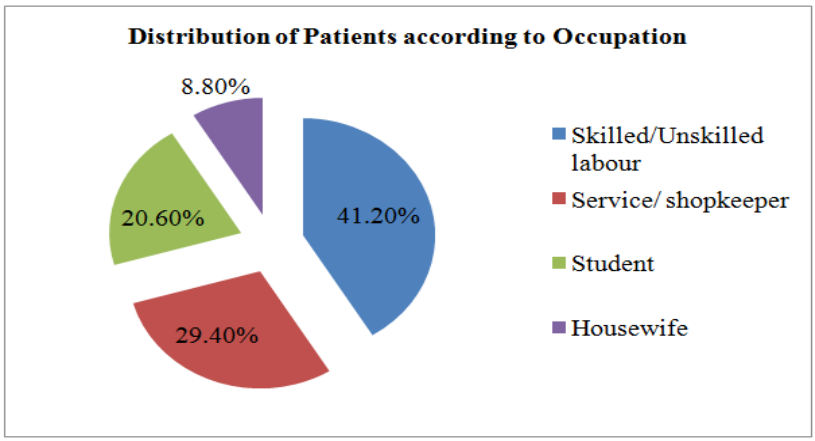

Fig 3 Shows: Distribution of Patients according to their Occupation

Patients were divided into four broad occupation categories skilled/unskilled labour (including labour, farmer, driver, Painter and tailor), service/shopkeeper, student and housewife. Majority of patients were skilled/unskilled labour (41.2%) followed by 29.4% were in service/shopkeeper, 26.6% students and 8.8% were housewives.

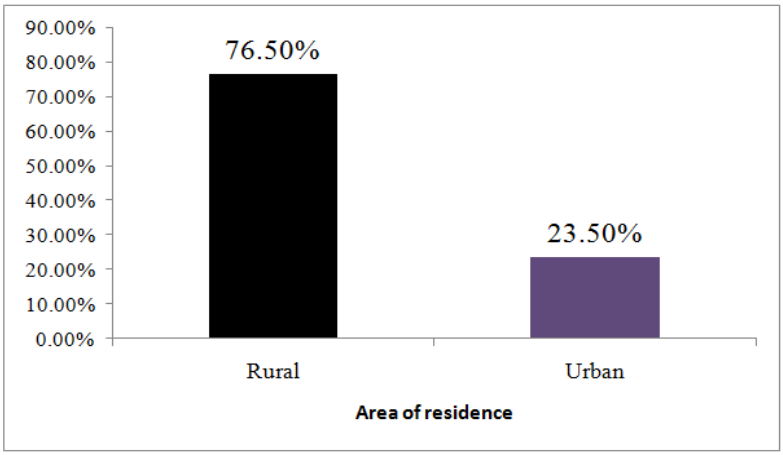

Fig 4 shows: Distribution of Patients according to area of Residence

Majority of Patients were from rural (76.5%) areas followed by 23.5% were from rural areas. Prevalance of rural over urban patients was 4.4 times.

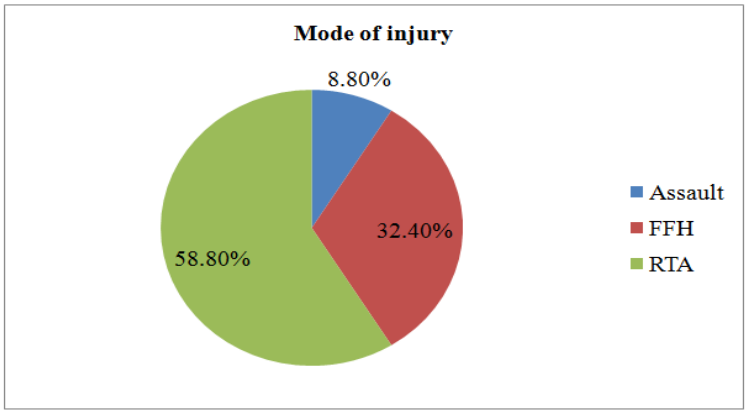

Fig 5 Shows: Distribution of Patients according to mode of injury

Road traffic accident was the most common mode of injury. A total of 58.8% patients had road traffic injury to be the most common mode of injury. There were 32.4% cases with fall from height as the mode of injury. 8.8% patients had the assault as the mode of injury.

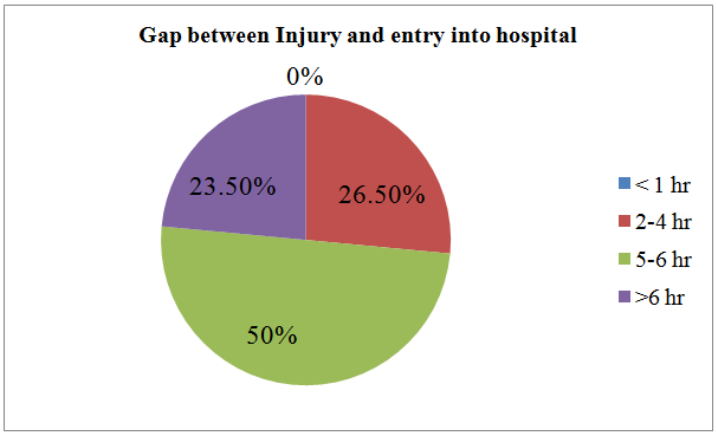

Fig 6 Shows: Distribution of Patients according to gap between injury and entry into hospital

None of the patients reported with in 1 hr of injury. The total of 26.5% reported between 2 to 4 hrs. There were 50% patents who reported between 5-6 hrs followed by 23.5% reported between 7 -8 hrs. None of the patients enrolled in the study reported after 8 hrs of injury.

Table 1 Shows: Distribution of Patents according to Severity of trauma (On GCS Scale) at the time of admission

SN	GCS Score	Severity	Percentage
1	8-11	Moderate	32.4%
2	<8	Severe	67.6%

The total 67.6% had GCS Scores indicating severe category of trauma and remaining 32.4 % had GCS scores indicating moderate category of trauma.

Table 2 Shows: Estimation of serum levels of trace elements at the time of admission

SN	Element	Mean	SD
1	Copper(cu) (mg/dl)	0.040	0.021
2	Zinc (Zn) (mg/dl)	0.191	0.071
3	Magnesium (Mg) (mg/dl)	0.472	0.340
4	Chromium (Cr) (ug/ml)	0.254	0.141

Table 3 Shows: Association between serum trace element levels and Severity of head injury

SN	Element	Moderate (GCS 8-11)		Severe (GCS<8)		Significance of Difference (Mann-whitney U test)	
		Mean	SD	Mean	SD	Z	P
1	Copper(Cu) mg/dl	0.061	0.025	0.029	0.007	4.589	<0.001
2	Zinc (Zn) mg/dl	0.231	0.068	0.172	0.065	2.010	0.046
3	Magnesium (Mg) mg/dl	0.452	0.249	0.482	0.380	0.129	0.913
4	Chromium (Cr) ug/ml	0.286	0.171	0.238	0.126	0.903	0.383

Mean copper levels were 0.029 mg/dlamong patients with severe category of head injury while mean copper level among patients with moderate GCS score were 0.061mg/dl, thus showing difference between two to be statistical significant (P<0.001). The other trace elements like Zinc, Magnesium and Chromium does not showed statically significant among different severity categories of trauma, however mean Cu and Zn levels were found to be significantly higher among those with moderate group as compared to severe group.

IV. Discussion

Head injury caused by trauma is one of the most important cause of hospital admission and mortality. It affects an individual both physically as well as psychologically by impairing the functional ability as well as cognitive ability of an individual. Head injury affects mainly the males who in productive years of their life stage. In present study, more than two third (70.6%) of the patients were within 40 years of age and were male (67.6%). Males are generally involved in outdoor and laborious tasks and perform task of more driving and physical labour making them more prone to trauma. The occupational profile of patients in present study corresponds with that observed by Yattoo et al[10] who observed labourers and farmers comprising the 37.3% of patients with head injury. In present study, only 8.8% were housewives which corresponds to the observation made by yatoo who reported a prevalence of 12.4% among housewives.

It was observed that road traffic accidents were the most important cause of head injury. The studies from india have reported road traffic injuries to be one of the most important cause of head injury and reported a high male preponderance as studied by Sharma et al and Gururaj[11,12] . Similar observation was made by yattoo et al[10] who reported a male to female ratio of 3:1. In a Study from Aligarh, U.P by Equabal et al[13] reported 83% of their cases with head injury to be males.

In present study, maximum number of cases was skilled/unskilled Labour (41.2%) who are exposed to occupational hazards of head injury and earn their livelihood by moving from one place to another place. The proportion of cases according to area of residence showed preponderance of rural people (76.5%) as compared to urban (23.5%). As most of the cases in present study had victims of road traffic accidents, it might be assumed that the rural people while moving towards the cities or nearby towns in order might be the victim of head injury. The study conducted by Verma et al[14] also reported a two third preponderance of rural population among victims of head injury owing to road traffic accidents.

In present study, fall from height and assault comprised the 32.4% and 8.8% of trauma victims. Yattoo et al[10] reported the proportion of fall from height and assault victims to be 32.2% and 18.8% respectively. In present study, none of the patients was brought into hospital within first hour after inflicting the injury. This could be because of the inclusion criteria of the study that allowed inclusion of only moderate to severe cases of head injury. The importance of golden hour on severity of head injury has already been explained in literature by Dinh et al[15]. Exactly half of the patients in present study were enrolled 5-6 hrs after inflicting the injury. Almost one quarter of patients (23.5%) reported between 7 to 8 hrs after inflicting the injury.

The impact of delay in hospital admission was visible in terms of GCS Scores which were found to be of severe order (GCS<8) in more than two third patients (67.6%). Tepas et al[16] have also discussed the relationship between delay in hospital admission and head injury management and have revealed a relationship

between duration of delay and GCS Scores. In present Study mean copper, Zinc, magnesium and chromium levels among trauma patients at the time of enrollement were 0.040 mg/dl, 0.191 mg/dl, 0.472 mg/dl and 0.254 ug/dl respectively. For copper, the reported normal levels ranges from 0.084 to 0.120 mg/dl whereas the same for zinc are 0.098 to 0.123 mg/dl as reported by Cheraskin et al[17]. Thus the mean copper level of the patients were below the reported normal range while those of zinc were higher than the normal range. Normal range of serum magnesium ranges from the 1.78 to 2.66 mg/dl as reported by Ghasemi et al[18], there by showing that mean magnesium levels among patients group were also lower than the normal described range. However, serum chromium level found to be 0.254 were within the normal range. The study conducted by Al-Adhami et al[19] reported the mean copper and zinc levels of patients with head injury to be lower but not significantly different from the control subjects whereas the serum magnesium levels among patients were significantly lower than that in controls.On Comparing the mean serum trace element levels and severity of head injury (in terms of GCS Score), mean serum copper and zinc levels were found to be significantly lower among those with severe grade of injury (GCS <8) as compared to those who had a moderate grade of injury (GCS 8-11). The present study finding are consistence with the observation made by Al-Adhami et al[19] who attempted to associate the serum trace elements levels with the severity of trauma and found a mild to moderate association using different methods of evaluation. In present study, we attempted to ascertain this relationship in terms of differences in mean serum trace element levels of patients with moderate GCS and those with severe GCS scores.

There is ample evidence to show, role of trace elements in anitioxidant defence, inflammatory process and wound healing in burn injuries.

V. Conclusion

Majority of Patients with head injury of moderate to severe grades were between age group 31 to 50 years. Males were affected more than twice the females. Maximum patients were skilled/unskilled labour followed by service/ shopkeeper More than three fourth affected patients were from rural areas. Majority of patients reached to hospital at least 4 hrs after the inflicting injury. More than 2/3rd patients had severe grade of injury. Mean copper and magnesium levels among patients of head injury at the time of enrolment were lower than the normal range for healthy subjects. Mean copper and zinc levels were found to be significantly higher among patients with moderate GCS score as compared to those with severe GCS scores.

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References

[1]. Becker D et al. Trauma and adolescence I: The nature and scope of trauma. Adolescent Psychiatry,2003.
[2]. Jennett B Epidemiology of head injury. J Newrol Neurosurg Psychiatry 1996;60:362-369.
[3]. Mass AIR, Stocchetti N, Bullock R. Moderate and severe traumatic brain injury in adults. Lancet Neurol 2008;7:728-41.
[4]. Fraga CG. Relevance, essentiality and toxicity of trace elements in human health. Molecular aspects of medicine 2005;26:235-244.
[5]. Saraymen R, Kilic E, Yazar S.Sweat Copper, Zinc, Iron, Magnesium and Chromium levels in National Wrestler. Inonu University Tip Fakultesi Dergisi 2004;11(1):7-10.
[6]. Young AB, Ott L, Beard D et al. The acute-phase response of the brain injured patient. J Neurosurg. 1988;69:375-80.
[7]. Mc Clain CJ, Twyman DL, Ott L, et al. Serum and urine zinc response in head-injured patients. J Neurosurg.1986;64:224-30.
[8]. Young B, Ott L, Kasavskis E, et al. Zinc supplementation is associated with improved neurological recovery rate and visceral protein levels of patients with severe closed head injury. J Neurotrauma. 1996;13:25.
[9]. Chaturvedi UC, Shrivastava R, Upreti RK, Viral infection and trace elements: A Complex interaction. Curr. Science 2004; 11(10): 1536-1554.
[10]. Yatoo Gh and Tabish A. The profile of head injuries and traumatic brain injury deaths in Kashmir. J. Trauma management & Outcomes 2008;2:5.
[11]. Sharma BR, Harish D, Singh G, Vij K. Patterns of fatal head injury in road traffic accidents. Bahrain Med Bull 2003;25(1):22-25.
[12]. Gururaj G. Road traffic deaths, injuries and disabilities in india: Current scenario. The National medical journal of india 2008;21(1):14-20.
[13]. Equabal MZ, Rizvi SJ, Husain M, Srivastava VK. A Study of the pattern of head injury in district Aligarh, Up, india. JIAFM 2005;27(2):103-107.
[14]. Verma PK, An epidemiological study of accidents among rural population. MD thesis Delhi: University of Delhi;1998.
[15]. Dinh MM, Bein K, Roncal S, Byrne CM, Petchell J, Brennan J. Redefining the golden hour for severe head injury in an urban setting: The effect of prehospital arrival times on patient outcomes. Injury. 2012.
[16]. Tepas JJ, Leaphart CL, Pieper P, Beaulieu CL, Spierre LR, Tuten JD, Celso BG. The effect of delay in rehabilitation on outcome of severe traumatic brain injury. J pediatr surg.2009;44(2):368-72.
[17]. Cheraskin E, carpenter JH and Rioedan HD. Difference in human serum copper and Zinc levels IN Healthy and patient population. Medical Hypothesis 1986;20:79-85.
[18]. Ghasemi A, Zahediasl S, Azizi F. References values for serum magnesium levels in young adults Iranian subjects. Biol trace Elem Res. 2010;138(13):99-106.
[19]. Al-Adhami NK, Al-Rawi WWH, Ibrahem AK. Estimation of some trace elements in severe head injury patients. Fac Med Baghdad 2007;49(4): 482-489.