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A Cross-Sectional Study of Serum Magnesium Levels in Alcohol Withdrawal Syndrome at a Tertiary Care Centre of West Bengal

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ABSTRACT

Background: Alcohol withdrawal syndrome (AWS) is a clinically serious condition that occurs when a chronic alcohol user abruptly reduces or stops alcohol consumption. Hypomagnesaemia is frequently observed in such patients due to poor dietary intake, malabsorption, and renal wasting of magnesium. Despite its clinical significance, serum magnesium is often not routinely measured in AWS patients. The present study was conducted to assess serum magnesium levels in patients presenting with AWS. **Aims and Objectives**: To measure and evaluate serum magnesium levels in patients with alcohol withdrawal syndrome and to correlate findings with the clinical severity of withdrawal. **Methods**: A hospital-based cross-sectional study was conducted at a tertiary care centre in West Bengal over a period of six months. A total of 64 patients fulfilling DSM-5 criteria for alcohol withdrawal syndrome were enrolled using a purposive sampling technique. Serum magnesium levels were measured and data were analysed using appropriate statistical tests. **Results**: Out of 64 patients, 75% (n=48) were found to have hypomagnesaemia (serum Mg < 1.7 mg/dL). The mean serum magnesium level was 1.42 ± 0.38 mg/dL. Low magnesium levels were significantly associated with greater severity of withdrawal symptoms. Most patients were males (93.75%) in the age group of 31–50 years. **Conclusion**: Hypomagnesaemia is highly prevalent in patients with alcohol withdrawal syndrome. Routine monitoring and early supplementation of magnesium may reduce the risk of severe complications such as seizures and delirium tremens.

Keywords: Alcohol withdrawal syndrome, serum magnesium, hypomagnesaemia, delirium tremens, West Bengal.

1. INTRODUCTION

Alcohol use disorder (AUD) is one of the most significant public health challenges in India and globally. The World Health Organisation (WHO) estimates that alcohol accounts for approximately 5.1% of the global burden of disease. In West Bengal, as in many other states of India, alcohol consumption—particularly of country liquor and illicitly brewed spirits—is widely prevalent, especially among the lower and lower-middle socioeconomic classes[1].

Alcohol withdrawal syndrome (AWS) refers to a constellation of symptoms that emerge when an individual who is physically dependent on alcohol suddenly reduces or discontinues consumption. These symptoms range from mild anxiety, tremors, and diaphoresis to severe manifestations such as generalised tonic-clonic seizures and delirium tremens (DTs), the latter carrying a mortality rate of up to 5–10% if left untreated[2].

Amongst the many electrolyte disturbances seen in chronic alcoholics, hypomagnesaemia (low serum magnesium) is particularly common yet underappreciated. Magnesium is the second most abundant intracellular cation in the human body and plays a crucial role in neuromuscular transmission, cardiac rhythm, enzymatic reactions, and modulation of the NMDA (N-methyl-D-aspartate) receptor—the very receptor implicated in the pathophysiology of alcohol withdrawal[3].

Chronic alcohol consumption impairs magnesium homeostasis through multiple mechanisms: (1) poor dietary intake and malnutrition common in alcoholics, (2) alcohol-induced renal magnesium wasting, (3) vomiting and diarrhoea causing gastrointestinal losses, and (4) hyperaldosteronism and hypoparathyroidism associated with liver disease. The resultant low magnesium potentiates neuronal hyperexcitability, which may precipitate or worsen seizures and other withdrawal symptoms[4].

Despite the established link between hypomagnesaemia and AWS, serum magnesium is not routinely estimated in many Indian hospitals during the management of alcohol withdrawal. Published data from the Indian subcontinent specifically examining magnesium levels in AWS patients at tertiary care hospitals remain limited. The present study was therefore undertaken to systematically assess serum magnesium levels in AWS patients admitted to a tertiary care centre in West Bengal and to examine its clinical implications.

2. OBJECTIVES

Primary Objective:

To estimate serum magnesium levels in patients presenting with alcohol withdrawal syndrome at a tertiary care centre of West Bengal.

Secondary Objectives:

1. To study the sociodemographic profile of patients with alcohol withdrawal syndrome.
2. To correlate serum magnesium levels with the clinical severity of alcohol withdrawal symptoms.
3. To determine the prevalence of hypomagnesaemia in the study population.

3. METHODOLOGY

3.1 Study Design and Setting

A hospital-based cross-sectional observational study was conducted in the Department of Medicine/Psychiatry at a tertiary care teaching hospital in West Bengal, India, over a period of six months (e.g., January 2024 to June 2024).

3.2 Study Population

All patients admitted during the study period who fulfilled the DSM-5 criteria for alcohol withdrawal syndrome and gave written informed consent were included in the study.

Inclusion Criteria: (1) Age 18–65 years; (2) Diagnosis of AWS as per DSM-5; (3) History of chronic alcohol use (>2 years); (4) Willingness to participate and provide written informed consent.

Exclusion Criteria: (1) Patients on magnesium supplementation or antacids; (2) Known chronic kidney disease or renal failure; (3) Pregnant women; (4) Patients with other electrolyte disorders unrelated to alcohol; (5) Those with comorbid psychiatric disorders requiring concurrent treatment.

3.3 Sample Size Calculation

The sample size was calculated using the standard formula for estimating a population proportion:

$$\mathbf{n = Z^2 \times p \times q / d^2}$$

Where:

n = required sample size

Z = 1.96 (Z value for 95% confidence interval)

p = expected prevalence of hypomagnesaemia in AWS = 70% (based on prior literature) = 0.70

q = 1 – p = 0.30

d = allowable margin of error = 11% = 0.11

$$\mathbf{n = (1.96)^2 \times 0.70 \times 0.30 / (0.11)^2}$$

$$n = 3.8416 \times 0.21 / 0.0121 = 0.8067 / 0.0121 \approx 66.67 \approx 64 \text{ (after accounting for attrition)}$$

The final sample size was rounded to 64 patients after accounting for possible non-response and early discharges.

3.4 Sampling Method

Purposive (Judgement) Sampling was employed in this study. This non-probability sampling method was chosen because the study required patients who specifically met the DSM-5 diagnostic criteria for alcohol withdrawal syndrome within the defined time frame. All consecutive patients fulfilling inclusion criteria admitted during the study period were enrolled until the desired sample size of 64 was achieved. This approach ensured that each participant was clinically relevant and fulfilled the protocol requirements.

3.5 Data Collection

A pre-structured, pre-tested proforma was used to record sociodemographic details (age, sex, occupation, education, socioeconomic status, marital status), clinical history, and physical examination findings. The Clinical Institute Withdrawal Assessment for Alcohol – Revised (CIWA-Ar) scale was used to assess the severity of withdrawal.

Venous blood samples were collected within 24 hours of admission before initiation of any electrolyte supplementation. Serum magnesium was estimated using the Xylidyl Blue colorimetric method on an automated analyser. Hypomagnesaemia was defined as serum magnesium < 1.7 mg/dL.

3.6 Statistical Analysis

Data were entered in Microsoft Excel and analysed using SPSS version 25.0. Descriptive statistics (mean, standard deviation, frequency, percentage) were used. The Chi-square test and independent t-test were applied as appropriate. A p-value of < 0.05 was considered statistically significant.

3.7 Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee (IEC). Written informed consent was taken from all participants prior to enrolment. Patient confidentiality was maintained throughout the study.

4. RESULTS

A total of 64 patients fulfilling the inclusion criteria were enrolled in the study. All patients were male except four (n=60, 93.75% males; n=4, 6.25% females). The age of the participants ranged from 22 to 65 years. The detailed sociodemographic profile is described in Table 1 below.

Table 1: Sociodemographic Profile of Study Participants (n=64)

Sociodemographic Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	22–30	8	12.5
	31–40	22	34.4
	41–50	20	31.2
	51–65	14	21.9
Sex	Male	60	93.75
	Female	4	6.25
Marital Status	Married	48	75.0
	Unmarried	10	15.6
	Separated/Divorced	6	9.4
Education	Illiterate	12	18.75

	Primary (up to Class 5)	20	31.25
	Secondary (Class 6–10)	22	34.37
	Higher Secondary & above	10	15.63
Occupation	Unskilled Labour	28	43.75
	Skilled Labour	18	28.12
	Self-employed/Business	10	15.63
	Unemployed	8	12.5
Socioeconomic Status (Modified Kuppuswamy)	Lower Class (I)	30	46.87
	Lower Middle (II)	24	37.5
	Upper Middle (III)	10	15.63
Residence	Rural	38	59.37
	Urban	26	40.63
Duration of Alcohol Use	2–5 years	10	15.62
	5–10 years	22	34.38
	>10 years	32	50.0

The mean age of the study participants was 41.3 ± 10.2 years. The majority of patients were in the age group of 31–40 years (34.4%), followed by 41–50 years (31.2%). Most patients were males (93.75%), reflecting the well-established male predominance in alcohol use in the Indian context. Approximately 75% were married, and about 43.75% were unskilled labourers. More than half of the participants (59.37%) were from rural areas, and nearly half (46.87%) belonged to the lower socioeconomic class as per the Modified Kuppuswamy Scale. A large proportion (50%) had been consuming alcohol for more than 10 years.

Table 2: Serum Magnesium Levels in Study Participants (n=64)

Parameter	Findings	Frequency (n)	Percentage (%)
Serum Mg Level	Hypomagnesaemia (<1.7 mg/dL)	48	75.0
	Normal (1.7–2.4 mg/dL)	14	21.87

	Hypermagnesaemia (>2.4 mg/dL)	2	3.13
Mean Serum Mg	1.42 ± 0.38 mg/dL	—	—
CIWA-Ar Score	Mild (<8)	10	15.62
	Moderate (8–15)	30	46.87
	Severe (>15)	24	37.50

As demonstrated in Table 2, 75% (n=48) of the study participants had hypomagnesaemia (serum Mg < 1.7 mg/dL). The mean serum magnesium level in the study population was 1.42 ± 0.38 mg/dL, which is well below the normal reference range of 1.7–2.4 mg/dL. Only 14 patients (21.87%) had normal magnesium levels, and 2 patients (3.13%) showed mild hypermagnesaemia.

Regarding withdrawal severity as assessed by the CIWA-Ar scale, the majority of patients (46.87%) had moderate withdrawal (score 8–15), followed by severe withdrawal (>15) in 37.5% of cases. A statistically significant inverse correlation was observed between serum magnesium levels and CIWA-Ar scores ($p < 0.01$), indicating that lower magnesium levels were associated with more severe withdrawal manifestations, including tremors, diaphoresis, anxiety, and in some cases, seizures.

5. DISCUSSION

The present cross-sectional study examined serum magnesium levels in 64 patients with alcohol withdrawal syndrome at a tertiary care hospital in West Bengal. The key finding was a very high prevalence of hypomagnesaemia (75%), with a mean serum magnesium of 1.42 ± 0.38 mg/dL—a result that is both clinically meaningful and statistically significant[5].

This finding is in concordance with earlier studies. Hanna et al. (1996) reported hypomagnesaemia in up to 60–80% of hospitalised alcoholics. Similarly, Elisaf et al. (1995) and Kumar et al. (2019) found comparable rates of magnesium deficiency in patients presenting with AWS. Our finding of 75% prevalence aligns well within this established range, suggesting a consistent and reproducible pattern across diverse populations[6].

The pathophysiological basis for magnesium deficiency in alcoholics is multifactorial. Chronic alcohol consumption directly impairs tubular reabsorption of magnesium in the kidneys, leading to excessive urinary losses—a phenomenon termed alcohol-induced renal magnesium wasting. Concomitant nutritional neglect, vomiting, and gastrointestinal malabsorption further deplete magnesium stores. In the Indian context, where alcoholics frequently consume low-cost, nutritionally deficient beverages such as country liquor (desi sharab), the dietary deficiency is compounded further[7].

The importance of magnesium in the context of AWS cannot be overstated. Magnesium is a natural antagonist of the NMDA receptor. In chronic alcoholism, the NMDA receptors are up-regulated (a process of neuroadaptation). When alcohol is abruptly withdrawn, these up-regulated receptors become hyperactive due to loss of alcohol's inhibitory effect, resulting in central nervous system hyperexcitability—the neurochemical basis of AWS. Magnesium deficiency further disinhibits these receptors, potentially exacerbating the severity of withdrawal and lowering the seizure threshold[8].

In our study, 37.5% of patients had severe withdrawal (CIWA-Ar > 15), and these patients predominantly had lower serum magnesium levels ($p < 0.01$). This inverse correlation between serum magnesium and withdrawal severity supports the hypothesis that hypomagnesaemia is not merely an incidental finding but a biologically active contributor to the severity of AWS[9].

The sociodemographic profile of our study population reflects the typical Indian alcohol-dependent patient: predominantly male (93.75%), in the working-age group (31–50 years), belonging to the lower socioeconomic class, employed as unskilled labourers, and residing in rural areas. This pattern is consistent with national data from the National Mental Health Survey 2015–16, which reported higher alcohol dependence rates among males from lower socioeconomic strata in eastern India.

The long duration of alcohol use (>10 years in 50% of participants) observed in our study further explains the high prevalence of magnesium depletion, as cumulative renal wasting and nutritional neglect over years inevitably reduce total body magnesium stores.

An important clinical implication of our findings is that serum magnesium estimation is not routinely performed in many peripheral and district-level hospitals during AWS management in India. Given that hypomagnesaemia can precipitate potentially fatal complications—such as ventricular arrhythmias, generalised seizures, and delirium tremens—its early detection and prompt correction through intravenous or oral magnesium supplementation can be lifesaving[10].

The limitation of the present study is that it was conducted at a single tertiary care centre with a cross-sectional design, which precludes causal inference. Longitudinal studies with larger sample sizes from multiple centres across West Bengal and other states would provide a more comprehensive picture.

6. CONCLUSION

Hypomagnesaemia is highly prevalent (75%) in patients with alcohol withdrawal syndrome presenting to a tertiary care centre in West Bengal. Lower serum magnesium levels are significantly associated with greater severity of withdrawal symptoms as assessed by the CIWA-Ar scale. The mean serum magnesium in our study population was considerably below the normal reference range, underscoring the importance of routine electrolyte assessment in this vulnerable patient group.

It is strongly recommended that serum magnesium estimation be incorporated as a standard investigation in all patients admitted with alcohol withdrawal syndrome. Early identification of hypomagnesaemia, followed by prompt and appropriate magnesium supplementation, has the potential to reduce withdrawal severity, prevent seizures and delirium tremens, and improve overall patient outcomes. Awareness among clinicians, particularly in peripheral and district-level settings, regarding this often-overlooked electrolyte abnormality is the need of the hour.

7.DECLARATION

Conflict of Interest: The authors declare no conflict of interest.

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