

Non Organ-Specific Autoantibodies (NOSA) in Treatment-Naïve Chronic HCV Patients

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ABSTRACT

Background: Chronic infection with hepatitis C virus (HCV) may lead to the production of autoantibodies and can cause autoimmune disorders. Non-organ-specific autoantibodies (NOSA), if present, are associated with more severe liver injury and may have a negative effect on the antiviral treatment response.

Aims: To measure the frequency of NOSA in chronic HCV patients of Shaikh Zayed Hospital, Lahore.

Methods: In this study, 199 Treatment-Naïve patients with chronic Hepatitis C were selected. NOSA was detected in the patients' sera by indirect immunofluorescence assay.

Results: Out of 199, 89 (44.7%) were male, while 110 (55.3%) were female. The female gender showed higher seropositivity (55.3%) as compared to males (44.7%) for all five autoantibodies. A total number of 179 (89.94%) patients were positive for at least one autoimmune marker, and 20 (10.05%) were negative for any autoimmune marker. Out of 199 patients, 141 (70.9%) were positive for anti-mitochondrial antibody (AMA). The second most common antibody was antinuclear antibody (ANA) in 117 (58.8%) patients. This was followed by anti-smooth muscle antibody 104 (52.2%), anti-liver kidney microsomal type 1 antibody (anti-LKM-1) 94 (47.2%), and F-actin antibodies 80 (40.2 %) in the cases studied.

Conclusion: Before antiviral treatment initiation, AMA and ANA tests, if performed routinely, may detect maximum NOSA-positive cases in patients with chronic hepatitis C. Whereas, treatment failure may be lessened in NOSA-positive cases by using immunosuppressive therapy.

Keywords: Autoantibodies; Liver Diseases; Microscopy; Fluorescence

Abbreviations: HCV: Hepatitis C Virus; HLA: Human Leukocyte Antigen; NOSA: Non Organ-Specific Autoantibodies; ANA: Antinuclear Antibodies; ASMA: Anti-Smooth Muscle Antibodies; AMA: Anti-Mitochondrial Antibodies; ANCA: Antineutrophil Cytoplasmic Antibodies; CDC: Disease Control; ANTI-LKM-1: Anti-Liver Kidney Microsomal Type 1 Autoantibodies; ANTI-DS DNA: Anti-Double-Stranded DNA; SPSS: Statistical Package of Social Sciences; FITC: Fluorescein Isothiocyanate; NOSAs: Non Organ-Specific Antibodies

Introduction

A wide variety of human viruses, including the hepatitis C virus (HCV), can induce an autoimmune response or enhance the already present immune response [1]. There are different mechanisms of autoantibody production in HCV patients. One of these is a molecular similarity between the viral proteins and self-proteins. Persistent HCV infection leading to the polyclonal B-Cell activation is another mechanism suggested for autoantibody production. Genetic predisposition is also proposed to be a likely mechanism for autoantibody presence in chronic HCV infection. Different human leukocyte antigen (HLA) types also increase the susceptibility to develop Non Organ-Specific autoantibodies (NOSA) in HCV patients [2]. Microorganisms contain a variety of antigens that also lead to the production of autoantibodies [3]. Autoantibodies can be used for diagnostic purposes and they also provide information about the prognosis of the disease [4]. Various types of autoantibodies are produced during liver diseases. These antibodies are present in the serum of the patients with viral hepatitis, alcoholic liver disease, non-alcoholic fatty liver disease, drug induced hepatitis, hepatocellular carcinoma and autoimmune diseases [4,5]. Autoantibodies can be divided into two groups; these can be organ specific and Non Organ-Specific during acute and chronic infection [6].

NOSA include antinuclear antibodies (ANA), anti-smooth muscle antibodies (ASMA), anti-mitochondrial antibodies (AMA), antineutrophil cytoplasmic antibodies (ANCA), anti-liver kidney microsomal type 1 autoantibodies (anti-LKM-1), and anti-double-stranded DNA (anti-ds DNA) antibodies [5,7]. Age, female gender and the extent of the liver disease are the risk factors for the production of autoantibodies [3]. Chronic HCV is an important cause of autoimmune disorders. According to some reports NOSA are associated with more severe liver injury and negatively affects the treatment response. However, in other studies, NOSA showed no negative impact on disease course and treatment response [8].

Objective

This study was conducted to estimate the frequency of Non Organ-Specific autoantibodies in chronic Hepatitis C patients.

Material and Methods

This cross sectional descriptive study was carried out at Shaikh Zayed Hospital, Lahore over a period of one year. After taking informed consent, samples were obtained from chronic HCV infected

patients and processed in the Department of Microbiology. Clinical Trial Number is not applicable in this study.

Sampling Technique

Convenient sampling technique was used.

Inclusion Criteria

Treatment-Naïve chronic hepatitis C patients, confirmed by PCR and ELISA for all age and gender groups were included in the study.

Exclusion Criteria

Patients with liver cirrhosis, hepatocellular carcinoma, those receiving interferon or anti-viral treatment were excluded.

Study Variables

ANA, ASMA, AMA, anti-LKM-1, and Anti-F-actin antibody.

Statistical Analysis

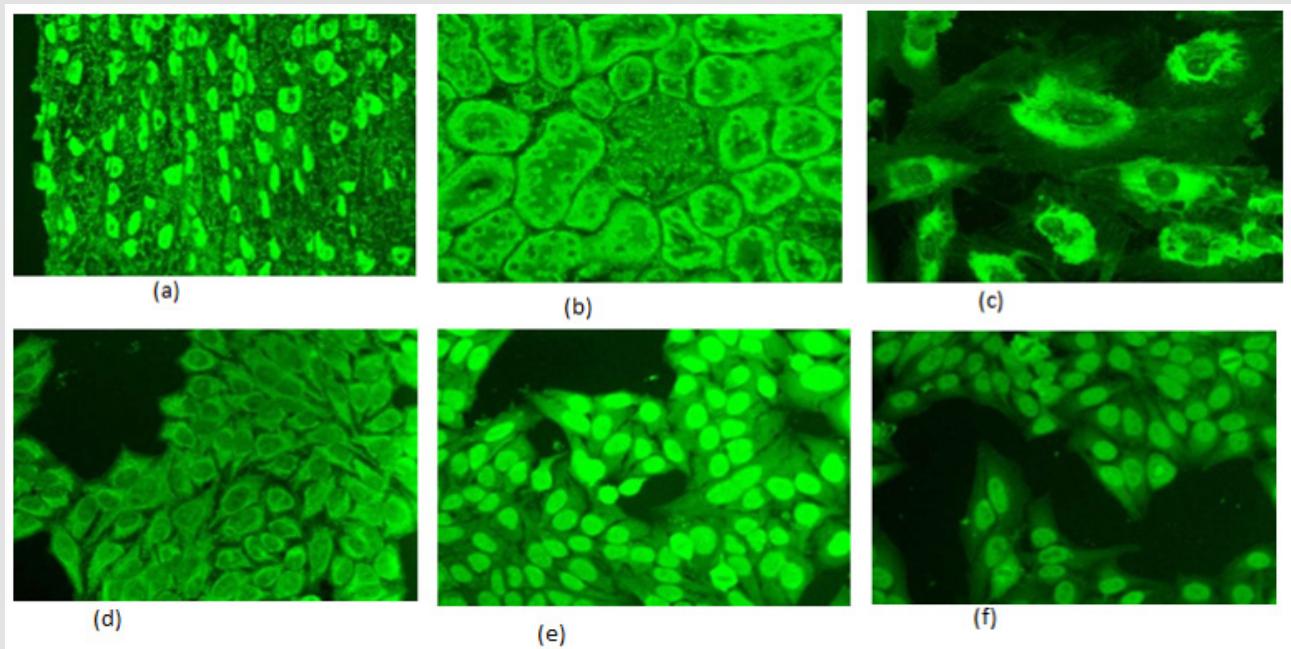
The data were analyzed by using the statistical package of social sciences (SPSS) version 20. The results were analyzed by using the chi-square test and the P value was considered significant if < 0.05 .

Methodology

After explaining the proper procedure and purpose of the study, consent was obtained from all 199 chronic HCV patients. Histories of the patients were taken, including name, age gender, marital status, registration number and address. Patients were also inquired about their treatment status, whether naïve or not. Blood samples of Treatment-Naïve chronic HCV patients were drawn by using an aseptic technique. Venous blood from each participant was taken aseptically in gel vacutainers. All the samples were transported to the laboratory immediately. The samples were centrifuged for 5 minutes at 5000 rotations per minute and sera were separated. Serums of the patients were stored at -20 degrees centigrade in Eppendorf tubes for further processing. AMA, ANA, anti-LKM-1, ASMA, and F-actin antibodies were detected by indirect immunofluorescence assay, using kits from EUROIMMUN AG, Germany. Microscopy was performed using Olympus BX41TF Fluorescence Microscope, Japan. The results were graded (1+ to 4+) based on intensity of fluorescence produced (Figure 1). The status and intensity of each antibody found in all cases is provided Table 1. The genotype analysis was not performed in our study. Guidelines of Centers for Disease Control (CDC), Georgia were referred for grading of fluorescence [9].

Table 1: The status and intensity of each antibody found in all cases.

		1+	2+	3+	4+	negative	Total
AMA	N	36	65	33	7	58	199
	intensity	%	18.10	32.70	16.60	3.50	29.10
LKM	N	26	41	20	7	105	199
	intensity	%	13.10	20.60	10.10	3.50	52.80
ASMA	N	25	51	19	9	95	199
	intensity	%	12.60	25.60	9.50	4.50	47.70
F_actin intensity	N	40	23	7	10	119	199
		%	20.10	11.60	3.50	5.00	59.80
ANA	N	59	35	15	8	82	199
	intensity	%	29.60	17.60	7.50	4.00	41.20



Note: Indirect immunofluorescence for representative Non Organ-Specific antibodies
Intensity of fluorescence:
a) 4+ for ASMA
b) 2+ for AMA
c) 4+ for F-actin
d) 2+ for ANA cytoplasmic pattern
e) 3+ for ANA homogenous pattern
f) 2+ for ANA fine speckled pattern. Anti-mitochondrial Antibodies; ASMA, Anti-Smooth Muscle Antibodies; AMA, Anti-mitochondrial Antibodies; ANA, antinuclear antibodies.

Figure 1: Representative Immunofluorescence Patterns of Non Organ-Specific Autoantibodies (NOSAs).

Principle

As a first step, combinations of different substrates are incubated with diluted patients’ samples. If the reaction is positive, specific antibodies of classes IgA, IgG, and IgM are attached to the antigens. During the second step, attached antibodies are stained with fluorescein isothiocyanate (FITC)-labeled anti-human antibodies and made visible with the fluorescence microscope [10].

Results

The study was conducted on 199 Treatment-Naïve chronic HCV patients who visited the outdoor/indoor in Shaikh Zayed Hospital, Lahore. Data shown in pie chart illustrates the distribution of autoimmune antibody status among patients, showing that 90% (179 patients) tested positive, while only 10% (20 patients) were negative

(Table 2). The high prevalence of autoantibodies suggests a strong autoimmune basis within the studied cohort, emphasizing the importance of routine serological screening. Detecting these antibodies supports early diagnosis, guides clinical decisions, and helps tailor immunosuppressive therapy. The small proportion of seronegative cases also highlights the need for complementary diagnostic tools. Overall, this figure underscores the significant diagnostic value of autoimmune antibody testing in identifying and managing autoimmune-related diseases in clinical practice (Figure 2).

Table 2: Status of autoimmune markers in all cases.

Total Cases	Positive cases		Negative cases	
	N	%	N	%
199	179	89.94	20	10.05

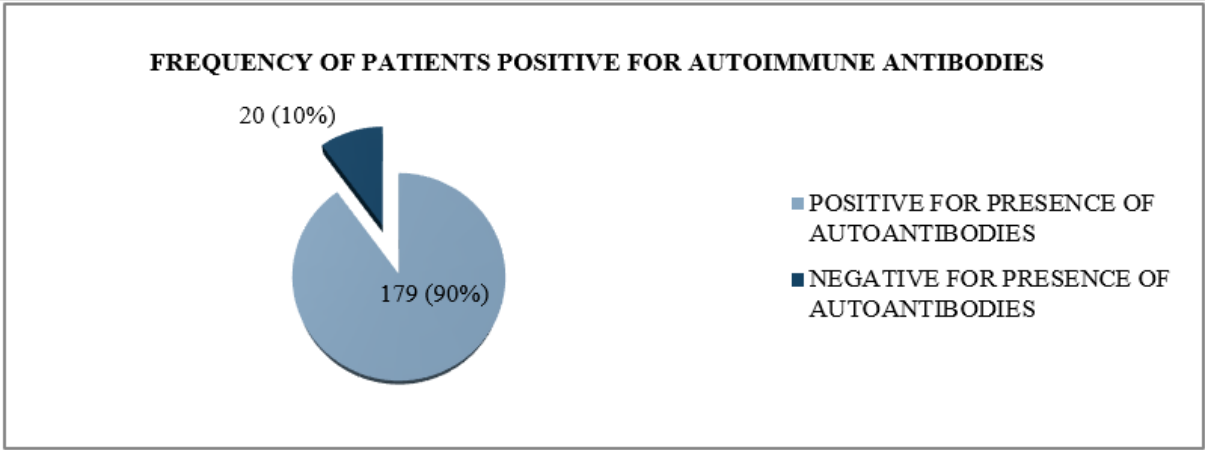


Figure 2: Frequency of Patients Positive for Autoimmune Antibodies.

This pie chart shows the distribution of autoimmune antibody positivity in a patient cohort. Out of the total patients analyzed, 179 (90%) were positive for the presence of autoantibodies, while only 20 (10%) were negative. The analysis of autoantibodies revealed that 141 (70.9%) cases were positive for AMA. The second most common autoantibody was ANA followed by ASMA, anti-LKM-1, and F-actin

antibodies. Even if samples showing 1+ intensity were scored in gray zone/negative, the total number of positive cases was 149 (74.87%) out of 199, and number of negative cases was 50. The status of each autoantibody was recorded for all cases but rates dropped notably when weak (1+) intensities were excluded (Table 3)

Table 3: Status of various Non Organ-Specific antibodies in all patients.

	Antibodies Status		Antibodies Status (excluding 1+ intensity cases)	
	n	%	n	%
AMA	141	70.9	105	52.7
ANA	117	58.8	79	39.6
ASMA	104	52.3	69	34.6
LKM-1	94	47.2	58	29.1
F-actin	80	40.2	40	20.1

Note: AMA, Anti-Mitochondrial Antibodies; Anti-mitochondrial Antibodies; ANA, Antinuclear Antibodies; ASMA, Anti-Smooth Muscle Antibodies; LKM, Anti-Liver Kidney Microsomal Type 1.

This highlights the importance of antibody strength in distinguishing true autoimmunity from low-level, potentially non-specific responses. Such stratification enhances diagnostic precision, supports disease classification, and informs treatment strategies. Moreover, co-occurrence of multiple NOSAs may indicate overlapping syndromes. Overall, this data emphasizes that both antibody presence and intensity are crucial for accurate interpretation and effective clinical decision-making in autoimmune conditions (Figure 3). This bar plot illustrates the prevalence of five key Non Organ-Specific an-

tibodies (AMA, ANA, ASMA, LKM-1, and F-actin) in a patient cohort. Each antibody is represented with two bars: one showing overall positivity and another excluding weak (1+) intensity cases. The noticeable drop-in positivity rates upon excluding low-intensity cases underscores the diagnostic value of antibody strength. This stratified approach improves clinical interpretation by reducing false positives from weakly reactive antibodies. The X-axis lists the antibody types, while the Y-axis indicates the percentage of positive cases, allowing clear visualization of their diagnostic contribution.

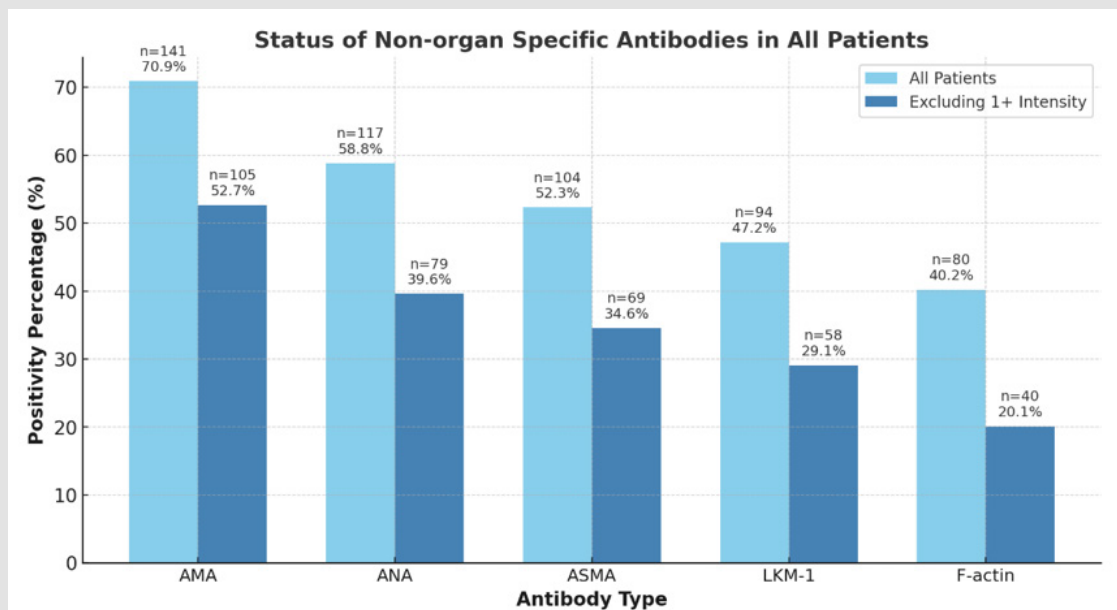


Figure 3: Diagnostic Distribution of Non Organ-Specific Antibodies.

Gender distribution of cases positive for various autoantibodies is shown in Figure 4. In this gender distribution, males were 89 (44.7%) while 110 (55.3%) were female. This bar chart compares the number of male and female patients testing positive for various Non Organ-Specific autoantibodies, including AMA, ANA, ASMA, LKM-1, and F-actin. Across most antibody types, females demonstrated higher positivity rates than males, suggesting a potential gender-related immune response difference in chronic hepatitis C infection. These findings underscore the importance of considering gender in autoim-

mune profiling and treatment planning; X-axis is Number of Cases and Y-axis is Types of Autoantibodies (e.g., Antinuclear, Antimitochondrial, ASMA, LKM-1, F-actin). A maximum number of patients were 94 (47.2%) in the age group 41-60 years, followed by 80 (40.2%) in the age group 21-40 years, 20 (10.1%) patients in the 61-80 years group and 5 (2.5%) patients in the age group 1-20 years (Table 4). Additionally, in this study we have also shown the distribution of five key non organ-specific autoantibody positivity in chronic HCV patients across different age groups shown in Figure 5.

Table 4: Age distribution of cases tested for various autoantibodies.

Age	N	%
1-20	5	2.5
21-40	80	40.2
41-60	94	47.2
61-80	20	10.1
Total	199	100.0

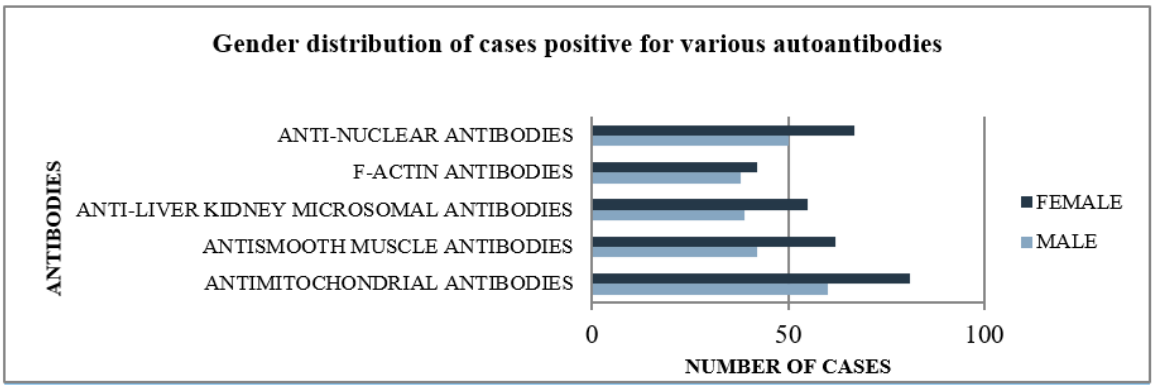


Figure 4: Gender-wise Distribution of Autoantibody Positivity in Chronic HCV Patients.

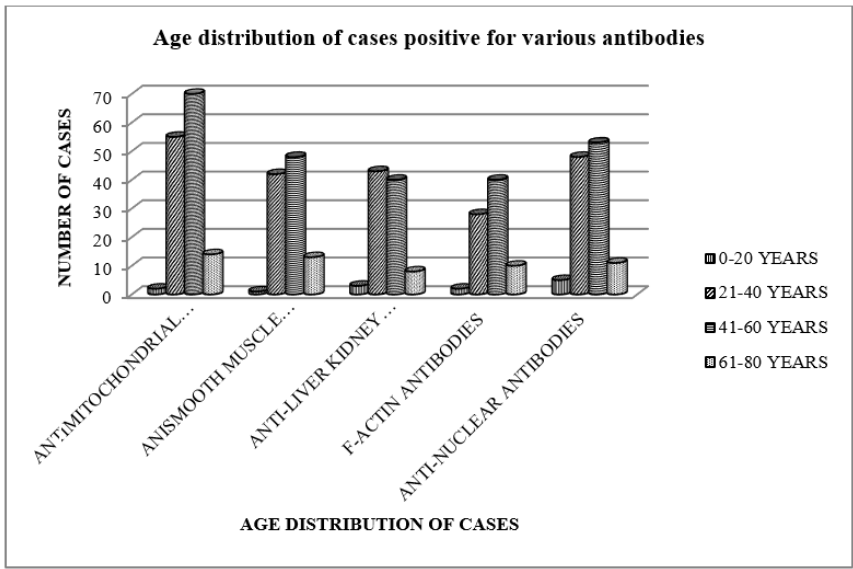


Figure 5: Age-wise Distribution of Autoantibody Positivity in Chronic HCV Patients.

The highest frequency of positivity was observed in the 41–60 years group across most antibodies, followed by 21–40 years. This trend suggests a higher autoimmune response in middle-aged individuals with chronic HCV, highlighting the need for early immunological screening and personalized treatment planning in this age group; X-axis represents Types of Autoantibodies (ANTIMITOCHONDRIAL, ANTISMOOTH MUSCLE, ANTI-LIVER KIDNEY, F-ACTIN, ANTI-NUCLEAR); Y-axis represents Number of Cases. Comparing gender distribution for AMA, positive cases were higher than negative in females while negative cases were equal in number for both genders. LKM had equal number of positive and negative cases for females while for males, the negative cases were more in number than the positive cases. The P-values for AMA and LKM were 0.337 and 0.385 respectively, which is insignificant for both categories. The status of ASMA for both genders revealed that there were more positive cases in females as compared to males. This difference was insignificant with a P-value of 0.198. The F-actin antibody had higher negative cases for both genders. ANA had more positive cases than negative in both genders. The F-actin and ANA both had insignificant differences between males and females with P-values of 0.519 and 0.501 respectively.

Discussion

Hepatitis C is quite common amongst the Pakistani population with a seroprevalence of 6.8% in adult population [11]. This infection can lead to cirrhosis of the liver and hepatocellular carcinoma. It is also a significant cause of mortality worldwide [12]. Presence of autoantibodies amongst HCV-positive patients may affect treatment response and strategy amongst these patients. Hence, it is very important to know the immune status of patients before starting HCV treatment [13]. This study was planned to estimate the frequency of NOSA in Treatment-Naïve chronic HCV patients. Current medical literature does not show any such published data on the Pakistani population. The only study conducted on the healthy Pakistani population showed ANA was positive in 0.4% of patients, which is considerably lower than the other countries (4-13%) [14]. In the present study, the frequency of NOSA positivity was 89.94%, which is higher than in reported studies [15,16]. This shows that there is a high frequency of NOSA in HCV-positive patients in the Pakistani population. Which might interfere with response to antiviral treatment. This aspect needs further research. In a study conducted in Greece, the overall prevalence of NOSA positivity was 73.2% in which ANA and ASMA were the most common antibodies and they found a very low prevalence of anti-LKM-1 in seropositive HCV subjects [15].

Overall high prevalence of NOSA was found in another study from Oman. They checked and compared the prevalence of NOSA and organ-specific autoantibodies in HCV patients and healthy controls and found a higher prevalence (66%) of NOSA in HCV patients as compared to healthy controls [16]. In contrast to our study (89.94%), other researchers showed low frequency (24-50.8%) of overall NOSA in their respective populations [17-24]. This contrast shows that

there is a difference in the demographic distribution of these autoantibodies. One possible reason might be the difference in ethnicity, geographic distribution, and method of detection of antibodies [20]. In our study, AMA was found to have the highest frequency i.e. 70.9%, followed by ANA (58.8%), ASMA (52.3%), LKM (47.2%), and F-actin (40.2%) (Table 1). In an Egyptian study, the frequency of reported different NOSA positive cases were ASMA (94.73%), AMA (73.90%), LKM (63.20%), and ANA (36.9%) [25]. In a study conducted in Greece ASMA was (74.5%), followed by ANA (53.9%) and LKM (2.9%) [26]. Another study conducted in Turkey showed ANA (64.3%), the most frequent autoantibody found amongst patients, while others were ASMA (9.9%) and LKM (0.6%) [27]. In an Indian study most frequent NOSA was ASMA (25%) followed by ANA (20%); in that study, they did not find AMA and LKM in any patient [17]. In a recent study conducted in the USA, the frequency of NOSA reported was ANA (21.8%), ASMA (13.3%), AMA (2.2%), and LKM (1.2%) [21].

These results are in total contrast to our study. In our study, 44.7% of patients with NOSA positivity were male and 55.3% were females. This gender distribution is consistent with other studies which show a high prevalence of autoantibodies amongst female patients [15,21]. In our study, most of the patients fall into age groups 21-40 years (40.2%) and 41-60 years (47.2%). This age distribution is also consistent with other populations (30-65 years) in various studies [15,21,23]. This shows that young patients are the most frequently affected by HCV and NOSA. On the evaluation of antibody positivity in different age groups, it was found that the difference in age distribution was insignificant for all antibodies and there was no association of an antibody to a certain age group. On the evaluation of antibody positivity in both genders, we found that the difference in gender distribution was insignificant for all antibodies and there was no association of an antibody to a particular gender. Thus no specific correlation was seen between the age and gender of patients and NOSA positivity [15,19,22,26].

Conclusion

The overall frequency of Non Organ-Specific autoantibody in our Treatment-Naïve chronic HCV patients is very high (89.94%). Among all five antibodies, AMA (70.9%) is the most common autoantibody found in HCV patients and the second most common antibody is ANA (58.5%), while the third most common antibody is ASMA (52.3%). The age group 21-40 and age group 41-60 years revealed more seropositivity for NOSA as compared to other age groups. The female gender shows more seropositivity as compared to the male gender.

Recommendations

We recommend that only AMA and ANA tests should be performed routinely to detect maximum Non Organ-Specific autoantibodies positive cases among patients with chronic hepatitis C infection before initiating antiviral treatment. In the case of NOSA positivity, immunosuppressant drugs should be prescribed to prevent treatment failure.

Further studies should be conducted to evaluate the actual association between NOSA positivity and treatment response in chronic HCV patients.

Limitations of Study

It was a single-center study, conducted in Shaikh Zayed Hospital, Lahore, Pakistan. Hence, our results do not predict the actual frequency of NOSA in the country at large. The small sample size was another limiting factor. Multicenter studies with a larger sample size in the future to detect the actual prevalence in our population should be conducted.

Funding

None.

Conflict of Interest

No conflict of Interest of authors.

Ethics Approval

The study was conducted after approval from the Institutional Review Board (IRB) of Shaikh Zayed Federal Postgraduate Medical Institute, Lahore. (Ref No. F-38/NHRC/Admn/IRB/338)

Declaration

All methods were carried out following relevant guidelines and regulations.

The informed consent was obtained from all subjects and/or their legal guardian(s).

Data Availability Statement

Data are available upon reasonable request for appropriate need till three years after the publication of this study, as we are planning to conduct a further study on the outcome of the presence of autoantibodies and their effect on antiviral therapy.

Contributors

The study was designed by HTH, MI and CL. SBA contributed to the data collection, and AK performed data analysis. SZHN, HT, and ZI critically reviewed and edited the manuscript. HTH, MAI, and MR drafted the final manuscript. MI was the research supervisor. All authors contributed to the discussion and interpretation of data, discussed the results, critically commented on the content, and approved the submission of the final manuscript.

Highlights

1. Chronic infection with the hepatitis C virus may lead to the production of autoantibodies and can cause autoimmune disorders.

2. Non-organ-specific autoantibodies (NOSA) was detected in the patients' sera by indirect immunofluorescence assay.
3. NOSA, if present, are associated with more severe liver injury and may have a negative effect on the antiviral treatment response.
4. The female gender showed higher seropositivity (55.3%) as compared to males (44.7%) for all five autoantibodies.
5. Out of 199 patients, 141 (70.9%) were positive for anti-mitochondrial antibody (AMA).
6. The second most common antibody was antinuclear antibody (ANA) in 117 (58.8%) patients.
7. This was followed by anti-smooth muscle antibody 104 (52.2%), anti-liver kidney microsomal type 1 antibody (anti-LKM-1) 94 (47.2%), and F-actin antibodies 80 (40.2 %) in the cases studied.
8. Before antiviral treatment initiation, AMA and ANA tests, if performed routinely, may detect maximum NOSA-positive cases in patients with chronic hepatitis C.
9. Treatment failure may be lessened in NOSA-positive cases by using immunosuppressive therapy.

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