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Prevalence of Transfusion-Transmitted Infections in Beta-Thalassemia Major Patients: A Cross-Sectional Study

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Abstract

Introduction: Beta-thalassemia major is an inherited hemoglobin disorder caused by defective synthesis of the beta-globin chain. Patients with beta-thalassemia major require regular blood transfusions, exposing them to transfusion-transmitted infections (TTIs). This study aimed to evaluate the prevalence of TTIs among beta-thalassemia major patients.

Methods: In this descriptive cross-sectional study, all 748 patients with transfusion-dependent beta-thalassemia major who were referred to Ali-Asghar Children's Hospital in Zahedan, Iran, during 2017–2018 were included. A census sampling method was used, and all eligible patients during the study period were evaluated. The presence of antibodies against hepatitis B, hepatitis C, and HIV was assessed using the enzyme-linked immunosorbent assay (ELISA), and PCR was performed to confirm hepatitis C and HIV infections. Demographic characteristics, including age and gender, and laboratory findings were extracted from patients' medical records. Data were analyzed using SPSS version 25. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize the data.

Results: The mean age of the patients was 15.57 ± 8.6 years. Among them, 392 (52.5%) were male, and 356 (47.5%) were female. The most common transfusion-transmitted infection was hepatitis C, observed in 8.02% (60 patients). Hepatitis B was found in 0.8% (6 patients), and HIV in 0.1% (1 patient). The mean age of patients with hepatitis C was 15.53 ± 6.4 years, while those with hepatitis B had a mean age of 15.3 ± 5.03 years. The highest prevalence of TTIs occurred in patients with longer transfusion histories. Additionally, the most common genotype of the hepatitis C virus was 1a (56.6%).

Conclusion: The findings of this study revealed that hepatitis C is the most common transfusion-transmitted infection among beta-thalassemia major patients, with genotype 1a being the predominant strain. Furthermore, an increased frequency of transfusions was associated with a higher risk of TTIs. Thus, greater attention to donor screening tests and appropriate immunization strategies is essential to reduce the prevalence of infections in patients requiring frequent transfusions.

Keywords: Beta-thalassemia, Blood transfusion, Hepatitis B, Hepatitis C, HIV infections

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Introduction

Thalassemia is a hereditary hemolytic anemia inherited in an autosomal recessive pattern and occurs equally in both sexes. This disease was first described in 1925 by Thomas Cooley, a pediatric specialist from Detroit, USA (1, 2). Thalassemia is caused by a decrease or complete absence of the production of alpha or beta globin chains. The genes responsible for producing beta globin are located on chromosome 11, while the alpha globin genes are located on chromosome 16 (3, 4). Beta thalassemia is most prevalent in Mediterranean regions, the Middle East, and Southeast Asia, with the lowest incidence in Northern Europe and North America. It is estimated that about 1.5% of the world's population are carriers of the beta-thalassemia gene (5).

Iran is one of the countries in the thalassemia belt. Beta-thalassemia is more common in regions around the Caspian Sea and the Persian Gulf. Around three million people in Iran are carriers of the beta thalassemia gene. In southeastern Iran, in Sistan and Baluchestan, the prevalence of beta-thalassemia is about 10%, while in other parts of the country, it ranges from 4% to 8% (5, 6). Sistan and Baluchestan province, with around 3,100 patients with thalassemia dependent on blood transfusions, also has the highest number of new major thalassemia births in the country (6). Beta-thalassemia is classified into three types based on the amount of beta chain production and the severity of clinical symptoms: beta-thalassemia minor, intermedia, and major. Beta-thalassemia major is the most severe form of the disease. Patients with this

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type of thalassemia typically show symptoms between 6 months and 2 years of age, experience severe anemia, and require regular blood transfusions (7, 8). Regular blood transfusions lead to iron overload and the deposition of iron in various organs, causing diabetes, hypopituitarism, growth hormone deficiency, hypothyroidism, hypoparathyroidism, hypogonadism, fibrosis, and cirrhosis of the liver, cardiac arrhythmias, and cardiomyopathy (9, 10). Other complications include osteoporosis, HIV infection, and hepatitis B and C (11).

In patients with beta-thalassemia major, regular blood transfusions are essential to manage severe anemia, but they also increase the risk of blood-borne infections, including hepatitis and HIV. These infections are primarily transmitted through contaminated blood products. Hepatitis B, C, and HIV are major concerns in thalassemia patients, as repeated transfusions can lead to the accumulation of these viruses in the bloodstream (12). The risk is heightened in areas with inadequate screening and blood safety measures. Preventive strategies, such as screening blood donors and using antiviral treatments, are crucial to minimizing these risks and improving the quality of life for affected individuals (13). This study aimed to evaluate the prevalence of transfusion-transmitted infections (TTIs) among beta-thalassemia major patients.

Methods

This cross-sectional study was conducted over six months at Ali Asghar Hospital in Zahedan, Iran. A census sampling approach was used. All transfusion-dependent beta-thalassemia major patients who attended the center during the study period were included. Patients without documented hepatitis B vaccination history were excluded. Routine annual screening for HBsAg, HBsAb, HBcAb, anti-HCV, and HIV antibodies was performed using ELISA. All positive serological results were confirmed using PCR to ensure diagnostic accuracy. Data extracted from medical records included: age, gender, duration of blood transfusion, number of transfusions, and age at diagnosis of viral infection.

The study was approved by the Ethics Committee of Zahedan University of Medical Sciences (Ethical code: IR.ZAUMS.REC.1396.132). Written informed consent was obtained from patients or their parents.

Data were analyzed using SPSS version 25. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to summarize data.

Results

A total of 748 transfusion-dependent beta-thalassemia major patients were included. Among them, 392 (52.5%) were male, and 356 (47.5%) were female. The mean age of patients was 15.57 ± 8.6 years.

Hepatitis C was identified in 60 patients (8.0%), representing the most common transfusion-transmitted infection. Among these, 37 patients (61.6%) were under 18 years, while 23 patients (38.3%) were older than 18 years. The mean age at diagnosis for HCV infection was 15.53 ± 6.4 years (Table 1).

Hepatitis B was detected in 6 patients (0.8%), among whom 4 were under 18 years of age, and 2 were older than 18. The mean age at diagnosis for HBV infection was 15.30 ± 0.03 years.

HIV infection was observed in one patient (0.1%), with the age at diagnosis being 20 years.

The mean duration of blood transfusions for patients with HBV was 23 ± 5.48 years. For patients with HCV, the mean transfusion duration was 24.56 ± 5.88 years.

Among HCV-positive patients, genotype 1a was the most prevalent (56.6%), followed by genotype 3a (23.3%), genotype 2b (11.6%), and genotype 4b (8.3%). These findings highlight the prevalence of transfusion-transmitted infections among beta-thalassemia patients and their association with prolonged transfusion history.

Discussion

This study evaluated transfusion-transmitted infections in a large cohort of transfusion-dependent beta-thalassemia major patients and demonstrated that hepatitis C remains the predominant infection. The predominance of HCV in transfusion-dependent populations has been consistently reported in previous regional and international studies.

A study by Chattopadhyay et al. in Bengal reported the prevalence of HBsAg at 3.69%, HBeAg at 1.05%, and anti-HCV at 8.97% (14). In our study, hepatitis C was the most common infection (8.02%), while the prevalence of hepatitis B (0.8%) was significantly lower. Regional differences in TTI prevalence may reflect variations in blood safety policies, implementation of nucleic acid testing, donor selection strategies, and vaccination coverage. National hepatitis B immunization programs and structured donor screening systems may contribute to the relatively low prevalence of HBV observed in this population.

In a systematic review in Pakistan on the epidemiology of hepatitis B and C in thalassemia major patients, the overall prevalence of hepatitis B and hepatitis C was 4.13% and 29.79%, respectively (15). In the aforementioned study, the prevalence of hepatitis B and C was significantly higher than in our study. In another systematic review conducted in Pakistan on blood-borne infections in thalassemia major patients, the seroprevalence of hepatitis B and hepatitis C was 3.13% and 26%, respectively, which was associated with frequency of blood transfusions, older age groups, and higher ferritin levels (16).

In another study in Dhaka, Bangladesh, the prevalence of hepatitis C, hepatitis B, and HIV in 148 transfusion-dependent thalassemia patients was 13.51%, 3.37%, and 0%, respectively, and 2% of patients had concomitant

Table 1. Prevalence of Transfusion-Transmitted Disease among Thalassemia Major Patients

Viral Infection	Number (n = 748)	Percentage (%)
Hepatitis B	6	0.8
Hepatitis C	60	8
HIV infection	1	0.1

Abbreviations: HIV: Human immunodeficiency virus

hepatitis B and C (17). The prevalence of hepatitis B and C in the study conducted in Bangladesh was higher than in our study, which is due to the coverage of hepatitis B vaccination in Iran and the careful screening of blood and blood product donors.

In a systematic review study conducted in Pakistan, the cumulative prevalence of hepatitis C in 5789 patients was 36.21%, reaching 45.98% in Punjab (18).

Our findings also indicate that prolonged transfusion exposure is associated with increased infection risk, likely due to cumulative exposure to blood products over time.

Several potential confounding factors may influence the infection risk in transfusion-dependent patients. Iron overload severity, adherence to iron chelation therapy, and socioeconomic status may affect immune function, healthcare access, and susceptibility to infection (3, 19).

Compared with studies conducted in neighboring countries, the prevalence of hepatitis B and C in this cohort was lower, which may reflect differences in healthcare infrastructure, screening strategies, and vaccination coverage.

This study has several limitations. The cross-sectional design does not permit causal inference. The single-center setting may limit generalizability. Additionally, some potential confounding variables, including iron overload indices and socioeconomic status.

Conclusion

Hepatitis C remains the most common transfusion-transmitted infection among transfusion-dependent beta-thalassemia major patients. Prolonged transfusion exposure is associated with increased infection risk. Strengthening donor screening strategies, maintaining hepatitis B vaccination coverage, and implementing periodic molecular screening for high-risk patients are recommended to further reduce the infection prevalence.

Authors' Contribution

Conceptualization: Ghasem Miri-Aliabad
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Competing Interests

The authors declare no conflict of interest.

Data Availability Statement

The data that support the findings of this study are available upon request from the corresponding author. The data are not publicly available because of privacy or ethical restrictions.

Ethical Approval

The study was approved by the Ethics Committee of Zahedan University of Medical Sciences (Ethical approval code: IR.ZAUMS.REC.1396.132).

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