Original Article

J Adv Med Biomed Res. 2024; 32(154): 323-330

Assessment of the Effectiveness of Direct-Acting Antiviral Therapy in Patients with Hepatitis C: A Follow-Up Analysis in Yazd, Iran

Zahra Irandegani [1], Roghaye Razavi [2], Sanaz Akhondi Meybodi [3], Nasim Namiranian [1], Mohsen Akhondi-Meybodi [2*]

1. Shahid Sadoughi University of Medical Sciences, Yazd, Iran

2. Yazd Diabetes Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

3. Tarbit Moders University, Tehran, Iran

Article Info

10.30699/jambr.32.154.323

Received: 2021/08/14;
Accepted: 2022/07/26;
Published Online: 12 Dec 2022;

Corresponding Information:
Mohsen Akhondi Meybodi,
Yazd Diabetes Research Center,Shahid Sadoughi University of Medical Sciences,Yazd,Iran
E-Mail: akhondei@yahoo.com

ABSTRACT

Background & Objective: Treating hepatitis C as a serious liver disorder is often associated with many problems. Nowadays, Direct-Acting Antiviral (DAA) agents serve as a major remedy in patients with hepatitis C virus (HCV). With regard to the limited information on the effect of using this treatment in different genotypes of the disease in our region, this study seeks to fill the research gap by evaluating the effect of new DAAs on different HCV genotypes in the city of Yazd.

Materials & Methods: Fifty-one patients with different HCV genotypes were treated with Sofosbuvir (SOF) 400 mg + Daclutasvir (DCV) 60 mg and SOF 400 mg + ledipasvir (LDV) 90 regimens. The viral load was assessed in these cases 12 weeks after the end of therapy.

Results: In this study, the mean age of patients was 50.04 (± 10.53) years. Among the participants, the most observed genotype was type 1 (54.8%). The most current risk factor was drug use (47%). The analysis revealed that 78% of the patients had a sustained virological response (SVR). SVR rate in HCV was obtained as follows: genotype 1 (77.3%), genotype 2 (66.7%), genotype 3 (87.5%), genotype 4 (100%) and genotype 1+3 (75%).

Conclusion: Overall, the application of DAAs has no side effects and induces relatively good therapeutic responses. However, the responses to the drugs used in this study have been lower than those reported in similar studies worldwide.

Keywords: Sustained virological response, Direct-acting antiviral agents, Hepatitis C, Iran

Introduction

Hepatitis C is a serious liver problem caused by HCV and imposes a heavy burden on the health care system **(1)**. It is estimated to affect approximately 71 million people worldwide **(2)**. The most common ways of infection transmission are blood transfusion and drug injections. Evaluations show that 23% of new HCV infections and 33% of the resulting deaths are attributed to those who inject drugs **(1, 3)**. The other risk factors that increase the chance of hepatitis C include high-risk sexual behavior, tattoos, alcohol consumption, and mucous contact with the blood or body fluids of an infected person **(4-7)**.

In real life, the medical treatment of hepatitis C is often difficult owing to other risk factors such as comorbidities, drug interactions, different HCV

genotypes (GT), economic considerations, and geographic diversity, which are usually controlled in clinical trials **(8, 9).** Studies have shown that the major goals of treating hepatitis C are to prohibit the disease transmission, curb the disease progression to cirrhosis and hepatocarcinoma (HCC), and reduce viral hepatitis-related mortality **(10, 11)**.

Because of the high recurrence of the disease as well as the long duration, low efficiency and rapid cessation of treatment due to significant side effects in interferon-based therapeutic regimens (PEG-IFN) **(10, 12-14)**, WHO guidelines issued in 2018 recommend the utilization of new DAA for the treatment of hepatitis C **(1)**. Remarkably, DAAs make it possible to treat HCV patients within a short time **(15)**. Achieving SVR is useful in eliminating the disease **(12, 16)**. In this case, one may refer to non-detectable RNA in the blood 12 weeks (SVR 12) or 24 weeks (SVR 24) after treatment. Several investigations have shown that DAAs have an efficacy of more than 90% in patients with HCV **(15, 17)**. In 2014, SOF, LDV and DCV, which were identified to have fewer side effects and higher SVR, became available for the improvement of HCV infection **(10, 14)**. These medications serve to inhibit specific nonstructural proteins in the HCV replication cycle **(10, 12)**. A combination of SOF with other inhibitory DAAs in patients with HCV can disrupt the virus replication cycle, hence being a safe and effective treatment **(18-20)**.

Because, the epidemiology of hepatitis C in different genotypes plays a determining role in the choice of therapeutic drugs **(21)**. It has been reported that, a combination of new DAAs may be effective as an antiviral agent in different genotypes of this disease. Hence, due to the limited information in this field in our region, in the present research, we report the impact of a combination of new DAAs (SOF + LDV / SOF + DCV) for different HCV genotypes in Yazd.

Materials and Methods

Study design and patient selection

The current prospective, cohort study was conducted on patients referring to Middle East Liver Diseases (MELD) Center in 2016. The main purpose of the research is tracking undetectable RNA in the blood 12 weeks after the completion of treatment, which means complete recovery from the disease with a very low chance of relapse. If HCV RNA was detected after 12 week after treatment, resistant was defined **(18)**.

Adults (≥ 18 years) with chronic HCV infection (being positive for HCV Ab and HCV RNA for more than 6 months) genotyped as HCV-1 or -4 were included consecutively in this study. The cases who took drugs including carbamazepine, phenytoin, rifampin, phenobarbital, antacids and rosuvastatin or had a history of taking amiodarone in the past three months, those with severe renal insufficiency, pregnant women, patients with no high life expectancy due to other diseases, as well as patients with HIV and HCV co-infection were excluded from the research.

The sample size was estimated via the formula represented for parallel clinical trials, with a confidence interval of 95% and type 2 errors (β) of 0.2 and considering the response to treatment 80% in studies **(21)** and a difference of 10%; finally, due to restrictions in patient access, 51 patients were examined.

The protocol of this survey was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences and Health Service and was in accordance with the principles of the Helsinki Declaration. At baseline, the aim of the research was explained to the patients and written informed consent was obtained from them.

Data collection

The demographic characteristics, information related to drug use, cupping, tattooing, transfusion of blood products, prison history and types of genotypes were recorded in specific forms at the beginning of the study **(Table 2)**. Overall, 51 patients with hepatitis C participated in the investigation and were prescribed the new DAAs regimen for 12 weeks. Participants were selected from several medical centers (shahid Sadoughi hospital and private clinic of other co-works (GI and infectious)) in Yazd whose hepatitis C disease had already been confirmed by an infectious disease specialist and its genotype was determined by Polymerase Chain Reaction (PCR). In this study, therapeutic DAA regimen prescribed for the treatment of the participants with GT3 virus was SOF 400 mg + DCV 60 mg (SOVODAK, Rojan Pharma, Tehran, Iran). For the other GT cases, it was SOF 400 mg + LDV 90 (LEDIBIOX, Bakhtar Bioshimi, Tehran, Iran). We used drugs without ribavirin in non-cirrhotic along 12 weeks and cirrhotic patients with ribavirin for 24 weeks. According to the recommended instructions, the drugs were taken on an outpatient basis every day **(Table 1)**

Table 1. Regimens prescribed for the study population

HCV genotype	DAA regimen
Genotype 1/2/4/1+3	SOF 400mg + LDV 90 mg (12 weeks)
Genotype 3	SOF 400 mg + DCV 60 mg (12 weeks)

DAA: direct Acting Antiviral; SOF: sofosbuvir; LDV: ledipasvir.; DCV:daclatasvir.

Twelve weeks after the completion of the DAA therapy, the RNA levels of serum HCV were analyzed separately in different GTs using PCR (Corbett real-time Australia). In addition, drug resistance in this study was considered as non-zero viral load in PCR, 12 weeks following treatment **(18)**. In this work, the response level was evaluated in terms of different variables. The patients were asked to report any side effects to their physician during the study.

Data analysis

The variables were reported as number (٪) or mean± standard deviation (SD). Statistical analysis was performed using SPSS 23.0 software (SPSS Inc., Chicago, IL). $P < 0.05$ was considered as a significant level.

Results

From 6 September 2017 to 5 September 2020, 50 eligible patients with hepatitis C who had been treated with DAA in a 12-week period were examined for a PCR analysis. One patient was excluded from the study due to loss of follow-up (migration).

Demographic characteristics

The mean age of the studied patients was 50.04 (± 10.53) years (34-79 years). The analyses indicated that those treated with DAA were mostly male (84.3%). Further, 34 patients (81%) were treated with SOF/ LDV for 12 weeks. The duration of the disease awareness before starting the treatment was 5.64± 6.00 months (1 to 28 months). Also, the mostly observed genotype was type 1 (54.8%); among the participants, there were 6, 8, 1, and 4 patients with genotypes 2, 3, 4, and 1 + 3, respectively (Table 2). The demographic information, clinical outcomes, and response to treatment were recorded for the patients treated with DAA **(Tables 2 and 3).**

Table 2. Baseline information of the HCV patients treated with DAAs regimen

	DAA treatment (n = 51)
Demographics	
Age (years), mean ± SD	50.04 (±10.53)
Female, n (%)	8 (15.7)
Male, n (%)	43 (84.3)
Direct-acting antiviral regimen, n (%)	
SOF (400mg) + LDV (90 mg)	34 (81)
SOF (400 mg) + DCV (60 mg)	8 (19)
HCV genotype, n (%)	
1	23 (54.8)
2	6 (14.3)
3	8 (19)
4	1 (2.4)
Combined (1+3)	4 (9.5)
Risk factors, n (%)	
Injecting drug users	22/51 (43)
Drug use	24/51 (47)
Transfusion of blood products	9/51 (17.6)
Cupping history	13/51 (25.5)
Tattoo history	9/51 (17.6)
Prison history	5/50 (10)
Sexual practices	3/9 (33)

DAA: direct-acting antiviral; SD: standard deviation; SVR: sustained virologic response; SOF: sofosbuvir; LDV: ledipasvir; DCV: daclatasvir

Table 3. SVR in volunteers who initiated direct-acting antiviral treatment

Variables	SVR12 n (%)	Resistant n (%)	Recurrence (relapsed) n (%)
Overall n= 50	39 (78%)	10 (20%)	1 (2%)
Female, n (%)	7 (87.5)	1 (12.5)	0 (0.0)
Male, n (%)	32 (76.2)	9 (21.4)	1 (2.4)
Genotype			
1	17 (77.3)	4 (18.2)	1 (4.5)
2	4 (66.7)	2 (33.3)	0 (0.0)
3	7 (87.5)	1 (12.5)	0 (0.0)
4	1 (100)	0 (0.0)	0 (0.0)
Combined (1+3)	3 (75)	1 (25)	0 (0.0)
Injecting drug users	17 (81)	4 (19)	0 (0.0)
Drug use	18 (78.3)	5 (21.7)	0 (0.0)
Transfusion of blood products	8 (88.9)	1 (11.1)	0 (0.0)
Cupping history	12 (92.3)	1 (7.7)	0 (0.0)
Tattoo history	9 (100)	0 (0.0)	0 (0.0)
Prison history	5 (100)	0 (0.0)	0 (0.0)
Sexual practices	3 (100)	0 (0.0)	0 (0.0)

In this research, the risk factors for hepatitis C were also examined. Of the 51 patients, 47% reported drug abuse, which was the most common risk factor among the participants. Moreover, all the individuals with risk factors of tattooing, prison, and high-risk sexual manners obtained SVR 12. The other risk factors are reported in **Table 3.**

Virological response

The results of viral responses to treatment regimens are reported in Table 3. In this study, five patients were found to have cirrhosis (9.8%). At the end of the investigation, of 51 patients, 39 cases (78%) obtained SVR12. SVR 12 was attained in 17 patients with GT1, 4 in GT2, 7 in GT3, 1 in GT4 and 3 in GT1 + 3. All patients with GT4 had SVR 12. In this study, 8 participants were resistant to treatment and unable to attain SVR12 most of whom were male. In addition, people with GT1 were more resistant to treatment with DAA drugs. Drug use was more common among people who were resistant to DAA. The findings of this investigation also demonstrated that one of the cases with GT1 had a viral recurrence in the twelfth week after the end of treatment. Note that no side effects were observed during the investigation.

Discussion

This study evaluated the success and efficiency of combining new DAAs (i.e., SOF + LDV / SOF + DCV) for different HCV genotypes. In the present study, 51 patients with hepatitis C underwent SOF / LDV and SOF / DCV regimens. Fifty patients completed the treatment period, whose SVR12 rate was 78%, which was associated with 20% resistance and 2% recurrence. In addition, 17 GT1, 4 GT2, 7 GT3, 1 GT4 and 3 GT1+3 Acquired SVR12. We also obtained 100% SVR with 12-week treatment with SOF / LDV in patients with HCV GT4. The lowest rates were observed in participants with GT2. In our study, all patients with recurrence had HCV GT1. None of the other genotypes in this study showed recurrence. One reason for this could be the small sample size. Similar to the results of this work, an investigation in Turkey reported 100%

SVR with 12-week treatment with SOF / LDV in cases with GT4 **(22)**. As a result, this drug regimen may be considered an effective factor in the treatment of HCV GT4 patients.

In the present study, 47% and 43% of patients had a history of oral and injectable drug abuse, respectively; this is inconsistent with the findings of a number of previous studies (vs. 72% and 15%, respectively) **(23, 24)**. Similar to previous studies, no side effects were observed in participants during the study **(25)**.

Overall, researchers have stated that the SVR rate when administering second-generation DAAs for the treatment of HCV in prisons varies from 85% to 98% [23]. In Iran, studies have exhibited that the SVR rate in patients with chronic HCV following adherence to DAA treatments is 96.7% to 100% **(26).** A study carried out by Heidarsharifi and colleagues in Iran on 147 volunteers with HCV infection treated with interferon-free diets based on sofosbuvir, with or without ribavirin, revealed that 100% achieved SVR12 (132 cases) **(26).** In a study conducted among 2015 prisoners in Iran, all were treated (SVR12 = 100%) (23). A similar finding was found in a research of 1,402 prisoners in Taiwan **(27)**. Andrew Hill and colleagues conducted an investigation on 616 HCV patients. The rate of SVR12 was 99% and SVR12 rate in patients of genotype 1 was 99% while in genotype 3 was 98% [28]. Overall, studies have reported that SOF/LDV treatment in East Asian cases improves outcomes for HCV-infected patients in a manner consistent with other studies **(25)**.

According to the literature, 75.3% of the patients in the United States had GT1, 16.3% of them GT2 and 8.5% GT3 **(29)**. Sullivan et al. **(23)** obtained similar results. In a study carried out in Iran, GT1a with the frequency of 47% was the most common, followed by GT3a at the rate of 36% was. The frequency of genotype distribution in Iran is similar to that in England, but it differs from countries such as Kuwait, Yemen, Iraq and Saudi Arabia, where GT4 is more common **(30)**. Study of Omura et al. in Japan 27 patients with HCV/HIV-1-infected hereditary bleeding disorders followed using SOF/LDV, SOF/RBV, and SOF/DCV regimens for 12 weeks. They found that 100% of volunteers attained SVR (26). Two studies in China and New Zealand, with a sample size of fewer than 50 patients, showed that 100% SVR rates were achieved following treatment with DAAs **(31, 32)**. In a research by Lee and colleagues on 30 cases of chronic hepatitis C following DAA therapy, 93.3% of volunteers achieved SVR **(33)**. Nagao et al. carried out an investigation in Japan. They gave 43 participants the SOF/LDV regimen, where only two patients did not reach the SVR **(34)**.

The SVR observed in this study is lower than in other studies in Iran and other countries. Based on the evidence, it seems that the small sample size in our study did not have a significant effect on this factor [35]. However, there is no medically justified reason for the difference observed in this study with previous studies. This may be due to differences between pharmaceutical companies. The drugs used in this study have been made in Iran, which can be the main cause of different therapeutic responses. However, the discrepancy does not justify the national results. One of the reasons for the observed difference may be the lack of attention to the previous behavior of the participants. In addition, a lack of body weight control, advanced liver disease, and fibrosis stage can be other causes of the discrepancy between the findings of this study and previous investigations. These factors can lead to treatment failure, but two other studies in Iran that used same drugs found SVR of 96.7 and 97.9 being higher than our study **(36, 37)** .

Our study had certain limitations. First, because of the variety of HCV genotypes, it was difficult to discuss the effectiveness of the drugs in terms of genotypes. In addition, while collecting the data, it was noticed that a large number of patients were deprived of regular medication due to the high cost of the drugs; thus, we were unable to include these patients in the research. Since sample size has a great impact on the findings, the relatively small sample size in this study was another limitation that affected the results. Finally, this study was carried out with no control group.

Conclusion

It was found that 78% of those who participated in this research could achieve SVR after 12 weeks of treatment with SOF/ DCV or SOF/ LDV. However, there was no evidence that more than 95% of patients with hepatitis C would respond to treatment with these drugs. The reason is still unknown but can be investigated further in prospective studies with larger sample sizes in our area.

Conducting a similar study on a larger scale and encouraging untreated patients to use DAA drugs are suggested. Due to such issues as the financial burden of drug procurement and laboratory costs and, therefore, the possibility of their unavailability to all patients, it is recommended to have reasonable distribution of medicine and nationwide treatment coverage for this disease. This will raise the number of people who successfully complete the disease treatment in a short period. The social shame caused by this disease in our society may prevent patients from being visited in time. Therefore, creating a culture and reinforcing the doctor-patient relationship can lead to better cooperation, earlier treatment initiation, and improved clinical management.

Acknowledgments

We want thank all patients as well as the Viral Hepatitis Units for their cooperation in the medical centers.

Authors' Contribution

Z.I, S.A.M, and M.A.M equally contributed to the conceptualization and design of the research. Z. I, S. A.M, N.N, and R.R collected and analyzed the data. S.A.M contributed to the interpretation of the data. N.N, R.R and Z.I drafted the manuscript. All authors critically revised the manuscript, agree to be fully accountable for the integrity and accuracy of the work and read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding

This study was supported by Shahid Sadoughi University of Medical Sciences with the approval number (IR.SSU.MEDICINE.REC.1397.212).

Ethics Approval and consent to participate

This study was supported by Shahid Sadoughi University of Medical Sciences with the approval number (IR.SSU.MEDICINE.REC.1397.212).

References

1.https://www.who.int/health-topics/hepatitis#tab=tab_1.

2. Bradley C, Scott R, Cox E, Palaniyappan N, Thomson B, Ryder S, et al. Short-term changes observed in multiparametric liver MRI following therapy with direct-acting antivirals in chronic hepatitis C virus patients. Europ Radiol. 2019;29(6):3100-7. https://doi.org/10.1007/s00330-018-5788-1 PMid:30506214 PMCid:PMC6510871

3. Pomper GJ, Wu Y, Snyder EL. Risks of transfusion-transmitted infections: 2003. Curr Opin Hematol. 2003;10(6):412-8. https://doi.org/10.1097/00062752-200311000-00003 PMid:14564170

4. Dienstag JL. Sexual and perinatal transmission of hepatitis C. Hepatology. 1997;26(S3):66S-70S. https://doi.org/10.1002/hep.510260712 PMid:9305667

5. Ohto H, Terazawa S, Sasaki N, Sasaki N, Hino K, Ishiwata C, et al. Transmission of hepatitis C virus from mothers to infants. New Eng J Med. 1994;330(11):744-50. https://doi.org/10.1056/NEJM199403173301103 PMid:8107740

6. Bronowicki J-P, Venard V, Botte C, Monhoven N, Gastin I, Choné L, et al. Patient-to-patient transmission of hepatitis C virus during colonoscopy. New Eng J Med. 1997;337(4):237-40. https://doi.org/10.1056/NEJM199707243370404 PMid:9227929

7. Haley RW, Fischer RP. Commercial tattooing as a potentially important source of hepatitis C infection: clinical epidemiology of 626 consecutive patients unaware of their hepatitis C serologic status. Medicine. 2001;80(2):134-51. https://doi.org/10.1097/00005792-200103000-00006 PMid:11307589

8. Ferreira VL, Borba HHL, Wiens A, Pedroso MLA, Radunz VFdC, Ivantes CAP, et al. Effectiveness and tolerability of direct-acting antivirals for chronic hepatitis C patients in a Southern state of Brazil. Brazil J Infect Dis. 2018;22(3):186-92. https://doi.org/10.1016/j.bjid.2018.04.003 PMid:29752891 PMCid:PMC9425658

9. Kwo PY, Puenpatom A, Zhang Z, Hui SL, Kelley AA, Muschi D. Initial uptake, time to treatment, and real-world effectiveness of all-oral direct-acting antivirals for hepatitis C virus infection in the United States: A retrospective cohort analysis. PloS one. 2019;14(8):e0218759. https://doi.org/10.1371/journal.pone.0218759 PMid:31437170 PMCid:PMC6705774

10. Alavinejad P, Hajiani E, Hashemi SJ, Shayesteh AA, Ebadi Borna K, Nasooti MA, et al. Hepatitis C virus treatment with sofosbuvir plus ribavirin regimen in Khuzestan province. Jundishapur J Chron Dis Care. 2018;7(4). https://doi.org/10.5812/jjcdc.81105

11. Iacob S, Cerban R, Pietrareanu C, Ester C, Iacob R, Gheorghe C, et al. 100% sustained virological response and fibrosis improvement in real-life use of direct acting antivirals in genotype-1b recurrent hepatitis C following liver transplantation. J Gastrointestin Liver Dis. 2018;27(2):139-44. https://doi.org/10.15403/jgld.2014.1121.272.100 PMid:29922758

12. Holzmann I, Tovo CV, Minmé R, Leal MP, Kliemann MP, Ubirajara C, et al. Effectiveness of

chronic hepatitis C treatment with direct-acting antivirals in the Public Health System in Brazil. Brazil J Infect Dis. 2018;22(4):317-22. https://doi.org/10.1016/j.bjid.2018.06.004 PMid:30036490 PMCid:PMC9427950

13. Pan CQ, Gayam V, Rabinovich C, Normatov M, Fidman B, Wang D, et al. Efficacy of direct-acting antivirals for chronic hepatitis C in a large cohort of older adults in the United States. J Am Geriat Soc. 2020;68(2):379-87. https://doi.org/10.1111/jgs.16206 PMid:31647119

14. Ji D, Chen GF, Wang C, Wang YD, Shao Q, Li B, et al. Twelve-week ribavirin-free direct-acting antivirals for treatment-experienced Chinese with HCV genotype 1b infection including cirrhotic patients. Hepatol Int. 2016;10(5):789-98. https://doi.org/10.1007/s12072-016-9755-0 PMid:27443347

15. Sette-Jr H, Cheinquer H, Wolff FH, de Araujo A, Coelho-Borges S, Soares SR, et al. Treatment of chronic HCV infection with the new direct acting antivirals (DAA): first report of a real world experience in Southern Brazil. Ann Hepatol. 2017;16(5):727-33. https://doi.org/10.5604/01.3001.0010.2717 PMid:28809742

16. Benhammou JN, Dong TS, May FP, Kawamoto J, Dixit R, Jackson S, et al. Race affects SVR 12 in a large and ethnically diverse hepatitis C-infected patient population following treatment with direct-acting antivirals: Analysis of a single-center Department of Veterans Affairs cohort. Pharmacol Res Perspect. 2018;6(2):e00379. https://doi.org/10.1002/prp2.379 PMid:29484189 PMCid:PMC5821896

17. Bachofner J, Valli PV, Bergamin I, Kröger A, Künzler P, Baserga A, et al. Excellent outcome of direct antiviral treatment for chronic hepatitis C in Switzerland. Swiss Med Week. 2018;148:w14560. https://doi.org/10.4414/smw.2018.14560 PMCid:PMC6100763

18. Sulkowski MS, Gardiner DF, Rodriguez-Torres M, Reddy KR, Hassanein T, Jacobson I, et al. Daclatasvir plus sofosbuvir for previously treated or untreated chronic HCV infection. New Eng J Med. 2014;370(3):211-21. https://doi.org/10.1056/NEJMoa1306218 PMid:24428467

19. Kowdley KV, Gordon SC, Reddy KR, Rossaro L, Bernstein DE, Lawitz E, et al. Ledipasvir and sofosbuvir for 8 or 12 weeks for chronic HCV without cirrhosis. New Eng J Med. 2014;370(20):1879-88. https://doi.org/10.1056/NEJMoa1402355 PMid:24720702

20. Foster GR, Irving WL, Cheung MC, Walker AJ, Hudson BE, Verma S, et al. Impact of direct acting antiviral therapy in patients with chronic hepatitis C and decompensated cirrhosis. J Hepatol. 2016;64(6):1224-31. https://doi.org/10.1016/j.jhep.2016.01.029 PMid:26829205

21. Serdar CC, Cihan M, Yücel D, Serdar MA. Sample size, power and effect size revisited: simplified and practical approaches in pre-clinical, clinical and laboratory studies. Biochem Med. 2021;31(1):27-53. https://doi.org/10.11613/BM.2021.010502 PMid:33380887 PMCid:PMC7745163

22. Demirturk N, Aygen B, Celik I, Mistik R, Akhan S, Barut S, et al. Real-world data from Turkey: Is sofosbuvir/ledipasvir with or without ribavirin treatment for chronic hepatitis C really effective? Turk J Gastroenterol. 2021;32(2):155-64. https://doi.org/10.5152/tjg.2020.19569 PMid:33960939 PMCid:PMC8975436

23. Hariri S, Alavi M, Roshandel G, Mohammadi Z, Fazel A, Amiriani T, et al. An intervention to increase hepatitis C virus diagnosis and treatment uptake among people in custody in Iran. Int J Drug Policy. 2021;95:103269. https://doi.org/10.1016/j.drugpo.2021.103269 PMid:33991887

24. Moradi G, Jafari S, Zarei B, Mahboobi M, Zavareh FA, Molaeipoor L, et al. Prevalence and risk factors for hepatitis B and hepatitis C exposure in Iranian prisoners: a national study in 2016. Hepatitis Monthly. 2019;19(7). https://doi.org/10.5812/hepatmon.91129

25. Younossi ZM, Stepanova M, Henry L, Han KH, Ahn SH, Lim YS, et al. Sofosbuvir and ledipasvir are associated with high sustained virologic response and improvement of health-related quality of life in East Asian patients with hepatitis C virus infection. J Viral Hepatit. 2018;25(12):1429-37. https://doi.org/10.1111/jvh.12965 PMid:29974665

26. Sharafi H, Behnava B, Azizi-Saraji A, Namvar A, Anvar A, Salimi S, et al. Treatment of hepatitis C virus infection with direct-acting antiviral agent-based regimens in Iranian patients with hereditary bleeding disorders. Virol J. 2021;18(1):1-10.

https://doi.org/10.1186/s12985-021-01659-0
PMid:34620204 PMCid:PMC8496886

27. Yang TH, Fang YJ, Hsu SJ, Lee JY, Chiu MC, Yu JJ, et al. editors. Microelimination of chronic hepatitis C by universal screening plus direct-acting antivirals for incarcerated persons in Taiwan. Open Forum Infect Dis; 2020: Oxford University Press US. https://doi.org/10.1093/ofid/ofaa301
PMid:32818142 PMCid:PMC7423289

28. Hill A, Khwairakpam G, Wang J, Golovin S, Dragunova J, Smith R, et al. High sustained virological response rates using imported generic direct acting antiviral treatment for hepatitis C. J Virus Eradicat. 2017;3(4):200-3. https://doi.org/10.1016/S2055-6640(20)30324-1
PMid:29057082

29. Nainan OV, Alter MJ, Kruszon-Moran D, Gao F-X, Xia G, McQuillan G, et al. Hepatitis C virus genotypes and viral concentrations in participants of a general population survey in the United States. Gastroenterol. 2006;131(2):478-84. https://doi.org/10.1053/j.gastro.2006.06.007
PMid:16890602

30. Samimi-Rad K, Nategh R, Malekzadeh R, Norder H, Magnius L. Molecular epidemiology of hepatitis C virus in Iran as reflected by phylogenetic analysis of the NS5B region. J Med Virol. 2004;74(2):246-52. https://doi.org/10.1002/jmv.20170
PMid:15332273

31. Stedman C, Hyland R, Ding X, Pang P, McHutchison J, Gane E. Once daily ledipasvir/sofosbuvir fixed-dose combination with ribavirin in patients with inherited bleeding disorders and hepatitis C genotype 1 infection. Haemophilia. 2016;22(2):214-7. https://doi.org/10.1111/hae.12791
PMid:26315711

32. Xiao H, Chen J, Wang J, Li J, Yang F, Lu H. Antiviral therapy for HCV in hemophilia A patients with HIV-1 co-infection. Medicine. 2019;98(30). https://doi.org/10.1097/MD.0000000000016524
PMid:31348267 PMCid:PMC6708971

33. Lee HW, Yoo KY, Won JW, Kim HJ. Direct acting antiviral agents in Korean patients with chronic hepatitis C and hemophilia who are treatment-naïve or treatment-experienced. Gut Liver. 2017;11(5):721. https://doi.org/10.5009/gnl17209
PMid:28874040 PMCid:PMC5593335

34. Nagao A, Hanabusa H. Brief report: the impact of ledipasvir/sofosbuvir on HIV-positive and HIV-negative Japanese hemophilia patients with 1, 4, and mixed-genotype HCV. J Acq Immune Def Syndrom. 2017;74(4):418-22. https://doi.org/10.1097/QAI.0000000000001271
PMid:27984558

35. Guedes TP, Garrido M, Morais S, Pedroto I. High rate of SVR with DAA in haemophiliacs with HCV infection: three decades of follow-up of a Portuguese single-centre cohort. Liver Int. 2020;40(7):1783-4. https://doi.org/10.1111/liv.14413
PMid:32133739

36. Merat S, Sharifi AH, Haj-Sheykholeslami A, Poustchi H, Fattahi B, Nateghi-Baygi A, et al. The efficacy of 12 weeks of sofosbuvir, daclatasvir, and ribavirin in treating hepatitis C patients with cirrhosis, genotypes 1 and 3. Hepatitis Monthly. 2017;17(1):4. https://doi.org/10.5812/hepatmon.44564

37. Sharafi H, Nikbin M, Alavian SH, Behnava B, Alavian SM. Efficacy and safety of generic sofosbuvir/ledipasvir fixed-dose combination in Iranian patients with chronic hepatitis C virus infection. Hepatit Month. 2017;17(6). https://doi.org/10.5812/hepatmon.12216

How to Cite This Article:

Zahra Irandegani, Roghaye Razavi, Sanaz Akhondi Meybodi, Nasim Namiranian, Mohsen Akhondi-Meybodi. Assessment of the Effectiveness of Direct-Acting Antiviral Therapy in patients with Hepatitis C: A Follow-up Analysis in Yazd, Iran. J Adv Med Biomed Res. 2024; 32(154): 323-330.

Download citation:
BibTeX | RIS | EndNote | Medlars | ProCite | Reference Manager | RefWorks

Send citation to:
Mendeley Zotero RefWorks