Le Infezioni in Medicina, n. 3, 374-383, 2023
doi: 10.53854/liim-3103-11

Comparative outcomes of direct-acting antiviral treatment in patients with HIV-Hepatitis C co-infection: insights from a single center experience in Colombia

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Article received 23 April 2023, accepted 26 July 2023

SUMMARY

Background: Direct-acting antivirals (DAA) were introduced to Latin America with the aim of eliminating hepatitis C (HCV) in the region. There are scarce data on the outcomes of people living with HIV and HCV treated with these medications in Colombia. This study compares the outcomes of patients with HIV-HCV co-infection and HCV mono-infection treated with DAAs.
Methods: Retrospective observational study including patients ≥18 years old with HCV infection treated with DAAs from August 2017 to December 2019 in a comprehensive center in Colombia. The main outcome was sustained virologic response (SVR). Secondary outcomes included reinfection, relapse and adverse events.
Results: We included 223 individuals with HCV treated with DAAs; 142 (63.6%) individuals were mono-infected and 81 (36.3%) co-infected. Genotypes 1b (49.7%) and 4 (33.9%) were the most common. Overall SVR after DAA treatment was 96.8%. Relapse rate was 2.24%, reinfection rate was 6.28% and adverse events occurred in 27.8% of cases. SVR was comparable in patients with co- and mono-infection (95% vs 97.8%, p=0.245).
Conclusion: DAA were effective in mono-infected (HCV) and co-infected (HCV/HIV) patients and reinfection was high in this last group.

Keywords: Hepatitis C, Human Immunodeficiency virus, Colombia, Direct-Acting Antivirals.

INTRODUCTION

It is estimated that 7 to 9 million adults live with chronic hepatitis C virus infection (HCV) in Latin America [1]. The incidence of HCV in Colombia has been estimated at 0.6 cases per 100,000 inhabitants year and approximately 350,000 peo-

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ple have chronic HCV infection [2, 3]. In people living with HIV (PLWH), the prevalence of HCV co-infection has been estimated to be almost five times that of the non-HIV population (6.2%), being especially prevalent in high-risk groups such as men who have sex with men (MSM) and people who inject drugs (PWID) [4, 5]. HCV and HIV transmission occurs most frequently secondary to injected drug use (IDU) and sexual transmission [6]. After HCV infection, accelerated progression of liver disease is higher among people with HIV/HCV co-infection [7].

In 2013 the first generation of direct-acting antivirals (DAAs) was approved by the FDA, followed by the development of second generation DAAs, improving HCV treatment outcomes by increasing sustained virologic response (SVR) to more than 90% with a good safety profile [8, 9]. The World Health Organization (WHO) set the objective of eliminating HCV by 2030 linking patients to medical care and enabling access to DAAs [10]. Following these recommendations, the Colombian Ministry of Health and Protection stablished a system of centralized purchase of DAAs through the Pan-American Health Organization (PAHO) in 2017 [11].

Few studies have described the outcomes of patients with chronic HCV infection treated with DAAs in Colombia, finding an effectiveness of 95%-96% [11, 12]. However, there is scarcity of real-world data on the effectiveness of treatment with DAA in patients with HIV/HCV co-infection in Latin America. The aim of this study was to describe the outcomes of co-infected and mono-infected patients treated with DAAs at a comprehensive center in Bogota, Colombia.

MATERIALS AND METHODS

We performed a retrospective observational cohort study to describe the outcomes of patients with chronic HCV infection with or without HIV co-infection treated with DAAs in a comprehensive center in Bogotá, Colombia. We included patients of age 18 or older, with a positive HCV antibody test and HCV RNA >12 IU/mL, who received at least one dose of DAAs from August 2017 to December 2019. Patients without HCV RNA (viral load) data for a period of >12 weeks following the completion of their treatment were excluded.

Description of the cohort, treatment and follow up

Our multidisciplinary team is based at Hospital Universitario San Ignacio (HUSI), Bogotá, Colombia, and consists of infectious diseases (ID) specialists, hepatologists, social workers and registered nurses.

Patients diagnosed with HCV were approached by their Health Insurance Organization (HIO) and given the opportunity to participate in the HCV program. This program involved an initial evaluation to confirm the diagnosis, assess the stage of liver fibrosis, and detect any complications. Subsequently, ID or hepatology specialists determined the type of treatment and the appropriate duration, following national and international guidelines [2, 13, 14]. Subsequently, patients underwent a social work evaluation to assess treatment adherence probability and identify the most appropriate medication delivery method, considering their location and occupation. The HIO coordinated daily visits by a designated nurse, responsible for administering the prescribed dose on-site.

Follow-up assessments were conducted during and after the treatment period and the frequency of follow-up visits depended on the duration of treatment. Patients who underwent a 12-week treatment regimen were scheduled for follow-up evaluations at 4, 8, 12, 24, and 36 weeks. Meanwhile, patients undergoing a 24-weeks treatment regimen had a similar follow-up schedule, with an additional follow-up visit at 48 weeks. The assessment of viral load occurred at 4 weeks after treatment initiation, at the end of treatment, 12 weeks after treatment completion (SVR visit), and 24 weeks after treatment completion to evaluate for reinfection. Laboratory tests to assess adverse events were performed on the first visit and at the end of treatment in all groups. In PLWH, the viral load was measured prior to starting DAA treatment to confirm virologic response (HIV viral load (VL) <50 copies / ml).

Available DAA regimens included sofosbuvir (SOF)/ledipasvir(LDV), SOF/daclatasvir(DCV), SOF/velpatasvir(VEL), ombitasvir/paritaprevir/ritonavir/dasabuvir, grazoprevir/elbasvir and simeprevir(SIM)/SOF. The medication of choice changed throughout the study depending on market availability and national guidelines.

All data were collected from medical records and uploaded into a database in REDCap® by trained

personnel. Quality control of the data was performed by two ID specialists during the study. Clinical and demographic variables included age, biological sex, sexual orientation, co-morbidities, prior treatment for HCV, history of liver transplantation, other medications, current substance use, current alcohol use, probable mode of transmission, adherence to HCV treatment (using a Directly Observed Therapy (DOT) strategy), any adverse events to DAA, time of treatment, treatment failure, infection relapse, AST to Platelet Ratio Index (APRI) and Fibrosis-4 (FIB4) scores and HIV status. Baseline laboratory tests included liver enzymes, metabolic panel, creatinine, HIV and hepatitis B serology, complete blood count, alfa fetoprotein, alkaline phosphatase, and HCV RNA (viral load). All patients had a liver ultrasound performed. Results of other specific tests such as elastography/FibroScan(R), MRI of the abdomen, endoscopy, HCV genotype were performed at the discretion of the attending physician. Laboratory tests at follow up included creatinine, liver enzymes, metabolic panel, HCV viral load and complete blood count. The main outcome was SVR and secondary outcomes included relapse, reinfection, and adverse events.

Definitions

For this study, patients with acute HCV infection with two HCV viral loads separated by one month showing an increase or a decrease of less than one logarithm were considered as having chronic HCV infection and were candidates for treatment with DAAs.

SVR was defined as an undetectable HCV RNA (<12 IU/mL) at 12 weeks after completing treatment [13, 15]. Treatment failure was defined as patients with a detectable viral load at 12 weeks after DAA discontinuation [16].

Reinfection was defined as a positive viral load after a negative viral load documented after 12 weeks of completing DAA therapy in patients with the presence of risk behaviors (e.g., injection drug use, unprotected sex, etc.) and unexplainable ALT increases. Alternative criterion for reinfection was the detection of a different HCV genotype compared to the genotype identified at the initiation of therapy. Relapse was considered a HCV RNA decrease that remained below the limit of detection during treatment, but was detectable after the discontinuation of treatment without re-infection criteria [15, 17]. Adverse events were any undesirable or negative effects experienced by patients during or after treatment. These events included a wide range of symptoms or complications, ranging from mild to severe.

Statistical analysis

Patient characteristics and clinical data were described using frequency measures for categorical variables and medians with IQR for continuous variables. The t-test for paired data and Wilcoxon's signed rank test were used to compare quantitative variables; the X^2 test and Fisher's exact test were used to compare categorical variables. Tests were two-tailed and a p value of less than 0.05 was considered statistically significant.

Treatment outcomes were further analyzed separately for HCV-mono-infected and HIV/HCV co-infected patients. The proportion of patients with SVR was estimated by dividing all patients who attained a non-detectable HCV viral load after 12 weeks after finalizing treatment by the total of patients who completed treatment in the respective group (co-infected or mono-infected). All statistical analyses were performed with STATA 16 (College Station, TX, USA).

Ethical considerations and confidentiality

This study was performed following all ethical considerations as stipulated by the Helsinki declaration. The Institutional Review Board of Hospital Unversitario San Ignacio and Pontificia Universidad Javeriana, Bogota, Colombia, approved this study with a waiver for informed consent given the retrospective nature of the study (approval number id: FM-CIE-0791-19). All data was stored in a secure database accessed only by authorized personnel. All data was de-identified.

RESULTS

We included a total of 223 individuals with HCV infection treated with DAAs between August 2017 and December 2019. Out of the total sample, 142 individuals (63.68%) had HCV mono-infection, while 81 individuals (36.3%) had HIV/HCV co-infection. In the mono-infection group, patients were predominantly female (97/142, 68.3%), and the median age was 62 years (IQR:60-64). In the co-infection group, all patients were male (81, 100%) with a median age of 33 years (IQR: 31-

Table 1a - Demographic characteristics of patients treated with direct-acting antivirals (DAA).

Variable	*HCV – mono-infected N=142*	*HCV + HIV – co-infected N=81*	*p - value*
Age (median, IQR)	62 (60-64)	33 (31 - 37)	<0.001
Male (n, %)	45 (32)	81 (100)	<0.001
Sexual orientation (n, %)			
MSM	2 (1.4)	71(88.7)	<0.001
MSM/W	0	3(3.7)	
MSW	35 (28.4)	5 (6.3)	
WSM	86 (69.9)	1(1.2)	
Co-morbidities (n, %)			
Cardiovascular disease	59 (41.5)	2 (2.4)	<0.001
Solid malignancies	10 (7.0)	1(1.2)	0.054
Hematological malignancies	3 (2.1)	0	0.188
Chronic kidney disease	13 (9.15)	0	0.005
Type II Diabetes Mellitus	24 (16.9)	1(1.2)	<0.001
Obesity	25 (18.12)	1(1.2)	<0.001
Hepatic Elastography (n, %) [a]	94 (66.19)	42 (51.8)	0.010
F0	5 (5.32)	3 (7.1)	
F1	8 (8.51)	10 (23.8)	
F2	22 (23.4)	16 (38.1)	
F3	26 (27.6)	7 (16.6)	
F4	33 (35.1)	6 (14.2)	
CHILD PUGH (n, %)			
A	46 (32.3)	6 (100)	<0.001
B	5 (3.5)	0	
C	1 (0.7)	0	
Hepatitis B co-infection (n, %)	1(0.7)	7(8.6)	<0.001
Previous treatment for HCV (n, %)	25 (17.6)	6 (7.4)	0.034
Psychoactive substance use† (n, %)	3 (2.1)	24(29.6)	<0.001
Alcohol use disorder† (n, %)	10 (7.0)	5(6.1)	0.803
HCV Genotype (n, %)			<0.001
1a	21 (15.3)	1(1.2)	
1b	106 (77.3)	1(1.2)	
2	4 (2.9)	1(1.2)	
3	3 (2.1)	2 (2.5)	
4	2 (1.4)	71(91.0)	
HCV-RNA [Log10 IU/mL (median, IQR)]	5.58 (5.46 – 5.86)	5.64 (5.52 – 5.87)	0.398
ALT [IU/L (median, IQR)]	66.5 (56.8 – 78.7)	86 (61.5 – 111.9)	0.009
HIV RNA <50 copies/mL (n, %)	–	60 (74)	–
HIV RNA [Log10 IU/mL (median, IQR)]	–	1.99 (1.8 – 2.2)	–
CD4 count [cells/lL (median, IQR)]	–	476 (398 – 505)	–
HIV Stage* (n, %)	–		
1		12 (14.81)	
2		51 (62.96)	
3		18 (22.22)	

IQR: Interquartile range. HCV: Hepatitis C Virus. ALT: alanine aminotransferase. RNA: Ribonucleic Acid. MSM: Men who have sex with men, MSW: Men who have sex with women, WSM: Women who have sex with men. MSM/W: Men who have sex with men and women. HIV: Human Immunodeficiency Virus.

[a] Denominator of the percentage estimator: n=94 and 42, respectively

† Refers to current use.

‡ Patients receiving 8, 11, 16, and 23 weeks of treatment discontinued due to intolerance or mortality

* Classified according to CDC 2014 criteria.

Table 1b - Treatment characteristics of patients treated with direct-acting antivirals (DAAs).

Variable	*HCV – mono-infected N=142*	*HCV + HIV – co-infected N=81*	*p - value*
DAA treatment (n, %)			
Sofosbuvir/ Ledipasvir	71(50.0)	44 (54.3)	0.602
Sofosbuvir/Velpatasvir	46 (32.4)	35(43.3)	
Sofosbuvir / Daclatasvir	6 (4.2)	0	
Sofosbuvir/ Ledipasvir/Ribavirine	5 (3.5)	0	
Dasabuvir + Ombitasvir/Paritaprevir/Ritonavir	5 (3.5)	0	
Sofosbuvir/Velpatasvir/Ribavirine	4 (2.8)	1(1.2)	
Simprevir/Sofosbuvir	2 (1.4)	1(1.2)	
Sofosbuvir / Daclatasvir/Ribavirine	2 (1.4)	0	
Grazoprevir/Elbasvir/Ribavirine	1(0.7)	0	
Ribavirin use (n, %)	12 (8.4)	1 (1.2)	0.027
Treatment duration‡ (n, %)			
8 weeks	4 (2.8)	0	
11 weeks	1 (0.7)	0	
12 weeks	118 (83.1)	79 (97.5)	0.912
16 weeks	1 (0.7)	0	
23 weeks	1(0.7)	0	
24 weeks	17 (11.9)	2 (2.47)	

HCV: Hepatitis C Virus. DAA: Direct-acting Antivirals. HIV: Human Immunodeficiency Virus.
‡ Patients receiving 8, 11, 16, and 23 weeks of treatment discontinued due to intolerance or mortality

37), and a majority were MSM (71, 89.4%), among whom 78 (96.8%) acquired the infection through sexual transmission. Table 1a describes the clinical characteristics of patients receiving DAA and Table 1b the treatment characteristics. When compared to patients with co-infection, patient with mono-infection were more likely to present with chronic co-morbidities, including cardiovascular disease (59, 41.5%), chronic kidney disease (13, 9.15%) and diabetes mellitus (24, 16.9%). Patients with mono-infection were more frequently infected through blood transfusion (67, 47.1%), or the transmission mode was unknown in 53 (37.3%).

The most frequently identified genotype in the mono-infection group was genotype 1b (106, 77.3%), whereas in the co-infection group the most frequent genotype was 4 (71, 91%); $p < 0.001$. Only 2 patients in both groups were infected with two genotypes.

Liver fibrosis was assessed using elastography in 136 out of 223 patients (61%), of which 39 (28.6%) exhibited fibrosis grade F4. Among patients with mono-infection, F4 was the most prevalent score (33, 35.1%), while the group with co-infection predominantly showed F2 scores (16, 38.1%). Cirrhosis was observed in only 6/81 (7.4%) patients with co-infection, all classified as Child-Pugh A.

In the mono-infection group, 52 patients (36.6%) were diagnosed with cirrhosis, most of them classified as Child Pugh A (46, 32.3%). Additionally, three cases of hepatocellular carcinoma were identified within this group.

Most patients received SOF-based schemes, either with VEL, LDV, DCV or SIM. Treatment adherence was close to 98% in both groups.

Among the 81 individuals with co-infection, all were on ART at the initiation of DAA treatment and 60 (74%) had an undetectable HIV viral load. The median CD4 count was 476 cells/µL (IQR: 398 – 505 cells/µL) and 4 patients (5%) had a CD4 count bellow 200 cells/µL. We observed a median of 492 CD4 cells/µL among patients with reinfection (IQR: 372 - 616). Five (6.1%) co-infected patients presented with syphilis during treatment, none of them had HCV reinfection. Other characteristics are shown in Table 1a and 1b.

SVR at 12 weeks was observed in 216 (96.8%) patients. The mono-infection group achieved SVR more often than the co-infection group, but the difference did not reach statistical significance

(139 (97.8%) vs 77 (95.0%) p = 0.245). Overall reinfection frequency was 6.28%, being more frequent in the co-infection group (13 (16.05%) vs 1 (0.7%), p<0.0001).

Relapse was observed in 1 patient (0.7%) within the mono-infection group and 4 patients (4.9%) within the co-infection group, resulting in an overall frequency of 2.24%. Among the patients with relapse, only 1 individual presented a CD4 count of less than 350 cells/uL. Among the 4 patients with relapse in the co-infection group, two of them had an HIV viral load greater than 1000 copies/uL at the beginning of DAA treatment. One patient received SIM + SOF and the other SOF + LED. Both patients were concurrently on a regimen of tenofovir/emtricitabine + dolutegravir for HIV management. The remaining two patients who experienced relapse had an undetectable HIV viral load at the beginning of DAA treatment (SOF + LED) and were undergoing treatment with tenofovir/emtricitabine + efavirenz for HIV. These four patients had HCV genotype 4 infection.

Seven patients (3.1%) did not achieve SVR, four of whom were in the co-infection group and experienced relapse. The remaining three patients were from the mono-infection group, all with F4 fibrosis and classified as compensated cirrhosis at the beginning of DAA treatment (SOF + LED). One patient had hepatocellular carcinoma and another had a hematological malignancy. The third patient experienced relapse. None of the three patients had received prior HCV treatment. Two out of the three patients died.

The most frequent adverse events were headache 13 (5.6%) and gastrointestinal symptoms (15, 6.4%), No grade 3 or 4 clinic or laboratory adverse event were reported. Treatment discontinuation was observed in only 1 patient with mono-infection (0.7%) due to intolerance. Three patients died before completing treatment, all of them in the mono-infection group. Table 2 shows the details of main and secondary outcomes.

DISCUSSION

This article describes the outcomes of DAA treatment in a cohort of patients with HCV in Bogota, Colombia, and compares the outcomes of patients with HIV/HCV co-infection with those of patients with HCV mono-infection. The overall SRV was high compared to that reported in other studies. Although a lower proportion of patients achieving SVR was found in the co-infection group compared to the mono-infection group, this difference was not statistically significant.

In international clinical trials and observational studies, treatment of chronic HCV infection with second generation DAA has shown an efficacy and effectiveness above 90% with a good safety profile [18-23]. In our study, we observed an overall SVR of 96.8%, which is comparable

Table 2 - Main and secondary outcomes by subgroups (monoinfected vs co-infected).

Outcome	*HCV Mono-infected*	*HCV/HIV co-infected*	*p-value**
Sustained virologic response SVR† (n, %)	139 (97.8)	77 (95.0)	0.245
Relapse (n, %)	1(0.7)	4 (4.9)	0.040
Reinfection (n, %)	1(0.7)	13 (16.0)	<0.001
Adverse events‡ (n, %)	45 (31,9%)	17 (20,9)	0.086
Fatigue	7 (4.9)	2 (2.4)	0.498
Insomnia	4 (2.8)	4 (4.9)	0.41
Headache	13 (9.1)	0	0.005
Gastrointestinal issues	12 (8.4)	3 (3.7)	0.173
Irritability	4 (2.8)	2 (2.4)	0.877
Abnormal blood count	2 (1.4)	0	0.283
Renal function impairment	1 (0.7)	0	0.449
Others§	2 (1.4)	6 (7.4)	0.33

SVR: Sustained Virologic Response. HCV: Hepatitis C Virus. HIV: Human Immunodeficiency Virus.
† Undetectable viral load (<12 IU/mL) at 12 weeks after finalization of DAA treatment.
‡At least one adverse event reported. Main events detailed by numbers and percentages for each sub-group's total patients.
§ Arthralgias (joint pain), anxiety, disesthesias in the hands, edema in lower limbs, emotional lability, depression, jaundice.

to the international literature. Compared to different studies in Colombia and Latin America, our overall SVR rate was similar and, in cases, slightly higher. For instance, a real-world study performed in Brazil followed 1,002 patients with chronic HCV infection, mostly with genotypes 1, 2 and 3, finding an overall SVR of 93.4% [24]. In this study 54% of patients had cirrhosis, 45.8% were treatment-experienced and a small proportion were PLWH (7%). No significant differences were observed in SVR for patients with advanced fibrosis, HIV/HCV co-infection or with prior treatment for HCV[24]. Similarly, a systematic review evaluating the effectiveness of DAAs for chronic HCV in South America including data from Argentina, Brazil, Chile, Colombia and Peru, found an pooled SVR of 95.5% with no statistically significant differences of SVR in patients with HIV or prior treatment for HCV, however, a significantly lower SVR was observed in patients with cirrhosis [25]. Of note, only four studies in the systematic review included PLWH and the frequency of HIV was below 20% in most studies. In addition, few patients with genotype 4 were included [25].

Only two studies have reported the outcomes of patients treated with DAAs in Colombia. Varon et al. studied the outcomes of patients with HCV treated with DAA in four Colombian cities [12]. They included 195 patients. The most frequent genotype was 1b (81.5%), followed by genotype 1a; no patients with genotype 4 were included. Prior treatment was reported in 34.4% of patients and 47.7% had cirrhosis. Only 1.5% of the sample had HIV/HCV co-infection. The overall SVR rate in this cohort was 95.4% [12]. On the other hand, Pérez et al. evaluated 543 patients with HCV and in contrast to the previous study, 16% of patients had genotype 4 and a high proportion had HIV/HCV co-infection (23%). In their analysis the overall SVR was 96% but no subgroup analysis was performed to evaluate the response rate in the HIV or genotype 4 groups [11]. In contrast, our study revealed a higher prevalence of genotype 4 infection (91%) among patients with HIV co-infection, with 95% of them achieving SVR. A study in Spain describing the outcomes of DAA treatment in a cohort of 462 patients with mono-infection (genotypes 1-4) showed a similar SVR for all genotypes, with a specific SVR of 95% in patients with genotype 4 [26]. Similarly, a large study from Spain described an SVR of 92.2-95.5% in patients with HIV/HCV coinfection and genotype 4 treated with DAAs[27]. In addition, a recent study from Egypt comparing SOF + LDV versus SOF + DCV in 90 patients with genotype 4 infection found a SVR of 98% and 96%, respectively, proving a good effectiveness with both regimens [28]. These regimens were the two main regimes used in our cohort with co-infection.

HCV co-infection is high in the HIV population, particularly in MSM and PWID due to high-risk practices [4]. Current guidelines recommend the same DAAs for patients with co-infection, as DAAs have proven to be effective in HIV patients [13]. Some real-world studies have found that SVR ranges from 85% to 92% in the PLWH[27, 29]. Our SVR rate in PLWH was lower in contrast to findings of a Brazilian study, where patients with co-infection achieved an SVR of 97.1% (31) but were similar to a study from Germany, where 94% of patients with co-infection had SVR [30].

Specific predictors of treatment failure with DAAs in patients with HIV/HCV co-infection include cirrhosis, high HCV viral load and a low CD4 cell count at baseline and follow up [27, 30]. However, only a small proportion of patients with co-infection in our cohort had cirrhosis (7.4%) and the median CD4 count was high, which reduces the probability of these factors influencing SVR. Other studies analyzing the association between mental health and SVR found that drug use and mental illness increased the odds of treatment failure and reduce treatment compliance [16, 31]. Darvishian et al. studied 4,477 HCV patients of which 453 (10.1%) were lost to follow up and odds of being loss to follow up were higher in those patients with history of substance use [32]. In our population with mono-infection only 3 (2.1%) patients reported substance use, whereas 24 (29.6%) of patients with co-infection had a history of substance use ($p<0.001$). However, after analyzing the relationship between substance and treatment failure, no statistically significant associations were found. In addition, no relevant issues were identified with treatment adherence.

When analyzing treatment failures (seven cases), three of them occurred in the mono-infection group and were possibly related to advanced liver disease. In all three cases, hepatic cirrhosis was identified, and one of them had hepatocellular carcinoma, which is one of the predictors of treat-

ment failure described in the literature [27, 30], In the co-infection group, there were four cases of failure related to relapse. Two of these patients were identified to be on efavirenz at the beginning of DAA therapy, which may have resulted in a drug interaction with DAAs [33, 34].

We found a high proportion of HCV reinfections in patients with HIV. Although this phenomenon was described before DAAs became widely available[35, 36], with the possibility of HCV elimination, reinfection has gained increasing attention. HCV infection in MSM, regardless of HIV status, is driven by high-risk sexual practices and substance use. Risk factors for HCV transmission in MSM include IDU, genital ulcers, unprotected anal intercourse, group sex, fisting and GHB (gamma hydroxy butyrate) use [37, 38]. Many of these risk factors are associated with reinfection in patients with HIV. In fact, a recent study found that among patients with HIV who achieved SVR after treatment with DAA, reinfection was higher in MSM who injected drugs or who had a positive STD test in the pre-SVR period, specifically chlamydia/gonorrhea test, which could be considered marker of unprotected sex [39]. Another study found that reinfection was associated with unprotected receptive anal intercourse, group sex, anal rinsing, sharing of sex toys and having more than ten casual sex partners in the last six months. Interestingly, they also described a poor immunovirologic HIV status as a factor associated to reinfection, specifically a nadir <200 CD4 cells/mm^3 and a recent CD4 cell count <500 cells/mm^3 [40]. These factors require further study in our population, as well as those related to high risk sexual behaviors.

We believe that in our study the high prevalence of genotype 4 could be related to a probable outbreak of HCV infection in MSM in the city of Bogotá, which has been perpetuated by the persistence of risk behaviors in the affected population, favoring cases of reinfection.

There are several limitations to our study. First, our data were collected retrospectively, hampering the possibility of capturing additional clinical variables. However, the data collected from patients treated with DAA in Colombia is extremely comprehensive for reimbursement purposes. Second, the sample of patients was small, which prevented us from performing a reliable multivariate analysis. Third, we were unable to collect further information on potential high risk sexual behaviors in the population with co-infection to explore factors associated with reinfection. Yet, this is the largest study from Colombia comparing treatment outcomes in patients with mono and co-infection treated with DAAs.

In conclusion, SVR was achieved by a proportion of patients similar to that of international real-world studies. DAA therapy was highly effective in patients with HCV mono infection and HIV/HCV co-infection, supporting the need to increase the access to DAA therapy to patients with HCV infection, regardless of HIV co-infection. Our results support the mounting evidence that addressing social determinants of health and an increasing implementation of harm reduction strategies in PLWH may help improving outcomes in the treatment of HCV infection.

Contributions

HV, JBC and AD conceptualized the study. HV, SMV and SVB analyzed the data. HV, AD, JBC, JPO and ARR drafted the manuscript. LMS and SMV collected the data. AD, SG, YS and SVB interpreted the results. All authors revised the manuscript critically and approved its final version. All authors agreed to be accountable for all aspects of the work.

Conflict of interests

The authors have no conflict of interests to declare.

Funding

This study did not receive any funding.

Acknowledgements

We would like to acknowledge Sandra Milena Moreno for her valuable help with the data collection.

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