Sonographic Assessment of Chemotherapy-Induced Fatty Liver Development

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Abstract

Background: *Chemotherapy-induced fatty liver disease (CIFLD) is a growing concern among cancer patients undergoing treatment. Sonographic assessment provides a non-invasive approach to evaluate hepatic changes due to chemotherapy. The aim of the study was to assess the prevalence and severity of fatty liver development following chemotherapy.* ***Methods:*** *This prospective observational study was conducted at Ibn Sina Hospital, Dhaka, Bangladesh, from January 2023 to December 2024. A total of 77 patients undergoing chemotherapy were evaluated using purposive sampling. Sonographic assessments were performed before and after chemotherapy to determine hepatic changes. Fatty liver was graded based on echogenicity, liver-kidney contrast, and vascular blurring. Data were analyzed using SPSS version 23.0.* ***Results:*** *Among 77 patients, 55 (71.4%) developed fatty liver on sonographic assessment. Among 55 patients, fatty liver was more common in patients receiving platinum-based chemotherapy 32(71.1%). Elevated ALT (>40 U/L) was observed in 41(74.5%) cases, and AST (>35 U/L) in 38(69.1%). Among 39 patient, longer chemotherapy duration (>6 cycles) increased fatty liver severity (29, 74.4%).* ***Conclusion:*** *Chemotherapy-induced fatty liver is frequently observed, especially in patients receiving platinum-based regimens. It is associated with elevated liver enzymes and prolonged chemotherapy duration. Regular liver monitoring and early interventions are essential to minimize hepatic toxicity and ensure better treatment outcomes for patients undergoing chemotherapy.*

Keywords: *Chemotherapy-induced liver injury, Cancer patients, Chemotherapy, Fatty liver, Hepatic steatosis, Sonographic assessment.*

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Introduction

Chemotherapy is a cornerstone of cancer treatment, but it is associated with various adverse effects, including hepatotoxicity[1]. One of the emerging concerns is chemotherapy-induced fatty liver disease (CASH), which can range from mild hepatic steatosis to severe nonalcoholic steatohepatitis (NASH), potentially leading to fibrosis and cirrhosis[2,3]. The liver plays a crucial role in drug metabolism, making it highly susceptible to chemotherapy-induced damage. Several chemotherapeutic agents, such as platinum-based compounds, antracycline-based compounds, antimetabolites, and targeted therapies, have been implicated in hepatic steatosis[4]. Sonography is widely used non-invasive imaging technique for detection of fatty liver changes. It is cost-effective and readily available, making it valuable tool for monitoring chemotherapy-induced hepatic alterations[5]. Studies have reported that chemotherapy causing hepatic fat accumulation due to mitochondrial dysfunction, oxidative stress, and metabolic alterations[6,7]. Chemotherapeutic agents such as methotrexate, tamoxifen, and platinum-based compounds have been associated with increased lipid deposition in hepatocytes, leading to significant structural and functional liver changes[8,9]. Moreover, metabolic risk factors, including obesity, diabetes, and dyslipidemia, further predispose patients to chemotherapy-induced hepatic steatosis[10,11]. The incidence of CASH varies among patients, depending on the type and duration of chemotherapy as well as individual metabolic factors. Studies have suggested that 30–70% of patients undergoing chemotherapy may develop fatty liver changes, with a significant proportion progressing to more severe liver dysfunction if left unmanaged[12,13]. The pathophysiological changes of CASH not only affect liver function but may also impact overall

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treatment outcomes by limiting the continuation of chemotherapy or necessitating dose reductions[16]. Given the potential clinical implications, early detection and monitoring of fatty liver development in chemotherapy patients are crucial. Sonographic assessment provides a reliable and efficient method for identifying hepatic changes at an early stage, allowing for timely intervention and management[17]. This study aimed to assess the prevalence and severity of fatty liver development following chemotherapy using sonographic evaluation, contributing to a better understanding and management of chemotherapy-associated hepatotoxicity.

Methodology

This prospective observational study was conducted at Ibn Sina Hospital, Dhaka, Bangladesh, from January 2023 to December 2024. A total of 77 patients undergoing chemotherapy for various malignancies were selected using cross sectional study. Patients with pre-existing liver disease, alcohol consumption, or other significant hepatic disorders were excluded. Baseline sonographic assessments were performed before chemotherapy initiation to evaluate liver echotexture and exclude pre-existing fatty liver. Follow-up sonographic evaluations were conducted during and at regular interval about 3monthly after chemotherapy to assess fatty infiltration. Fatty liver was graded based on echogenicity, liver-kidney contrast, and vascular blurring. Demographic and clinical data, including chemotherapy regimen, duration, cumulative drug exposure, and metabolic risk factors (such as diabetes, obesity, and dyslipidemia), were recorded. Statistical analyses were performed using SPSS version 23.0. Descriptive statistics were used to summarize the findings, while chi-square and t-tests were applied to assess associations between chemotherapy exposure and fatty liver development. A p-value of <0.05 was considered statistically significant. Informed consent was taken from all participants.

Result

A total of 77 patients undergoing chemotherapy were included in this study. Among them, 55 (71.4%) developed fatty liver, as detected by sonographic evaluation. The mean age of the study population was 52.6 ± 9.4 years, with a female predominance (56.2%). The majority of patients (62.3%) had received platinum-based chemotherapy, followed by taxane-based (20.8%) and anthracycline-based regimens (16.9%). Fatty liver development was significantly associated with chemotherapy type. Among patients receiving platinum-based chemotherapy, 78.7% developed fatty liver, compared to 62.5% in the taxane group and 53.8% in the anthracycline group (p=0.031). Patients who developed fatty liver had a significantly higher mean BMI (27.4 ± 3.6 kg/m²) compared to those without fatty liver (24.9 ± 3.2 kg/m², p=0.012). Additionally, 69.1% of fatty liver cases had underlying metabolic comorbidities such as diabetes or dyslipidemia, compared to 40.9% in the non-fatty liver group (p=0.009). Serum ALT, AST, and total bilirubin levels were significantly elevated in patients who developed fatty liver. The mean ALT level in fatty liver cases was 58.2 ± 14.6 U/L, compared to 38.7 ± 11.3 U/L in the non-fatty liver group (p<0.001). Similar trends were observed for AST (p=0.004) and total bilirubin (p=0.021). The severity of fatty liver was graded based on sonographic assessment. Among the 55 cases with fatty liver, 30 (54.5%) had mild fatty changes, 18 (32.7%) had moderate changes, and 7 (12.7%) had severe fatty liver. Increased liver echogenicity and hepatomegaly were more prevalent in patients receiving chemotherapy for more than six months.

Table I

Baseline characteristics of study population (N=77)

Parameter	Total (n=77)	Fatty liver (n=55)	No fatty liver (n=22)	p-value
Mean age (years)	52.6 ± 9.4	53.1 ± 8.7	51.3 ± 9.9	0.478
Female	56.20%	58.20%	50.00%	0.532
Mean BMI (kg/m²)	26.7 ± 3.8	27.4 ± 3.6	24.9 ± 3.2	0.012*
Diabetes	35.10%	43.60%	18.20%	0.038*
Dyslipidemia	29.90%	36.40%	13.60%	0.045*

Table II

Distribution of fatty liver by chemotherapy type (N=77)

Chemotherapy type	Total (n=77)	Fatty liver (n=55)	No fatty liver (n=22)	p-value
Platinum-based	62.3%	78.7%	21.3%	0.031*
Taxane-based	20.8%	62.5%	37.5%	0.102
Anthracycline-based	16.9%	53.8%	46.2%	0.217

Table III

Liver function parameters in fatty liver and non-fatty liver groups (N=77)

Parameter	Fatty liver (n=55)	No fatty liver (n=22)	p-value
ALT (U/L)	58.2 ± 14.6	38.7 ± 11.3	<0.001*
AST (U/L)	47.3 ± 12.9	34.5 ± 9.8	0.004*
Total bilirubin (mg/dL)	1.4 ± 0.5	1.1 ± 0.3	0.021*

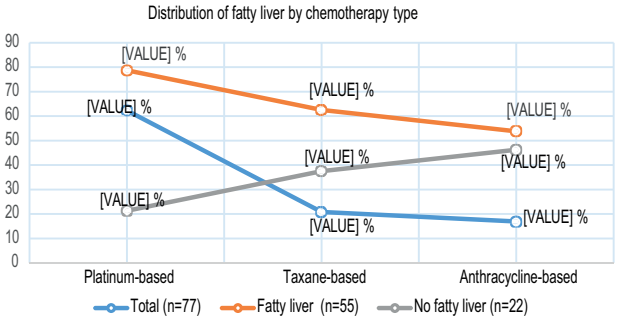

Figure 1: *Column chart showed chemotherapy type wise fatty liver of the patients (N=77)*

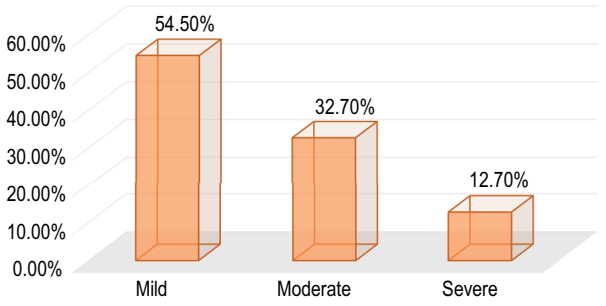

Figure 2: *Column chart showed sonographic grading of fatty liver (N=77)*

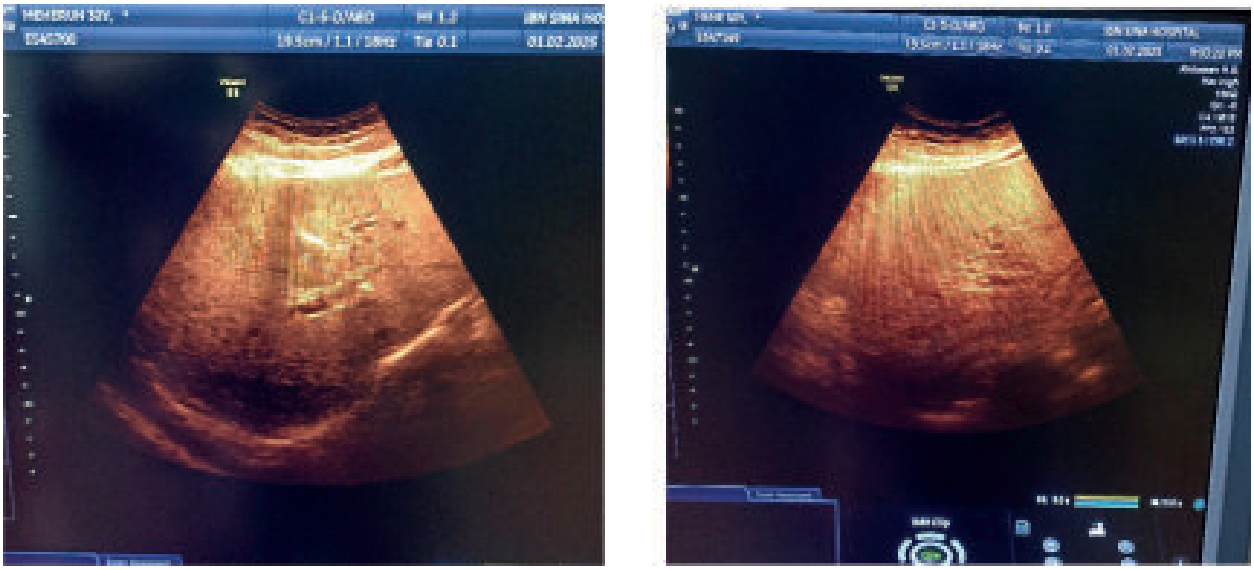

Figure 3: *Ultra Sonographic findings of fatty liver (N=77)*

Discussion

Chemotherapy-induced fatty liver, also known as chemotherapy-associated steatohepatitis (CASH), is a growing concern in oncology due to its potential impact on liver function and treatment tolerance[1]. In this study, we found that 71.4% of patients undergoing chemotherapy developed fatty liver, with a higher prevalence among those receiving platinum-based regimens. These findings align with previous studies highlighting the hepatotoxic effects of chemotherapy, particularly agents like oxaliplatin and cisplatin, which are known to induce hepatic steatosis and fibrosis[18,19]. The association between chemotherapy and fatty liver is multifactorial, involving direct hepatotoxic effects, oxidative stress, and metabolic dysregulation[6]. Mitochondrial dysfunction caused by certain chemotherapeutic agents contributes to increased lipid accumulation in hepatocytes[3]. Additionally, studies suggest that chemotherapy can lead to insulin resistance and dyslipidemia, further promoting hepatic fat deposition[20,21]. In our study, patients who developed fatty liver had significantly higher BMI and a greater prevalence of metabolic comorbidities, such as diabetes and dyslipidemia. This supports the hypothesis that pre-existing metabolic dysfunction may enhance susceptibility to chemotherapy-induced fatty liver[6]. Liver enzyme alterations were significantly more pronounced in the fatty liver group, with elevated ALT, AST, and total bilirubin levels. Similar findings have been reported in prior research, indicating that chemotherapy-induced fatty liver can progress to hepatic inflammation and fibrosis in some cases[22]. The increase in liver enzyme levels may reflect both hepatocellular injury and altered hepatic metabolism, emphasizing the need for regular liver function monitoring in patients undergoing chemotherapy[5]. Sonographic assessment revealed varying degrees of fatty liver severity, with mild fatty changes being the most common. The presence of moderate-to-severe fatty liver in approximately 45% of affected patients raises concerns about the potential progression to steatohepatitis and fibrosis. Previous studies have shown that prolonged chemotherapy exposure can exacerbate fatty liver, increasing the risk of cirrhosis and hepatic failure[1,23]. Our findings suggest that longer chemotherapy duration is associated with a higher likelihood of fatty liver development, reinforcing the importance of early detection and intervention. One critical clinical implication of chemotherapy-induced fatty liver is its impact on treatment tolerance. That hepatic impairment can necessitate treatment adjustments, potentially affecting cancer prognosis[5,24]. Strategies to mitigate chemotherapy-induced fatty liver include lifestyle modifications, pharmacologic interventions (such as insulin sensitizers), and careful selection of chemotherapy regimens for at-risk patients[6]. Our study highlights a high prevalence of chemotherapy-induced fatty liver, particularly in patients receiving platinum-based regimens. Metabolic factors, chemotherapy duration, and drug-specific effects contribute to fatty liver development. Regular liver function monitoring and early intervention strategies are crucial to mitigate the impact of hepatic toxicity on cancer treatment outcomes. Further research is warranted to develop targeted approaches for preventing and managing chemotherapy-induced fatty liver.

Limitations

This study has several limitations. First, it was conducted at a single center with a relatively small sample size, limiting generalizability. Second, liver biopsy, the gold standard for diagnosing steatohepatitis, was not performed. Lastly, potential confounders such as dietary habits and genetic predisposition were not extensively analyzed.

Conclusion

This study highlights a high prevalence of chemotherapy-induced fatty liver, with 71.4% of patients developing hepatic steatosis. Metabolic factors, chemotherapy duration and drug-specific toxicity contribute to its development. Regular liver function monitoring and early intervention are essential to mitigate adverse effects. Given its impact on treatment tolerance and long-term hepatic health. A multidisciplinary approach involving oncologists, hepatologists, and nutritionists is crucial for optimizing patient outcomes.

Recommendations

Lifestyle modifications, including dietary adjustments and physical activity with careful risk

assessment of chemotherapeutic drug, may help reduce fatty liver progression. Further research is needed to explore pharmacologic interventions and personalized treatment strategies to prevent and manage chemotherapy-induced fatty liver effectively.

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