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Original Research Article

Incidence of Anemia and Serum Protein Deficiencies in Patients with Acute Traumatic Spinal Cord Injury

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Abstract

Introduction: In the acute phase of traumatic Spinal Cord Injury, many patients suffer from anemia, hypoproteinemia and hypoalbuminemia which can contribute to easy fatiguability and an overall hindrance to the rehabilitation effort. This study was conducted to further investigate the incidence of anemia, hypoproteinemia and hypoalbuminemia in patients with acute traumatic spinal cord injury (SCI).

Methods: This prospective study was carried out at department of physical medicine and rehabilitation, SMS Medical College, Jaipur. Adults with acute traumatic spinal cord injury (n=200) were recruited. The enrolled patient's demographic data, clinical examination, ASIA scale grade, blood reports (hemoglobin, Serum Total protein, Serum Albumin) were analyzed at admission.

Result: In 200 recruited patients at initial admission, 53% (n=106) patients were anemic (hemoglobin <13.0 g/dl in males and Hb <12g/dl in female), 24 percent were hypoalbuminemic (s. albumin <3.2 g/dl) and 64 percent were hypoproteinemic (S. total protein <6.5 g/dl). Deficiencies were most commonly observed in complete spinal injury (ASIA A) and statically significant association (p <0.05) with severity of injury with each deficiency was observed.

Conclusion Therefore we should concern about the treatment and progression of anemia and protein deficiencies in the spinal cord injured patients.

Keywords: SCI, Anemia, hypoproteinemia, hypoalbuminemia, Hb, ASIA.

Introduction

The global incidence of spinal cord injury (SCI) is 720 cases per million [1] and global prevalence of SCI is 236-1009 cases per million population [2]. In India, the average annual incidence of spinal cord injury is 15000 with a prevalence of 0.15 million [3].

Road traffic accidents, falls, acts of violence and sporting injuries are the leading causes of traumatic SCI. While the

prognosis for the return of motor function is of most concern to the patient, the multi-organ-system nature of SCI must be considered by the medical team as patients strive to regain maximal functional independence. SCI is predominantly caused by high-impact injuries associated with motor vehicle accidents (36–48%), violence (5–29%), falls (17–21%), and sports or recreational activities (7–16%) [4].

American Spinal Impairment Association Scale, described SCI as complete or incomplete SCI. In the complete SCI there is complete loss of sensation and motor function below neurological level without sacral sparing and in incomplete SCI there is preservation of some motor/sensory function with sacrum sparing [5].

In the acute phase of traumatic SCI, many patients suffer from anemia and serum protein deficiency. Anemia in acute SCI is multi-factorial in etiology. As trauma, acute patients often lose blood secondary to traumatic episode or during life-saving surgeries and stress contributes to a negative effect on erythrocytes. In the period shortly following injury to the spinal cord, patients also typically have negative nitrogen balances and concomitant decreased serum protein concentrations and nutritional deficiencies which render them more vulnerable to secondary medical complications [6].

Previous studies reported that 85 percent of acutely injured patients demonstrated an anemia (Hg <13.6 g/dl) which was typically of a normochromic normocytic nature [7]. Acute SCI patients had abnormally low serum albumin (<3.5g/dl) two weeks after injury [8]. Lipetz et al reported 65% incidence of anemia (<13 g/dl), 86.7% of hypoalbuminemia (albumin <3.2g/dl) and 48.9% of hypoproteinemia (s. total protein <6.5 g/dl) [6]. This study further investigated the incidence of anemia and decreased serum protein concentrations so often observed in the acute phase of traumatic SCI.

Material and Method

This study was a analysis of data collected on newly injured individuals with traumatic SCI during acute care. The Center enrolled acute patients with SCI and collected demographic information, clinical examination, ASIA impairment grading scale, medical information, blood investigation (Hb, S. total protein, S. albumin) reports after the admission at Rehabilitation Research Center(RRC), S.M.S Medical College. The primary aim was to obtain information related to the incidence of anemia, hypoproteinemia and hypoalbuminemia. After the approval of Research Review Board, 200 patient of traumatic acute SCI admitted in RRC included in the study after giving a written consent and applying inclusion and exclusion criteria. The enrolled patient's demographic data, physical examination and blood reports,ASIA impairment scale grading data collected and assess the patients for anemia, hypoproteinemia at admission.

Inclusion and Exclusion Criteria:

Age 18 year and older patients admitted with acute traumatic SCI and given written informed consent included in study. Patients who have autoimmune disease and previous neurological disorder were excluded.

Statistical analysis:

The data was entered in Microsoft excel spread sheet. Microsoft office 2019 and SPSS 25.0 was used to data analysis. Continuous data was summarised in form of Mean and Standard Deviation. The difference in mean was analysed using student 't' test. Nominal/ categorical variables was presented as proportions and compared by Chi-Square test. P value <0.05 will be taken as significant.

Results

In our study, 54 (27%) cases were of 25-34 years, followed by 50 (25%) cases of 35-44 years and least 10 (5%) cases were of 55-64 years age group.Mean age of the cases was 37.76±13.91 years. In study sample 63% (n=126) patients were complete SCI and 37% (n=67) were incomplete SCI. Patients were considered anemic for a Hg <13.0 g/dl, hypoalbuminemic for a serum Albumin <3.2 g/dl and total protein deficient for a serum TP <6.5 g/dl. (Table 1)

Table 1: Demographic and characteristics of patient's population (n = 200)

Mean Age (years)	**37.76±13.91**
Male (%)	76%
Complete SCI	63%
Incomplete SCI	37%
Tetraplegic	48.5%
Paraplegic	48%
Intact	3.5%

Mean hemoglobin of population was 12.32 ± 0.97, it was found 53% of cases were anemic. In anemic cases mean hemoglobin was 10.87 ± 1.1 A greater incidence of anemia was observed in both complete patients when compared with incomplete patients. Chi-square analysis identified a significant relationship (p=0.028) between the incidence of anemia and complete or incomplete injury. (Table 2)

Table 2: Anemia in patients at admission

Injury Classification	**Patients with Anemia (n)**	**Patients without Anemia (n)**
Complete SCI (ASIA-A)	59	67
Incomplete SCI (ASIA-B,C,D)	41	26
Intact (ASIA- E)	3	4

*Statistically significant (p<0.05)

At the time of admission, 24 percent of all subjects were hypoalbuminemic with a mean Albumin of 2.9 g/dl (±0.54), a statistically significant relationship was observed between the incidence of hypoalbuminemia and severity of spinal injury. At the time of admission, 64 percent of patients were hypoproteinemic with a mean serum total protein of 6.38 g/dl (±0.62). chi-square analysis revealed a statistically significant relationship (p=0.006) between the incidence of hypoproteinemia and severity of spinal injury. (Table 3)

Table 3: Protein deficiency in patients at admission

Injury Classification	**Patients with hypoproteinemia (n)**	**Patients with hypoalbuminemia (n)**
Complete SCI (ASIA-A)	93	41
Incomplete SCI (ASIA-B,C,D)	30	6
Intact (ASIA- E)	5	1

*Statistically significant (p<0.05)

Discussion

The anemia so often observed in the acute phase of SCI is multi-factorial in etiology. As trauma victims, acute SCI patients often lose blood secondary to the traumatic episode or during lifesaving surgeries. Stress of trauma produces serum milieu which affect the red blood cells production and life span. This includes an increased susceptibility of erythrocytes to the

hemolytic effects of circulating epinephrine derived compounds and the presence of toxic plasma substances such as organic phosphates [9]. The blood Hemoglobin, which was measured in our study and typically utilized clinically to quantify an anemic state.

The overall incidence of anemia in the acute traumatic SCI population at RRC (Rehabilitation Research Institute), Sawai Man Singh (SMS) Hospital Jaipur, was 53%. Previous studies have shown that approximately 65% [6], 79% [7] and 52.3% [10] of patients with acute traumatic SCI. Hirsch et al Identified early causes of anemia were blood loss due to bony soft tissue or visceral injury, gastrointestinal bleeding, and surgery [11].

Huang et al reported in a study of 50 acute SCI patients, that in addition to the blood loss associated with a bony injury to the spine, 11 of 50 patients experienced gastrointestinal hemorrhage and two required a transfusion [7]. Perkash and Brown reported that the relatively frequent use of aspirin and NSAIDS as analgesics in the acute phase of injury and the resultant mild gastrointestinal hemorrhage which can result in 4 ml (15 mg Hg/1 ml blood) of blood loss daily [10].

In this study a statistically significant association was found between anemia incidence and complete injury of spine (ASIA A). Our findings were supported by author Lipetz et al [6] and Furlan JC et al [12].

The catabolic response to acute SCI and the concomitant decreased serum protein concentrations have been the subject of much investigation. A study reported 10 patients with complete injuries who demonstrated negative nitrogen balances and an average seven kg weight loss during the acute post-injury period [13]. Albumin levels are often distorted by fluid shifts and acute blood loss. Hepatic respond as acute-phase reactants and serum levels decline after acute stress. Also, patients with SCI have an extremely high elimination rate of serum albumin, with its long half-life of 18 to 21 days, serum albumin is an insensitive marker for the adequacy of nutritional support. In addition lower concentrations of serum albumin early after injury (≤1 month) are also associated with more severe SCI and predicted poor neurological recovery [14].

Hypoalbuminemia is unsurprisingly common in the acute phases of injury [15]. Patients after severe trauma to the spinal cord is often marked by the inability to ingest adequate amounts of protein and the failure to assimilate fully protein which is ingested or administered parenterally which may leads to hypoproteinemia [16].

The overall incidence of hypoproteinemia and hypoalbuminemia in our study was 64% and 24% respectively. 73.8% of complete SCI (ASIA A) patients were hypoproteinemic and 32.5 % of complete SCI were hypoalbuminemic. 44.7% of incomplete SCI (ASIA B,C,D) patients were hypoproteinemic and 9% of incomplete SCI were hypoalbuminemic. The statistically significant association between complete SCI and incidence of hypoalbuminemia, hypoproteinemia was found in our study. Lipetz et al revealed a statistically significant association between severity of SCI and hypoproteinemia.

Conclusion

Anemia, hypoproteinemia and hypoalbuminemia incidence is high after acute traumatic spine injury, and these are associated with severity of spinal injury. Therefore we should concern about the treatment and progression of anemia and protein deficiencies in the spinal cord injured patients.

Limitations

This is a single center-based study with a small sample size. Anemia of chronic disease was not rule-out in this study. Furthermore, research is needed.

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