Original Article

# Impact of Sustained Virological Response on Liver Function and Fibrosis Regression in Chronic Hepatitis C: A FibroScan Based Assessment

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## ABSTRACT

**Background:** Chronic hepatitis C virus (HCV) infection is a major cause of liver fibrosis, cirrhosis, and hepatocellular carcinoma. Antiviral therapy can achieve sustained virological response (SVR) and may contribute to fibrosis regression. This study evaluated biochemical, virological, and structural liver outcomes following antiviral treatment and identified factors associated with fibrosis improvement.

**Methods:** A cohort study was conducted at the Department of Gastroenterology, Services Institute of Medical Sciences, Lahore, from October 2025 to April 2025 including 104 adults with chronic HCV infection. Baseline assessments included FibroScan liver stiffness measurement, liver function tests (ALT and AST), and quantitative HCV viral load. Patients received antiviral therapy according to national guidelines and were followed until 12 weeks after treatment completion (SVR12). Outcomes included changes in liver fibrosis, biochemical parameters, and viral load. Independent-samples t-tests and Chi-square tests were used for comparisons.

**Results:** The mean age was 44.4 ± 15.5 years; 62.5% were male and 71.2% had no comorbidities. Baseline FibroScan, ALT, and AST values were 12.6 ± 5.3 kPa, 73.1 ± 26.6 U/L, and 71.0 ± 24.0 U/L, respectively. At SVR12, significant reductions were observed in liver stiffness (10.3 ± 5.2 kPa), ALT (38.2 ± 24.4 U/L), AST (38.8 ± 23.5 U/L), and viral load. Non-responders had significantly higher viral loads ($p < 0.001$). Adverse events were significantly associated with poorer fibrosis improvement ($p = 0.005$).

**Conclusion:** Antiviral therapy effectively improves virological, biochemical, and fibrosis-related outcomes in chronic HCV patients. Early treatment and careful monitoring of adverse events may optimize fibrosis regression and overall clinical outcomes.

**Keywords:** Chronic hepatitis C; Antiviral agents; Liver fibrosis; Elasticity imaging techniques; Sustained Virologic Response; Treatment Outcome; Drug-Related Side Effects and Adverse Reactions

## INTRODUCTION

Hepatitis C virus (HCV) is one of the most prevalent causes of chronic hepatitis, cirrhosis, and hepatocellular carcinoma. According to the World Health Organization (WHO), an estimated 50 million people were living with chronic hepatitis C virus (HCV) infection worldwide in 2022, corresponding to a global prevalence of approximately 0.7–0.8%.[1] The progressive development of liver fibrosis, cirrhosis and hepatocellular carcinoma in infected individuals contribute to the escalating morbidity, mortality and health care expenses.[2,3] It is estimated that risk of developing cirrhosis is 41% within thirty years.[4,5] This threat is further enhanced by co-morbidities such as obesity, diabetes, and long-term alcohol use. The management of the HCV infection has been greatly enhanced with the advent of the direct-acting antivirals (DAAs).[6] DAA therapies achieve sustained virological response (SVR) rates exceeding 95% and are associated with shorter treatment durations, improved tolerability, and fewer adverse effects compared with older interferon-based regimens.[7] The primary goal of HCV treatment is to achieve sustained virological response (SVR), which substantially lowers the risk of cirrhosis, hepatocellular carcinoma, and liver-related complications.[8,9]

Existing evidence shows that SVR is involved in the regression of liver fibrosis. These changes have been effectively monitored using non-invasive techniques such as transient elastography (FibroScan 2). In a large real-world study conducted in Egypt, Abdel Alem et al. reported that hat 42.7 percent of patients with baseline cirrhosis (F4) had some degree of fibrosis regression to F3, F2, or F1 with the use of DAAs. Also, 66.7 percent of F3 patients had reduced fibrosis. Overall, 28.4% of patients with sig-

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nificant fibrosis (F 3 and above) changed to non-significant fibrosis (F 2 and below), and the reduction in FIB-4 index was significant ($p < 0.001$).[10] Similar findings were reported in a cohort of 248 DAA-treated patients followed from 2015 to 2017, where 77.8% of those with significant fibrosis (F2–F4) demonstrated fibrosis regression accompanied by a significant decline in liver stiffness ($p = 0.01$). However, improvement was less pronounced among patients with metabolic syndrome, HCV-related complications, or hepatocellular carcinoma.[11]

Recent multicenter rates (2023-2024) are still reporting 50-60% of patients regressing fibrosis post-SVR with approximately 25-30% of patients regressing advanced fibrosis to F2 or less .[12,13] Given the potential of DAA therapy to achieve SVR and reverse liver fibrosis, this study aimed to assess the impact of DAA-induced SVR on liver function and fibrosis regression in patients with chronic hepatitis C using FibroScan.

## PARTICIPANTS AND METHOD

The study was a prospective cohort study that was carried out in a period of six months after getting the approval from the Institutional Review Board Ref No: IRB/2025/16/SIMS within the Department of Gastroenterology, Services Institute of Medical Sciences (SIMS), Lahore. The number of enrolled patients was 104 patients with chronic hepatitis C infection. The sample size was determined by the expected increase in the fibrosis grade of 77.8% with a margin of error of 5% and at a confidence level of 95, the following formula was used: $(n = (Z(\alpha/2)^2 x p(1-p))/d^2)$.[11] Participants were recruited consecutively from the outpatient and inpatient clinics of the Department of Gastroenterology, Services Institute of Medical Sciences (SIMS), Lahore, during the study period. Adult patients (≥18 years) with chronic hepatitis C infection confirmed by positive HCV RNA testing and a baseline FibroScan assessment were screened for eligibility. Consecutive sampling was employed. Patients who provided written informed consent initiated antiviral therapy and were followed prospectively until 12 weeks after treatment completion (SVR12). For the final analysis, only patients who completed antiviral therapy, achieved a documented sustained virological response (SVR12), and underwent follow-up assessments were included. Patients who had decompensated cirrhosis, other chronic liver diseases (e.g., hepatitis B, autoimmune hepatitis, NAFLD, and Wilson's disease), were co-infected with HIV, were transplanted, had a history of heavy alcohol or substance abuse, and were pregnant or lactating were excluded.

Structured proformas and hospital records were used to record demographic data, past clinical history, and baseline laboratory values. All patients were tested with FibroScan at admission to determine the level of liver stiffness and fibrosis. Antiviral treatment was given based on national treatment guidelines and patients were closely monitored during the treatment process as well as after the treatment process. Baseline, and throughout therapy and 12 weeks post-treatment (SVR12) clinical and laboratory tests and liver function tests and viral load were conducted. FibroScan was replicated at SVR12 to assess the changes in the fibrosis stage. Patients who started to improve their fibrosis stage from baseline were termed as being a responder. Patients who showed no change or progression in fibrosis stage during follow-up were classified as non-responders. Additional clinical information was also captured such as adverse events, therapy adherence and comorbidity.

SPSS version 25.0 was used in data analysis. The continuous variables, such as age, baseline FibroScan score, ALT, AST, and platelet count, were reported as mean and standard deviation (SD), whereas categorical variables, such as sex, fibrosis stage (F2 to F4), comorbidities, and fibrosis improvement, were reported as frequencies and percentages. Independent-samples t-tests were used to compare continuous variables between groups, and the Chi-square test was used for categorical variables. Additionally, 95% confidence intervals (95% CIs) were calculated for key outcome measures. A p-value $< 0.05$ was considered statistically significant.

## RESULTS

A total of 104 patients with chronic hepatitis C participated in this study. They included 65 males (62.5%) and 39 females (37.5%). The average age of the participants was 44.4 + 15.5 years with the lowest and highest ages of 19 and 70 years, respectively. The majority of the patients (71.2%) did not have any comorbidities, but 28.8% had one or more comorbid conditions. It had a mean baseline liver hardness of 12.6 + 5.3 kPa using the FibroScan. The average levels of ALT and AST in the serum of the study population were 73.1 + 26.6 U/L and 71.0 + 24.0 U/L, respectively. The baseline viral load was also high and had a range of $5.79 \times 10^6$ to $3.22 \times 10^6$ IU/mL. These data are related to the fact that the cohort was formed by the middle-aged adults with moderate levels of liver fibrosis and active viral replication, and a significant percentage of the participants were without comorbid conditions (Table 1).

Temporal changes in liver stiffness (FibroScan), serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), and HCV viral load from baseline to Week 24 following antiviral therapy. Progressive reductions in liver stiffness, liver enzyme levels, and viral load were observed throughout treatment and follow-up, indicating sustained virological response and improvement in liver-related parameters (Figure 1).

**Table 1: Comparison of biochemical, virological, and fibrosis parameters at SVR12 between responders and non-responders**

| Parameter | Group | Mean ± SD | p-value | 95% CI of Difference |
|---|---|---|---|---|
| ALT (U/L) | Responder | 38.2 ± 24.4 | 0.415 | -6.39 to 15.36 |
| | Non-Responder | 33.8 ± 20.6 | | |
| AST (U/L) | Responder | 38.8 ± 23.5 | 0.178 | -18.12 to 3.39 |
| | Non-Responder | 46.1 ± 22.5 | | |
| Viral Load (IU/mL) | Responder | 516 ± 3826 | <0.001 | -16,202 to -10,769* |
| | Non-Responder | 14,002 ± 10,164 | | |
| FibroScan (kPa) | Responder | 10.3 ± 5.2 | 0.908 | -2.52 to 2.24 |
| | Non-Responder | 10.4 ± 5.0 | | |

*P-value<0.05

**Table 2: Association of fibrosis improvement with baseline characteristics and adverse events**

| Variable | Fibrosis Improvement | Responder | Non-Responder | Total | $\chi^2$ | p-value |
|---|---|---|---|---|---|---|
| Comorbidities | No | 57 (71.3%) | 17 (70.8%) | 74 (71.2%) | 0.002 | 0.968 |
| | Yes | 23 (28.7%) | 7 (29.2%) | 30 (28.8%) | | |
| Sex | Male | 49 (61.3%) | 16 (66.7%) | 65 (62.5%) | 0.231 | 0.631 |
| | Female | 31 (38.8%) | 8 (33.3%) | 39 (37.5%) | | |
| Adverse Events | No | 72 (90.0%) | 16 (66.7%) | 88 (84.6%) | 7.721 | 0.005 |
| | Yes | 8 (10.0%) | 8 (33.3%) | 16 (15.4%) | | |

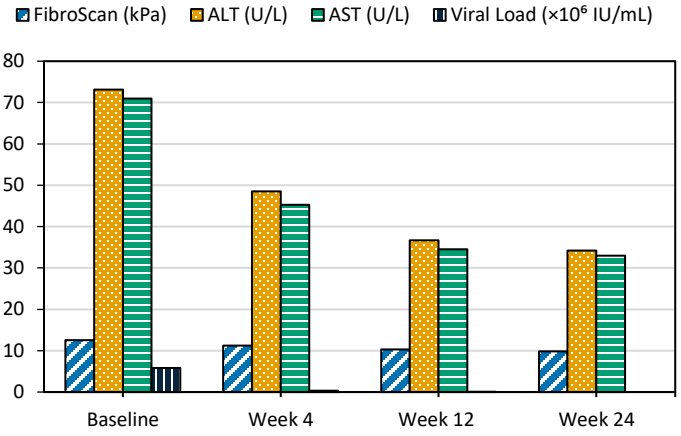


**Figure 1: Comparison of mean clinical parameters over time**

No statistically significant difference was found between responders and non-responders in mean ALT (38.2 ± 24.4 vs. 33.8 ± 20.6 U/L, p = 0.415), AST (38.8 ± 23.5 vs. 46.1 ± 22.5 U/L, p = 0.178) and FibroScan (10.3 ± 5.2 vs. 10.4 ± 5.0 kPa, p = Conversely, viral load at SVR 12 was much higher in non-responders than in responders (14,002 ± 10,164 vs. 516 ± 3,826 IU/mL, p < 0.001), indicating that non-responding patients still had persistent viremia. These results indicate that there was no significant difference between the functions and fibrosis measures between the groups, but virological response clearly distinguished responders and non-respondents (Table 2).

## DISCUSSION

This study involving 104 patients with chronic hepatitis C demonstrated that antiviral therapy was associated with significant biochemical, virological, and structural improvements in liver health. At baseline, patients exhibited elevated liver enzyme levels (ALT and AST) and a mean FibroScan score of 12.6 kPa. Following treatment, a substantial reduction in viral load was observed, with most patients achieving sustained virological response (SVR). Progressive reductions in liver stiffness and normalization of liver enzyme levels were also noted during follow-up, indicating improvement in liver-related outcomes.[14,15] We found in our longitudinal data that liver stiffness (FibroScan), ALT and AST continued to decrease after antiviral therapy, which is consistent with previous results that fibrosis, which is considered permanent, can regress after HCV has been eradicated. As an example, a randomized controlled trial of 70 patients receiving direct-acting antivirals (DAAs) showed that liver stiffness improved over 12 months follow-up by more than 30 percent.[15] A further study in the cyprometry of paired liver biopsies and mor-

phology validated that there is a great deal of collagen depletion in patients with SVR.[16]

Notably, we compared the responders and non-responders and found that, although there was no significant difference in ALT, AST, and FibroScan, when compared to non-responders, the viral load at SVR12 revealed significant dramatic differences ($p < 0.001$), and persistent viremia is the most critical distinguishing characteristic. This has been in favor of the paradigm that virological clearance is the pillar in the field of long-term liver health benefits.[6,17] When discussing the predictors of fibrosis improvement, we did not find any significant effect of sex or baseline comorbidity. Yet, the rate of adverse events observed during treatment was much higher in non-responders, which indicates that treatment tolerability and adherence might affect the results of fibrosis. This justifies the importance of rigid observation and control of side effects in order to maximize the therapeutic effect.[16] We have findings that are in agreement with bigger and longer term studies. HCV patients who received DAAs and were followed over a number of years reported fibrosis regression in about 57% of the participants, and regression especially in those with greater baseline fibrosis.[6] In addition, meta-analysis of cirrhotic patients who had undergone SVR reported that over half of them had regression of the cirrhosis and more advantage was found with longer follow up.[17] These findings ought to be viewed within the context of limitations despite the positive changes they bring. We have a sufficient sample size, but it is smaller than some of the larger registries and we do not have as much follow-up (up to SVR12) to assess how much fibrosis can be reversed and how long-term it can be. The non-invasive techniques like transient elastography had limitations; the decrease of the liver stiffness can also indicate a clearance of inflammation and not actual architectural remodeling. Moreover, post-SVR, residual fibrosis can still exist and the patient might have a non-resolved risk of having complications like hepatocellular carcinoma.[18,19] The progress occurred in the area of long-term follow-up of patients who reached SVR with histological enhancement of liver fibrosis over a span of 5 years has lent support to the idea that indeed structural regression is reached in the long run.[14]These insights highlight the importance of continued monitoring despite the presence of a viral cure, and suggest that non-invasive biomarkers or elastography may be used to do so, however, these techniques should also remind us that we may need to reset the cut-off values of post-SVR assessment.

## CONCLUSION

DAA therapy does not only reach a high rate of SVR, but also leads to the enhancement of liver biochemistry and noninvasive measures of fibrosis. This observation is supported by higher fibrosis improvement, which is linked to the lack of adverse instances, which is a clinical significance of therapy tolerability management. Future studies are required to concentrate on long-term consequences, optimization of noninvasive monitoring plans and the usage of other factors predicting fibrosis regression in order to inform the post-SVR surveillance and intervention.

### Author Contributions

**UA:** Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft.
**TR:** Conceptualization, Methodology, Writing – original draft.
**IA:** Formal analysis, Data curation.
**BM:** Data curation.
**NK:** Formal analysis, Conceptualization.
**AK:** Conceptualization, Methodology, Writing – original draft.

## REFERENCES


1. World Health Organization. Global progress report on HIV, viral hepatitis and sexually transmitted infections, 2021. Geneva: WHO; 2021.
2. World Health Organization. Global hepatitis report 2024: action for access in low- and middle-income countries. Geneva: World Health Organization; 2024 [cited 2026 Aug 6]. Available from: WHO Global Hepatitis Report 2024
3. Polaris Observatory HCV Collaborators. Global change in hepatitis C virus prevalence and cascade of care between 2015 and 2020: a modeling study. Lancet Gastroenterol Hepatol. 2022;7(5):396-415. doi:10.1016/S2468-1253(21)00472-6.
4. Ghany MG, Morgan TR. Hepatitis C guidance 2023 update: American Association for the Study of Liver Diseases–Infectious Diseases Society of America recommendations for testing, managing, and treating hepatitis C. Hepatology. 2024;79(2):e219-e344.
5. Roudot-Thoraval F. Epidemiology of hepatitis C virus infection. Clin Res Hepatol Gastroenterol. 2021 May;45(3):101596. doi: 10.1016/j.clinre.2020.101596. Epub 2021 Feb 17. PMID: 33610022.
6. Abu-Freha N, Mathew Jacob B, Elhoashla A, Afawi Z, Abu-Hammad T, Elsana F, Paz S, Etzion O. Chronic hepatitis C: Diagnosis and treatment made easy. European Journal of General Practice. 2022 Dec 31;28(1):102-8.
7. Chiang DJ, Pritchard MT, Nagy LE. Obesity, diabetes mellitus, and liver fibrosis. Am J Physiol Gastrointest Liver Physiol. 2011 May;300(5):G697-702. doi: 10.1152/ajpgi.00426.2010. Epub 2011 Feb 24. PMID: 21350183; PMCID: PMC3094133.
8. Zhu X, Jia L, Yue M, Zhang A, Xia X, Yu R, Chen H, Huang P. DAA treatment for HCV reduce risk of hepatocellular carcinoma: a 10-years follow-up study based on Chinese patients with hepatitis C. Scientific Reports. 2024 Oct 10;14(1):23760..
9. Kozuka R, Tamori A, Enomoto M, Muto-Yukawa Y, Odagiri N, Kotani K, Motoyama H, Kawamura E, Hagihara A, Fujii H, Uchida-Kobayashi S. Risk factors for liver-related and non-liver-related mortality following a sustained virological response after direct-acting antiviral treatment for hepatitis C virus infection in a real-world cohort. Journal of Viral Hepatitis. 2023 May;30(5):374-85.
10. Abdel Alem S, El Kassas M, Moustafa B, Elakel W, Elbaz T, Abdel Aziz A, et al. Liver fibrosis regression in hepatitis C patients after direct-acting antivirals: Real-world Egyptian experience. Egypt J Intern Med. 2022;34(1):1–9.
11. Mauro E, Crespo G, Montironi C, Londono MC, Hernandez-Gea V, Ruiz P, et al. Portal pressure and liver stiffness in long-term follow-

up of HCV cirrhosis after SVR. Clin Gastroenterol Hepatol. 2018;16(10):1494–502.e2.
12. Cheung MCM, Walker AJ, Hudson BE, Verma S, McLauchlan J, Mutimer DJ, et al. Outcomes after successful direct-acting antiviral therapy for patients with chronic hepatitis C and cirrhosis. J Hepatol. 2021;74(4):702–12.
13. Mauro E, Londono MC, Montironi C, Jovani M, Cabrera J, Coll S, et al. Liver fibrosis regression and clinical outcomes in chronic hepatitis C after DAA therapy: long-term follow-up study. Clin Mol Hepatol. 2023;29(1):88–101
14. Wamoto T, Nozaki Y, Inoue T, Suda T, Mizumoto R, Arimoto Y, et al. Histological improvement of fibrosis in patients with hepatitis C who achieved a 5-year sustained virological response to treatment with direct-acting antivirals. J Gastroenterol. 2025 Feb;60(2):197-209. doi: 10.1007/s00535-024-02165-0. Epub 2024 Nov 25. PMID: 39585387; PMCID: PMC11794422.
15. Tao XM, Zeng MH, Zhao YF, Han JX, Mi YQ, Xu L. Direct-acting antivirals failed to reduce the incidence of hepatocellular carcinoma occurrence in hepatitis C virus associated cirrhosis: A real-world study. World Journal of Hepatology. 2024 Jan 27;16(1):41.
16. Elsharkawy A, Samir R, El-Kassas M. Fibrosis regression following hepatitis C antiviral therapy. World journal of hepatology. 2022 Jun 27;14(6):1120.
17. Tanwar S, Rhodes F, Srivastava A, Trembling PM, Rosenberg WM. Inflammation and fibrosis in chronic liver diseases including non-alcoholic fatty liver disease and hepatitis C. World journal of gastroenterology. 2020 Jan 14;26(2):109. doi: 10.3748/wjg.v26.i2.109
18. Rabell-Bernal A, López-Valle R, Morales-Santiago A, Toro DH. The Impact of a Sustained Virologic Response to Hepatitis C Virus Treatment on Liver Stiffness in the Puerto Rico Veterans Attending Liver Clinics in the Veterans Affairs Caribbean Healthcare System. Puerto Rico Health Sciences Journal. 2022 Aug 15;41(3):123-7.
19. Yılmaz N, Yılmaz UE, Tanrıverdi Ö, Örmeci N. Fibrosis changes following viral clearance and its relation to HCC. Academic Journal of Gastroenterology & Hepatology (AJGH). 2022. DOI: 10.33552/AJGH.2022.03.000564