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ALT and AST Enzyme Levels in Chronic Kidney Disease Patients Undergoing Hemodialysis

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ABSTRACT

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were commonly used as indicators of liver function. In patients with chronic kidney disease (CKD), particularly those undergoing hemodialysis (HD), levels of these enzymes were often found to be lower than in non-HD patients. This literature review aimed to examine changes in AST and ALT levels among CKD patients undergoing HD. Articles published between 2015 and 2025 were identified through Google Scholar and PubMed using the keywords "ALT AND AST AND Chronic Kidney Disease AND Hemodialysis." A total of nine studies met the inclusion criteria and were analyzed. Overall, AST and ALT levels were found to be consistently lower in HD patients compared with non-HD patients. Enzyme levels tended to increase following dialysis sessions, a change that was attributed to hemoconcentration and the removal of circulating enzyme inhibitors during the dialysis process. However, variation was observed across studies, which was linked to differences in dialysis protocols, timing of blood sampling, and patients' clinical conditions. These findings indicated that reduced liver enzyme levels in HD patients did not necessarily reflect normal liver function, but rather reflected dialysis-related factors and nutritional deficiencies commonly seen in this population. It was concluded that interpretation of liver function tests in CKD patients undergoing HD required careful consideration of dialysis-related variables and individual patient characteristics.

1. INTRODUCTION

Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are transaminase enzymes widely used in clinical practice as indicators of hepatocellular injury. Both enzymes are predominantly located within hepatocytes, so that elevated serum levels generally reflect liver cell injury or dysfunction. However, interpretation of AST and ALT levels is not always straightforward, as it can be influenced by various factors beyond liver damage, including nutritional status, body fluid volume, and the patient's systemic condition (Ahmed et al., 2023).

In patients with chronic kidney disease (CKD), particularly those who have reached the end stage and are undergoing hemodialysis, a different phenomenon from the general population has been observed. Various studies have shown that AST and ALT levels in hemodialysis patients tend to be lower compared to non-dialysis CKD patients and healthy individuals (Ahmed et al., 2023; Abo Bker et al., 2016; Agidew et al., 2023). This phenomenon is considered unusual, as low liver enzyme levels do not necessarily reflect better liver function, but may instead be influenced by physiological and metabolic changes occurring in hemodialysis patients. Therefore, understanding the factors underlying changes in AST and ALT levels is important to avoid clinical misinterpretation.

Several mechanisms have been proposed to explain the decrease in AST and ALT levels in hemodialysis patients. These mechanisms include hemodilution due to fluid retention, vitamin B6 deficiency—which acts as a coenzyme in transamination reactions—and possible changes in enzyme distribution or clearance related to the dialysis process (Xia et al., 2023). Nevertheless,

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the exact mechanism underlying the low AST and ALT levels in this population is not yet fully understood, and further study is needed to summarize the available evidence.

In addition to affecting the interpretation of liver function, changes in AST and ALT levels also carry important clinical relevance. Hemodialysis patients are known to have a higher risk of liver disorders, whether due to hepatitis virus infection associated with repeated medical exposure or the use of various medications with hepatotoxic potential. Under these circumstances, apparently low AST and ALT levels may lead to underdiagnosis or delayed detection of liver disorders if interpreted using the same reference values as the general population. Therefore, understanding the characteristics of liver enzymes in hemodialysis patients is an important aspect of daily clinical evaluation.

Beyond individual enzyme levels, the AST/ALT ratio has also been reported to have clinical value in CKD patients. This ratio is not only used to help assess liver disorders but has also been associated with metabolic conditions and cardiovascular risk, including chronic heart failure, which frequently accompanies CKD (Kim et al., 2018; Liu et al., 2021). These findings indicate that changes in AST and ALT in hemodialysis patients may carry broader implications beyond liver function assessment alone.

The number of patients undergoing hemodialysis continues to increase alongside the rising prevalence of CKD worldwide. In Indonesia, hemodialysis is the most widely used renal replacement therapy, with the number of active patients continuing to grow each year (PERNEFRI, 2021). This growing patient population increases the risk of delayed detection of liver disorders, while no standardized guidelines currently exist for interpreting AST and ALT levels specifically for the hemodialysis population. Reference values still used in clinical practice are based on the general population, which may lead to clinical misinterpretation when applied directly to hemodialysis patients without accounting for their specific characteristics.

Although various studies have reported decreased AST and ALT levels in hemodialysis patients, the results obtained still show variation across studies and have not yet produced a truly standardized conclusion regarding the pattern of change or its underlying mechanisms. Most available studies are also observational in nature, with diverse population characteristics. This condition creates a need for a literature review that can summarize and analyze the published scientific evidence. Based on the above description, this literature review aims to describe and analyze changes in AST and ALT levels in chronic kidney disease patients undergoing hemodialysis, as well as to identify the factors influencing these changes based on the available scientific literature.

2. METHOD

This study used a computer with internet access to conduct a literature search through two main databases, namely Google Scholar and PubMed. The keywords used were "ALT AND AST AND Chronic Kidney Disease AND Hemodialysis" in English and their Indonesian equivalents. Selected articles were publications from the period 2015–2025. This study is a literature review aimed at identifying, evaluating, and synthesizing scientific evidence related to aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels in chronic kidney disease (CKD) patients undergoing hemodialysis. Article selection was carried out in stages. The initial stage involved reviewing titles and abstracts to assess relevance to the topic, followed by reading the full text of the articles to confirm relevance and data completeness. The inclusion criteria in this study were articles written in Indonesian or English that discussed AST and ALT levels in CKD patients undergoing hemodialysis. The exclusion criteria included articles that were not accessible in full text, as well as articles that discussed liver disease without any relation to CKD or hemodialysis. The population examined consisted of CKD patients undergoing hemodialysis. The intervention analyzed was the hemodialysis procedure, compared against CKD patients not undergoing hemodialysis, as well as differences in AST and ALT levels before and after hemodialysis sessions. The outcome observed was the change in AST and ALT levels reported in each study.

The collected data were analyzed qualitatively using a narrative synthesis method. The results of each study were compared and synthesized to identify consistency of findings, variation between studies, and possible factors influencing changes in AST and ALT levels in hemodialysis patients.

3. RESULT AND DISCUSSION

Result

After conducting the literature search, nine journals meeting the criteria were identified and examined using the literature review method. The results of the literature review of these nine journals are presented in the following tables:

Table 1. Changes in AST and ALT Levels in Hemodialysis Patients Compared to Non-Hemodialysis

Author and Year	N (HD/Non-HD)	AST (HD) (IU/L)	AST (Non-HD) (IU/L)	ALT (HD) (IU/L)	ALT (Non-HD) (IU/L)
Abo Bker et al., 2016	80/40	15.0 ± 5.0	34.0 ± 7.0	10.0 ± 4.0	24.0 ± 7.0
Wally., 2016	50/55	18.48 ± 4.14	30.5 ± 10.75	16.82 ± 4.38	26.94 ± 13.07
Kumari et al., 2017	50/50	15.56 ± 7.34	27.43 ± 4.78	14.34 ± 5.98	33.98 ± 3.65
Allawi et al., 2017	50/50	17.48 ± 5.08	30.3 ± 12.9	16.78 ± 7.54	33.52 ± 15.11
Kakey et al., 2017	76/41	23.38 ± 1.29	34.79 ± 2.16	15.54 ± 0.86	25.87 ± 2.44
Khan et al., 2018	160/170	13.9 ± 1.1	23.0 ± 2.2	17.8 ± 1.1	28.53 ± 5.3
latiwesh et al., 2018	53/50	14.49	17.34	7.62	15.96
Kumar Jha et al., 2020	68/140	19.32 ± 10.80	27.42 ± 10.76	26.88 ± 41.97	32.86 ± 16.10
Agidew, 2023	40/60	5.71 ± 1.90	18.49 ± 5.72	4.41 ± 2.98	14.35 ± 8.36

Based on Table 1, the highest AST level among hemodialysis (HD) patients was reported by Kakey et al. (2017) at 23.38 ± 1.29 IU/L, while the lowest was reported by Agidew et al. (2023) at 5.71 ± 1.90 IU/L. For ALT levels, the highest value among HD patients was found in Kumar Jha et al. (2020) at 26.88 ± 41.97 IU/L, and the lowest in Agidew et al. (2023) at 4.41 ± 2.98 IU/L.

Table 2. Changes in AST and ALT Levels in CKD Patients Before and After Hemodialysis

Author and Year	N (HD)	AST Pra-HD (IU/L)	AST Pasca-HD (IU/L)	ALT Pra-HD (IU/L)
Abo Bker et al., 2016	20	13.0 ± 4.0	22.0 ± 4.0	8.0 ± 4.0
Wally., 2016	50	18.48 ± 4.14	10.08 ± 3.49	16.82 ± 4.38
Kakey et al., 2017	76	23.38 ± 1.29	27.12 ± 0.98	15.54 ± 0.86
Grant et al., 2018	14	16.0 ±3.8	21 ± 11.9	12.0 ± 5.8
Kumar Jha et al., 2020	68	19.32 ± 10.80	17.66 ± 8.84	26.88 ± 41.97

Based on Table 2, most studies reported an increase in AST and ALT levels following hemodialysis, as observed in the studies by Abo Bker et al. (2016), Kakey et al. (2017), and Grant et al. (2018). However, several other studies, such as Wally (2016) and Kumar Jha et al. (2020), instead showed a decrease in AST and ALT levels after hemodialysis. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are commonly used biochemical markers in the assessment of liver status. Based on the literature reviewed, patients with chronic kidney disease (CKD) undergoing hemodialysis generally had lower AST and ALT levels than non-hemodialysis individuals. This finding was observed across several studies, although the magnitude and direction of changes varied between studies. Hemodialysis patients compared with 34.0 ± 7.0 IU/L in non-hemodialysis individuals. Similar findings were reported by Wally (2016), Kumari et al. (2017), and Allawi et al. (2017), who also demonstrated lower AST levels among patients undergoing hemodialysis. These findings indicate that AST concentrations may be reduced in patients with CKD receiving hemodialysis.

ALT levels also tended to be lower in hemodialysis patients, although greater variability was observed among studies. Kumar Jha et al. (2020) reported an ALT level of 26.88 ± 41.97 IU/L in hemodialysis patients, whereas Agidew et al. (2023) reported a substantially lower ALT level of 4.41 ± 2.98 IU/L in hemodialysis patients compared with 14.35 ± 8.36 IU/L in non-hemodialysis individuals. These findings suggest considerable heterogeneity in ALT levels among patients undergoing hemodialysis. Several studies also evaluated changes in AST and ALT levels before and after hemodialysis. For AST, Abo Bker et al. (2016) reported an increase from 13.0 ± 4.0 U/L before hemodialysis to 22.0 ± 4.0 U/L after hemodialysis. Similarly, Kakey et al. (2017) reported an increase from 23.38 ± 1.29 U/L to 27.12 ± 0.98 U/L, while Grant et al. (2018) reported an increase from 16.0 ± 3.8 U/L to 21.0 ± 11.9 U/L. In contrast, Wally (2016) reported a decrease in AST from 18.48 ± 4.14 U/L to 10.08 ± 3.49 U/L, and Kumar Jha et al. (2020) reported a decrease from 19.32 ± 10.80 U/L to 17.66 ± 8.84 U/L.

A similar pattern of variability was observed for ALT. Abo Bker et al. (2016) reported an increase from 8.0 ± 4.0 U/L before hemodialysis to 17.0 ± 3.0 U/L after hemodialysis. Increases were also reported by Kakey et al. (2017), from 15.54 ± 0.86 U/L to 19.41 ± 0.83 U/L, and Grant et al. (2018), from 12.0 ± 5.8 U/L to 19.0 ± 17.8 U/L. Conversely, Wally (2016) reported a decrease

in ALT from 16.82 ± 4.38 U/L to 8.3 ± 3.58 U/L, while Kumar Jha et al. (2020) reported a decrease from 26.88 ± 41.97 U/L to 21.96 ± 11.76 U/L.

Discussion

The findings of this literature review indicate that AST and ALT levels in patients with CKD undergoing hemodialysis are generally lower than those observed in non-hemodialysis individuals. This finding is clinically relevant because reduced aminotransferase levels in patients undergoing hemodialysis do not necessarily indicate preserved liver function. Instead, they may reflect complex metabolic, nutritional, and physiological alterations associated with advanced CKD and the hemodialysis procedure.

Several mechanisms may contribute to the reduced AST and ALT levels observed in hemodialysis patients. One possible mechanism is hemodilution resulting from fluid retention, which may decrease the measured serum concentration of circulating enzymes. In addition, the accumulation of uremic toxins may alter hepatocellular metabolic activity and interfere with protein synthesis, potentially contributing to reduced aminotransferase concentrations. Protein-energy malnutrition, which is relatively common among patients undergoing hemodialysis, may further reduce the availability of substrates required for enzyme synthesis. The loss or removal of circulating enzymes during the dialysis process may also contribute to lower serum aminotransferase levels.

Another important factor is vitamin B6 (pyridoxal-5-phosphate) deficiency. Pyridoxal-5-phosphate is an essential cofactor for aminotransferase activity, and its deficiency may reduce the enzymatic activity of AST and ALT, resulting in lower serum concentrations. Therefore, the low aminotransferase levels observed in hemodialysis patients may reflect alterations in enzyme activity and metabolism rather than an absence of hepatic injury. This consideration is particularly important when interpreting liver biochemical parameters in patients with advanced CKD. The lower AST levels observed in several studies are consistent with previous observations that aminotransferase activity may be suppressed in patients undergoing chronic hemodialysis. Factors such as malnutrition, uremic toxin accumulation, impaired protein synthesis, and vitamin B6 deficiency may collectively contribute to this phenomenon (Kumari et al., 2017; Khan et al., 2018). Furthermore, underlying liver conditions and comorbidities may influence aminotransferase concentrations and should therefore be considered when interpreting these findings.

Although AST and ALT were generally lower in hemodialysis patients than in non-hemodialysis individuals, changes occurring during a single hemodialysis session were inconsistent. Some studies demonstrated an increase in AST and ALT after hemodialysis, whereas others reported a decrease. The increase in aminotransferase levels observed in studies by Abo Bker et al. (2016), Kakey et al. (2017), and Grant et al. (2018) may be associated with hemodynamic changes, oxidative stress, inflammatory responses, or hemoconcentration resulting from fluid removal during dialysis. Hemoconcentration may increase the measured concentration of circulating enzymes even without new hepatic injury.

In contrast, the decreases in AST and ALT reported by Wally (2016) and Kumar Jha et al. (2020) may be related to changes in intravascular and extracellular fluid distribution, removal of circulating substances during dialysis, or alterations in the metabolic environment following uremic toxin clearance. Differences in dialysis techniques and patient characteristics may also contribute to these opposing findings. Thus, the acute effect of hemodialysis on aminotransferase levels cannot be explained by a single mechanism. The considerable heterogeneity among studies may also be explained by differences in patient age, duration of CKD, duration of hemodialysis treatment, dialysis frequency and duration, dialyzer membrane characteristics, nutritional status, inflammatory status, and laboratory measurement methods. In addition, comorbid conditions such as hepatitis B or hepatitis C infection, congestive heart failure, fatty liver disease, and diabetes mellitus may affect aminotransferase levels. Medication use and other underlying hepatic conditions may further contribute to inter-study variability (Allawi et al., 2017; Kakey et al., 2017; Latiwesh et al., 2018).

Overall, the findings suggest that aminotransferase concentrations in hemodialysis patients are determined by multiple interacting mechanisms. The generally lower AST and ALT levels compared with non-hemodialysis individuals may reflect a combination of hemodilution, uremic toxin accumulation, impaired protein synthesis, enzyme removal during dialysis, protein-energy malnutrition, and vitamin B6 deficiency. Meanwhile, the inconsistent changes observed before and after individual hemodialysis sessions indicate that the immediate effect of dialysis on aminotransferase levels is more complex and may depend on the balance between hemoconcentration, fluid redistribution, enzyme removal, metabolic changes, and patient-specific factors.

From a clinical perspective, AST and ALT levels should therefore be interpreted cautiously in patients undergoing hemodialysis. A low aminotransferase level should not automatically be interpreted as evidence of normal hepatic function. Assessment of liver status in this population should instead incorporate the patient's clinical condition, nutritional status, comorbidities, and other relevant biochemical parameters. Further prospective studies with larger sample sizes and better control of nutritional status, inflammation, comorbidities, and dialysis-related factors are warranted to clarify the mechanisms underlying changes in aminotransferase levels in patients undergoing hemodialysis.

In conclusion, this literature review demonstrates that AST and ALT levels are generally lower in patients undergoing hemodialysis than in non-hemodialysis individuals, whereas changes in aminotransferase levels before and after hemodialysis are inconsistent across studies. These findings indicate that the relationship between hemodialysis and liver enzyme levels is complex and multifactorial. The findings therefore support the importance of cautious and comprehensive interpretation of AST and ALT levels in patients with CKD undergoing hemodialysis.

4. CONCLUSION

The findings of this literature review indicate that AST and ALT levels in patients with chronic kidney disease undergoing hemodialysis differ from those observed in non-hemodialysis populations, reflecting the potential effects of uremia, nutritional status, and the hemodialysis process on liver enzyme levels. Although AST and ALT levels tend to be lower in hemodialysis patients, changes in enzyme levels before and after hemodialysis are variable, suggesting that the relationship between hemodialysis and liver enzyme levels is complex and multifactorial. Therefore, liver enzyme measurements should not be used as the sole parameters for assessing hepatic status in patients undergoing hemodialysis. Instead, AST and ALT results should be interpreted in conjunction with the patient's clinical condition, nutritional status, comorbidities, and other relevant laboratory parameters to improve the accuracy of hepatic assessment.

In clinical practice, physicians and healthcare professionals managing patients with chronic kidney disease undergoing hemodialysis are advised to interpret AST and ALT levels cautiously and to consider additional clinical and laboratory parameters when evaluating hepatic status. A comprehensive approach may facilitate the early detection of underlying hepatic abnormalities that could otherwise be overlooked because of relatively low aminotransferase levels. Further research is recommended to clarify the relationship between hemodialysis and liver enzyme levels through prospective studies involving larger sample sizes and better control of potential confounding factors, particularly nutritional status, inflammation, comorbidities, and dialysis protocols. Such studies may provide a more comprehensive understanding of the mechanisms underlying changes in AST and ALT levels among patients undergoing hemodialysis.

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