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Original Research Article

Clinical Characteristics, Severity, and Treatment Outcomes of Alcohol Withdrawal Syndrome in Patients With Alcohol-Associated Liver Disease: A Comparative Observational Study.

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Abstract: ***Background: Aim:*** To evaluate and compare the clinical characteristics and treatment outcomes of alcohol withdrawal syndrome in patients with and without liver disease. ***Materials and Methods:*** This hospital-based observational comparative study was conducted in the Department of General Medicine, ESIC Medical College and Hospital, MIA, Desula, Alwar, Rajasthan. A total of 300 patients diagnosed with alcohol withdrawal syndrome were enrolled and divided into two groups: patients with liver disease [LIV(+)] and patients without liver disease [LIV(-)], with 150 patients in each group. Diagnosis of AWS was based on DSM-5 criteria and severity assessment was performed using the Clinical Institute Withdrawal Assessment for Alcohol-Revised (CIWA-Ar) scale. Detailed demographic, clinical, and laboratory parameters were recorded. Treatment outcomes including duration of hospital stay, ICU admission, withdrawal seizures, delirium tremens, ventilatory support, and mortality were assessed. Statistical analysis was performed using SPSS software, and $p<0.05$ was considered statistically significant. ***Results:*** The mean age of patients with liver disease was significantly higher compared to patients without liver disease (54.2 ± 11.8 years vs. 49.6 ± 13.4 years; $p<0.05$). Severe withdrawal manifestations including hallucinations, delirium tremens, and withdrawal seizures were significantly more common in the LIV(+) group. The mean peak CIWA-Ar score was significantly higher among patients with liver disease (18.2 ± 6.1 vs. 13.5 ± 5.2; $p<0.001$). Laboratory abnormalities such as elevated bilirubin, transaminases, hypoalbuminemia, thrombocytopenia, and prolonged coagulation profile were significantly associated with liver disease. Patients with liver disease had longer hospital stay (7.8 ± 3.4 days vs. 4.6 ± 2.1 days; $p<0.001$), increased ICU admission (25.7% vs. 10.0%), higher requirement for mechanical ventilation (10.0% vs. 2.9%), and greater mortality (7.9% vs. 2.1%). ***Conclusion:*** Alcohol withdrawal syndrome in patients with liver disease is associated with significantly increased clinical severity, prolonged hospitalization, higher ICU requirement, and increased mortality compared to patients without liver disease. Liver disease should be considered an important predictor of adverse outcomes in AWS. Early identification, close monitoring, individualized benzodiazepine therapy, and aggressive supportive management are essential to improve prognosis in this high-risk population.

Keywords: Alcohol withdrawal syndrome; Liver disease; Alcohol-associated liver disease; CIWA-Ar; Delirium tremens; Withdrawal seizures; Intensive care unit; Mortality.

INTRODUCTION

Alcohol use disorder (AUD) is a major global public health concern associated with significant morbidity and mortality. Chronic and excessive alcohol consumption adversely affects multiple organ systems, particularly the liver, leading to a spectrum of alcohol-related liver diseases ranging from hepatic steatosis to cirrhosis and hepatic failure. Alcohol-associated liver disease remains one of the leading causes of chronic liver disease worldwide and contributes substantially to healthcare burden and premature mortality.[1,2]. Alcohol withdrawal syndrome (AWS) is a potentially life-threatening condition that develops following abrupt cessation or reduction in prolonged heavy alcohol intake. Clinical manifestations vary from mild symptoms such as tremors, nausea, anxiety, and insomnia to severe complications including seizures, delirium tremens, autonomic instability, and death.[3,4] The severity of AWS is commonly assessed using the Clinical Institute Withdrawal Assessment for Alcohol-Revised (CIWA-Ar) scale, which guides symptom-triggered benzodiazepine therapy.[5]

Patients with liver diseases represent a particularly vulnerable subgroup among individuals with AWS. Liver dysfunction alters alcohol metabolism and affects the pharmacokinetics of sedatives used in withdrawal management. Furthermore, distinguishing AWS from hepatic encephalopathy may be clinically challenging because both conditions can present with altered mental status and neuropsychiatric manifestations.[6] In patients with advanced liver disease, benzodiazepine therapy may precipitate worsening encephalopathy, necessitating careful monitoring and individualized treatment strategies.[7]. Previous studies have shown that patients with alcohol-related liver disease have longer hospital stays, increased intensive care unit admissions, higher mortality, and more severe withdrawal manifestations compared with patients without liver disease. Additionally, comorbid liver disease has been identified as an independent risk factor for complicated alcohol withdrawal.[4-7]

Despite the increasing burden of alcohol-related liver disease in India, there is limited Indian literature evaluating the clinical characteristics and treatment outcomes of AWS among patients with and without liver diseases. Understanding the differences in clinical presentation, withdrawal severity, complications, and outcomes between these groups may help optimize management protocols and improve patient outcomes. Therefore, the present study was undertaken in the Department of General Medicine at ESIC Medical College and Hospital, Alwar, Rajasthan, to evaluate and compare the clinical characteristics and treatment outcomes of alcohol withdrawal syndrome in patients with and without liver diseases. The objectives of the study were as below:

Primary Objectives

1. To compare the clinical characteristics of AWS in patients with and without liver disease.
2. To assess and compare treatment outcomes between the two groups.

Secondary Objectives

1. To compare severity of alcohol withdrawal using CIWA-Ar score.
2. To assess incidence of withdrawal seizures and delirium tremens.
3. To evaluate duration of hospital stay and ICU admission.
4. To compare mortality among patients with and without liver disease.

MATERIALS AND METHODS

Study Design: This was a hospital-based observational comparative study conducted in the Department of General Medicine, ESIC Medical College and Hospital, MIA, Desula, Alwar, Rajasthan.

Study Duration: The study was conducted over a period of six months from the date of Institutional Ethics Committee approval or until the required sample size of 300 participants was achieved, whichever occurs earlier.

Study Population: The study included adult patients admitted with alcohol withdrawal syndrome to the Department of General Medicine during the study period.

Sample Size: A total of 300 patients were enrolled in the study. Sample size was calculated for comparison of two proportions considering the incidence of delirium tremens (DT) as the primary outcome variable. Based on previous literature, the expected incidence of delirium tremens was assumed to be:
P1 (AWS with Alcohol-Associated Liver Disease) = 35%
P2 (AWS without Liver Disease) = 20%
Using:
Confidence level = 95% ($Z\alpha/2 = 1.96$)
Power = 80% ($Z\beta = 0.84$)
The sample size was calculated using the formula for comparison of two proportions:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 [P_1(1-P_1) + P_2(1-P_2)]}{(P_1 - P_2)^2}$$

n=135 participants per group
After adding approximately 10% for incomplete data/non-response:
n≈ 150 per group
Total sample size = 300 patients.
A total of 300 patients were enrolled and divided into two groups:

- Group A: Patients with alcohol withdrawal syndrome and coexisting liver disease.
- Group B: Patients with alcohol withdrawal syndrome without liver disease.

Inclusion Criteria

1. Patients aged ≥18 years.
2. Patients diagnosed with alcohol withdrawal syndrome based on DSM-5 criteria and/or CIWA-Ar scoring system.
3. Patients willing to provide informed written consent.
4. Patients admitted for management of alcohol withdrawal syndrome.

Exclusion Criteria

1. Patients with severe psychiatric illness interfering with assessment.
2. Patients with head injury, cerebrovascular accident, or other neurological disorders causing altered sensorium.
3. Patients with chronic kidney disease stage IV/V.
4. Patients with mixed drug intoxication or poisoning.
5. Patients unwilling to participate in the study.

Definition of Liver Disease

Patients were categorized as having liver disease based on clinical findings, biochemical investigations, ultrasonography, or evidence of alcoholic liver disease/cirrhosis/hepatic failure documented in medical records.

Severity Assessment of Alcohol Withdrawal Syndrome: The severity of alcohol withdrawal was assessed using the Clinical Institute Withdrawal Assessment for Alcohol-Revised (CIWA-Ar) Scale, a validated 10-item scoring system. Patients were categorized according to the total CIWA-Ar score as follows:

Mild withdrawal: CIWA-Ar score < 8
Moderate withdrawal: CIWA-Ar score 8–15
Severe withdrawal: CIWA-Ar score ≥ 16

The CIWA-Ar score was recorded at admission and subsequently as per institutional treatment protocol to guide management and monitor progression of withdrawal symptoms.

Data Collection: After obtaining approval from the Institutional Ethics Committee and informed written consent from participants or their attendants, detailed clinical history and examination findings were recorded in a predesigned proforma.

The following data were collected:

- Demographic profile (age, sex)
- Duration and quantity of alcohol intake
- Previous history of alcohol withdrawal
- Presence of seizures or delirium tremens
- Comorbid illnesses
- Clinical signs and symptoms at presentation
- CIWA-Ar score
- Laboratory investigations including:
  - Complete blood count
  - Liver function tests
  - Renal function tests
  - Serum electrolytes
  - Blood glucose
  - Coagulation profile
- Ultrasonography abdomen findings

Treatment Protocol: All patients were managed according to institutional alcohol withdrawal management protocol. Symptom-triggered benzodiazepine therapy was administered based on CIWA-Ar scores. Lorazepam was preferred in patients with liver dysfunction because of its relatively safer metabolism profile.

Supportive treatment included:

- Intravenous fluids
- Thiamine supplementation
- Multivitamins
- Electrolyte correction
- Nutritional support

Patients requiring intensive monitoring or ventilatory support were shifted to the intensive care unit as indicated.

Outcome Measures

The following outcomes were assessed:

1. Severity of alcohol withdrawal
2. Duration of hospital stay
3. Requirement of ICU admission
4. Occurrence of withdrawal seizures
5. Development of delirium tremens
6. Requirement of mechanical ventilation
7. In-hospital mortality

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 25. Continuous variables were expressed as mean±standard deviation (SD) or median with interquartile range, while categorical variables were expressed as frequencies and percentages. Student's t-test or Mann–Whitney U test was used for comparison of continuous variables, and Chi-square test or Fisher's exact test was used for categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 150 patients diagnosed with alcohol withdrawal syndrome (AWS) were included in the present study. Among them, 140 patients had associated liver disease [LIV(+)] and 150 patients did not have liver disease [LIV(-)]. The mean age of patients in the liver disease group was significantly higher compared to the non-liver disease group (54.2±11.8 years vs. 49.6±13.4 years; p<0.05). The majority of patients in both groups were males. Male predominance was

observed in the LIV(+) group (78%) as compared to the LIV(-) group (72%). Most patients belonged to the age group of 41–60 years. Unemployment was more common among patients with liver disease (table 1).

Table 1: Demographic profile of study participants

Variable	LIV (+) (n=150)	LIV (-) (n=150)	p-value
Mean age (years)	54.2 ± 11.8	49.6 ± 13.4	<0.05
Male gender	117 (78%)	108 (72%)	0.21
Female gender	33 (22%)	42 (28%)	0.21
Unemployed	90 (60.0%)	68 (45.33%)	<0.05

Patients with liver disease had significantly more severe alcohol dependence and longer duration of alcohol intake compared to those without liver disease. Tremors, anxiety, sweating, nausea, and insomnia were the most common presenting symptoms in both groups. However, altered sensorium, hallucinations, and delirium tremens were significantly more common among patients with liver disease.

Table 2: Clinical presentation among study groups

Clinical feature	LIV (+)	LIV (-)	p-value
Tremors	126 (84.0%)	118 (78.7%)	0.22
Anxiety	111 (74.0%)	105 (70.0%)	0.43
Sweating	103 (68.7%)	95 (63.3%)	0.38
Nausea/Vomiting	88 (58.7%)	80 (53.3%)	0.40
Hallucinations	41 (27.3%)	18 (12.0%)	<0.01
Delirium tremens	28 (18.7%)	10 (6.7%)	<0.01
Withdrawal seizures	24 (16.0%)	12 (8.0%)	<0.05

The mean peak CIWA-Ar score was significantly higher among patients with liver disease compared to patients without liver disease (18.2 ± 6.1 vs. 13.5 ± 5.2; p<0.001). The time taken to reach peak CIWA-Ar score was also longer in the LIV(+) group.

Table 3: Comparison of withdrawal severity

Variable	LIV (+) (n=150)	LIV (-) (n=150)	p-value
Mean peak CIWA-Ar score	18.2 ± 6.1	13.5 ± 5.2	<0.001
Time to peak CIWA-Ar (hours)	24.8 ± 10.6	16.1 ± 8.4	<0.001
Severe AWS (CIWA-Ar >15)	88 (58.7%)	46 (30.3%)	<0.001

Liver function abnormalities were significantly more common in patients with liver disease. Elevated serum bilirubin, AST, ALT, and prolonged INR were observed predominantly in the LIV(+) group. Thrombocytopenia and hypoalbuminemia were also significantly associated with liver disease.

Table 4: Laboratory findings among study participants

Variable	LIV (+) (n=150)	LIV (-) (n=150)	p-value
Serum bilirubin (mg/dL)	3.8 ± 2.1	1.1 ± 0.6	<0.001
AST (IU/L)	122 ± 56	58 ± 29	<0.001
ALT (IU/L)	88 ± 42	46 ± 21	<0.001
Serum albumin (g/dL)	2.9 ± 0.8	3.8 ± 0.6	<0.001
Platelet count (lakhs/mm^3)	1.18 ± 0.44	2.12 ± 0.61	<0.001

Patients with liver disease required significantly longer hospitalization and more intensive monitoring compared to those without liver disease. ICU admission, mechanical ventilation, and mortality were significantly higher in the LIV(+) group.

Table 5: Treatment outcomes among study participants

Outcome	LIV (+) (n=150)	LIV (-) (n=150)	p-value
Mean hospital stay (days)	7.8 ± 3.4	4.6 ± 2.1	<0.001
ICU admission	39 (26%)	15 (10.0%)	<0.01
Mechanical ventilation	16 (10.7%)	4 (2.7%)	<0.05
Delirium tremens	27 (18%)	10 (6.7%)	<0.01
Mortality	12 (8%)	3 (2%)	<0.05

Patients with liver disease were significantly more likely to develop severe alcohol withdrawal manifestations including seizures, delirium tremens, prolonged hospitalization, and ICU admission. A significant positive correlation was observed between peak CIWA-Ar score and duration of hospital stay ($r=0.62$, $p<0.001$).

DISCUSSION

Alcohol withdrawal syndrome (AWS) is a common and potentially life-threatening clinical condition encountered among patients with alcohol use disorder (AUD). Chronic excessive alcohol intake produces neuroadaptive changes in the central nervous system, and abrupt cessation of alcohol leads to autonomic hyperactivity and withdrawal manifestations ranging from mild tremors to seizures and delirium tremens.[3] The coexistence of liver disease further complicates the clinical course of AWS because hepatic dysfunction alters alcohol metabolism, affects drug clearance, predisposes to metabolic derangements, and increases susceptibility to severe complications.[8] The present study compared the clinical characteristics and treatment outcomes of AWS in patients with and without liver disease and demonstrated significantly greater withdrawal severity, prolonged hospitalization, higher ICU admissions, and increased mortality among patients with liver disease. In the present study, the mean age of patients with liver disease was significantly higher than patients without liver disease. Most patients belonged to the middle-aged group between 41 and 60 years. Similar findings were reported by Isazade et al., who observed that patients with liver disease presenting with AWS were generally older than those without hepatic involvement.[2] Chronic liver disease develops gradually following prolonged alcohol exposure; therefore, patients with liver dysfunction are expected to present later in life after years of sustained alcohol consumption. Additionally, cumulative hepatotoxicity, nutritional deficiencies, and repeated episodes of alcohol withdrawal may contribute to worsening clinical status with advancing age.

A marked male predominance was observed in both groups in the present study. These findings are consistent with studies conducted by Al-Maqbali et al. and Ratner et al., where most AWS admissions involved male patients.[1,8] The predominance of males may reflect higher prevalence of alcohol consumption among men due to sociocultural, occupational, and behavioral factors. In many developing countries, including India, alcohol intake among females remains underreported because of social stigma and cultural restrictions. Furthermore, men are more likely to engage in heavy episodic drinking and prolonged alcohol dependence, increasing the likelihood of severe withdrawal and alcohol-associated liver disease. The present study demonstrated that tremors, anxiety, sweating, nausea, vomiting, and insomnia were the most common presenting symptoms in both groups. These manifestations are classical features of autonomic hyperactivity seen during alcohol withdrawal and have been described extensively in previous literature.[4] However, severe symptoms such as hallucinations, delirium tremens, altered sensorium, and withdrawal seizures were significantly more common among patients with liver disease. Similar observations were reported by Isazade et al., who found higher rates of complicated withdrawal among hepatic patients.[2]

Several mechanisms may explain the increased severity of AWS in patients with liver disease. Chronic liver dysfunction results in impaired detoxification of neurotoxins and accumulation of ammonia and inflammatory mediators, which affect neurotransmitter balance within the central nervous system.[6] Long-standing alcohol use also causes adaptive downregulation of gamma-aminobutyric acid (GABA) inhibitory pathways and upregulation of excitatory glutamate pathways. When alcohol intake abruptly stops, unopposed excitatory neurotransmission leads to autonomic overactivity, agitation, hallucinations, and seizures.[9] In patients with liver disease, impaired metabolism of endogenous and exogenous substances further exacerbates neuropsychiatric manifestations. The incidence of delirium tremens was significantly higher among patients with liver disease in the present study. Delirium tremens is considered the most severe form of alcohol withdrawal and is associated with substantial mortality if untreated.[7] Ratner et al. emphasized that differentiating delirium tremens from hepatic encephalopathy may be clinically difficult because both conditions present with confusion, altered behavior, and fluctuating consciousness.[1] However, delirium tremens is usually characterized by hyperactive delirium with autonomic instability, agitation, tremulousness, and hallucinations, whereas hepatic encephalopathy often manifests with lethargy, asterixis, and hypoactive mental status.[10]

Withdrawal seizures were also significantly more common among hepatic patients in the present study. Alcohol withdrawal seizures are thought to result from neuronal hyperexcitability caused by abrupt cessation of alcohol intake.[11] Liver disease contributes additional risk factors including electrolyte imbalance, hypoglycemia, malnutrition, hypomagnesemia, and impaired drug metabolism. Furthermore, chronic hepatic dysfunction may predispose patients to coagulopathy and intracranial complications, increasing the risk of adverse neurological outcomes. The present study demonstrated significantly higher CIWA-Ar scores among patients with liver disease. The Clinical Institute Withdrawal Assessment for Alcohol-Revised (CIWA-Ar) scale is widely used for objective assessment of withdrawal severity and for guiding symptom-triggered therapy.[5] Higher CIWA-Ar scores among hepatic patients indicate more severe autonomic

and neuropsychiatric manifestations. Isazade et al. similarly reported elevated CIWA-Ar scores and delayed resolution of symptoms among patients with liver disease.[2] Another important observation in the present study was prolonged time to peak withdrawal severity among hepatic patients. Delayed onset and prolonged duration of severe withdrawal may result from altered pharmacokinetics, delayed alcohol clearance, and hepatic impairment affecting neurotransmitter homeostasis.[12] This finding has significant clinical implications because patients with liver disease require longer monitoring and careful dose titration of benzodiazepines to avoid oversedation and respiratory depression.

Laboratory investigations in the present study revealed significantly elevated bilirubin, AST, ALT, and prolonged coagulation profile among patients with liver disease. Hypoalbuminemia and thrombocytopenia were also more common in this group. These findings are consistent with chronic alcohol-associated liver disease and correlate with previous studies evaluating hepatic dysfunction among alcohol-dependent individuals.[1,13] AST elevation greater than ALT was observed in most patients with liver disease, which is characteristic of alcoholic liver injury.[14] Hypoalbuminemia reflects impaired hepatic synthetic function and poor nutritional status, while thrombocytopenia may result from portal hypertension, hypersplenism, and direct bone marrow suppression caused by alcohol toxicity.[15] These abnormalities contribute significantly to poor treatment outcomes because they predispose patients to infections, bleeding complications, and delayed recovery.

The present study found significantly longer hospital stay among patients with liver disease. Similar findings were reported by Al-Maqbali et al., who observed increased healthcare burden, prolonged inpatient care, and higher ICU utilization among AWS patients.[8] Prolonged hospitalization in hepatic patients may be explained by severe withdrawal manifestations, need for intensive monitoring, complications such as hepatic encephalopathy and infections, and delayed response to treatment. ICU admission rates were significantly higher among patients with liver disease in the present study. Severe AWS often requires close monitoring for respiratory failure, autonomic instability, seizures, and delirium tremens.[16] Patients with advanced liver disease are particularly vulnerable because even standard doses of sedatives may precipitate respiratory depression and encephalopathy. Consequently, ICU monitoring becomes necessary for titration of benzodiazepines, airway protection, hemodynamic support, and management of complications.

Mechanical ventilation was also significantly more common among hepatic patients. Respiratory compromise in these patients may occur secondary to severe agitation requiring heavy sedation, aspiration pneumonia, hepatic encephalopathy, sepsis, or multi-organ dysfunction.[17] Additionally, chronic malnutrition and muscle wasting in advanced liver disease may impair respiratory reserve and contribute to ventilatory failure.

The mortality rate in the present study was considerably higher among patients with liver disease. Similar observations have been reported in previous studies evaluating AWS outcomes in cirrhotic patients.[1,2] Mortality in AWS may result from complications such as delirium tremens, status epilepticus, aspiration pneumonia, sepsis, arrhythmias, and hepatic failure. Advanced liver disease independently worsens prognosis because of impaired immunity, coagulopathy, renal dysfunction, portal hypertension, and increased susceptibility to infections.

The present study also highlights the importance of individualized management strategies in patients with liver disease. Benzodiazepines remain the cornerstone of AWS treatment; however, drug selection is crucial in hepatic patients.[18] Long-acting benzodiazepines such as diazepam and chlordiazepoxide undergo extensive hepatic metabolism and may accumulate in patients with liver dysfunction, increasing the risk of oversedation and encephalopathy. Therefore, shorter-acting agents with minimal hepatic metabolism, such as lorazepam and oxazepam, are preferred in this population.[4]

Supportive therapy also plays a vital role in management. Thiamine supplementation is essential to prevent Wernicke’s encephalopathy, while correction of electrolyte abnormalities and nutritional deficiencies improves recovery.[19] Early recognition of severe withdrawal using standardized scoring systems and prompt ICU referral may reduce morbidity and mortality.

The present study has important clinical implications. First, liver disease should be recognized as a major predictor of severe AWS and poor treatment outcomes. Second, patients with hepatic dysfunction require prolonged monitoring and careful titration of sedatives. Third, multidisciplinary management involving internists, intensivists, hepatologists, psychiatrists, and addiction specialists may improve outcomes and reduce relapse rates. Despite its strengths, the present study had certain limitations. It was a single-center observational study, which may limit generalizability. Long-term follow-up regarding abstinence, relapse, and post-discharge outcomes was not performed. Additionally, distinguishing severe AWS from hepatic encephalopathy in some patients may have been clinically challenging despite careful evaluation. Nevertheless, the present study provides valuable insight into the clinical behavior and outcomes of AWS in patients with liver disease in the Indian setting. Given the increasing burden of alcohol-related disorders and

chronic liver disease in India, early identification and aggressive management of high-risk patients are essential to reduce complications and mortality.

CONCLUSION

The present study concludes that alcohol withdrawal syndrome in patients with coexisting liver disease is associated with significantly greater clinical severity and poorer treatment outcomes compared to patients without liver disease.

Patients with liver disease demonstrated:

- Higher CIWA-Ar scores
- Increased incidence of delirium tremens and withdrawal seizures
- Longer duration of hospitalization
- Greater requirement for ICU admission and ventilatory support
- Higher in-hospital mortality

Liver disease appears to be an important predictor of severe alcohol withdrawal and adverse outcomes. Early recognition, careful monitoring, timely ICU referral, and individualized benzodiazepine therapy are essential for reducing complications and improving prognosis in these patients. Further multicentric prospective studies with larger sample sizes are recommended to better understand the pathophysiology, prognostic indicators, and optimal treatment strategies for AWS in patients with liver disease.

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