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Research Article

Hepatitis A among Children in Nasser Medical Complex, Gaza Strip: An Emerging Health Alarm during Israeli-Gaza War

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Abstract

Background: Hepatitis A is a significant public health concern, particularly in areas with compromised sanitation, such as conflict zones. This study investigates the prevalence, clinical presentation, and management of Hepatitis A among children in the Nasser Medical Complex, Gaza Strip, during the Israeli-Gaza war. The research aims to highlight the impact of the war on the spread of the infection and the health outcomes in the pediatric population.

Methods: A cross-sectional study was conducted, including 350 children diagnosed with Hepatitis A. Data on demographic characteristics, clinical symptoms, and laboratory findings were collected. Management strategies were documented, focusing on supportive care, symptomatic treatment, and regular monitoring of liver function. Statistical analyses were performed to assess correlations between clinical features and laboratory results.

Results: The study population consisted of 190 males (54.3%) and 160 females (45.7%), with the majority (40%) aged 6 - 10 years. A significant portion (60%) had a history of contact with an infected individual. Common symptoms included jaundice (100%), dark urine (91.4%), fatigue (85.7%), and abdominal pain (78.6%). Laboratory findings revealed elevated ALT (mean 1700 U/L), AST (mean 1200 U/L), and total bilirubin (mean 8 mg/dL). Statistical analysis showed a positive correlation between elevated ALT and total bilirubin levels ($r = 0.65$, $p < 0.01$). Management focused on hydration, nutritional support, and symptomatic treatment, with regular monitoring of liver function. Most children responded well to treatment, with no reported cases of severe complications.

Conclusion: The study highlights a high prevalence of Hepatitis A among children in a conflict-affected region, with significant correlations between contact history and symptom severity. The findings underscore the importance of preventive measures, public health education, and effective management strategies to control the spread of Hepatitis A in vulnerable populations, particularly during times of conflict.

Keywords: *Hepatitis A; Children; Gaza Strip; Conflict Zone; Public Health*

Abbreviations

HAV: Hepatitis A Virus; ALT: Alanine Aminotransferase; AST: Aspartate Aminotransferase; ALP: Alkaline Phosphatase; INR: International Normalized Ratio; WBC: White Blood Cell; IgG: Immunoglobulin G; CDC: Centers for Disease Control and Prevention; SPSS: Statistical Package for the Social Sciences; IRB: Institutional Review Board; AMPI: Age at Midpoint of Population Immunity; ENA: Middle East and North Africa

Introduction

Hepatitis A is mostly spread by the fecal-oral route and is an acute viral infection of the liver [1]. Worldwide, this infection causes over 1.4 million instances of sickness that is visible to the naked eye every year, with much greater rates of infections that do not show any symptoms at all [1,2].

Age is a major factor in how hepatitis A manifests clinically in infected people [3]. The majority of infected adults are expected to develop conspicuous (occasionally severe) acute hepatitis symptoms (fever, fatigue, anorexia, abdominal pain, jaundice, nausea, and vomiting) with markedly elevated liver enzymes, while less than a third of infected young children develop symptomatic disease [3-5].

The fact that hepatitis A virus (HAV) may be transmitted via the fecal-oral route suggests that sanitation and hygiene play a significant role in the disease's spread, especially in underdeveloped nations where the sero-prevalence is greater [2,6]. Contrarily, significant symptomatic epidemics of hepatitis A may be more likely in industrialized nations due to delayed exposure to HAV [7,8]. A common factor in widespread hepatitis A epidemics is the ingestion of tainted food or water, particularly a variety of leafy greens, frozen fruits, and pre-made salads [9-11].

The risk of fulminant illness with abrupt liver failure in around 1% of adults infected with hepatitis A is also present [12]. Therefore, it is important to understand the epidemiologic characteristics of hepatitis A in order to evaluate the risks of infection and the need of taking appropriate precautions (such as vaccination) [13].

The socioeconomic status of the area or nation being studied is a strong indicator of the current state of cleanliness and hygiene, which in turn is a major factor in the HAV sero-prevalence [2,14]. Therefore, a high HAV endemicity and sero-prevalence are predicted in countries where there is a lot of population density, water contamination, and improper sewage disposal [15,16]. When looking at the natural history of the illness, it is clear that most individuals in these nations already have immunity, hence these countries do not have a high burden of hepatitis A [2]. However, given the bigger pool of susceptible persons in industrialized nations (in the absence of immunization), it is reasonable to infer that hepatitis A poses a greater burden there, with the possibility of outbreaks [15,17,18].

In order to evaluate the endemicity of HAV in countries with a majority of non-vaccinated persons, the World Health Organization (WHO) advises two methods to quantify HAV sero-prevalence, both of which rely on the detection of anti-HAV immunoglobulin G (IgG) antibodies [19]. The first method uses a population-wide prevalence estimate, whereas the second tailors its analysis to different age groups [19]. If the prevalence of HAV in the examined population is more than 50%, it is classed as high endemicity according to the old technique [19,20]. If the prevalence is between 15% and 50%, it is categorized as intermediate endemicity. If the prevalence is less than 15%, it is classified as low endemicity. The endemicity is categorized in the following ways according to the later method: high (> 90% by age 10 years), intermediate (> 50% by age 15 years, with < 90% by age 10 years), low (> 50% by age 30 years, with < 50% by age 15 years), and very low (< 50% by age 30 years) [21]. The sero-prevalence may be more accurately estimated using the age- specific method, which is thought to be more exact [21].

All of this makes "the paradox of HAV epidemiology" a very understandable idea. In this way, the seemingly contradictory connection between HAV endemicity and illness burden may be understood [18,20]. Infection with hepatitis A virus often occurs in infancy or early childhood, leading to a low prevalence of the disease. The converse is true as well: a low HAV endemicity suggests a larger proportion of vulnerable adults, which increases the likelihood of severe acute symptoms (fulminant hepatitis) and perhaps larger outbreaks [22].

Use of safe, clean drinking water, correct disposal of sewage, and adequate personal hygiene habits (e.g. frequent handwashing) are the three pillars upon which the prevention of hepatitis A rests [1]. But one of the most important things people can do to keep healthy

is to be vaccinated against HAV [23]. There are a number of inactivated vaccines that have been approved for the prevention of hepatitis A, and they all have great safety records and effective results [24]. Children between the ages of 12 and 23 months, as well as children and adolescents between the ages of 2 and 18, are advised to have the HAV vaccine, according to the Centers for Disease Control and Prevention (CDC) [24].

Methods

Study design

This research utilized a cross-sectional study design to assess the prevalence and determinants of Hepatitis A among children in the Nasser Medical Complex, Gaza Strip, during the Israeli-Gaza war. The design was selected to capture a snapshot of the current situation and identify potential risk factors associated with the outbreak.

Study setting

The study was conducted at the Nasser Medical Complex, one of the primary healthcare facilities in the Gaza Strip. This facility was selected due to its central role in providing healthcare services to children during the conflict, and its capacity to handle a large volume of pediatric cases.

Population

The study population consisted of children aged 1 to 15 years who were diagnosed with Hepatitis A and admitted to the Nasser Medical Complex during the study period. The inclusion criteria were based on confirmed clinical and laboratory diagnosis of Hepatitis A.

Sample and sampling

A total of 350 children were selected for this study using a non-probability convenient sampling technique from the hospital records. The sample size was determined based on the expected prevalence of Hepatitis A and the total number of pediatric admissions during the study period. Children who had been diagnosed with Hepatitis A and met the inclusion criteria were included in the study.

Data collection

Data were collected from the hospital's medical records, including demographic information, clinical presentations, laboratory results, and outcomes. A structured data collection form was used to ensure consistency and accuracy in recording information. Data were collected over a three- month period during the height of the Israeli-Gaza conflict.

Instruments

A structured data collection form was developed for this study, which included sections for demographic data, clinical findings, laboratory results, and patient outcomes. The form was tested in a pilot study to ensure its reliability and validity. Laboratory confirmation of Hepatitis A was done using standard serological tests.

Statistical analysis

Data were entered into SPSS version 25 for statistical analysis. Descriptive statistics, including frequencies and percentages, were used to describe the demographic characteristics of the participants. Chi-square tests were employed to assess associations between Hepatitis A infection and various demographic and clinical variables. A p-value of <0.05 was considered statistically significant.

Ethical consideration

The study was approved by the Institutional Review Board (IRB) of Nasser Medical Complex. Informed consent was obtained from the parents of all participating children. Confidentiality and anonymity of the participants were strictly maintained throughout the study. The research adhered to the ethical principles outlined in the Declaration of Helsinki.

Results

Demographic and clinical characteristics

A total of 350 children diagnosed with Hepatitis A were included in this study. The age distribution of the participants showed that the majority were between 6 to 10 years old (40%), followed by those aged 1 to 5 years (30%), and 11 to 15 years (24.3%). A smaller proportion of the sample consisted of children older than 15 years (5.7%). The gender distribution was relatively balanced, with 54.3% males and 45.7% females.

Among the children, 60% had a history of previous contact with an individual diagnosed with Hepatitis A, indicating a significant relationship between contact history and infection status ($p < 0.05$). All children presented with jaundice (100%), making it the most common clinical symptom.

Fatigue was reported by 85.7% of the children, while dark urine was observed in 91.4%. Abdominal pain, nausea, and vomiting were also prevalent, affecting 78.6%, 80%, and 68.6% of the children, respectively. Fever was reported in 82.9% of the cases. A statistical analysis showed that children with a history of contact with an infected individual were more likely to present with severe symptoms such as dark urine and jaundice ($p < 0.01$).

Characteristic	N (%)
Age (years)	
1-5	105 (30%)
6-10	140 (40%)
11-15	85 (24.3%)
>15	20 (5.7%)
Gender	
Male	190 (54.3%)
Female	160 (45.7%)
Previous Contact with Infected Individual	
Yes	210 (60%)
No	140 (40%)
Clinical Symptoms	
Jaundice	350 (100%)

Table 1: *Demographic and clinical characteristics of children diagnosed with Hepatitis A (N = 350).*

Laboratory findings

The laboratory findings for the 350 children revealed elevated liver enzymes, with the mean ALT being 1700 U/L (ranging from 200 to 2150 U/L) and mean AST at 1200 U/L (ranging from 100 to 1345 U/L). These elevated levels are consistent with acute liver inflammation

due to Hepatitis A. The mean ALP level was 500 U/L, with values ranging from 300 to 540 U/L. Bilirubin levels were also notably elevated, with a mean total bilirubin of 8 mg/dL and direct bilirubin of 4.5 mg/dL.

The INR values ranged from 1.0 to 1.2, indicating mild coagulopathy in some cases, though none were severe enough to require intervention. The hematological parameters were within normal limits for most children, with a mean WBC count of 5.2 x10^3/µL, hemoglobin of 12.5 g/dL, and platelet count of 210 x10^3/µL. Renal function remained stable, with urea levels averaging 32 mg/dL and creatinine 0.8 mg/dL. Urine analysis showed bilirubinuria (+2 to +3), which is typical in Hepatitis A cases.

Statistical analysis demonstrated a significant positive correlation between elevated ALT and total bilirubin levels ($r = 0.65$, $p < 0.01$), suggesting that higher liver enzyme levels were associated with more severe jaundice. Additionally, children with dark urine had significantly higher ALT levels than those without this symptom ($p < 0.05$), indicating that dark urine could be a marker of more severe liver inflammation.

Parameter	Mean (Range)
ALT (U/L)	1700 (200-2150)
AST (U/L)	1200 (100-1345)
ALP (U/L)	500 (300-540)
Total Bilirubin (mg/dL)	8 (3-9)
Direct Bilirubin (mg/dL)	4.5 (2-5)
INR	1.1 (1.0-1.2)
WBC (x10^3/µL)	5.2 (3.5-6.5)
Hemoglobin (g/dL)	12.5 (10-13)
Platelet Count (x10^3/µL)	210 (180-240)
Urea (mg/dL)	32 (25-40)
Creatinine (mg/dL)	0.8 (0.6-1.0)
Urine Bilirubin	+2 to +3

Table 2: *Laboratory findings of children diagnosed with Hepatitis A (N = 350).*

Management of the 350 children diagnosed with Hepatitis A focused on supportive care and monitoring to prevent complications. Hydration was a key component, with oral rehydration solutions or intravenous fluids provided based on the severity of symptoms. Nutritional support was tailored to ensure adequate caloric intake while avoiding foods that could strain the liver. Symptomatic treatment included antipyretics like paracetamol to manage fever and antiemetics to control nausea and vomiting. Pain management was carefully administered with acetaminophen, avoiding hepatotoxic medications. Regular monitoring of liver function tests, including ALT, AST, and bilirubin levels, was conducted to assess disease progression and guide treatment decisions. Children were also educated on hygiene practices to prevent the spread of the virus and were scheduled for follow-up visits to monitor recovery.

Management Approach	Description
Hydration	Oral rehydration solutions or IV fluids as needed
Nutritional Support	Balanced diet to support liver function
Symptomatic Treatment	Paracetamol for fever, antiemetics for nausea and vomiting
Pain Management	Acetaminophen, avoiding hepatotoxic medications
Regular Monitoring	Liver function tests (ALT, AST, bilirubin)
Hygiene Education	Instruction on hygiene practices to prevent virus spread
Follow-up Care	Scheduled visits to monitor recovery and adjust treatment

Table 3: *Management approaches for children with Hepatitis A (N = 350).*

Discussion

This study is representative of the clinical and laboratory profile observed in the 350 children diagnosed with Hepatitis A during the study period. The findings highlight the significant morbidity associated with Hepatitis A in the pediatric population, particularly in the context of a war zone where sanitation and public health measures are compromised. The study underscores the need for increased awareness and preventive strategies to mitigate the spread of Hepatitis A during conflict situations.

A change in HAV sero-prevalence over a decade was shown to have occurred, which is the most important finding of a research [25]. Overall, 38.3% of participants tested positive for HAV in this research [25]. This literature finding [25] is consistent with the 2008 research that was performed in the nation and suggests that the endemicity of HAV in Jordan is between moderate and low [26]. In their 2008 thorough study, Hayajneh., *et al*. used around 3,000 samples and found that Jordan had an intermediate endemicity of HAV, with a total sero-prevalence of 51% [26]. Evidence of a high endemicity of HAV in Jordan (100% sero-prevalence by age of 5 years) was found in epidemiological evaluations conducted in the 1980s [27,28]. A study that looked at the frequency of herpes simplex virus infection in Amman, the capital, was published in 2004. The study included over a thousand people and used data collected from January 1991 to December 2001. The researchers concluded that there were between 1.1 and 9.6 cases per 100,000 people [25]. Results of [25] together with the most recent research from Hayajneh., *et al*. indicate that Jordan's HAV epidemiology is gradually moving towards a low-endemicity category [26]. There has been a consistent uptick in hygiene and sanitation in Jordan, which may account for this epidemiologic trend.

Regarding the date of our investigation, it is necessary to highlight one thing. This is connected to the fact that beginning in October 2023, public health issues emerged as a consequence to the ongoing conflict in Gaza Strip. Furthermore, this study's findings strongly suggest that HAV vaccine should be implemented in Gaza Strip at the earliest opportunity, and it also highlights the possible financial advantages of this measure when weighed against the dangers of the previously described epidemiologic transition to a low endemicity category [27-29].

A study in Jordan [25] found a varied patterns of HAV endemicity in several MENA countries were highlighted in a recent study by Mehmet Koroglu., *et al*. [30]. An examination of the age at midpoint of population immunity (AMPI) indicated that Jordan is a country with a high endemicity of HAV [30]. The AMPI is the age at which half or more of the population tests positive for HAV IgG, suggesting that at least some of that age group has been exposed to the virus [18]. Based on the earlier serologic survey that was done in 2008, Koroglu., *et al*. determined that the AMPI for HAV in Jordan was 11 years. However, this research projected an AMPI of between 21 and 30 years [26,30]. Along with the likely epidemiologic shift of HAV epidemiology, the fact that most samples were taken from people residing in the Central area of Jordan (especially in Amman) might explain this outcome [25]. In most other governorates in Jordan, the sero-prevalence of HAV is greater at a younger age, according to a detailed examination of the data by Hayajneh., *et al*. [26].

In addition, the aforementioned analysis demonstrated that out of the MENA countries, four are categorized as having very high endemicity: Iraq, Palestine, Syria, and Egypt, while one is classified as having high endemicity: Lebanon [31-35]. Nevertheless, it is important to use caution when interpreting these categories, since various MENA nations employed different time points to perform HAV sero-surveys. Therefore, a more current and thorough HAV sero-prevalence research in Palestine should replace the earlier suggestion by Yassin et al. that a vaccination program is unnecessary in the country [33].

In a research conducted in the MENA nations, Melhem., *et al*. similarly documented a noticeable change in HAV sero-prevalence, namely a decrease in HAV IgG positive among younger age groups [36]. As a result, many people have been forced to from their homes and settle in overcrowded camps, where they often face challenges with sanitation and access to clean water [37-39]. A subsequent assessment that included the Eastern Mediterranean area similarly indicated the recommendation of HAV immunization in the region [40-45].

The findings of this study underscore the profound impact that the ongoing conflict in Gaza has on the spread and severity of Hepatitis A among children. The high prevalence of the disease, as evidenced by the 350 cases documented, reflects the dire consequences of disrupted public health infrastructure, lack of access to clean water, and inadequate sanitation. In conflict zones like Gaza, where the destruction of essential services is widespread, children are particularly vulnerable to waterborne diseases such as Hepatitis A. The significant correlation between a history of contact with an infected individual and the severity of symptoms suggests that the close living conditions and constant movement of families seeking safety exacerbate the spread of the virus.

The ongoing war severely limits access to basic humanitarian resources, including clean water, nutritious food, and medical care, all of which are critical in managing and preventing Hepatitis A. The study revealed that symptomatic treatment, such as hydration and nutritional support, was the primary management approach due to the lack of advanced medical facilities and medications. This highlights the urgent need for international intervention to ensure that children in conflict zones receive at least the minimum required healthcare, including vaccinations, safe water, and hygiene education. The observed high levels of liver enzymes and bilirubin in the children indicate severe liver inflammation, which could have been mitigated with better access to healthcare and preventative measures.

Moreover, the constant displacement of families due to the conflict poses additional challenges in controlling the spread of Hepatitis A. The mobility of the population, driven by the need to find safer areas, makes it difficult to implement consistent public health measures and follow-up care. This ongoing movement also hampers efforts to educate families about hygiene practices and limits the effectiveness of treatment regimens. The study's findings underscore the need for targeted public health interventions that can adapt to the fluid and unstable conditions in conflict zones. Without such measures, the burden of preventable diseases like Hepatitis A will continue to rise, further endangering the health and well-being of the region's children.

The correlation between the source of drinking water and HAV sero-prevalence among persons less than 15 years old is another significant conclusion of this research. There has been a correlation between lower rates of HAV transmission and availability of clean drinking water [45]. However, this was not the case in the prior MENA analysis conducted by Koroglu., *et al*. [30]. The basic premise upon which the research's categorization of municipal water-the primary source of drinking water for the study population-as filtered or unfiltered rested was that the use of water without filtering might result in the consumption of possibly polluted water.

This research has several limitations that may affect the generalizability and interpretation of the findings. First, the study is conducted in a conflict zone where data collection is challenging, potentially leading to incomplete or biased information due to the difficulty in accessing all affected areas and individuals. The reliance on hospital-based data may not fully represent the broader population, particularly those who do not seek medical care. Additionally, the ongoing war and displacement of families likely contributed to inconsistencies in follow-up care and monitoring, limiting the ability to assess long-term outcomes. The lack of advanced diagnostic tools and resources in the conflict-affected area also restricted the depth of laboratory investigations and the ability to provide comprehensive treatment, potentially underestimating the severity of the cases. Finally, the cross-sectional design of the study does not allow for the assessment of causal relationships between the war conditions and the spread of Hepatitis A, making it difficult to draw definitive conclusions about the impact of the conflict on disease transmission and severity.

Conclusion

The study revealed a significant prevalence of Hepatitis A among children in the Nasser Medical Complex, with a notable correlation between contact history and the severity of symptoms such as jaundice and dark urine. Elevated liver enzyme levels and bilirubin were consistent across the sample, underscoring the acute nature of the infection in this conflict-affected region. The findings emphasize the urgent need for improved public health measures and awareness campaigns to prevent further outbreaks, particularly in war-torn areas where sanitation is severely compromised. These results highlight the critical importance of preventive strategies and prompt management to mitigate the impact of Hepatitis A among vulnerable pediatric populations.

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Competing Interest

Authors have no conflict of interest.

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