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COMPARATIVE ANALYSIS OF ANTIVIRAL THERAPIES IN CHRONIC HCV PATIENTS: CLINICAL OUTCOMES AND TREATMENT IMPLICATIONS

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Abstract *Hepatitis C Virus is an enveloped single-stranded RNA virus of the family Flaviviridae and genus hepacivirus. HCV infection can lead to severe conditions like liver cirrhosis and hepatocellular carcinoma. Different Antiviral drugs are used for the treatment of HCV based on genotypes. This study aimed to assess the clinical efficacy of direct acting antivirals drug used for the treatment of HCV patients. Blood samples of 110 HCV patients were collected and confirmed by ICT, ELISA, and real-time PCR. Furthermore, the patients' demographic data and biochemical tests were performed before and after the treatment. Patients were classified into two groups: one being treated with sofosbuvir+ribavirin and the other with sofosbuvir+daclatasvir. SVR was determined after 3 and 6 months of treatment. The results showed that male patients (54.5%) were more than females (45.5), and HCV was prevalent in urban areas (62.7%). HCV was found to be highly prevalent in patients aged 36 to 55 (46.4%). The frequent route of transmission was found to be unsafe barber visits (38.2%), followed by unsafe therapeutic injections (31.8%), unsafe dental procedures (24.5%), and blood transfusion (3.6%). Overall, SVR after 24 weeks was 89.1%; for those using sofosbuvir plus ribavirin, SVR was 93.2%, and for sofosbuvir plus daclatasvir was 84.3%. The adverse effects were noted such as generalize body aches, fatigue, headache, and fever in both DAAs groups. This study concludes that high prevalence of HCV in male patients, mostly from urban areas, with exposure to unsafe barber visits, multiple therapeutic injections, and dental procedures. Sofosbuvir plus ribavirin showed slightly higher efficiency, but overall, the SVR was remarkable for both combinations against chronic HCV infection.*

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Keywords*:* *HCV; sustained virological response (SVR); sofosbuvir; ribavirin; daclatasvir; direct-acting antivirals (DAAs)*

Introduction

Hepatitis is the inflammation of hepatic cells (liver parenchymal cells) or liver cancer in humans, which is caused by Hepatitis C virus (HCV). It can also be caused by autoimmune disorders occasionally (Jamil et al. 2024). HCV can be transmitted from person to person through various routes, i.e., blood transfusion, toothbrushes, sharing of razors, contaminated syringes, surgical equipment, barbershops, contaminated dental apparatus, unsafe sex, and drug abuse. There are five major types of hepatitis, ranging from hepatitis A to hepatitis E, caused by 5 viruses, namely hepatitis A to E viruses, and hence are named after the virus that causes them (Bashir et al., 2017; Ullah et al., 2023). The seroprevalence in Pakistan ranges from 2.3 to 14.1% in different geographical regions. Pakistan is a developing country, and the general population has low literacy about the diagnosis and treatment of HCV infection. Hence, HCV can be regarded as a huge economic, health, and public burden for the country, especially in the less developed province of Khyber Pakhtunkhwa, Pakistan (Haider et al., 2020). Hepatitis C Virus is an enveloped and single-stranded positive-sense RNA virus with 50nm genome and a high ratio of genetic variation (Pandian et al., 2023). HCV is a significant public health problem globally, which mainly affects the liver, leading to chronic hepatitis, liver cirrhosis, fibrosis, and hepatocellular carcinoma (HCC), increasing the morbidity and mortality of the viral infection all around the world (Hassan et al., 2024). Approximately 50 million people have chronic HCV infection globally, with about 1 million new infections annually. In 2022, there were approximately 242,000 deaths due to Hepatitis C complications (Khaliq et al., 2018). Studies revealed that the prevalence of genotype 1b of the virus is responsible for developing HCC, which leads to higher fatality (Petruzziello et al., 2017). It has also been observed that long-lasting and untreated HCV is the major cause of higher fatality of the infection (Petruzziello et al., 2019). In Humans, the risk

factors for transmission of HCV are primarily through sharing needles or contaminated equipment with HCV-infected blood. Transmission from an infected mother to a newborn and accidental needle-stick injury transmission are also common (Alter, 2017). The highest prevalence of HCV is associated with African and East Mediterranean regions, while the lowest prevalence, i.e., less than 2% of the population, is found to be in regions such as Australia, America and Western Europe (Umer et al., 2016). In Pakistan, 6% of the total population is estimated to have anti-HCV antibodies, showing that the viral infection in the general population of Pakistan is increasing at an alarming rate, which is worth consideration (Mooneyhan et al., 2023).

HCV has no effective vaccine, but currently available direct-acting antivirals (DAAs) can cure more than 95% of people infected with hepatitis C regardless of the genotype, which offers higher SVR and having least side effects and lesser treatment duration. In addition to improved efficacy, antiviral therapy has become safer, more convenient, and shorter, with most patients completing treatment in only 8 or 12 weeks. Furthermore, treatment regimens have been simplified by eliminating the need for ribavirin (RBV), resulting in enhanced tolerability and a more streamlined treatment approach. The refinement of antiviral therapy has laid the foundation for realizing the WHO's ambitious target of eradicating HCV as a major public health concern by 2030. Achieving this target hinges on identifying HCV infection in individuals who are unaware they have it, thereby ensuring timely diagnosis and treatment (Brzdęk et al., 2023). At this time, there is no national-level hepatitis surveillance system developed in Pakistan that identifies the importance and severity of HCV as a threat to public health in the country (Al Kanaani et al., 2023). The present study focuses on the efficiency of antiviral drugs used against hepatitis C virus infection in Peshawar, Pakistan.

Materials and methods

Study Design

The current study was performed at Rehman Medical Institute (RMI), Hayatabad Medical Complex (HMC), and the Microbiology Research Laboratory (MRL), Department of Microbiology, Abasyn University, Peshawar, Pakistan. Samples were collected from HCV patients (admitted to RMI and HMC) after getting written consent from the patients to be included in the research study. The collected samples were transported to MRL Abasyn University, Peshawar, through proper protocols. The samples were confirmed to be positive for HCV by detecting antibodies and viral load through ELISA and RT-PCR, respectively. Patients' history and demographic data were collected. The patients were started on treatment with sofosbuvir plus ribavirin and sofosbuvir plus daclatasvir combinations. In this study, all the patients were treated, and the SVR rate was determined after 12 and 24 weeks, respectively. The efficiency of each combination was determined based on the SVR of the antiviral agents after 12 or 24 weeks of treatment. The patients' samples were again screened for HCV RNA by RT-PCR. During the treatment, adverse effects were noted.

Criteria of the study

Patients diagnosed with chronic HCV and aged>16 years were included in the study. Samples were obtained from patients who agreed to give their written informed consent and started the prescribed treatment with prescription and acknowledgment of the designated health practitioner at the respective hospital. Patients negative for HCV diagnosis or with a low viral load (<1000 iu/L), those diagnosed with hepatitis B or D virus, and those with autoimmune hepatitis were excluded from the research study.

Enzyme-Linked Immunosorbent Assay (ELISA)

ELISA was performed using a Human HCV IgG (Hepatitis C Virus Antibody IgG) ELISA Kit (cat#EH3774) purchased from Wuhan Fine Biotech Co., Ltd. Samples were subjected to a 2nd-generation Enzyme-Linked Immunosorbent Assay (ELISA) for the detection of HCV antibodies in the patients' blood. The procedure was done according to Standard Operating Procedures (SOPs) defined and evaluated by many researchers in the past (Ullah et al., 2020).

RNA Extraction and cDNA synthesis

RNA was extracted from serum samples using the QIAamp Viral RNA Mini Viral RNA Extraction Kit (Qiagen Inc.). The reverse transcription was carried out by Reverse Transcriptase PCR using a specific reverse primer according to the proper protocol. The cDNA synthesis was Complete RT buffer (5X) 4µl, RNAs inhibitors 0.5µl, dNTPs (10mM) 1µl, M-MLV RTase (200U/µl) 1µl, Reverse Primer (10 pmol/µl) 1µl, RNA (20-50ng) 10µl and dH2O (final volume adjusted to 20µl). The temperature profile for cDNA was: 37℃/60 min, 70℃/10 min, and 22℃/∞ min (Zeba et al., 2014).

Study of Polymerase Chain Reaction

The samples were identified as HCV-positive by finding the HCV 5'-UTR, and HCV genotyping was subsequently conducted using multiplex PCR by the procedure (Zeba et al., 2014; Sandmann et al., 2019). The viral titer was determined by RT- PCR using the manufacturing kit (Sacace Biotechnologies kit Altona) with the following protocols for viral load determination (Ullah et al., 2023). Stage 1: Hold 50 ºC for 30 min. Stage 2: Hold 95 ºC 15 min. Stage 3, 2-Temperature Cycle 95ºC 20 sec 60 ºC 40 sec; repeat the cycle up to 40 times (Ullah et al., 2023; Zeba et al., 2014).

Treatment of Patients

The patients included in the study (n=110) were divided into two groups (the first has 59 patients, the second 51). Each group was treated with different combinations of direct-acting antiviral agents (DAAs). The first group received treatment with

sofosbuvir plus ribavirin, and the second group with sofosbuvir plus daclatasvir (sarwar and Khan 20217). The patients were diagnosed with HCV before treatment with ICT, ELISA, PCR, and liver function tests (LFTs). The patients were treated for 12 weeks, and those with no response or SVR were treated for 24 weeks. After the treatment, the same tests were performed again, and sustained virological response (SVR) was determined. Sustained virological response (SVR) was determined for each patient and was further correlated with the patient's initial viral load or any comorbidity, LFTs, and the DAAs being given and analyzed statistically for further interpretation (Table 2).

Statistical Analysis of Data

The data were statistically analyzed with the help of SPSS Statistics software (v22) and MS Excel 2019. Sustained Virological Response (SVR) rates were compared across different DAAs regimens used for treatment. Associations between different risk factors, gender, age groups, genotypes, SVR, and adverse effects were drawn and represented as frequencies and percentages. The data were represented in the form of frequency/percentile tables and graphs where necessary.

Results

Demographic characteristics of the study

The patients' data were analyzed and distributed according to the demographic information. Demographic information of patients included gender, age group, possible route of transmission, and locality of the patient. In this study, the prevalence of HCV was slightly higher in males, 60 out of 110 (54.5), as compared to females, 50 out of 110 (45.5%), as shown in Figure 1. The prevalence of HCV was higher in patients from urban areas, at 69 out of 110 (62.7%), as compared to patients from rural areas, at 41 out of 110 (37.3%). Patients from urban areas were more likely to get infected with HCV because of a congested population, unsafe eating and drinking habits, unsafe barber and dental procedures, and being exposed to most of the risk factors.

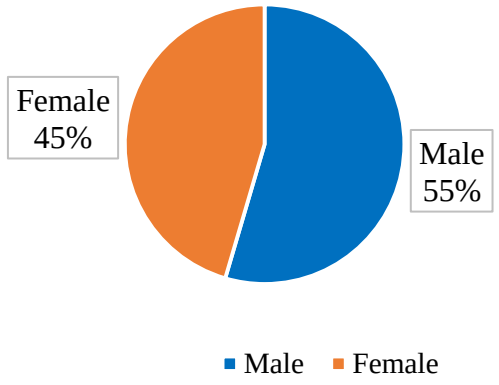

Figure 1. Gender wise distribution of HCV patients

Prevalence of HCV based on age groups

Patients were classified into three groups based on their ages: group 1 (16 – 35 years), group 2 (36 – 55 years), and group 3 (56 – 74 years). The prevalence of HCV was observed to be highest in the age group 36-55 years at 51 out of 110 (46.4%), followed by patients with old age in the older age group 56 to 75 years, which was 42(38.1%). The lowest prevalence was observed in young patients aged 16 to 35 years, 17(15.5%). Figure 2 is provided to explain and graphically represent the age-wise distribution of HCV patients.

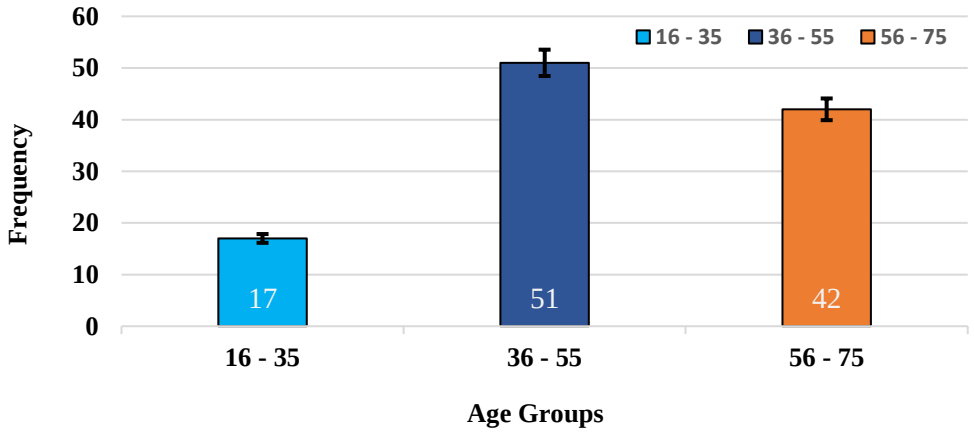

Figure 2. Age-wise distribution of HCV patients

Route of Transmission of HCV

Data regarding possible routes of transmission of HCV infection were analyzed using SPSS to determine the frequency of different portals and routes of HCV transmission. Out of total 110 patients included in the study, 42 patients (38.2%) were found to be visiting unsafe barber's for shaving or other procedures during the course of getting infected by HCV followed by 35 patients (31.8%) who received multiple therapeutic injections before getting infected, 27 patients (24.5%) were found to have unsafe dental procedures, 4 patients (3.6%) were those with blood transfusions and only 2 patients (1.8%) were those with tattooing history

before diagnosing with HCV. The graphical representation of risk factors or route of transmission is given in Figure 3.

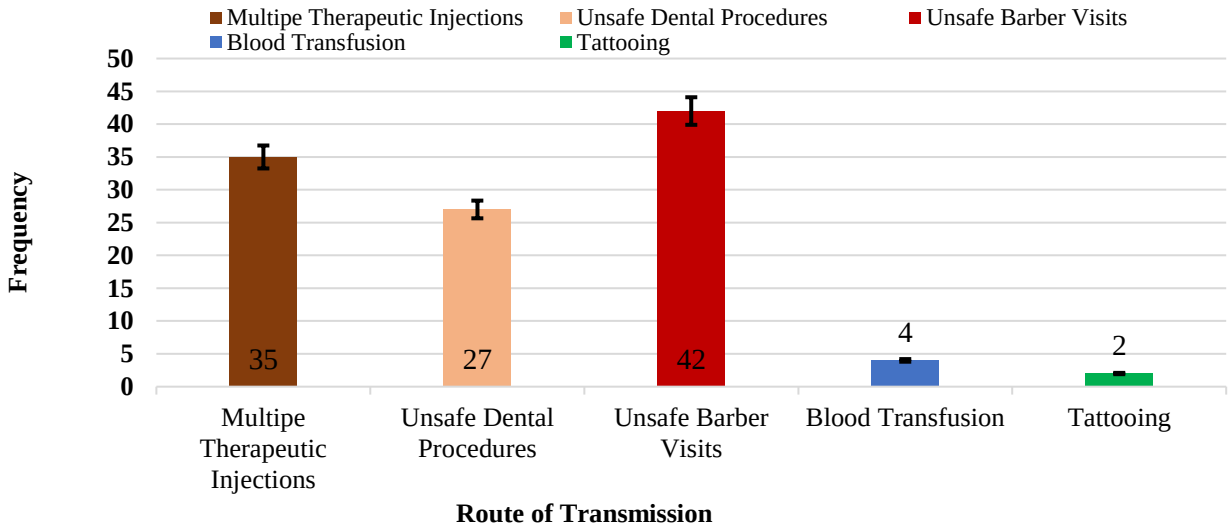

Figure 3. Frequency of different routes of transmission of HCV

Prevalence of different HCV genotypes

Prevalence of HCV genotypes in chronic HCV patients was determined by analyzing the data, and it was observed that the most prevalent genotype in the area was 3a (43.6%), followed by 3b (31.8%), 2a (11.8%), and untypeable (7.3%); 4 samples were found to be mixed genotypes (3.6%) and 1a (1.8%). Figure 4 shows the prevalence of different genotypes of HCV in the collected samples.

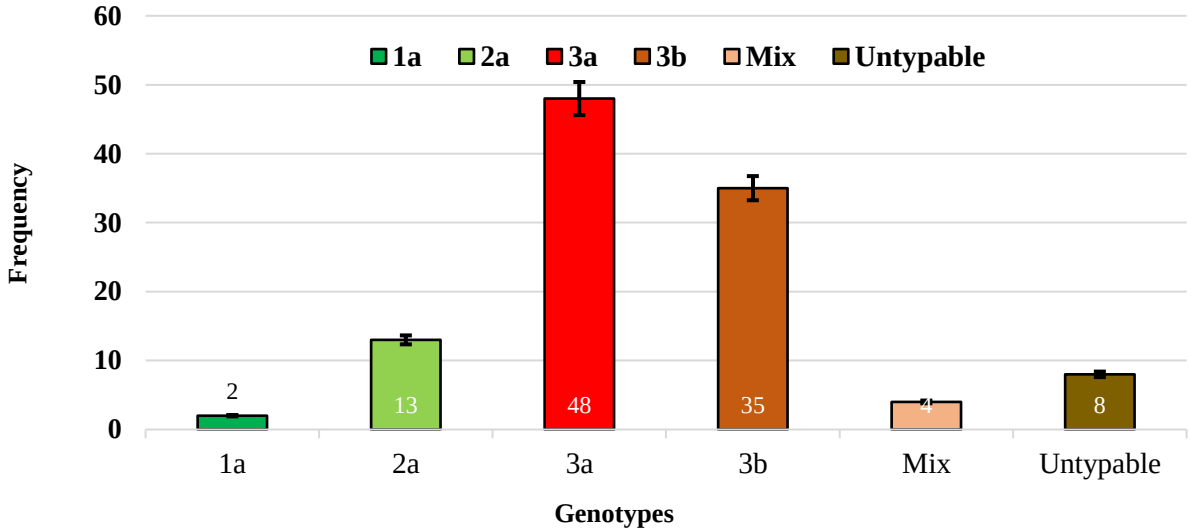

Figure 4. Classification of HCV genotypes

Sustained Virological Response (SVR)

Sustained virological response (SVR) was reported for all patients at the end of treatment after 12 and 24 weeks. SVR was determined as the percentage of patients who responded to treatment and whose end-of-treatment PCR was found to be negative. Overall, the SVR after 24 weeks was found to be 89.1% (98 out of 110), and only 10.9% (12 out of 110) of patients were found to be non-SVR after treatment. This was improved compared to SVR after 12 weeks of treatment, which was 82.3% (91 out of 110) responders and 17.2% (19 out of 110) non-responders. Furthermore, the SVR after 24 weeks was correlated with factors such as antivirals being used, age group, gender, and HCV genotypes. It was found that patients receiving sofosbuvir+ribavirin treatment resulted in 93.2% (n=55) SVR, while only 7.8% (n=4) patients were non-SVR. On the other hand, for sofosbuvir+daclatasvir treatment, the SVR was found to be slightly lower at 84.3% (n=43), and 15.7% (n=8) patients were non-SVR. Out of 89.1% SVR (n=98), 53 were male patients while 45 were female. In total, of 60 male patients, 88.3% (n=53) were SVR while 11.7% (n=7) were non-SVR, and out of 50 female patients, 90% (n=45) were SVR while 10% (n=5) were non-SVR. For different age groups, SVR was found to be 94.1% (16 out of 17)

for the age group 16 – 35 years, 94.1% (48 out of 51) for 36 – 55 years, and 81% (34 out of 42) for 56 – 75 years. SVR was higher in patients aged 36 to 55 years and was found to be lower in older patients. SVR was found to be higher against HCV genotypes 3a, 3b, 2a, and 1a, which was 96% (46 out of 48), 88.5% (31 out of 35), 84.6% (11 out of 13), and 100% (2 out of 2), respectively. While SVR was lowest for untypeable and mixed genotypes, it was 62.5% (5 out of 8) and 75% (3 out of 4), respectively. SVR of patients in correlation with DAAs used, gender, age, and HCV genotype is represented in Table 1.

Table 1. Sustained Virological Response (SVR) of HCV patients

Parameters		SVR	Non-SVR	Total
		SVR 12 91 (82.73%)	**SVR 12 19 (17.27%)**	**110**
		SVR 24 98 (89.1%)	**SVR 24 12 (10.9%)**	**110**
DAAs combination used	**Sofosbuvir+Ribavirin**	55/59 (93.2%)	4/59 (7.8%)	59
	Sofosbuvir+Daclatasvir	43/51 (84.3%)	8/51 (15.7%)	51
	Total	**98**	**12**	**110**
Gender	**Male**	53/60 (88.3%)	7/60 (11.7%)	60
	Female	45/50 (90%)	5/50 (10%)	50
	Total	**98**	**12**	**110**
Age group	**16-35**	16/17 (94.1%)	1/17 (5.9%)	17
	36-55	48/51 (94.1%)	3/51 (5.9%)	51
	56-75	34/42 (81%)	8/42 (19%)	42
	Total	**98**	**12**	**110**
HCV genotype	**1a**	2/2 (100%)	0 (0%)	2
	2a	11/13 (84.6%)	2/13 (15.4%)	13
	3a	46/48 (96%)	2/48 (4%)	48
	3b	31/35 (88.5%)	4/35 (11.5%)	35
	Mix	3/4 (75%)	1/4 (25%)	4
	Untypeable	5/8 (62.5%)	3/8 (37.5%)	8
	Total	**98**	**12**	**110**

Efficiency of different DAAs used

Efficiency of DAAs used, sofosbuvir plus ribavirin and sofosbuvir plus daclatasvir, was determined by analyzing the SVR, serological tests, PCR, and adverse effects developed in patients after the treatment period. For sofosbuvir plus ribavirin, the SVR was determined to be 93.2% (n=55 out of 59), and for sofosbuvir plus daclatasvir, the SVR was 84.3% (n=43 out of 51). Overall, it was recorded that the SVR of sofosbuvir plus ribavirin (93.2%) was higher than sofosbuvir plus daclatasvir (84.3%). After the treatment, different tests were performed, and it was found that ALT was raised in 18 patients, of whom 8 patients (44.4%) were using sofosbuvir plus ribavirin while 10 patients (55.6%) were using sofosbuvir plus daclatasvir. ALT was raised in more patients using sofosbuvir plus daclatasvir (55.6%) as compared to sofosbuvir/ribavirin (44.4%). AST was found to be raised in 20 patients; 8 patients (40%) were using sofosbuvir plus ribavirin, while 12 patients (60%) were using sofosbuvir plus daclatasvir. 18 patients tested positive by PCR test and these were non-responders or non-SVR patients. Of the 18 PCR-positive (non-SVR) patients, only 6 patients (33.3%) were using sofosbuvir plus ribavirin, while 12 patients (66.7%) were using sofosbuvir+daclatasvir. The non-SVR patients were more in the group using sofosbuvir plus daclatasvir treatment (66.7%) as compared to sofosbuvir plus ribavirin treatment (33.3%).

Adverse effects were also recorded after treatment and analyzed as per the DAAs used for the treatment of chronic HCV patients. The data showed that 29 patients had generalized body aches, of whom 16 (55.2%) were using sofosbuvir plus ribavirin while 13 (44.8%) were using sofosbuvir plus daclatasvir. 10 patients were reported with fatigue and 10 with headache, of whom 6 (60%) were using sofosbuvir plus ribavirin while 4 (40%) were using sofosbuvir plus daclatasvir for fatigue and headache. 5 patients had fever, of which only 1 (20%) was using sofosbuvir plus ribavirin, while 4 (80%) were using sofosbuvir plus daclatasvir. Overall, 56 patients were reported to have no adverse effects after the treatment period, of which 30 (53.6%) were using sofosbuvir plus ribavirin while 26 (46.4%) were using sofosbuvir plus daclatasvir. The efficiency of sofosbuvir plus ribavirin and sofosbuvir plus daclatasvir is further explained in Table 2.

Table 2. Efficacy of different antiviral drugs against HCV patients

Direct Acting Antivirals used by groups of patients		Sofosbuvir+ribavirin (%)	Sofosbuvir+daclatasvir (%)	Total
		59 (54%)	**51 (46%)**	**110**
SVR after treatment	**SVR (24 weeks)**	55/98 (56.1%)	43/98 (43.9%)	98
	Non-SVR (24 weeks)	4/12 (33.3%)	8/12 (66.7%)	12
	Total	**59**	**51**	**110**
ALT test	**Raised**	8/18 (44.4%)	10/18 (55.6%)	18
	Normal	51/92 (55.4%)	41/92 (44.6%)	92
	Total	**59**	**51**	**110**
AST test	**Raised**	8/20 (40%)	12/20 (60%)	20
	Normal	51/90 (56.7%)	39/90 (43.3%)	90
	Total	**59**	**51**	**110**
PCR after treatment	**Positive**	6/18 (33.3%)	12/18 (66.7%)	18
	Negative	53/92 (57.6%)	39/92 (42.4%)	92
	Total	**59**	**51**	**110**
Adverse effects	**Generalized body aches**	16/29 (55.2%)	13/29 (44.8%)	29
	Fatigue	6/10 (60%)	4/10 (40%)	10
	Headache	6/10 (60%)	4/10 (40%)	10
	Fever	1/5 (20%)	4/5 (80%)	5
	No Adverse Effects	30/56 (53.6%)	26/56 (46.4%)	56
	Total	**59**	**51**	**110**

Discussion

Hepatitis C is the inflammation of the liver caused by hepatitis C virus. The virus is known to spread from person to person by contact with the blood of an infected person (Khatun and Ray 2019). Hepatitis C virus (HCV) is an enveloped, single-stranded, positive-sense RNA virus coated by a core protein and enveloped in a lipid bilayer, which taxonomically belongs to the genus Hepacivirus of the family *Flaviviridae* (Moradpour et al., 2013). The most common ways of transmission of the virus are sharing needles, sharing barbers' equipment, unsafe dental procedures, and unsafe blood transfusion (Thursz and Fontanet 2014). According to the World Health Organization (WHO), about 71 million individuals are infected globally with HCV, with mortality of about 400,000 patients per annum (Petruzziello et al., 2019). As a major public health issue worldwide, HCV is reported to have infected about 6% of the total population of Pakistan – a developing country (Haqqi et al., 2019). The most prevalent genotype of HCV in Pakistan is 3a, followed by 3b. Besides these genotypes 2 is the most common genotypes detected in Pakistan include 1a, 2a, and untypeable genotypes, respectively (Ullah et al., 2020). To control the spread and management of the virus, viral eradication is essential; presently, interferon-free remedies, also known as direct-acting antivirals (DAAs), are being used. These drugs are used in combinations of two classes of antivirals and are known to shorten the duration of treatment, achieve high success rates of treatment, and are known to be well tolerated by patients. The treatment duration ranges from 8 to 12 to 24 weeks depending on the patient's status (Sandmann et al., 2019). Hepatitis C Virus infections are mostly treated with DDAs combinations such as sofosbuvir plus ribavirin, sofosbuvir plus daclatasvir, or sofosbuvir plus velpatasvir these days, with higher SVR rates and minimal adverse effects (Neant et al., 2020). In the present study, we found that the prevalence of HCV was higher in females as compared to males. The prevalence was higher in the age group ranging from 36 to 55 years, followed by older people ranging from 56 to 75 years, and the lowest in younger people aged 16 to 35 years. Depending on the patient's locality or geographic location, the prevalence of HCV was higher in urban areas than in rural areas. The prevalence of different HCV genotypes was determined, and genotype 3a was found to be the most prevalent, followed by 3b, 2a, and 1a. Our results corresponded with previous findings (Ullah et al., 2021) on the prevalence of HCV and confirmed HCV infection by ICT, ELISA, and reverse transcriptase PCR. They reported a higher prevalence of HCV in males as compared to females, which contradicts our results which may be possibly because of the difference in sample size, as their sample size was far larger than ours. On the other hand, they reported the highest prevalence of HCV genotype 3a, followed by 1a, 2a, and 3b, which is in strong agreement with our study.

It was found in the current study that unsafe barber visits for shaving or other purposes (38.2%) are frequently associated with the transmission of HCV infection in the general population, followed by unnecessary and unsafe prescription of therapeutic

injections, unsafe dental procedures, blood transfusion, and tattooing or body piercing. This is in agreement with the case report published by Mahmood and Raja (2017), who reported that the risk factors associated with the transmission of HCV infection in Pakistan are unsafe blood transfusions, unsafe and unnecessary use of multiple therapeutic injections, unsafe surgical procedures, visiting barbers, and body part piercing. In the present study, SVR was reported to be 89.1%, which was quite considerable. It was also found that the SVR was higher for the sofosbuvir + ribavirin combination (93.2%) as compared to SVR for the sofosbuvir + daclatasvir combination (84.3%). SVR was higher in female patients (90%) and higher than in male patients (88.3%). The adverse effects associated with the DAAs used were not that many but couldn't be neglected, and it was reported that for 59 patients who used sofosbuvir+ribavirin, the most frequent adverse effect was generalized body ache, followed by fatigue, headache, and fever, while 30 out of 59 patients showed no considerable adverse effects. Among 51 patients using the sofosbuvir + daclatasvir combination, the most frequent adverse effect was generalized body ache (13/51), followed by fatigue (4/51), headache (4/51), and fever (4/51), while 26 out of 51 patients showed no considerable adverse effects. A study was reported (Ullah et al., 2023) on HCV antiviral drugs and SVR rate, in which HCV genotypes were successfully treated with sofosbuvir + daclatasvir with ribavirin for 12 and 24 weeks. Similarly, our study is closely related to the results of this work.

A study was reported by Karniawan et al. (2018) on the efficiency of sofosbuvir + ribavirin and sofosbuvir + daclatasvir, looks to meet up with our SVR results. A total of 309 patients were included in the study; of them, 199 patients (64.5%) were positive for genotype 1. The SVR for sofosbuvir + daclatasvir was also higher than for sofosbuvir + ribavirin, at 98% and 91%, respectively. In patients with liver cirrhosis, SVR for sofosbuvir + ribavirin was 85% and for sofosbuvir + daclatasvir was 100%. Their results slightly contradict ours, and that may be because of the prevalence of genotypes in both studies, as the prevalent genotype in their study was 1 and in ours was 3a and 3b, and may also be affected by the geographical difference in both studies. But overall, in both of the studies, the SVR or efficiency was good, and both the DAAs combinations showed an impressive efficacy against chronic HCV infection. This study has certain limitations, such as sample size; the majority of patients did not agree to provide consent. We were unable to perform genome sequencing of untypeable genotypes due to lack of genome sequencing facilities in Pakistan. High cost and limited access to DAAs in certain regions, and lastly limited awareness and education of health care professionals about HCV genotype and their clinical implications.

Conclusions

The study concludes that most of the patients are from urban areas associated with risk factors such as unsafe barber visits, unnecessary multiple therapeutic injections, unsafe dental procedures, and blood transfusion. The most prevalent genotypes of HCV in the area are 3a, 3b, and 2a. It is also concluded that SVR is higher for sofosbuvir plus ribavirin as compared to sofosbuvir plus daclatasvir, but both combinations showed incredible SVR results with minimum adverse effects. Both DAAs combinations therapy result minimum adverse effects, mostly generalized body aches, fatigue, and fever. Finally, it is concluded that the new DAAs available, such as sofosbuvir, ribavirin, and daclatasvir, are efficient and safe options for the treatment of chronic HCV patients with or without any comorbidities.

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Statements and Declarations

Ethical approval and consent to participant

The study was approved from the ethical committee of Faculty of life sciences, department of health and biological sciences, Abasyn University Peshawar (Ref. No. IERC-AUP 2024-09). The informed consent was obtained from the entire patient involved in this study who was above the age of fifteen year.

Consent for publication

All the authors agree to publish the manuscript.

Author's Contributions

AA and AU designed the research study. AA performed the research. AU and SK provided resources for data analysis and interpretation of results, AA and AU performed software. AA, AU and SK investigated and performed analysis. AU and AA proofread the manuscript. All authors contributed to editorial changes in the manuscript. All authors have read and agreed to the published version of the manuscript.

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Competing Interests

The authors declare that they have no financial or none, financial competing interests related to this work...

Consent to Participate

Not applicable.

Data Availability

All data generated or analyzed during this study are included in this published article.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work, the author(s) have not used any ChatGPT (OpenAI) tool.