International Journal of Medical and Health Sciences
Volume 11 Issue 02 June 2025
ISSN- 2456 - 6063
DOI: **https://doi.org/10.69980/r7e52w77**

CLINICAL EVALUATION OF BIOCHEMICAL MARKERS IN HEPATITIS C AND ASSOCIATED LIVER DISEASES

Dr. Harpreet Singh[1], Dr. Kavya Srinivasan[2], Dr. Rajeev Malhotra[3], Dr. Nida Rahman[4], Dr. Sandeep Choudhury[5]

[1] Department of Gastroenterology, Postgraduate Institute of Medical Education and Research, Chandigarh, India
[2] Department of Biochemistry, Madras Medical College, Chennai, Tamil Nadu, India
[3] Department of Hepatology, Institute of Liver and Biliary Sciences, New Delhi, India
[4] Department of Microbiology, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India
[5] Department of Internal Medicine, Assam Medical College, Dibrugarh, Assam, India Email: harpreet.singh@pgimer.edu.in

Received:- 24/03/25	Revised:-26/04/25	Accepted:-27/05/25	Published:- 29/06/25

Abstract
Hepatitis C is a significant liver disease, which may progress from minimal hepatic inflammation to fibrosis and cirrhosis. Laboratory measures give valuable information about liver damage, dysfunction and disease progression. This research examined biochemical marker profiles in a Hepatitis C dataset of blood donors, hepatitis, fibrosis and cirrhosis cases. Biochemical markers, such as AST, BIL, GGT, ALB, CHE, CREA, ALT, ALP, CHOL and PROT were evaluated using descriptive statistics, group comparison, trend analysis, and cirrhosis deviation. Biochemical differences between groups were observed. The highest variation was observed in cirrhosis cases, with an increase in AST, BIL, GGT, and CREA and decrease in ALB and CHE compared to blood donor group. These suggest that severe liver damage is linked to multiple biochemical dysfunction related to liver cell damage, bile metabolism, decreased synthetic capacity, and potentially other systems. The research demonstrates the potential of biochemical profiling as a feasible and understandable means of evaluating the impact of Hepatitis C-associated liver disease. While conventional markers should not be used to diagnose liver disease, their integrated assessment may contribute to early identification, follow-up, and risk assessment of progressive liver disease.

Keywords: Hepatitis C; Biochemical markers; Liver disease; Cirrhosis; Liver function tests.

1. Introduction

Hepatitis C virus (HCV) infection is a serious medical and public health issue due to its close link with the development of chronic liver disease, fibrosis, cirrhosis and subsequent hepatic complications. Silent disease can develop in the initial phases of the disease, and the liver damage can develop before clinical manifestations occur. Thus, regular laboratory testing is crucial in the detection of biochemical changes associated with HCV infection and liver damage (Bagheri et al., 2024). Biochemical and hematological values were found to be effective early predictive indicators to diagnose HCV infection and to comprehend alterations in liver functions caused by the disease.

Liver is a key organ in the metabolism, detoxification and bile processing as well as protein synthesis. Damage to hepatic cells and/or impairment of liver function can result in subsequent changes in serum biochemical parameters. Typical markers include alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), bilirubin, albumin, cholinesterase (CHE), cholesterol, creatinine and total (Tamber et al., 2023). These markers are common clinical indicators to assess liver damage, malfunctioning, and the severity of the disease. Biomarkers of liver diseases have been acknowledged as important markers of hepatic injury and aiding clinical decision-making.

The liver disease caused by HCV typically has a progressive clinical course. Infection may cause initial hepatic inflammation, and eventually fibrosis and cirrhosis in some individuals. These changes are associated with biochemical changes that reflect a worsening of liver injury and a decrease in liver function. High aminotransferases, in particular, AST and ALT are typically associated with hepatocellular damage, and the presence of elevated bilirubin can suggest the lack of bile metabolism. Increased GGT may be associated with a cholestatic injury or liver stress. Conversely, decreased albumin and cholinesterase could be a sign of poor hepatic synthetic capacity, especially in terminal liver disease.

Non-invasive biomarkers are particularly valuable in the evaluation of liver diseases as they can provide information of clinical significance without the risks of invasive tests, such as liver biopsy. Biomarker assessment in HCV cirrhosis can help diagnose early stages of advanced liver disease and aid in patient management. Suan et al. (2022) presented the diagnostic characteristics of non-invasive biomarkers in HCV-related cirrhosis, which could justify the use of biochemical indicators to assess the severity of the disease. This highlights the need for further investigation into the common markers in various clinical classes such as blood donors, hepatitis, cirrhosis and fibrosis.

Other recent studies have further demonstrated the diagnostic potential of biomarker methods for HCV. Biomarkers can help not only to detect infection but also disease progression, systemic disease and treatment response. Woo and Choi (2024) reiterated that biomarkers are important in identifying HCV infection, and they will be relevant in clinical assessment. Likewise, Saeed et al. (2023) observed the association of HCV with various clinical markers such as ALT, AST, GGT, total bilirubin, creatinine and other markers, which also highlights the need for biochemical profiling for disease evaluation.

Biochemical changes may also occur in patients with chronic HCV with coexisting conditions, such as diabetes. Such alterations may affect the severity of the disease and interpretation of biochemical results. According to Abdo et al. (2021), sustained virological response (SVR) following antiviral therapy may have an impact on metabolic complications among diabetic patients with chronic HCV. This indicates that when interpreting biochemical markers in HCV, the context of liver function, metabolic derangements and disease stage could all play a role.

Biochemical abnormalities are more significant and evident in advanced liver disease, such as cirrhosis. Elevated AST, bilirubin, GGT and creatinine may reflect severe liver disease or complications and low albumin and cholinesterase may reflect reduced synthetic function. Research on biochemical markers in cirrhosis and its various forms has also proved the clinical value of marker-mediated distinction of states of liver disease (Pasha et al., 2020). Also, liver function and fibrosis have been positively linked with biochemical marker variations among chronic liver disease patients (Fang et al., 2024).

This study examines a Hepatitis C dataset which includes data from blood donors, hepatitis, fibrosis and cirrhosis patients. The data contains demographic data, regularly measured biochemical markers, which make it possible to systematically analyze the distribution of markers and disease-specific changes. This study deals with descriptive analysis, comparison between groups, trends and biochemical variations in cirrhosis. The specific focus is made on AST, BIL, GGT, ALB, CHE and CREA due to clinical meaningful differences observed between the analyzed groups.

The importance of this study is that it introduces laboratory parameters that are readily available to assess changes in biochemicals in relation to conditions of HCV and liver disease. Comparing healthy and disease groups, the study gives insight into biochemical changes associated with disease development. The results could help to interpret the liver function markers and aid in clinical decision making of biochemical changes in hepatitis, fibrosis and cirrhosis. The study aims are:

1. To evaluate the overall biochemical marker profile of the Hepatitis C dataset.
2. To analyze biochemical marker variations across blood donor, hepatitis, fibrosis, and cirrhosis groups.
3. To evaluate major biochemical deviations associated with cirrhosis compared with blood donor records.

2. Methodology

2.1 Research Design

The Hepatitis C data was examined to explore the clinical significance of biochemical markers profiles against the Hepatitis C and liver disease-related conditions (Soriano, 2021). The research design used in this study was quantitative analytical research as the data was made up of measurable clinical laboratory values. This study was observational because it did not involve any experimental intervention, but instead, the existing patient laboratory records were analyzed. The principal objective was to investigate the changes in biochemical markers in various clinical groups such as blood donors, suspected blood donors, Hepatitis C patients, fibrosis patients and cirrhosis patients. This was an appropriate design to determine the pattern of biochemical changes that were related to the liver disease status and progression.

2.2 Data Source and Sample

The dataset was based on 615 observations based on lab records on blood donors and patients with Hepatitis C-related issues. The data consisted of demographic data and blood test results of a biochemical test. Age, sex, albumin, alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase, bilirubin, cholinesterase, cholesterol, creatinine, gamma-glutamyl transferase, total protein and clinical category were the variables. These variables offered pertinent clinical and pathological data on evaluation of liver functioning and sickness severity. The analysis was done on all valid observations in the dataset. Statistical and clinical interpretation of the dataset was preceded by reviewing data to ensure completeness, consistency, and appropriateness.

2.3 Variables and Measures

The primary outcome variable was the category of clinical status, which was the type of health of a particular individual. These were the categories of blood donor, suspected blood donor, Hepatitis C, fibrosis and cirrhosis. Independent variables were biochemical markers and demographics. Demographic variables were age and sex and the biochemical variables were albumin, alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase, bilirubin, cholinesterase, cholesterol, creatinine, gamma-glutamyl transferase, and total protein. ALT and AST were regarded as significant signs of hepatocellular damage, whereas ALP and GGT were connected with liver and biliary pathologies. The bilirubin was a measure of liver excretory capacity and albumin and total protein were a measure of liver synthetic capacity. These variables were chosen as they are the clinically important variables of Hepatitis C and progressive liver damage.

2.4 Data Processing and Preparation

The data was also treated to maintain an analytical accuracy and reliability before analysis. Data structure, variable names, data types and completeness of records were analyzed. The cases of missing values were determined in some biochemical variables of interest and addressed with appropriate statistical treatment to minimize the bias in the interpretation. The categorical variable sex was transformed to an appropriate form of analysis, whereas the clinical category variable was kept to compare groups of analyzing them. Abnormal or extreme values of numerical biochemical indicators were screened. Because the values of clinical labs can be inherently different between healthy and diseased patients, there was no automatic filtering of extreme values unless they were evidently not in line with the dataset format. This pre-treatment made sure that the data set was suitable to undergo descriptive, comparative, and clinical analysis of Hepatitis C-related biochemical profiles.

2.5 Data Analysis Technique

The analysis was carried out into two significant steps. The demographic and biochemical characteristics of the data were summarized using first, the descriptive statistics. Mean, standard deviation, minimum and maximum values of the continuous variables were used to indicate the values and frequencies and percentages were used to indicate frequencies and percentages of the categorical variables respectively. Second, analysis was conducted through comparing and associating to investigate variations in biochemical markers in clinical groups. The profiles of the blood donors were compared to the profiles of Hepatitis C, fibrosis and cirrhosis cases to determine the biochemical changes in the course of the disease. ALT, AST, bilirubin, albumin, GGT, and total protein were given special attention since these are highly correlated with liver damage, liver functioning and severity of the disease. The last interpretation concentrated on the determination of clinically meaningful biochemical patterns that would help in comprehending the progression of the liver disease and Hepatitis C.

3. Results

3.1 Descriptive Statistical Analysis of Biochemical Markers

The descriptive statistics were calculated to give an overview of the general distribution of the biochemical markers of the Hepatitis C dataset. The findings revealed a broad range of liver-related markers including ALT, AST, BIL, CREA, and GGT indicating variation in the biochemical profiles in the clinical records. The general descriptive statistics are in Table 1.

Table 1. Overall Descriptive Statistics of Biochemical Markers

Parameter	Mean	SD	Minimum	Maximum
ALB	41.62	5.78	14.90	82.20
ALP	68.28	26.03	11.30	416.60
ALT	28.45	25.47	0.90	325.30
AST	34.79	33.09	10.60	324.00
BIL	11.40	19.67	0.80	254.00
CHE	8.20	2.21	1.42	16.41
CHOL	5.37	1.13	1.43	9.67
CREA	81.29	49.76	8.00	1079.10
GGT	39.53	54.30	4.50	650.90
PROT	72.04	5.40	44.80	90.00

3.2 Group-wise Comparative Analysis

Mean values of each group were done to test the difference in biochemical parameters between blood donor, hepatitis, fibrosis, and cirrhosis groups. Table 2 indicated that cases of cirrhosis had the highest mean values of AST, BIL, CREA, and GGT than the blood donor group. Conversely, ALB, CHE and CHOL had lower cases of cirrhosis, which implies a diminished liver functional capacity. Figure 1 indicates that AST, BIL, and GGT levels were more elevated in disease-related subcategories, especially cirrhosis. Conversely, ALB was lower in the cirrhosis group, suggesting that there was a different biochemical profile in severe liver disease.

Table 2. Mean Values of Biochemical Markers Across Clinical Groups

Marker	Blood Donor	Hepatitis	Fibrosis	Cirrhosis
ALB	42.24	43.83	41.76	32.48
ALP	68.37	42.11	37.84	93.22
ALT	26.63	26.90	59.60	22.97
AST	26.55	75.73	81.17	107.46
BIL	8.53	15.62	13.43	59.13
CHE	8.40	9.28	8.33	3.82
CHOL	5.49	5.10	4.60	4.01
CREA	78.98	73.96	73.49	138.22
GGT	29.04	92.58	79.55	129.44
PROT	72.11	74.70	76.10	70.05

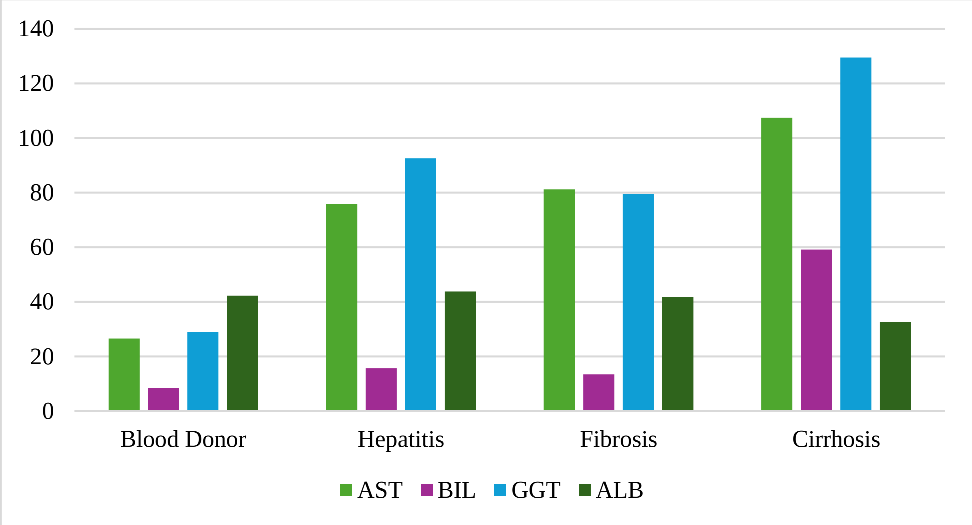

Figure 1. Comparative Distribution of Key Biochemical Markers (AST, BIL, GGT, and ALB) Across Clinical Groups

3.3 Variation of Liver Function Markers

The trend analysis was performed on the markers that are directly related to liver functioning and severity of the disease. Table 3 indicates that AST, BIL, and GGT exhibited an upward trend with blood donor history to cirrhosis with a downward trend in ALB and CHE in severe liver disease. These alterations suggest a definite biochemical alteration that is linked to progressive hepatic involvement.

Table 3. Trend Analysis of Key Markers

Marker	Blood Donor	Hepatitis	Fibrosis	Cirrhosis	Trend
AST	26.55	75.73	81.17	107.46	Increasing
BIL	8.53	15.62	13.43	59.13	Increasing
GGT	29.04	92.58	79.55	129.44	Increasing
ALB	42.24	43.83	41.76	32.48	Decreasing
CHE	8.40	9.28	8.33	3.82	Decreasing

3.4 Identification of Clinical Deviations in Cirrhosis

The greatest deviation was observed in cirrhosis compared to blood donor group. Table 4 demonstrates that cirrhosis group had higher AST, BIL, CREA, and GGT and lower ALB and CHE. These data suggest that the biochemical profile of cirrhosis records was the most changed among the considered clinical groups. As illustrated in Figure 2, there were significant biochemical deviations in cirrhosis cases than in blood donors. AST, BIL, CREA and GGT were elevated and ALB and CHE were decreased in the cirrhosis group.

Table 4. Comparison of Cirrhosis with Blood Donor Group

Marker	Blood Donor	Cirrhosis	Difference
ALB	42.24	32.48	↓ 9.76
AST	26.55	107.46	↑ 80.91
BIL	8.53	59.13	↑ 50.60
CHE	8.40	3.82	↓ 4.58
CREA	78.98	138.22	↑ 59.24
GGT	29.04	129.44	↑ 100.40

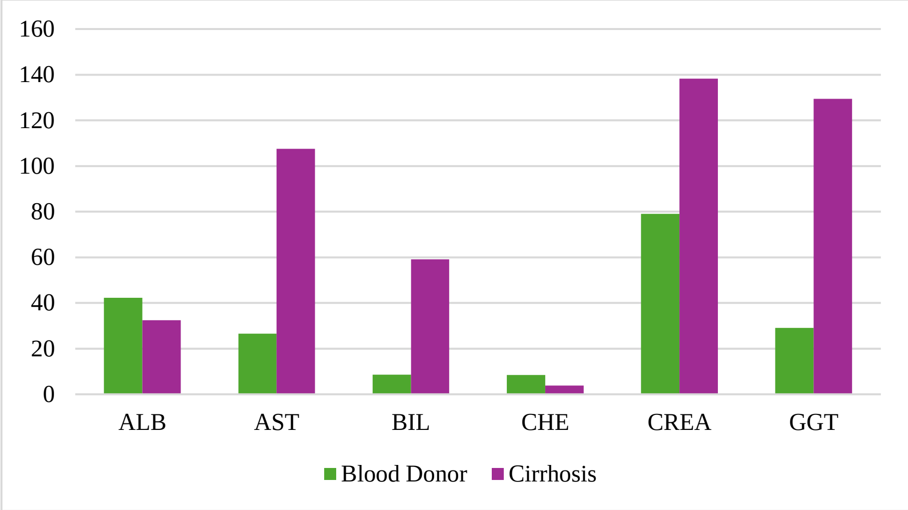

Figure 2. Biochemical Marker Deviations in Cirrhosis Compared to Blood Donors

4. Discussion

The current research compared the biochemical marker profiles among various clinical populations, such as blood donors, hepatitis, fibrosis and cirrhosis in order to comprehend their clinical implications in the liver disease caused by Hepatitis C. The results revealed evident differences in the main liver functioning indicators, especially AST, BIL, GGT, ALB, CHE, and CREA, with the progressive biochemical alterations due to the severity of the disease.

A major finding of this study is that AST, BIL and GGT are highly increased in cases of cirrhosis compared to blood donors. These results are in line with the past studies that emphasize the importance of aminotransferases and bilirubin as a measure of hepatocellular injury and liver dysfunction. The high bilirubin levels, especially, are closely related to liver dysfunction and metabolic abnormalities, which supports their diagnostics in the progression of liver disease (Liang et al., 2022). On the same note, elevated levels of AST are an indication of hepatocellular damage and have been associated with poor clinical outcomes in patients with liver diseases (Liu et al., 2024).

The fact that the GGT levels have been increased in all disease groups also confirms it as a liver injury and oxidative stress biomarker. GGT tends to be high in pathological conditions that may have dysfunction of the bile duct and chronic liver damage and can be a valuable marker in distinguishing between normal and disease states. The gradual increase in the AST, BIL and GGT of blood donors to cirrhosis in this study indicate a definite biochemical pattern that is linked to deteriorating liver functioning.

Markers associated with liver synthetic activity, including albumin (ALB) and cholinesterase (CHE), on the other hand, demonstrated a downward trend of the cases of cirrhosis. This decrease is an indication of poor protein production ability of the liver and this is a characteristic of liver disease of the advanced stage. These results are consistent with those of other research conducted earlier which have shown that patients with cirrhosis and other chronic liver diseases have low albumin content. Moreover, markers associated with platelets have also been recommended as an indicator of liver disease severity, especially in the case of cirrhosis and fatty liver disease (Gadallah et al., 2024). Even though the parameters of platelets were not considered in the current data, the observed decrease in the levels of ALB and CHE confirms the idea of impaired liver activity in the later stages of the disease.

The level of creatinine (CREA) was also detected as high in the case of cirrhosis, which means that there could be a renal one or systemic complications of advanced liver disease. This is of clinical importance as liver dysfunction may frequently result in the multi-organ involvement, especially to kidney functions. The correlation between liver disease and the systemic metabolic changes also was observed in patients with metabolic-associated fatty liver disease, in which liver dysfunction affects the overall clinical outcome (Hayat et al., 2022).

The trend analysis in this study showed a definite pattern of increase and decrease in the AST, BIL and GGT and decrease in the ALB and CHE of blood donors and cirrhosis respectively. This trend indicates the shift of comparatively normal liver functioning to severe hepatic defect. Such biochemical development has been also observed in chronic liver diseases, where metabolism and pathological alterations increase with the progression of the disease and add to disease severity (Hashim et al., 2025). These results emphasize the need to consider a combination of different biochemical markers to gain a clearer insight into the progression of disease rather than individual parameter.

The comparison between the blood donors and the cases of cirrhosis, which had the most significant biochemical deviations, is another significant aspect of this study. The rapid rise of liver injury markers and the concomitant decline of synthetic function markers underline the level of hepatic dysfunction in cirrhosis. These findings indicate the clinical usefulness of biochemical markers as a tool of differentiating normal and pathological conditions and also as an indicator of severe liver disease.

5. Conclusion

The assessment of the biochemical markers offers useful clinical information on the conditions of Hepatitis C and related liver diseases as it is a reflection of hepatic damage as well as functional impairment. The biochemical perturbation of the liver, which is present not only in cases of cirrhosis but also in other instances of advanced liver disease, is an increase in AST, BIL, GGT, and CREA with a compensatory decrease in ALB and CHE levels. These patterns indicate progressive damage to hepatocytes, disrupted bile metabolism, diminished synthetic functions and potential systemic damage. An intriguing implication of these findings is that standard laboratory parameters may help detect clinical disease-related changes with the use of available and affordable clinical data. Combined with other biochemical markers, biochemical markers can be used to differentiate between fairly normal liver profiles and severe pathological conditions. An increase in the number of injury-related and a decrease in the number of function-related markers can thus play a significant role as a warning of an increased need to conduct a closer clinical assessment and monitoring. It also highlights in the analysis the relevance of integrated biochemical profiling in the development of liver disease. Although these markers are impossible to substitute the confirmatory diagnostic measures, they may complement the primary examination, facilitate the risk identification, and inform the subsequent clinical research. Such marker-based assessment can be particularly valuable in the resource-limited environments since it is based on the regularly available parameters of blood-tests.

References

1. Abdo, M., Rabiee, A., Abdellatif, Z., Alem, S. A., & Moustafa, A. (2021). Impact of sustained virological response on metabolic disorders in diabetic chronic hepatitis C virus patients after treatment with generic sofosbuvir and daclatasvir. *European Journal of Gastroenterology & Hepatology*, *33*(12), 1588-1594.
2. Bagheri, S., Fard, G. B., Talkhi, N., Rashidi Zadeh, D., Mobarra, N., Mousavinezhad, S., ... & Hosseini Bafghi, M. (2024). Laboratory biochemical and hematological parameters: early predictive biomarkers for diagnosing hepatitis C virus infection. *Journal of clinical laboratory analysis*, *38*(24), e25127.
3. Fang, X., Yin, Y., Zhao, H., Wang, C. E., Li, H., Shang, Y., ... & Qi, X. (2024). Effect of fatty liver disease on liver function and fibrosis in patients with chronic hepatitis B: a cross-sectional study. *Frontiers in Medicine*, *11*, 1481051.
4. Gadallah, A. N. A. A., Elshayeb, E. I., Montaser, B. A. E. M., Shaheen, G. A. A. F., Abd El, A. E. E. A., & Mostafa, A. (2024). Plateletcrit and Mean Platelet Volume in the Evaluation of Liver Cirrhosis and Nonalcoholic Fatty Liver Disease in Egyptian Patients. *Surgery, Gastroenterology and Oncology*, *29*(2), 105.
5. Hashim, M. M. A., Khan, M. A. M., Ashraf, M. U., Mohsin, S., Zahoor, K., Niazi, J., ... & Khalid, S. (2025). Pathological evolution and internal medicine management of nonalcoholic fatty liver disease (NAFLD) in the era of metabolic dysfunction-associated steatotic liver disease (MASLD). *Cureus*, *17*(6), e86963.
6. Hayat, U., Ashfaq, M. Z., Johnson, L., Ford, R., Wuthnow, C., Kadado, K., ... & Siddiqui, A. A. (2022). The association of metabolic-associated fatty liver disease with clinical outcomes of COVID-19: a systematic review and meta-analysis. *Kansas Journal of Medicine*, *15*(2), 241.
7. Liang, C., Yu, Z., Bai, L., Hou, W., Tang, S., Zhang, W., ... & Zheng, S. (2022). Association of serum bilirubin with metabolic syndrome and non-alcoholic fatty liver disease: a systematic review and meta-analysis. *Frontiers in endocrinology*, *13*, 869579.
8. Liu, H., Li, H., Deng, G., Zheng, X., Huang, Y., Chen, J., ... & Wang, X. (2024). Association of AST/ALT ratio with 90-day outcomes in patients with acute exacerbation of chronic liver disease: a prospective multicenter cohort study in China. *Frontiers in Medicine*, *11*, 1307901.
9. PASHA, M. K., KuMaR, B. R., MacheRla, R., REDDY, S. L., PANI, S. K., AYESHA, Q., ... & REDDY, G. M. (2020). Biochemical Markers of Ascitic Fluid to Differentiate Ovarian Cancer from Liver Cirrhosis Patients. *Journal of Clinical & Diagnostic Research*, *14*(6).
10. Saeed, U., Uppal, M. R., Uppal, M. S., Uppal, R., Khan, A. A., Hassan, A., & Piracha, Z. Z. (2023). Hepatitis C virus associated ALT, AST, GGT, Bili T, HB, HBA1C, CREAT, PT, aPPT, AFP, CEA, CA 125, CA 19-9, iPTH biomarkers, computed tomography and HCV burden of disease during pre COVID-19 era (2018-2019) and post COVID-19 era (2020-2022) in Pakistan. *Brazilian Journal of Biology*, *84*, e271451.

11. Soriano, F. (2021). *Hepatitis C prediction dataset: Laboratory values of blood donors and Hepatitis C patients* [Data set]. Kaggle. https://www.kaggle.com/datasets/fedesoriano/hepatitis-c-dataset
12. Suan, M. A. M., Chan, H. K., Sem, X., Shilton, S., & Hassan, M. R. A. (2022). Diagnostic performance of two non-invasive biomarkers used individually and in sequential combination for cirrhosis associated with hepatitis C virus infection. *Scientific Reports*, *12*(1), 20153.
13. Tamber, S. S., Bansal, P., Sharma, S., Singh, R. B., & Sharma, R. (2023). Biomarkers of liver diseases. *Molecular biology reports*, *50*(9), 7815-7823.
14. Woo, J., & Choi, Y. (2024). Biomarkers in detection of hepatitis C virus infection. *Pathogens*, *13*(4), 331.