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ORIGINAL RESEARCH

Çocukluk Çağında Hangisi Daha Tehlikeli; Rotavirüs mü Adenovirüs mü?

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Özet

Amaç: *Hastanemiz Çocuk Polikliniğinde gastroenterit tanısı alan hastalarda Rotavirüs ve Adenovirüs sıklığının immunokromatografik yöntemle belirlenmesi ve etken dağılımının yaş, cinsiyet ve aşılanma durumuna göre değişiminin retrospektif olarak değerlendirilmesi.*

Gereç ve yöntem: *Ocak 2015 - Kasım 2020 tarihleri arasında ishal, kusma, dehidratasyon ve ateş şikayetleri olan ve akut gastroenterit tanısı alan hastalar taze dışkı örnekleri alınarak değerlendirildi. Veriler tanımlayıcı istatistikler kullanılarak sunulmuştur.*

Bulgular: *Çalışmaya dahil edilen akut gastroenterit hastalarının sayısı 1.192 idi. Hastaların ortalama yaşı 18±SD aydı (min: 1 ay, maks: 180 ay). Adenovirüs ve Rotavirüs antijenleri tüm vakaların %10'unda (n=119) tespit edildi. Rotavirüs antijeni tüm vakaların % 6,6'sında (n=78) ve Adenovirüs antijeni % 3,1'inde (n=38) pozitifti. Rotavirüs pozitif vakalarda hastaneye yatış oranı 5.1 kat daha yüksekti (p<0.001). Ateş ve kusmanın Adenovirüs veya Rotavirüs pozitif olan hastalarda istatistiksel olarak daha yüksek olduğu gözlenmiştir. (p=0.001).*

Sonuç: *Rotavirüsün özellikle dehidrasyona yol açan şiddetli kusma/ishali olan çocuklarda akılda tutulması gerektiği gösterilmiştir. Bu nedenle erken çocukluk döneminde Rotavirüs aşılaması çok önemlidir.*

Anahtar Kelimeler: *Rotavirüs, Adenovirüs, Enterit, Çocukluk Çağı, Rotavirüs Aşısı*

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Which One Is More Dangerous in Childhood Rotavirus or Adenovirus?

Abstract

Objective: *Determination of the frequency of Rotavirus and Adenovirus in patients diagnosed with gastroenteritis in the Pediatric Polyclinic of our hospital by immunochromatographic method and retrospective evaluation of the change in the distribution of the agent according to age, gender and vaccination status.*

Method: *Those patients with complaints of diarrhea, vomiting, dehydration, and fever as well as those diagnosed with acute gastroenteritis were evaluated by taking fresh stool samples between January 2015 and November 2020. The data were presented using descriptive statistics.*

Results: *The number of acute gastroenteritis patients included in the study was 1,192. The mean age of the patients was 18±SD months (min: 1 month, max: 180 months). Adenovirus and Rotavirus antigens were detected in 10% of all cases (n=119). Rotavirus antigen was positive in 6.6% (n=78) and Adenovirus antigen was positive in 3.1% (n=38) of all cases. The hospitalization rate was 5.1 times higher in Rotavirus positive cases ($p<0.001$). It was observed that fever and vomiting were statistically higher in patients with Adenovirus or Rotavirus positive. ($p=0.001$).*

Conclusion: *It has been shown that Rotavirus should be kept in mind, especially in children with severe vomiting/diarrhea leading to dehydration. Therefore, Rotavirus vaccination is very important in early childhood.*

Keywords*: Rotavirus, Adenovirüs, Enteritis, Childhood, Rotavirus Vaccine*

Introduction

In underdeveloped nations, acute gastroenteritis (AGE) is a significant cause of death and morbidity in children under the age of five. It is the third leading cause of death in children under the age of five, after pneumonia and premature birth complications. Gastrointestinal infections are common in developing countries where hygienic conditions and health systems are inadequate.

Increased stool frequency (AGE) is a clinical condition that can occur with or without vomiting or fever. Diarrhea generally lasts for less than seven days and does not exceed 14 days[1]. The most common microbiological causes of infectious gastroenteritis differ according to age, geographic region, and type of diarrhea. Agents can be viral, bacterial and parasitic or infection can be due to multiple agents. Viral agents are responsible for approximately 60% of all gastroenteritis. The peak incidence of the disease is often 3-24 months before weaning, due to a reduction in transplacental antibodies and the development of protective immunity. Viral agents include rotavirus, enteric adenoviruses, astroviruses, noroviruses and caliciviruses[2,3]. Rotaviruses in particular have historically

been the most frequent cause of viral gastroenteritis. Rotaviruses were discovered to be the cause of 30–50% of diarrhea in children under the age of five in Turkish investigations [4,5].

Since the clinical findings of viral gastroenteritis are non-specific, laboratory evaluation is essential to determine the causative agent. By showing the virus' presence in the feces (using electron microscopy or molecular studies) or by identifying it using ELISA tests and other immunological procedures, viral gastroenteritis can be diagnosed [6].

This study was conducted retrospectively and cross-sectionally to determine the frequency of Rotavirus and Adenovirus in children diagnosed with Acute Gastroenteritis between January 2015 and November 2020, and to determine the distribution of the factors according to age, gender, vaccination rates, hospitalization and seasonal variables.

Materials and Methods

Study design

This study is a retrospective and cross-sectional study, and children, who applied to the Pediatric Outpatient Clinic between January 2015 and November 2020 and were diagnosed with AGE, were included. Demographic characteristics of all cases included in the study were noted.

Approval for the study was granted by the Ethics Committee of Memorial Bahçelievler Hospital, dated 08.06.2023 and numbered 102. The study group consisted of children, who were diagnosed with acute gastroenteritis and admitted to the Memorial Private Diyarbakır Hospital, Department of Pediatrics with complaints of diarrhea, vomiting, dehydration and fever between the specified dates. All stool samples were examined in the central laboratory of our hospital, and those with macroscopically watery stools. The study only included samples that were parasite-free under a microscope. Cases with known immunodeficiency diagnosis or in whom parasites (Giardia intestinalis, Entamoeba histolytica etc.) were detected in stool samples and where bacteria grew in stool cultures. were excluded from the study.

The qualitative immunochromatographic test kit (VIKIA BioMerieux SA Rota-Adeno, France) with sensitivity and specificity in fecal material reported as 99.9% and 97.8% respectiviely for rotavirus, and 99.9% and 97% for enteric adenovirus, was used in accordance with the company's working procedures.

Group classification

Children who had rotavirus found in their stool samples and those who had adenovirus were separated into two groups for the research. Apart from these factors, other pathogens were evaluated separately.

Statistical Analysis

The SPSS 25.0 (IBM Corporation, Armonk, New York, United States) program was used in the analysis of the variables. The conformity of the data to the normal distribution was evaluated with the Shapiro-Wilk Francia test Mann-Whitney U test was used together with Monte Carlo results to compare the groups formed according to adenovirus and rotavirus positivity with each other based on the age variable. The comparison of the column ratios with each other was expressed by the Benjamini-Hochberg corrected p-value results. The Odds ratio was used with 95% confidence intervals to show the extent to which those with a risk factor outnumbered those without. While the general distributions of quantitative variables were shown in the tables as Mean (standard deviation) / Median (Minimum -1st Quartile - 3rd Quartile - Maximum) for analysis, they were expressed as Median (1st Quartile - 3rd Quartile). Categorical variables were shown as n (%) in all tables. The variables were analyzed at a 95% confidence level, and a p-value of less than 0.05 was considered significant.

Results

1,402 children were diagnosed with acute gastroenteritis within the specified periods. However, 145 cases were excluded from the study because parasites were detected and 65 cases had another underlying disease. Of the 1,192 patients, who met the criteria, 41.4% (n=493) were female and 58.6% (n=699) were male. The mean age of infants were 31.2 (SD:33.7) Adenovirus or rotavirus antigen were detected as positive in 9.9% (n=119) of the children. Rotavirus antigen was found to be positive in 65.6% (n=78) of cases, adenovirus antigen in 31.9% (n=38), and both rotavirus and adenovirus antigen positivity in 2.5% (n=3).

52.6% (n=20) of the adenovirus positive samples were male, as were 61.5% (n=48) of the rotavirus positive samples; 3 of the samples, which were found to be positive for both rotavirus and adenovirus antigen, were from female patients. Regarding both Rotavirus and Adenovirus antigens, there was no statistically significant gender difference ($p>0.05$).

The relationship between the antigen positivity of both viruses and the season was evaluated separately; both rotavirus and adenovirus antigen positivity was mostly detected in the autumn and winter months ($p>0.05$). The demographic characteristics and seasonal distribution of the cases are summarized in Table 1.

Table 1*. General characteristics of the children*

	Mean (SD) / Median (Min-Q1-Q3-Max)
Age (month)	31.25 (33.67) / 19 (1-8-43-180)
	n (%)
Male gender	699 (58.6)
Seasons Cases	
Spring cases	257 (21.6)
Summer cases	371 (31.1)
Autumn cases	340 (28.5)
Winter cases	224 (18.8)
Vaccine positivity	440 (36.9)
Hospitalization	156 (13.1)
Fever positivity	253 (21.2)
Vomiting positivity	241 (20.2)
Dehydration positivity	57 (4.8)

The cases included in the study were analyzed separately according to the positivity of adenovirus and rotavirus and are shown in Table 2. There was no difference between the two groups according to age, gender and seasonal characteristics ($p>0.05$). The incidence of rotavirus was 4.3 times higher in those who were not vaccinated with rotavirus, and adenovirus positivity was statistically significantly higher in rota-vaccinated cases ($p<0.001$). The rate of hospitalization was higher in rotavirus positive cases, and the rate of hospitalization was 5.1 times higher in rotavirus positivity ($p<0.001$). When it came to fever and vomiting, there was no difference between the groups. The presence of dehydration was higher in rotavirus positive cases. The results are given in Table 2. The distribution by symptoms is shown in Figures 1 and 2.

***Table 2**. Analysis of cases according to Adenovirus and Rotavirus Positivity*

	Adenovirus (n=38)	**Rotavirus (n=78)**	**P**
	Median(Q1-Q3)	**Median(Q1-Q3)**	
Age (m)	19 (11-38)	18 (10-28)	0.528 [u]
	n (%)	**n (%)**	
Male Gender	20 (52.6)	48 (61.5)	0.423 [c]
Season Cases			0.743 [c]
Spring cases	5 (13.2)	13 (16.7)	
Summer cases	7 (18.4)	13 (16.7)	
Autumn cases	15 (39.5)	36 (46.2)	
Winter cases	11 (28.9)	16 (20.5)	
Vaccine positivity	**22 (57.9)**	19 (24.4)	**<0.001** [c]
			4.3 (1.9-9.8) [or]
Hospitalization	6 (15.8)	**38 (48.7)**	**<0.001** [c]
			5.1 (1.9-13.5) [or]
Fever positivity	22 (57.9)	45 (57.7)	0.999 [c]
Vomiting positivity	21 (55.3)	50 (64.1)	0.419 [c]
Dehydration positivity	4 (10.5)	**26 (33.3)**	**0.012** [c]
			4.3 (1.4-13.3) [or]

[c] Pearson Chi Square Test(Monte Carlo),
[u] Mann Whitney U test(Monte Carlo),
[or] Odds Ratio (95% Confidence interval for Odds Ratio),
NS.: Notsignificant, SD. Standard Deviation, Min:Minimum, Max.:Maximum, Q1: 1st Quartile, Q3: 3rd Quartile

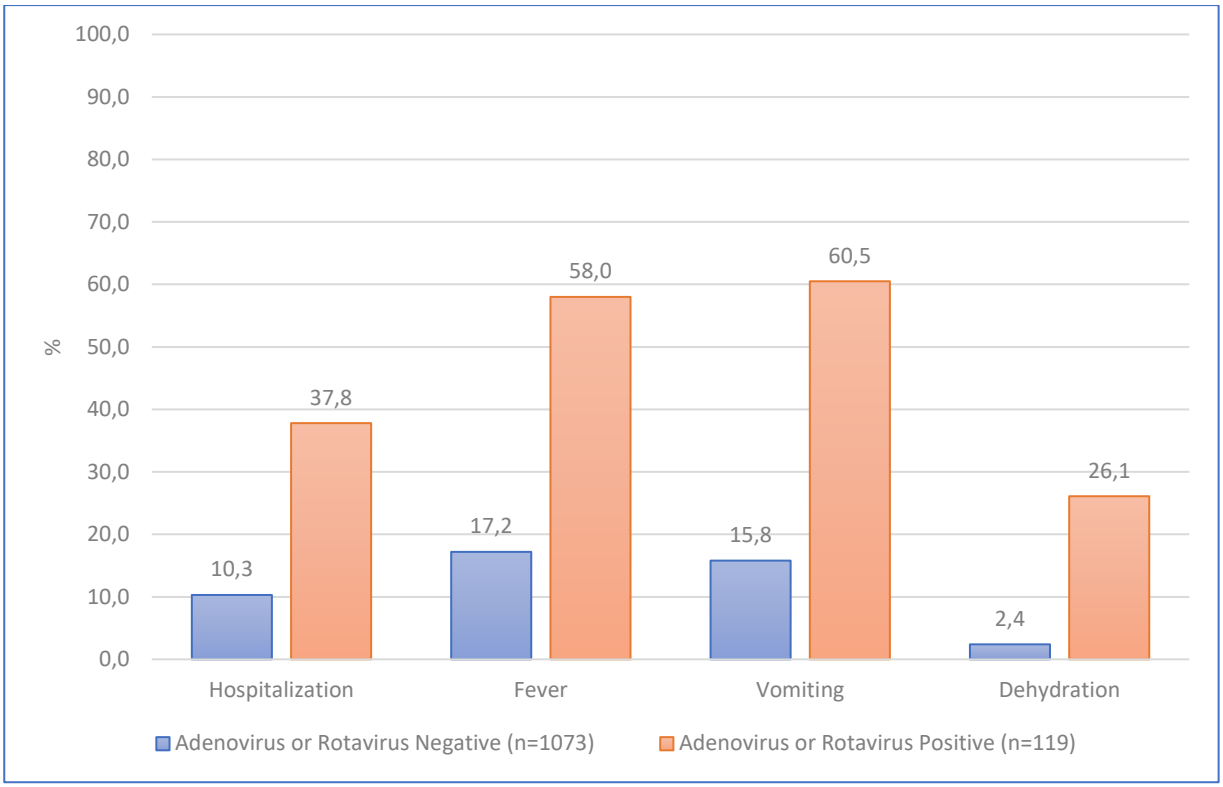

Figure 1. *Distribution of cases according to symptoms*

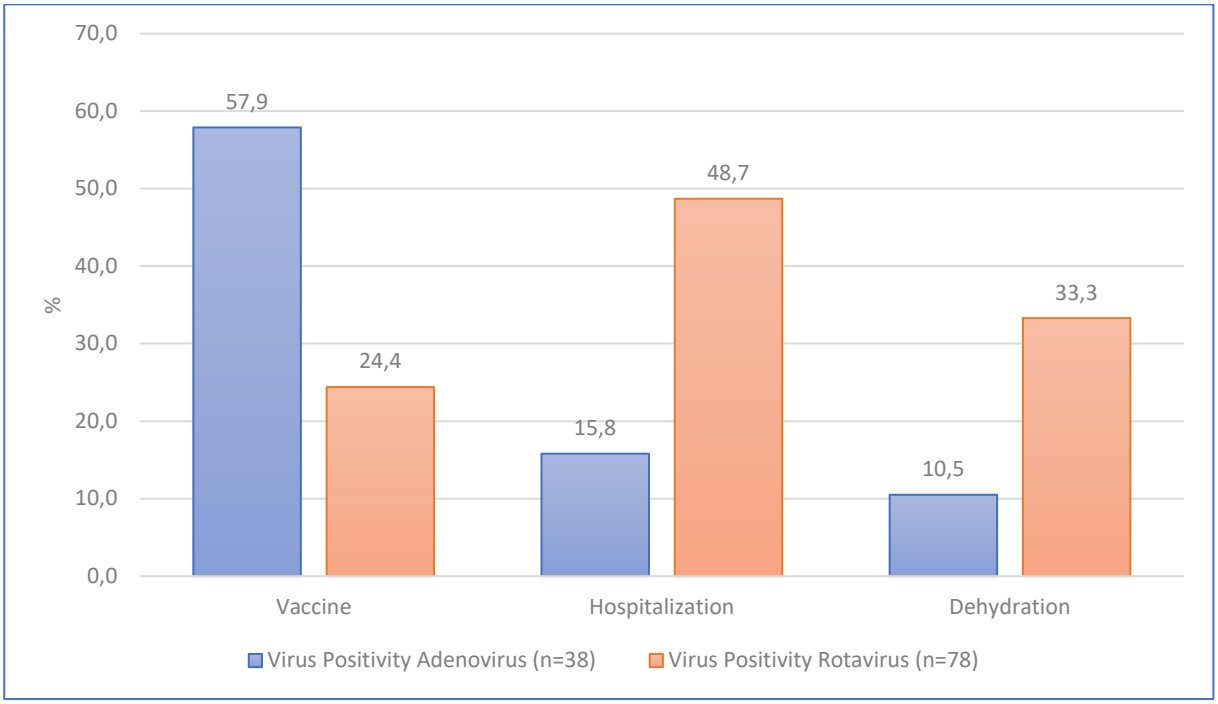

Figure 2*. Distribution of cases according to Adenovirus and Rotavirus Positivity*

The cases included in the study, who were positive for adenovirus or rotavirus and other gastroenteritis agents, are compared in Table 3. The groups did not differ in terms of age, gender, or vaccination rates. Rotavirus or adenovirus antigen positivity was detected most in autumn and winter, with a seasonally significant difference observed between cases with and without rotavirus and adenovirus antigens. (p<0.001). Hospitalization was found to be statistically higher in patients, who were found to be positive for adenovirus or rotavirus. (p=0.001). According to the analysis, there were 5.3 times more hospitalizations, 6.7 times more fever, 8.2 times more frequent vomiting and 14.2 times more dehydration in adenovirus or rotavirus positive cases. Similarly, fever and vomiting were found to be statistically higher in patients with positive for adenovirus or rotavirus. (p=0.001).

Table 3. *Analysis of cases according to viral agents*

	Other Agents (n=1073)	**Adeno and/or Rota Virus Positivity (n=119)**	**P**
	Median(Q1-Q3)	**Median(Q1-Q3)**	
Age (m)	19 (8-43)	18 (11-29)	0.598 [u]
	n (%)	**n (%)**	
Male Gender	631 (58.8)	68 (57.1)	0.769 [c]
Season Cases			**<0.001** [c]
Spring cases	237 (22.1)	20 (16.8)	NS.
Summer cases	**351 (32.7)**	20 (16.8)	**<0.001**
Autumn cases	288 (26.8)	**52 (43.7)**	**<0.001**
Winter cases	197 (18.4)	27 (22.7)	NS.
Vaccine positivity	399 (37.2)	41 (34.5)	0.617 [c]
Hospitalization	111 (10.3)	**45 (37.8)**	**<0.001** [c]
			5.3 (3.5-8) [or]
Fever positivity	184 (17.2)	**69 (58.0)**	**<0.001** [c]
			6.7 (4.5-9.9) [or]
Vomiting positivity	169 (15.8)	**72 (60.5)**	**<0.001** [c]
			8.2 (5.5-12.3) [or]
Dehydration positivity	26 (2.4)	**31 (26.1)**	**<0.001** [c]
			14.2 (8-24.9) [or]

[c] Pearson Chi Square Test(Monte Carlo); Post Hoc Test: Benjamini-Hochberg Correction,
[u] Mann Whitney U test(Monte Carlo),
[or] Odds Ratio (95% Confidence interval for Odds Ratio),
NS.: Notsignificant, SD. Standard Deviation, Min:Minimum, Max.:Maximum, Q1: 1st Quartile, Q3: 3rd Quartile

Discussion:

Although acute gastroenteritis is more common in developing countries, it is a common public health problem that can cause significant issues all over the world. This study investigated rotavirus and adenovirus positivity in childhood according to age, gender, seasons, and symptoms at presentation over a five-year period. Although the data belong to a single center, the rate of hospitalization in childhood, fever, and vomiting were found to be higher in those with gastroenteritis due to adenovirus or rotavirus compared to other factors. In addition, rotavirus-positive cases were compared with adenovirus-positive cases, and it was found that more hospitalizations and more dehydration were found in rotavirus-positive children.

In most temperate areas, acute viral gastroenteritis occurs throughout the year, with an autumn and winter preponderance [7,8]. In our research, we discovered that the fall months were more common for rotavirus and adenovirus positive cases.

The most frequent cause of viral gastroenteritis in children in the past was rotavirus. In nations where newborns are consistently immunized against rotavirus, rotavirus gastroenteritis has significantly decreased. But some older children and adults continue to have rotavirus illness symptoms [9,10]. To better understand the epidemiology of rotavirus infection among children with diarrhea visiting two hospitals in Ankara, Turkey, a prospective research was carried out between September 2004 and December 2005 [11]. Rotavirus was found in 39.7% of the 322 stool samples, and it primarily impacted children between the ages of 6 and 23 months. In another study, Caneriği et al [12] collected a total of 341 stool samples from pediatric patients. They found that rotavirus positivity in stool samples was 23.1%. Most of the cases were detected in the winter months. In another study from Turkey [13], rotavirus positivity was 18.7% (n = 126). 8.9% of those tested positive for adenovirus, and 4.4% also had rota-adenovirus co-infection. In December, January, February, and March, rotavirus positive cases predominated. Regarding vomiting, dehydration, and the cohabitation of diarrhea and vomiting in clinical parameters, there was a substantial difference between rotavirus positive cases and negative cases13. In our study, only 6% of rotavirus-related gastroenteritis cases were detected. We think that the low rate of positive detection of rotavirus in our country may be related to the vaccination rate, which is close to 37%. In the United States, laboratory surveillance during the prevaccine (2000 to 2006) and postvaccine (2007 to 2018) periods demonstrates decreases in rotavirus-positive laboratory tests (from 26 to 6 percent) and rotavirus-positive laboratory tests during the characteristic autumn-winter peak (from 43 to 14 percent) and during the "rotavirus season" (from 26 to 9 weeks) [14]. As a matter of fact, in our study, the incidence of rotavirus was found to be lower in children, who were vaccinated with rotavirus. However, the rotavirus vaccine is not free in Turkey and in many other

countries, so access to the vaccine can be difficult for many families. It shows once again how important the vaccine is in countries where rotavirus is common.

Although most viral enteric infections are asymptomatic, nearly every child experiences more than one episode of symptomatic acute gastroenteritis before the age of two [15,16]. In symptomatic children, illness usually begins 12 hours to 10 days after exposure and lasts 3 to 9 days [17,18,19]. The typical presentation is diarrhea, vomiting, or both; additional symptoms may include fever, abdominal pain or cramps, anorexia, headache and myalgia [20]. Children may experience only diarrhea or vomiting at first, but with progression they may become ill enough to require hospitalization. About 10 percent of children hospitalized for rotavirus infection have only fever and/or vomiting at presentation [21]. In children, vomiting is a prominent feature in both rotavirus and norovirus gastroenteritis [22]. In our study, the most common symptom was vomiting, which was present in 64.1% of rotavirus-positive children. Similarly, it was present in 60% of rotavirus positive and adenovirus positive cases.

In a review of 135 cases of polymerase chain reaction-confirmed gastroenteritis from a tertiary care children's hospital between 2006 and 2009 (during which there was an outbreak of norovirus)[8]. Diarrhea was present in 90% of cases, and vomiting was present in 56%. Abdominal cramping was reported in 12%; abdominal distension in 16%; and abdominal tenderness in 16%[8]. In our study, 57.7% of rotavirus-positive children had fever, similarly, 58% of rotavirus and adenovirus-positive cases had fever. In cases of gastroenteritis due to other agents, fever was present only in 17.2%. This situation makes us think that patients with diarrhea due to rotavirus and adenovirus infections present with a noisier clinical picture. Rotavirus and adenovirus infections should be kept in mind in diarrhea cases that require hospitalization, especially in cases under the age of two. This situation led to a statistical difference in our study.

Dehydration caused by acute viral gastroenteritis necessitating medical treatment is most common in young children, especially those under the age of two[23]. Young children are more prone to dehydration than older kids are because they have smaller fluid stores, a faster metabolic rate, a larger body surface to volume ratio, and a greater reliance on others to deliver fluids. Dehydration may be common, especially due to rotavirus. In our study, it was observed that there was 33.3% dehydration in rotavirus positive cases and this led to a statistical difference. At the same time, hospitalization was found to be higher in rotavirus positive cases compared to adenovirus positivity, this situation was found more in rotavirus positive cases. Rotavirus infection should be considered especially in cases requiring hospitalization and where there is severe diarrhea and vomiting that may lead to dehydration.

Conclusion

In conclusion, increased bowel frequency, with or without vomiting, fever, or abdominal discomfort, is a clinical condition that frequently denotes acute gastroenteritis. Acute viral gastroenteritis is often caused by a viral pathogen. It has been shown that vomiting, fever and hospitalizations may be more frequent in rotavirus and adenovirus infections, and that rotavirus should be kept in mind especially in children with severe vomiting/diarrhea leading to dehydration. Therefore, rotavirus vaccination is very important in early childhood. In terms of both reducing hospitalizations and reducing morbidity, reimbursement of countries by the existing health system can be considered.

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ORIGINAL RESEARCH

General Characteristics of Our Patients Diagnosed with Autoimmune Hepatitis: Single Center Experience

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Abstract

Objective: *Autoimmune hepatitis (AIH) is a chronic inflammatory liver disease of unknown etiology. Our aim was to investigate the general characteristics of our AIH patients, the treatments administered, and the responses to these treatments, and to compare these with the data available in the literature.*

Method: *Between 2010-2020, data from 62 patients diagnosed with AIH at our clinic were retrospectively reviewed. The study investigated the general characteristics at the time of diagnosis, laboratory values, autoantibody levels, liver histology, treatment status and responses, as well as follow-up and survival times.*

Results: *Of the patients, 57 were female, the average age of was 34.76±14.9 years. At the time of diagnosis, a more than tenfold increase in aminotransferase levels and acute hepatitis were statistically significantly higher in females($p<0.05$). While there was a statistically significant relationship between the average time to remission and aminotransferase levels($p<0.05$), no significant relationship was found between the development of relapse($p>0.05$).*

Conclusion: *AIH should always be considered in patients with acute and chronic liver disease, hypergammaglobulinemia, and especially those with other autoimmune diseases. It is important to remember that AIH responds well to treatment and patients can be maintained in remission for extended periods with appropriate therapy.*

Keywords*: ANA, Autoimmune hepatitis, Cirrhosis*

Introduction

Autoimmune hepatitis (AIH) is a chronic progressive inflammatory liver disease that arises due to the loss of self-tolerance against liver antigens. Its etiology is not fully understood, and it can occur across all ethnic groups and ages. Like most autoimmune diseases, AIH is more commonly seen in females. AIH is divided into two types based on the accompanying autoantibodies. Type 1 AIH is

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more common in children and adults, while Type 2 AIH is more often observed in children and adolescents. The incidence and prevalence of the disease worldwide are 0.7-2/100,000 and 4-25/100,000, respectively [1,2]. Although the exact etiology of AIH is unknown, genetics, age, gender, and environmental factors are suggested to play a role in its development. The heterogeneity in clinical presentation can complicate the diagnosis of the disease. Patients may present with symptoms ranging from asymptomatic transaminase elevation to acute, fulminant, chronic hepatitis, and signs of liver cirrhosis [3].

The diagnosis of AIH is made using the scoring system developed by the International Autoimmune Hepatitis Group (IAHG) in 1993 and revised in 1999. This system includes numerous parameters such as gender, autoantibodies, immunoglobulin G (IgG) and liver enzyme levels, alcohol consumption, exposure to hepatitis viruses and hepatotoxic agents, the presence of concomitant autoimmune diseases, histopathological findings, and the response to treatment [4]. All viral hepatitides, especially those caused by hepatitis viruses, toxic hepatitis, and drug-related hepatitis should be considered in the differential diagnosis of AIH [5].

Immunosuppressive therapies administered halt the progression of the disease, lead to a regression in fibrosis score, and prevent the progression to cirrhosis. Therefore, suspecting the disease and making an early diagnosis is very important [6]. The initial treatment is planned according to the patient's age, comorbid conditions, and disease activity. In the initial treatment, corticosteroids are given alone or in combination with azathioprine. Alternative immunosuppressive agents such as mycophenolate mofetil, tacrolimus, cyclosporine, sirolimus, and budesonide are used for patients who do not respond to conventional treatments or to minimize the side effects associated with corticosteroids [7]. Mycophenolate mofetil is the first choice among alternative agents. The goal of the treatment is to achieve sustained remission without medication. Liver transplantation can be performed for patients who develop acute liver failure, decompensated cirrhosis, and hepatocellular carcinoma [8].

Materials and Methods

At the Internal Medicine and Pediatrics clinics of Dicle University Faculty of Medicine, 62 patients diagnosed with autoimmune hepatitis between 2010-2020 and whose data were accessible were included in the study. Patients with malignancy, active infection, chronic haematological disease and pregnant women were excluded. Data regarding the patients gender, age at initial diagnosis, exposure to drugs, alcohol, and toxic substances, as well as the history of autoimmune diseases in the patients themselves and their close relatives were recorded. During the initial diagnosis and

subsequent follow-ups, laboratory data such as complete blood count, ALT, AST, ALP, GGT, total bilirubin, albumin, and IgG levels were examined. The titers of autoantibodies and viral markers (HBsAg, anti-HBs, anti-HCV, anti-HAV IgM) checked at the initial diagnosis were recorded. Histological data from liver biopsies, including findings such as interface hepatitis, lymphoplasmacytic cell infiltration, rosette formation, bile duct changes, and the presence of granulomas, were investigated. Findings compatible with cirrhosis in ultrasound and/or tomography examinations at the initial diagnosis were recorded. The patients' disease status at hospital admission (acute hepatitis, chronic hepatitis, acute liver failure, and cirrhosis), the start date of treatment, medications and dosages used in treatment, complications developed during treatment, responses to treatment, and their latest status were documented. Patients with ALT and/or AST levels more than ten times the normal at initial diagnosis, without a history of chronic liver disease, and without cirrhosis findings in imaging were considered to have acute hepatitis. Those with clinical and/or imaging findings compatible with cirrhosis were considered to have cirrhosis. A complete response was defined as a return to normal levels of serum ALT and AST along with IgG after treatment, while those who did not drop below 50% of the normal levels during treatment were considered non-responsive. Those who showed more than a 25% increase in ALT, AST, and/or IgG levels after a complete response were considered to have relapsed.

The diagnosis of AIH was made using the scoring system developed by the International Autoimmune Hepatitis Group (IAHG) in 1999. According to the scoring system, those who scored 15 or above before treatment were considered definite AIH patients, and those who scored between 10 and 15 were considered probable AIH patients. After treatment, those who scored 17 or above were considered definite AIH patients, and those who scored between 12 and 17 were considered probable AIH patients.

This study was approved by the Non-Interventional Clinical Research Ethics Committee of Dicle University Faculty of Medicine with decision number 84 dated 05.03.2020.

Statistical Analysis

The statistical analyses of the results obtained in the study were performed using the SPSS (Statistical Package for the Social Sciences) 18.0 statistical software package. Descriptive statistics for continuous variables were expressed as mean ± standard deviation, minimum, and maximum values, while categorical variables were expressed as number and percentage. Additionally, the Chi-square test was used for the analysis of categorical variables. Overall survival, intra-group survival, and 5-year life expectancy were examined using the Kaplan-Meier test. In these tests, a p (probability) value of less than 0.05 was considered statistically significant.

Results

Of the 62 patients included in the study, 57 (91.9%) were female, with a female to male ratio of 11:1. The average age of the patients was determined to be 34.76±14.9 years (female 35±14.5 / male 32±21). The average follow-up period was 34.7±23.4 (1-60 months) months, during which 2 (3.2%) patients died. The average survival time of our patients was 105 months (standard deviation: 2.1; CI:101.5-110), and the 5-year survival rate was found to be 92%. The laboratory findings at the time of diagnosis are shown in Table 1. A viral hepatitis panel was examined in all patients, and HBsAg, anti-HCV, and anti-HAV IgM were found to be negative. None of the patients had a history of alcohol, drug, or toxic substance intake. Anti-HBs was positive in 29 patients (46.7%). At the initial diagnosis, acute hepatitis was present in 34 patients (54.8%), 33 of whom were female, and cirrhosis was present in 19 patients (30.6%). Acute hepatitis was significantly higher in females compared to males ($p<0.05$).

Table 1: Laboratory values of patients at the time of diagnosis

	Min.	Max.	Average	Reference
ALT(U/L)	48	2740	545,1	0-30
AST(U/L)	31	4202	535	0-30
ALP(U/L)	67	845	207	<150
GGT(U/L)	10	1482	199,9	<55
T.bil(mg/dl)	0,3	16,7	2,86	0,3-1,2
D.bil(mg/dl)	0,1	10,3	1,79	0-0,5
Globulin(g/dl)	3,2	8,4	4,88	2-3
IgG (mg/dl)	1160	5070	2261	<1600

AST: Aspartate Aminotransferase, ALT: Alanine Aminotransferase, ALP: Alkaline Phosphatase, GGT: Gamma Glutamyl Peptidase, IgG: Immunoglobulin G

The number of patients with an increase in ALT and/or AST values more than tenfold at the time of diagnosis was 34 (54.8%) (33 females and 1 male). The increase in aminotransferase levels more than tenfold at the time of diagnosis was statistically significantly higher in females ($p<0.05$). Of the 43 patients who were treated and followed up after treatment, 25 (58.1%) (24 females and 1 male) had aminotransferase levels increased more than tenfold. While the average time to remission for these patients was 13 months, the average time to remission for patients with less than a tenfold increase in aminotransferase levels was 9.3 months. The average time to remission for patients, regardless of aminotransferase levels, was found to be 11 months. There was a statistically significant relationship between the average time to remission and aminotransferase levels ($p<0.05$). Of the 19 patients who relapsed, 10 (52.6%) had an increase in aminotransferase levels more than tenfold at the initial diagnosis. No statistically significant relationship was found between the aminotransferase levels at the initial diagnosis and the development of relapse ($p>0.05$). Of the 34

patients who showed more than a tenfold increase in liver enzymes at the time of diagnosis, 8 (23.5%) developed liver cirrhosis, while 24 (70.5%) did not have cirrhosis, and data for 2 patients were not accessible. No significant relationship was found between the increase in liver enzyme levels at the time of diagnosis and the development of liver cirrhosis ($p>0.05$).

The positivity rates of autoantibodies in our study were identified as follows: ANA (71.6%), ASMA (16%), anti-LKM1 (2%), AMA (15%), anti-LC-1 (5.1%), anti-SLA/LP (8.4%), and p-ANCA (20.8%). Among the patients included in the study, 38 (61.2%) had type 1 AIH, 3 (5%) had type 2 AIH, and 8 (12.8%) had overlap syndrome. Coexistence of AIH with primary biliary cholangitis (PBC) was found in 7 patients (11.2%), AIH with primary sclerosing cholangitis in 1 patient (1.6%), and seronegative AIH in 13 patients (21%). Additional autoimmune diseases were present in 23 patients (37.1%), with autoimmune thyroiditis (AIT) being the most common, observed in 10 patients (16.1%). PBC was seen in 7 patients (11.2%), SLE in 3 patients (4.8%), and RA in 3 patients (4.8%). No statistically significant relationship was found between liver enzyme elevation, the presence of additional autoimmune diseases, and autoantibody positivity ($p>0.05$).

Liver biopsies performed on patients showed interface hepatitis in all (100%), lymphoplasmacytic cell infiltration in 25 (59.5%), rosette formation in 12 (19.4%), and bile duct changes in 14 (22.6%). Interface hepatitis, lymphoplasmacytic cell infiltration, and rosette formation were present in 7 patients (11.3%), interface hepatitis and lymphoplasmacytic cell infiltration in 25 (40.3%), and interface hepatitis and rosette formation in 12 (19.4%). Histopathologically, interface hepatitis followed by lymphoplasmacytic cell infiltration was most frequently observed in patients who had more than a tenfold increase in liver enzymes at the initial diagnosis. However, no statistically significant relationship was found between enzyme elevation and any histopathological findings ($p>0.05$).

According to the IAHG scoring system, before treatment, 45 patients (72.5%) in our study had a definite diagnosis, and 17 (27.5%) had a probable diagnosis. The average IAHG score of the 43 patients treated and followed up before treatment was 17.44 (±2.7), while after treatment it was 19.9 (±3.7). The increase in the IAHG score after treatment was found to be statistically significant ($p<0.05$). Of the 43 patients treated and followed up, 35 (81.3%) had a definite diagnosis and 8 (18.7%) had a probable diagnosis at the time of diagnosis, while after treatment, 5 patients with a definite diagnosis shifted to the probable diagnosis category, and 4 patients with a probable diagnosis shifted to the definite diagnosis category. This necessitates scoring before and after treatment, as a statistically significant conversion was observed between patients with definite and probable diagnoses before and after treatment ($p<0.05$).

Azathioprine and prednisolone treatment were administered to 39 patients (62.9%), while only prednisolone treatment was given to 5 patients (8.1%). Information about the treatment of 18 patients (29%) could not be obtained. Of the 43 patients treated and followed up during the first 60 months, 26 (60.47%) responded completely to the treatment, 13 (30.23%) partially, and 4 (9.3%) did not respond. Azathioprine and prednisolone were given to 22 (84.6%) of the patients who achieved a complete response, while only prednisolone was given to 4 (15.4%). Relapse was observed in 19 (73%) of the 26 patients who achieved a complete response. On average, relapse occurred 19.77 months after remission. Decreases in liver enzyme, bilirubin, and IgG levels were observed from the first month of treatment. Significant reductions in ALT, AST, and IgG were detected at the end of the first month, while a significant reduction in total bilirubin was detected at the end of the third month ($p<0.05$). The decrease in ALP and GGT levels was not found to be statistically significant in relation to the treatment ($p>0.05$) (Figures 1,2,3).

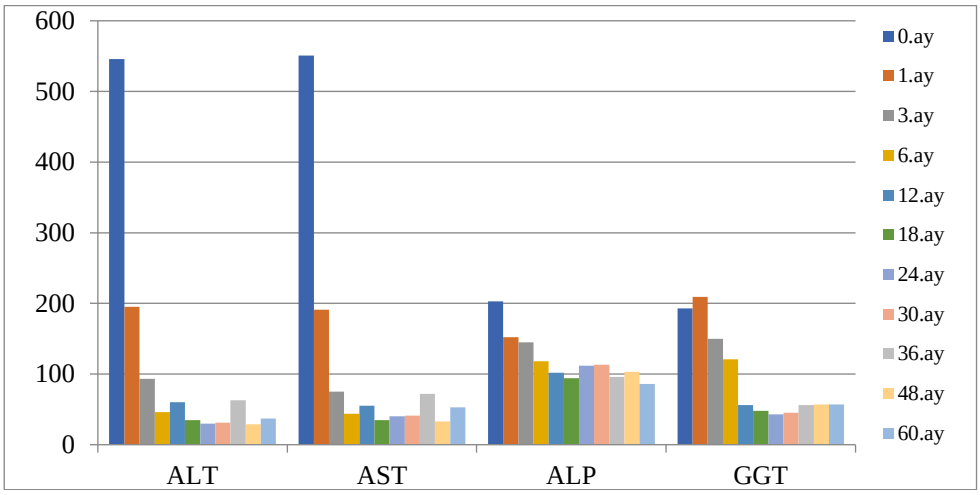

Figure 1: Monitoring of Biochemical Markers

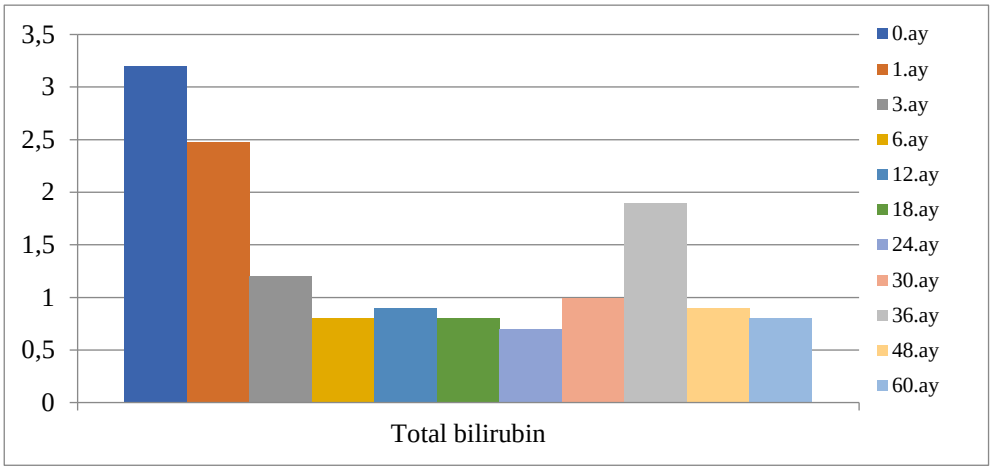

Figure 1: Total Bilirubin Monitoring

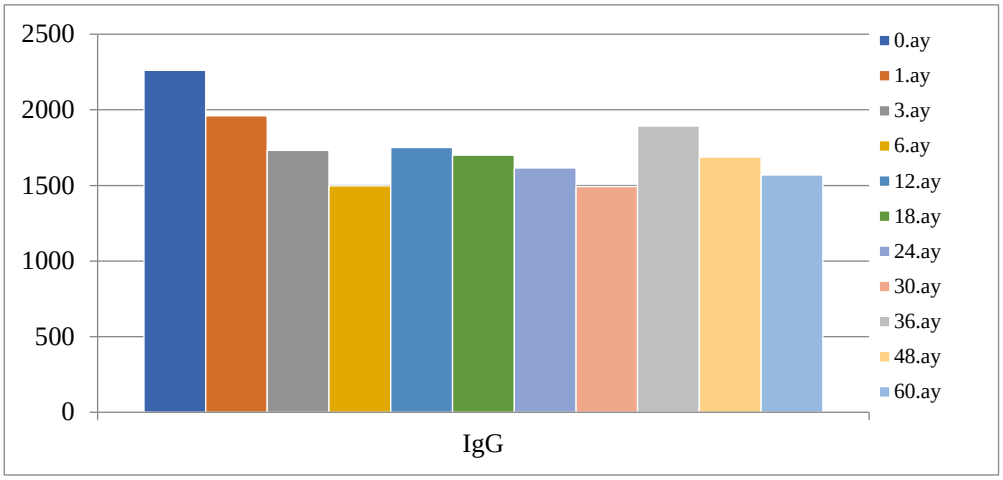

Figure 3: IgG Monitoring

Discussion:

Although the literature classically mentions a bimodal distribution of the peak age of patients with AIH in childhood and adulthood, recent studies emphasize that the disease can be seen at any age [9]. In a prospective study by Agarwal et al. in India, the age range of patients was taken as 5-61, with an average age of 31±17.1 [10]. Our study, similar to this one in terms of age range, also found a comparable average age (34.76 ± 14.9). As seen in our study, it has been reported by different authors that the majority of AIH patients are women [11]. In studies the F/M ratio is up to 6/1 [12]. In our study, the F/M ratio was determined to be 11.4/1, which is high compared to the literature, but the higher proportion of women is consistent with the literature. These data also show us that different ratios may exist in each region and race.

Studies conducted on different societies report that type 1 AIH is commonly seen in the adult population, constituting approximately 67-80% of cases [13]. In our study, type 1 AIH was found at a rate of 61.2%, which is slightly lower than the literature. The higher proportion of seronegative AIH cases in our study (21%) compared to the literature might be the reason for the lower rate of type 1 AIH cases found in our study. Type 2 AIH is seen much less frequently, constituting less than 10-15% of AIH cases in studies conducted in Europe and North America [14]. In our study, the rate of type 2 AIH was found to be below 10%. The rate of patients with overlap syndrome in our study was observed to be 12.8%. The coexistence of AIH with Primary Biliary Cholangitis (PBC) was 11.2% and with Primary Sclerosing Cholangitis (PSC) was 1.6%. Previously reported AIH-PBC ratios in the literature range from 2-20% [15]. The frequency of AIH-PSC overlap varies according to

diagnostic criteria and the population studied, and a recent review by Nayagam et al. reported a frequency ranging from 1.7-12.5% [16]. In a report by the Mayo Clinic, 162 type 1 AIH, 37 PBC, and 26 PSC patients, a total of 225 patients defined by standard criteria, were examined, and it was indicated that 18% of the patients showed features of overlap syndrome [17]. When we look at the literature, the rate of overlap syndrome varies even within the same societies.

The issue has been attributed to the use of different scoring systems and the lack of a standard diagnostic method [18]. In a large patient series evaluated by Czaja, ANA positivity in AIH was found to be 80%, while ASMA positivity was 63% [19]. In our study, while the ANA positivity rate (71.6%) was close to the literature, the ASMA positivity rate was found to be lower (16%) than the literature. In our study, p-ANCA positivity was observed in 8 of the 28 type 1 AIH patients (28.5%) for whom p-ANCA data were available. The literature has identified p-ANCA positivity in some patients with type 1 AIH [20]. In this respect, our study's data are consistent with the literature. In a study conducted by Abe et al., SLA/LP autoantibody positivity, specific to the disease, was detected in approximately 30% of patients diagnosed with AIH [21]. In our study, this rate was observed to be 8.4%, which is lower than the literature. In our study, AMA positivity was detected at a rate of 15%, which is consistent with the literature.

IgG levels may not increase in every case of AIH; indeed, in our study, IgG levels were found to be <2000 mg/dl in 27 of the 52 patients (51%) for whom data were available. In a large series study by Zeniya et al., serum IgG levels were found to be below 2000 mg/dl in 392 of 1008 patients (38.9%) [21]. Most patients in our study indicate that IgG levels can be normal at diagnosis. It is a known fact that there is an increase in the frequency of extrahepatic autoimmune diseases in AIH, and this has been reported to be between 20-50% in clinical studies [22]. Another autoimmune disease was present in 37.1% of the AIH patients in our study, which is similar to the literature. When we looked at the accompanying autoimmune diseases in our patients, AIT was most found to accompany (16%). In large series of recent reports, AIT has been reported to be the most common autoimmune disease accompanying AIH, similar to our study (7.5-18%) [23]. The presence of SLE was detected at 4.8% in our patients. In a study conducted by Mashiba et al., the coexistence of AIH with SLE was 3.1%, which is close to our study [21]. Another finding of our study is that the presence of extrahepatic autoimmune diseases is more common in female patients. It is already known that autoimmune diseases are more common in women. Therefore, it is not surprising that this pattern is also seen in AIH. As in many studies, Fabbri's study reported that the rate of accompanying autoimmune diseases was also higher in women with AIH [24].

In some studies, in the literature, a high rate of cirrhosis at the time of diagnosis, such as 33.9%, has been reported in patients diagnosed with AIH [25]. In a study conducted by Al Chalabi et al. in 2006, cirrhosis was detected at the time of diagnosis in 30% of patients with AIH, and some patients were observed to have complications of portal hypertension such as hypersplenism, esophageal variceal bleeding, and signs of decompensated liver disease [26]. Our cirrhosis rate at the time of diagnosis (30.6%) is consistent with the literature in light of this information. Interface hepatitis is a histopathological finding that strongly supports the diagnosis of AIH but can also be observed in hepatitis caused by other reasons. In a study conducted by Mulder et al. in 2016, interface hepatitis was reported in 84-98% of AIH cases [27]. The reason we observed interface hepatitis in all our patients is thought to be due to the high sensitivity of the pathology and our acceptance of a positive result even when the interface hepatitis score is ≥1, meaning that it is present even at a minimal-mild level.

Although different remission durations have been reported in the literature, the average time for patients to enter remission is stated to be 12 months [28]. The reason for this variability in the literature could be due to the different treatment regimens used. Studies have reported that 50-86% of patients develop relapse within one year after treatment cessation, necessitating the resumption of treatment, and relapse is often observed within the first 6 to 12 months [29]. While the relapse rates in our study (73%) are consistent with the literature, the time to relapse (19.77 months) was later. In a study conducted in South Korea, the mortality rate of the disease was found to be 2.18% [30]. In our study the mortality rate was 3.2%.

Due to the insufficient treatment follow-up data, we lack information on whether the treatment was stopped or not, how long the patient received treatment, and if they entered remission, how much longer they were followed up with treatment or without treatment. Also, for some patients whose treatment status is unknown, although they had laboratory follow-ups after diagnosis, follow-ups related to treatment could not be performed.

Another area of limitation was related to the definition of remission. In our study, the definition of remission was based on biochemical values, and the histological remission criterion could not be used due to the absence of control biopsies or, more precisely, the lack of data on this matter. This is because some guidelines consider histological improvement as a criterion for ideal remission [31]. On the other hand, the British Society of Gastroenterology suggests that treatment can be terminated if liver enzyme and immunoglobulin levels remain normal for a certain period after treatment [32].

Conclusion

In our study, we believe that AIH plays a significant role in the etiology of acute and chronic liver diseases observed in our region, and especially in patients with elevated liver enzymes and increased IgG levels, without a history of viral marker positivity, alcohol, toxic substance, drug use, and with positive autoantibodies, AIH must be considered. When starting treatment in these patients, the current clinical picture of the patient, the response to medications, and drug complications should be taken into account. It should not be forgotten that these patients need to be followed up regularly and for an extended period.

Conflict of interest: The authors have no conflict of interest related to this study.

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ORIGINAL RESEARCH

The Effect of Various Molotov Cocktails on Different Surfaces and Evaluation of Fire Changes

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Abstract

Objective: *Molotov cocktails are a classic homemade weapon used over the past 80 years; also known as gasoline bombs. However, there is not enough research in the literature. Molotov cocktail is classified as a mildly explosive substance. But a Molotov cocktail is not an explosive. This is a handmade lighter. It is used to set fire to targets in terrorist attacks.*

Method: *In our study, classic homemade Molotov cocktails were used. Oil, diluent, sugar, cologne, epoxy resin, paraffin, egg white, liquid and solid detergent, bleach, wood glue were added to the mixture. Parameters such as burning temperature, burning time, glass and nail spreading diameter, and residues of the Molotov cocktail were investigated. The prepared molotov cocktails were broken on 5 different floors, and the effect of changing the floor on the parameters was investigated..*

Results: *In our study, 51 (59.3%) of 86 molotov cocktails were broken. Most of the destruction occurred in the wall. According to the results we obtained, a relationship was found between the content of the Molotov cocktail, the burning temperature and the time. It was found that the damage was increased with the addition of substances to the mixture.*

Conclusion: *In addition, in our study, it was noticed that the Molotov cocktail did not explode by itself and did not cause damage to the environment by throwing nails.*

Keywords*: Molotov Cocktail, Terrorism, Explosives, Incendiaries.*

Introduction

The purpose of the Molotov cocktail is to set the targets on fire[1]. Molotov cocktails, also called incendiary bombs, were primarily used in wars to destroy tanks. Now it is used by terrorists and protesters to harm the environment[2]. Injuries or deaths occur as a result of the Molotov cocktail fire. In our country, in 2009, 17 years old Serap Eser died due to a Molotov cocktail thrown on a bus[3]. A reference study is required for a correct approach.

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Molotov cocktails are of 2 types; classical molotov cocktails and chemical molotov cocktails. In classical molotov cocktails, the preferred combustible material is placed in a glass bottle. Cotton or wool fabrics are generally preferred as wicks because synthetic fabrics containing nylon can melt quickly and prevent fire. The piece of fabric is inserted from the head of the bottle so that a part of it remains outside the bottle. The outside part of the fabric is burned with lighters, matches and similar igniters and thrown to the target surface, breaking the glass. In addition, by creating a mixture of substances such as sugar, liquid detergent, polystyrene foam, motor oil and rubber cement, it is ensured that it adheres better to the target surface and is difficult to extinguish [4].

Some publications describe chemical molotov cocktails that cause fires as a result of chemical combinations. These molotov cocktails are not favored by protesters because the chemicals are poorly known and difficult to obtain. In these molotov cocktails, instead of using fabric for ignition, the reaction of substances is used. For example, a mixture of sulfuric acid and gasoline is placed in a glass bottle and the bottle cap is closed. The mixture of potassium chlorate and sugar is added to the water and absorbed into the napkin. The napkin is dried. The dried napkin is glued to the glass bottle containing the sulfuric acid and gasoline mixture. When the thrown bottle is broken, the sulfuric acid reacts with the potassium chlorate in the napkin and ignites[5].

In our study, the burning properties of molotov cocktails will be seen. How long the burning continues, the spread of the fire and the burning temperature it reaches will be measured. It will be seen whether the additional substances mixed into the Molotov cocktail content increase the damage to the environment. The change of parameters with the effect of the surfaces of Molotov cocktails broken on 5 different surfaces will be determined. In addition, the changes in the extinguished molotov cocktails will be evaluated. Based on this study, it is aimed to explain the following issues about the molotov cocktail: Is the molotov cocktail a bomb? Do healthcare workers recognize the molotov cocktail? What injuries can a Molotov cocktail cause?

Materials and Methods

Various Molotov cocktails were prepared with easily available detergents, hand soap, eggs, cologne, resin, nails, thinner, glue, waste oil, bleach, paraffin and sugar. The effect areas, burning times and properties of these Molotov cocktails were determined (Table 1). 'Testo' branded thermometer was used. Molotov cocktail was prepared with brown beer bottles with a glass thickness of 0.3 cm. Molotov cocktails were thrown freely by the same person to experience the street actions. The amount of material in the Molotov cocktail has been determined by utilizing the experiences of bomb experts. However, the amount of content of these molotov cocktails, which are

prepared even by children in most countries, is not fixed. The experiment was conducted within the scope of a project supported by DUBAP (Dicle University Scientific Research Projects Coordinatorship). During the experiment, the contributions of the Diyarbakır Bomb Disposal Directorate, Diyarbakır Fire Department and Diyarbakır AFAD were received.

Table 1. *The materials of the mixtures, the amounts added and how many Molotov cocktails were made are shown.*

Material		**How many (%)**
Gas Only	110-220-330 ml	9 (10,5%)
Waste oil	50 ml (with 150 ml gasoline)	8 (9,3%)
Thinner	120 ml (with 150 ml gasoline)	6 (7%)
Candy	40 gr (with 150 ml gasoline)	9 (10,5%)
Cologne	120 ml (with 150 ml gasoline)	8 (9,3%)
Rosin	10 ml (with 150 ml gasoline)	10 (11,6%)
Paraffin	50 gr (with 150 ml gasoline)	4 (4,7%)
Egg white	10 gr (with 150 ml gasoline)	7 (8,1%)
Liquid soap	40 ml (with 150 ml gasoline)	6 (7%)
Bleach	50 ml (with 150 ml gasoline)	4 (4,7%)
Detergent	40 gr (with 150 ml gasoline)	6 (7%)
Glue	15 ml (with 150 ml gasoline)	7 (8,1%)
Soap and Sugar	40ml, 40gr (with 150 ml gasoline)	2 (2,3%)
Total	86 (100%)	

All the data obtained as a result of our study were analyzed using the SPSS Statistics 24.0 package program. Descriptive statistics, frequency calculations, Chi-square, nonparametric tests and Kruskal Wallis test calculations were made.

Results

35 (40.7%) of 86 Molotov cocktails could not be broken, and 51 (59.3%) of them were broken. Our broken Molotov cocktails immediately caught fire. The most effective parameter in breaking the glass bottles was the type of surface. In the Chi-square analysis between the fractured status and the surface type, p=0.000 was found to be significant. In other surfaces (soil, gravel) that have the properties to absorb the force, the fracture has not been fully achieved. In other words, for the Molotov cocktail to start a fire, it must be broken on hard surfaces such as concrete, metal and cars.

The average burning temperature of our Molotov cocktails, which were broken on all surfaces, was 350 °C. The highest combustion temperatures were achieved with molotov cocktail mixtures containing resin, paraffin, and glue. The contents of Molotov cocktails were compared with the combustion temperature, burning time, type of ground, amount of gasoline, and splash distance. In the Kruskal Wallis test analysis, significance was found between combustion temperature and burning times with some molotov content. (Table 2).

Table 2. *Kruskal Wallis test analysis was performed. Significance was found between combustion temperature and burning times with some molotov contents. A multiple comparison test was performed between the parameters found to be significant.*

	Gasoline	**Temperature**	**Duration**	**Diameter**	**Ground Type**
Ki Kare	4,075	34,884	21,026	8,452	13,890
Df	12	12	12	12	12
Asymp. Sig.	,982	,000	,050	,749	,308

Multiple comparison analysis was performed between nonparametric independent samples to determine the significant mixture contents. The Box Plot graph, which includes the analysis of combustion temperature and cocktail contents, is shown below (Figure 1). It is seen in the graph that the highest combustion temperatures are reached in mixtures containing gasoline, resin, paraffin, soap-sugar, and glue. It was observed that the combustion temperature of mixtures containing thinner, sugar, resin, paraffin, soap, bleach, liquid soap-sugar, detergent, and glue was in a narrow range. In addition, it has been observed that they can reach similar temperatures in each combustion. Combustion temperatures of mixtures containing waste oil, cologne, and eggs are distributed over a wider range. The lowest combustion temperatures were observed in molotov cocktail mixtures containing sugar-gasoline. The factors affecting the combustion temperature change are mentioned in the discussion section.

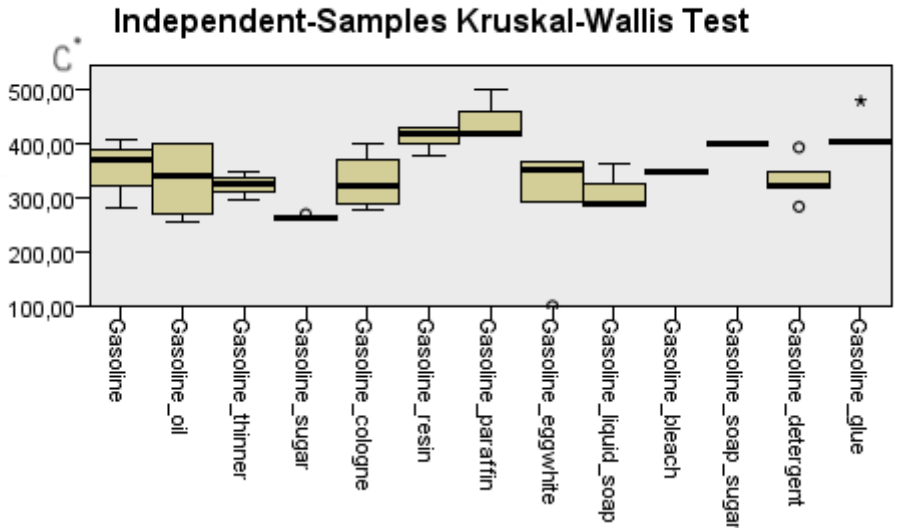

Figure 1*. Multiple comparisons between Temperature and Independent samples, Kruskal Wallis Test, Box Plot graph. *Total N(Fractured)=51, Test Statistic=34,884, Asymp Sig.(2-Test)=,000*

The average burn time we achieve in all our Molotov cocktails is 192 seconds. The combustion duration was affected by parameters such as the wind in the air, the ground and the added material.

In the Chi-square statistical analysis, significance was found between the change in Molotov cocktail content and the burning time (Table 2, Asymp, Sig.=0.50). Multiple comparison analysis was performed to determine the significant items. Multiple comparison analysis was performed between the burn time and independent samples using the Kruskal-Wallis Test. The created Box Plot graphic is given in Figure 2. It is seen in the graph that the longest burning time is in Molotov cocktails containing glue, paraffin, and oil. The median values of most mixtures are close to each other. The burning times of cocktail mixtures containing thinner, resin, egg, soap, and soap-sugar are in a narrow range. The burning times of the other mixtures showed a wide range.

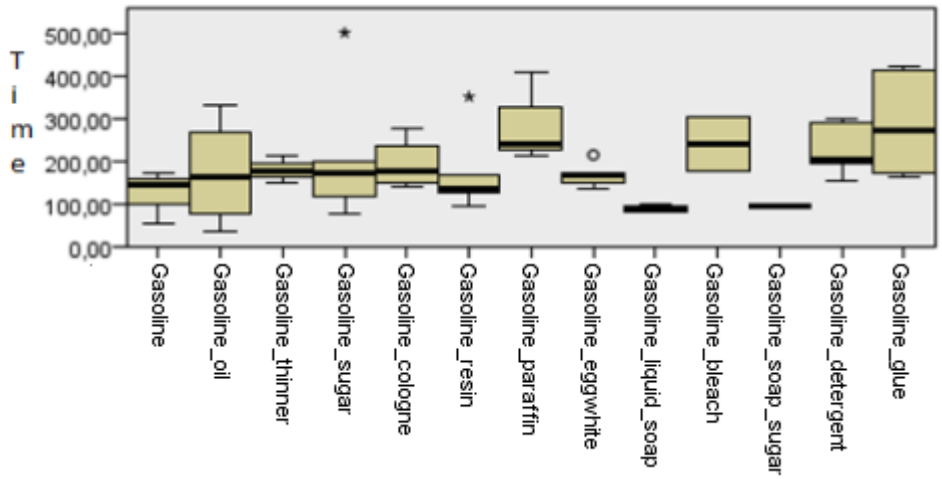

Figure 2: *Multiple comparisons between Time and Independent samples, Kruskal Wallis Test, Box Plot graph. *Total N(Fractured)=51, Test Statistic=21,026, Asymp Sig.(2 Test)=,050*

The maximum diameter at which the flame spread was measured with the help of a meter. The highest splash distances were seen on the concrete floor which was hard and transmits the force as well.An American cloth was hung on the wall and Molotov cocktails were thrown at certain distances (1-2-3-4 meters). It has been seen from which distances the splashing flame can burn the cloth. In 50% of Molotov cocktails thrown at a distance of 4 meters, the flames spread to the cloth, but it did not create enough effect to ignite the cloth. In 50% of Molotov cocktails thrown 3 meters away, the flames spread to the cloth and ignited the cloth. Burning American cloth has been replaced. Molotov cocktails were thrown at distances of 2 meters and 1 meter. All Molotov cocktails broken at both distances caused burns in the cloth.

Discussion:

It has been determined in our study that the combustion temperature and burning time can be increased by strengthening the Molotov cocktail content. As the burning temperature and duration

increase, the destruction of the fire also increases and it becomes more difficult to extinguish. Fire contact with humans is dangerous at these high temperatures. May cause severe burns to tissues.A fire created by a Molotov cocktail; According to studies, it can be extinguished in less than 5 seconds with the use of fire extinguishers[2]. For this reason, the damage caused by the Molotov cocktail can be minimized by quick extinguishing interventions and first aid.

Gasoline is a rapidly, highly flammable, and highly volatile substance. It has a long burning time because it consists of different components with boiling points ranging from 32 to 204°C [6]. It is preferred as an accelerator by 75% of those with the aim of arson [7]. In addition, due to its high volatility, a large amount of evaporated gasoline creates a flammable gas zone in the combustion area. This flammable gas zone makes the dispersal of the fire and the ignition area unpredictable [8]. Gasoline is an apolar molecule. Intra-inter molecular forces occur when the substances added to the gasoline are polar or nonpolar. These forces affect the combustion temperature and combustion times. In a study with chemical Molotov cocktails in Spain, sugar was added to mixtures to exothermic reactions and cause stronger, longer burning [5]. In this study, the sticky surface prolonged the burning time of the Molotov cocktail prepared with sugar mixture. Burning times were measured to be above the average burning time of other Molotov cocktails.

Epoxy resin is a synthetic, high molecular weight, thermoset polymer group macromolecule. Its carbon-rich structure allows it to burn easily and well. When a polymer is heated, its chains begin to break down, resulting in volatile fuel molecules [9]. For this reason, large polymers such as epoxy resin are expected to burn similarly to polyvinyl ester groups [10]. As expected, Molotov cocktails containing an epoxy resin-gasoline mixture could reach similar combustion temperatures with glue-gasoline mixtures during combustion. In the mixtures containing resin, high combustion temperatures were reached during each combustion and it was observed that the temperature range was narrow. Burn time was also found in a narrow range.

Wood glue is polyvinyl acetate[11]. These carbon-rich compounds burn well and produce an exothermic reaction. For this reason, higher combustion temperatures have been achieved in our molotov cocktails containing wood glue. The longest burning times were observed in our mixtures containing glue. In addition, when this Molotov cocktail was extinguished, a white residue was detected on the floor.

Paraffin is an alkane with 26-30 carbons and is apolar[12]. The combustion of paraffin alone is an exothermic reaction, so it raises the ambient temperature as the mixture burns. The highest burning temperature and burning time were observed in the molotov cocktail mixture with paraffin added. In addition, the thrown Molotov cocktails formed a sticky layer on the combustion floor. It is

thought that the purpose of using paraffin is to increase the destruction by providing adhesion, long burning, and high temperature.

Liquid detergent and solid detergent contain hydrophilic and hydrophobic groups. In other words, detergents contain both polar and nonpolar parts. Detergents do not contain molecules from the flammable group [13]. For this reason, it is thought that the burning temperature and burning times of Molotov cocktails containing detergents are below the average measurements.

The sodium hypochlorite in bleach is not a combustible substance on its own, it is a strong oxidizer. Fumes from a mixture of sodium hypochlorite and gasoline during combustion can be highly toxic; Hazardous substances such as chloroform, dichloromethane, and hydrochloric acid can be produced [14]. During the experiment, it was observed that a gas was produced when we mixed gasoline and bleach. An above-average burning temperature and burning time were measured in Molotov cocktails containing bleach.

Waste oil is a nonpolar molecule[15]. The non-polar gasoline and oil have become a homogeneous mixture. In these Molotov cocktails, the average burning temperature was 335°C and the burning time was 171 seconds. The oil kept the ambient temperature high with exothermic combustion and increased the ambient temperature. In addition, due to the non-volatility of the oil, the burning time is longer than in some mixtures.

Thinner is a nonpolar molecule and has high volatility[16]. It creates a homogeneous mixture with nonpolar gasoline. Although it has high volatility, the average combustion temperature was 323 °C and the burning time was 178 seconds.

Cologne is a polar molecule[17]. It has been observed that it can be temporarily dispersed in gasoline with quick agitation. Cologne is a flammable, highly volatile, and flammable substance, so the average burning temperature and burning times have been reached.

The average burning temperature and burning time of the other Molotov cocktails were below the mixtures with egg white added. Egg white formed a sticky and flammable layer on the floor. When extinguished, the viscous structure of the egg left a white residue.

Combustion times are not directly proportional to the fact that the substance in the mixture contains flammable molecules. Because the unit amounts of the added substances in the distribution were not kept equal. The amount of the substance was determined by the information received from the security forces. For example, 10 ml of epoxy resin and 15 ml of wood glue are used in our mixtures. The resin should burn similarly to the polyvinyl ester groups [18]. However, the burning time of the mixtures containing wood glue could not be reached. Because the quantities are different. The change in carbon numbers per unit amount also affects combustion times. It has been determined in

our study that the combustion temperature and burning time can be increased by strengthening the Molotov cocktail content. As the burning temperature and duration increase, the destruction of the fire also increases and it becomes more difficult to extinguish. Fire contact with humans is dangerous at these high temperatures. May cause severe burns to tissues.

Limitations of the Study

It is the first study in its field on the Molotov cocktail. For this reason, comparison and discussion could not be done sufficiently. In addition, explosives were not used in our study. The residues formed as a result of combustion and their chemistry have not been studied.

Conclusion

Molotov cocktails are known for their association with civil unrest and violent protests and are still widely used as incendiary weapons in various conflicts and riots [19]. As we experienced in our study, a Molotov cocktail is an improvised incendiary device, unlike an IED (improvised explosive device). Considering the damage it causes and the stress it creates on the public conscience, the Molotov cocktail can act like a weapon. Therefore, crimes committed with a Molotov cocktail should be punished as if committed with a weapon.

A study was conducted on thermal protective fabrics exposed to Molotov cocktails, evaluating the physical properties and protective performance of the fabrics when exposed to fire generated by simulated Molotov cocktails [20]. This research contributes to the understanding of the effectiveness of protective clothing materials in mitigating the effects of Molotov cocktails on various surfaces. In our study, the fires caused by Molotov cocktails reached temperatures that could cause severe burns. Such research provides valuable information for improving fire safety measures and developing strategies to reduce the impact of incendiary devices such as Molotov cocktails.

In situations of ethnic riots or civil unrest, Molotov cocktails can increase tensions and civilians may resort to arming themselves with such weapons as a means of protection [21] . The use of Molotov cocktails for this reason not only poses a threat to law enforcement, but also endangers the lives of those involved, potentially causing serious burn injuries [20.] Moreover, Molotov cocktails have been used by various groups for different purposes, including terrorist activities. For example, documented cases include attacks on financial institutions and symbolic landmarks [22]. The use of Molotov cocktails in such scenarios shows that they are used not only as a means of protest, but also as a means of terror and repression.

In forensic medical cases, it is very important for healthcare professionals to determine the difference between a bomb injury and a Molotov cocktail injury in order to determine the nature of

the crime. Bombs can cause explosive or shrapnel injuries, while handmade incendiary Molotov cocktails cause burn injuries. These issues should be taken into account when preparing the report in forensic cases. In addition, ingredients added to the Molotov cocktail mixture can be detected in samples taken in laboratories. Attention should be paid to whether substances that increase the destruction of the Molotov cocktail are used. If this is detected, the penalty for the offense should be increased.

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