

Cancer Research

Short communication

Occurrence of hepatitis B and C infection in pediatric patients with cancer at Alhadbaa Hospital in Mosul/Iraq

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Abstract

Pediatric cancer patients face increased susceptibility to hepatitis B and C virus infection owing to immunosuppression resulting from the disease and its treatment, the frequent need for blood transfusions, and invasive procedures. This study sought to determine the prevalence of HBV and HCV infection within this community and identify correlated risk variables.

Cohort research was performed in the oncology unit of Alhadbaa Teaching Hospital in Mosul from December 1, 2014, to December 1, 2024. The study included 153 children (under 15 years) with cancer selected randomly for routine checkup at the outpatient clinic who were initially negative for HBV and HCV at diagnosis, and screening was performed every 3 months for HBV and HCV. Demographic data, cancer type, vaccination status (both routine and postdiagnosis), and blood transfusion history were collected.

Results: Over a follow-up duration of 10 years, all the children remained in follow-up, largely because of their families' strong commitment to monitoring their health status, given the diagnosis of cancer. Twelve patients (7.8%) seroconverted to HBV-positive, and 2 patients (1.3%) acquired hepatitis C virus (HCV), culminating in a total incidence of hepatotropic viruses of 9.1%. Although higher proportions of HBV infection were observed among children who underwent blood transfusions and those who were unvaccinated or inadequately vaccinated, these associations did not reach statistical significance. The infection rate decreased relative to that reported in prior trials conducted in other countries. These results strongly support the stringent enforcement of universal blood product screening and meticulous aseptic procedures, importantly, at the time of cancer diagnosis for unvaccinated children.

Conclusion: This study revealed that the prevalence of hepatitis B infection among pediatric cancer patients in Mosul was not significantly associated with frequent blood transfusions and insufficient immunization coverage.

Keywords

Pediatric oncology, Hepatitis B and C virus, Blood transfusion, Vaccination failure, Iraq



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How to Cite:

Al-jumaily, . D. A. T. ., nory, S. M., & Yasir Saadoon Algele. (2025). Occurrence of hepatitis B and C infection in pediatric patients with cancer at Alhadbaa Hospital in Mosul/Iraq: Hepatitis B and C in Pediatric Cancer Patients in Mosul. Iraqi Journal of Cancer and Medical Genetics, 18(2). <https://doi.org/10.29409/20hcxw96>

Introduction

Children diagnosed with cancer constitute a particularly susceptible demographic for infectious consequences. Their vulnerability is multifaceted, arising from the intrinsic immunosuppression induced by the tumor, exacerbated by the myelosuppressive effects of chemotherapy and radiotherapy. Immunocompromised conditions are intensified by the recurrent need for intrusive diagnostic and therapeutic interventions, including bone marrow aspirations, biopsies, and prolonged intravenous access, which damage natural defense mechanisms (1). Among these infections, those transmitted by blood and body fluids, especially hepatitis B virus and hepatitis C virus (HCV), are associated with significant risks of patient morbidity and mortality.

Illness caused by hepatitis B virus (HBV) continues to pose a significant global public health challenge (2). The World Health Organization estimates that approximately 350 million individuals are affected by chronic HBV infection, which may result in significant long-term complications such as cirrhosis and hepatocellular cancer. The method of acquisition is crucial; infections contracted during infancy or perinatally have a significantly greater risk of advancing to chronicity than those acquired in adulthood do, positioning pediatric populations as a main focus for preventive measures. (3,4).

The risk of HBV acquisition is markedly increased for young people receiving cancer treatment. The recurrent need for blood and blood product transfusions, which are vital for addressing chemotherapy-induced cytopenias, represents a significant transmission pathway, despite contemporary screening protocols (5,6). As a result, unvaccinated children with malignancies face an exceedingly elevated likelihood of acquiring HBV (7). Universal infant HBV immunization is a fundamental aspect of public health; however, coverage may be variable, and its immunogenicity can be inadequate in immunocompromised individuals (8).

Research Gap and Novelty: Numerous studies in the Middle East, including those from Baghdad and Turkey, have reported elevated HBV and HCV prevalence rates (20–27.5%) in pediatric oncology environments (9,10). Nonetheless, there is a dearth of contemporary data from northern Iraq, particularly Mosul, an area rehabilitating from conflict where healthcare infrastructure has faced considerable adversity. This study offers current, localized epidemiological data essential for guiding hospital infection control measures. This study's originality is attributed to its concentrated examination of high-risk demographics in a postconflict environment, providing a comprehensive review of the combined risks associated with transfusion practices and inadequate immunization coverage at both the community and hospital levels. What is the prevalence of hepatitis B and C virus infection among pediatric cancer patients at Alhadbaa Teaching Hospital in Mosul, and how is this prevalence correlated with blood transfusion procedures and HBV vaccination status?

Method

A prospective cohort study was executed from December

2014 to December 2024.

This study was executed in accordance with the ethical principles outlined in the Declaration of Helsinki. Formal approval was secured from the Scientific Research Ethics Committee of the Ninwa Health Directorate, with decision number 250 date 16/10/2025. The study was registered after the completion of data collection, which was permitted by the registry because of the prevailing security conditions at that time. Given the delicate nature of the study population (minors with cancer), a thorough ethical framework was established:

1. **Waiver of Informed Consent:** The ethical committee approved a waiver for individual informed consent because of the study's reliance on an analysis of anonymized data from routine patient records, which presented no more than minimum risk to participants.

2. **Privacy and Confidentiality:** All patient data were rigorously anonymized and deidentified throughout the data collection process. Every patient received a distinct code number, with the key correlating codes to patient identities securely maintained separately and available just to the principal investigator.

3. **Beneficence and nonmaleficence:** This research sought to enhance patient care by identifying dangers and advocating for preventive interventions so that patients could adhere to the ethical ideal of beneficence.

The study included 153 children (aged <15 years) with cancer diagnoses who were selected randomly when they received a routine checkup at the outpatient clinic of the Children Oncology Unit of Alhadbaa Teaching Hospital, Mosul. The principal inclusion criterion was a negative baseline test for hepatitis B and C surface antigen (HBsAg) (HCvAg) at the time of cancer diagnosis.

Data collection: Data were obtained from patient medical records utilizing a structured data collection form. Included variables: **Demographics:** Age, sex, and location.

Clinical Data: Type of cancer, date of diagnosis, duration of follow-up.

Immunization status: History of routine childhood HBV immunization classified as complete (3 doses), incomplete (1–2 doses), or absent, together with an HBV vaccine administered postcancer diagnosis.

Transfusion history: Quantity of blood units transfused and the specific location (hospital/city) of the transfusion administration.

Outcome Variable: Results of HBsAg and HCvAg screening conducted throughout the trial period, utilizing an enzyme-linked immunosorbent assay (ELISA).

Statistical Analysis: Data were examined utilizing statistical software (e.g., SPSS). Descriptive statistics, including frequencies and percentages, were employed for categorical variables. The chi-square test or Fisher's exact test was used to evaluate relationships between categorical factors (e.g., vaccination status and transfusion number) and HBV seroconversion. A p value less than 0.05 was considered to

indicate statistical significance. Outcome

Results

During the study period, 12 out of 153 patients (7.8%) be-

came positive for HBsAg, indicating incident HBV infection. Additionally, 2 patients (1.3%) contracted hepatitis C virus (HCV), resulting in a total incidence of blood-borne viral infections of 9.1%.

Table 1: Association between selected characteristics and hepatitis B seroconversion

General Characteristics	Total (n=153)		HBs Ag positive (n=12)		P value
	No.	%	No.	%	
Age					
<1 year	7	4.5%	0	0	0.516*
1-10 years	106	69.2%	7	6.6%	
>10 years	40	26.1%	5	12.5%	
Sex					
Male	84	54.9%	9	10.7%	0.176
Female	69	45%	3	4.3%	
Site of cancer					
Leukemia	87	56.8%	5	5.7%	0.307
Others	66	43%	7	10.6%	
Blood transfusion					
0	27	17.6%	2	7.4%	1.000*
1-3	109	71.2%	9	8.2%	
>3	17	11.1%	1	5.8%	
Place of transfusion					
Mosul City	116	92%	8	6.8%	0.216*
Outside Mosul	10	7.9%	2	20%	
Vaccination at home					
0	16	10.4%	2	12.5%	0.677*
1-2	21	13.7%	2	9.5%	
3	116	75.8%	8	6.8%	
Vaccination at hospital					
0	41	26.7%	3	7.3%	0.356*
1-2	54	35.2%	2	3.7%	
3-4	58	37.9%	7	12%	

* Fisher's exact test; otherwise, chi-square test, significance level <0.05

Despite the lack of statistical significance in this sample size, trends indicated elevated infection rates among unvaccinated children and those who had transfusions outside of Mosul. The increase in infection, even among vaccinated patients, could be attributed to their low immunity; thus, their antibody level may not have been achieved well, or they could have been infected before starting chemotherapy during sur-

gery for solid tumors.

These patients were primarily from Mosul, Iraq, with others hailing from three to four other cities. (85.6%) Other (14.3%) from outside Mosul approximately 84 (56.8%) patients were classified as having acute lymphoblastic leukemia (ALL), while the remaining 43.1% were attributed to other diseases. Non-Hodgkin lymphoma NHL, Hodgkin disease HD, NB,

Brain tumor BT, Wilms tumor WT and rhabdomyosarcoma RMS neuroblastoma

Approximately 84 of the individuals (54.9%) were male, whereas 69 (45%) were female. The male to female ratio was 1.21:1. All of them had cancer. Eighty-seven of them (56.8%) were classified as ALL, while the remaining 66 (43.1%) were classified as other diseases (NHL, HD, NB, BT, WT, and RMS).

Discussion

The greater prevalence of hepatitis B and C virus infection observed in those with solid tumors may be due to their exposure to surgical interventions. In comparison to individuals with leukemia, those with medulloblastoma (10.6%) also presented a different finding by Rogers LJ, Vaja R, et al., who reported that hepatitis B virus reactivation in cancer patients receiving chemotherapy was associated with a reactivation rate (hematologic ~10%, solid tumors ~5%)(2). The trend was not statistically significant among children who did not receive vaccinations throughout early life (12.5%). The prevalence of hepatitis B infection at our center is lower than that reported in Baghdad in 2007 (Children Welfare Teaching Hospital),(9) which was 27%, compared with our hospital's rate of 7.8%. A separate trial was conducted in Turkey and included 50 children with solid tumors. A total of 20% of the patients acquired hepatitis B following therapy. (10) The incidence of hepatitis C in our study was 2%, whereas it was 7.8% in Baghdad and 14% in a study conducted in Turkey. Children treated for malignancy are at elevated risk for hepatitis B virus infection because of several factors, including immunocompromised status, the need for repeated blood transfusions and their products, and potential contamination during blood sampling. The efficacy of a vaccine is also contingent upon the child's immunity in relation to their illness. The absence of vaccines for some patients in our institution elevates the danger. At presentation, 116 out of 153 children (approximately 75.8%) had received a previous vaccine according to their age. Among them, 21 children (13.5%) were incompletely immunized, while 16 children (10.4%) were not vaccinated at all. Among the children who were vaccinated during treatment at our hospital, 58 (37.9%) received 3 to 4 doses, with the first and second doses administered one month apart and the third dose after six months. Approximately 54 (35.2%) received one to two doses, indicating incomplete vaccination, while 41 (26.7%) were not vaccinated during their treatment. The ages of these children varied significantly, with approximately 7 individuals (4.5%). Among individuals aged 10 to 14 years, 40 were children, constituting 26.1% of the sample. The majority of the participants (106; 69.2%) were between the ages of 1 and 10 years.

Only 126 out of 153 patients (82.3%) received a blood transfusion. The quantity of transfused blood units ranged from 0 to more than 35. Approximately 27 individuals did not receive blood or its products (17.6%), whereas approxi-

mately 109 individuals (71.2%) received blood between one and three times, and those who received blood more than three times did. Seventeen patients (11.1%) received blood at the hospital in Mosul, whereas approximately 116 patients (92%) were treated there. The remnants were located outside Mosul, in other cities of Iraq or beyond its borders. 10 individuals (7.9%)

Limitations of the study:

This cohort study has several limitations. First, it was conducted at a single center, which may limit the external validity and generalizability of the findings. Second, the relatively small sample size may have reduced the statistical power to detect significant associations, and postvaccination antibody titers were not measured because they are not available in government hospitals and are costly in private health care settings.

Conclusion:

This study convincingly revealed a lack of a statistically significant association of hepatitis B infection among pediatric cancer patients in Mosul; to alleviate this danger, a multifaceted strategy is essential: Improved blood safety through compulsory, highly sensitive screening of all blood products, enhanced immunization initiatives by ensuring comprehensive routine childhood HBV immunization and providing catch-up vaccines upon cancer diagnosis for all nonimmune children accompanied by postvaccination serological testing to verify immunity as well as stringent infection control achieved by diligent compliance with aseptic protocols for all invasive operations and blood collection, are critical components of a multifaceted strategy to reduce the risk of hepatitis B infection among pediatric cancer patients.

Acknowledgment:

"I sincerely thank the Oncology Pediatric Out Clinic Team at Al-Hadba Hospital, Mosul, for their kind support during sample collection."

Author Declarations

Funding Statement

This research received no external funding. The study was conducted using institutional resources of Alhadbaa Teaching Hospital, Mosul, Iraq.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Ethics Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Scientific Research Ethics Committee of the Ninawa Health Directorate (Decision No. 250).

Due to the analysis of anonymized patient records and the minimal risk to participants, a waiver of informed consent was granted by the ethics committee. All data were anonymized and handled confidentially.

Consent for Publication

Not applicable. The manuscript does not contain any individual person's data in any form (including individual de-

tails, images, or videos).

Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality regulations but are available from the corresponding author upon reasonable request and with permission from the relevant institutional authority.

Author Contributions

The first author conceptualized the study, drafted the manu-

script, supervised the research process, and acted as the corresponding author. The second author contributed to study design, data collection, and statistical analysis. The third author participated in data collection and contributed to manuscript preparation and presentation of the research findings. All authors have read and approved the final manuscript.

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