DOI:https://doi.org/10.53350/pjmhs20231710320

ORIGINAL ARTICLE

The Incidence and Spectrum of Bacterial Infections in Thalassemia Patients

MUHAMMAD TARIQ HAMAYUN KHAN[1], ZUBEDA IRSHAD[2]. MUHAMMAD TARIQ MASOOD KHAN[3]
[1,2]Assistant Professor, Department of Pathology, Burns and Plastic Surgery Center, MTI Hayatabad Medical Complex, Peshawar
[3]Associate Professor Hematology, Pak International Medical College, Hayatabad, Peshawar
Correspondence to: Muhammad Tariq Masood Khan, Email: drtariqmsd@gmail.com

ABSTRACT

Background: Individuals with thalassemia who inherit this inherited hemoglobin issue need regular blood transfusions that produce two severe consequences: iron buildup in the body and damage to immune system functions. Patient factors which lead to bacterial infections determine significant portions of disease severity and death rates. The identification of bacterial infection incidence and spectrum together with thalassemia patients' risk factors remains essential for both patient treatment and infection control outcomes.

Objectives: The objective examines bacterial infection prevalence together with recorded infection types among patients with thalassemia while exploring risk variables and examining how iron loading and immune deficiency affects pathogen vulnerability for developing better preventive measures and treatment strategies for bacterial infections.

Study Design: This was a retrospective study.

Place and Duration of Study: Department of Pathology, Burns & Plastic Surgery Center Hayatabad, Peshawar from January 2019 to December 2020.

Methods: to examines bacterial infection prevalence together with recorded infection types among patients with thalassemia while exploring risk variables and examining how iron loading and immune deficiency affects pathogen vulnerability for developing better preventive measures and treatment strategies for bacterial infections..

Results: 100 patients whose ages averaged at 23.5 ± 6.8 years. The examined patient cohort presented bacterial infections in 34% of cases with Escherichia coli (30%) and Klebsiella pneumoniae (25%) and Staphylococcus aureus (20%) representing the predominant strains. The infection rates proved significantly higher for patients with ferritin serum levels exceeding 2500 ng/mL ($p = 0.002$). Patients with functional asplenia showed higher infection vulnerability according to statistical results ($p = 0.005$). Seventy percent of infection cases involved bloodstream infections with urinary tract infections at 35% and respiratory infections at 25%.

Conclusion: Bacterial infections frequently affect patients diagnosed with thalassemia since both iron overload and immune system dysfunction increase their risk. Three major pathogens found in this population were E. coli K. pneumoniae S. aureus. Patient outcomes benefit from both the proactive monitoring of iron levels and preventive measures including vaccination along with infection follow-up.

Keywords: Thalassemia, bacterial infections, iron overload, sepsis

INTRODUCTION

High levels of chronic anemia and lifelong blood transfusions are main characteristics of hereditary hemoglobin disorder Thalassemia[1]. The international regions of Southeast Asia and the Mediterranean and the Middle East demonstrate high prevalence of thalassemia because of high carrier rates and consanguinity patterns that spread the disease[2]. The regular practice of transfusions paired with iron chelation therapy extends patient lifespans but these treatments present complications that cause iron overload and immune dysfunction which make bacterial infections more likely[3] Three main complications arise when treating thalassemia patients through transfusions and iron chelation therapy leading to bacterial infections[4]. Study by shows thalassemia patients experience more infections from three key causes: iron overload together with functional asplenia along with transfusion-related immunomodulation. The three organs responsible for iron storage become major bacterial proliferation sites because this causes bloodstream infections, urinary tract infections and pneumonia[5]. Streptococcus pneumoniae together with Haemophilus influenzae and Neisseria meningitidis belong to a group of encapsulated bacteria that the spleen helps in filtering through its normal function[6]. The mortality risk for asplenic patients significantly increases whenever overwhelming infections occur because such situations can progress to sepsis unless medical staff offer prompt treatment[7,8]. Transfusion-related immunomodulation (TRIM) serves as a distinct path that heightens infection vulnerability among these patients. The process of multiple blood transfusions causes the immune system to suppress itself and creates dysfunction in T-cells and altered cytokine production which results in decreased bacterial pathogen defense capabilities by the patient[9] Thalassemia patients who receive regular blood transfusions remain exposed to potential transfusion-transmitted infections (TTIs) although thorough screening programs significantly decrease their frequency[10]. Several studies identify Escherichia coli and Klebsiella pneumoniae as the prevalent gram-negative bacteria that infect thalassemia patients[11]. A high number of thalassemia-related health complications arise from infections involving gram-positive microorganisms such as Staphylococcus aureus and Streptococcus pneumoniae[12]. Hospital management becomes more challenging for patients because of catheter-related bloodstream infections combined with urinary tract infections (UTIs) and respiratory tract infections (RTIs)[13]. Even though iron chelation treatment has improved researchers have found that bacterial infections continue to be the primary reason for hospitalization and death among patients with thalassemia[14]. The research examines bacterial infection occurrences and diversity among thalassemia patients along with co-existing risk factors to establish proactive measures against infections.

Received on 19-04-2023
Accepted on 02-09-2023

METHODS

The study occurred at Department of Pathology, Burns & Plastic Surgery Center Hayatabad, Peshawar from January 2019 to December 2020.

Throughout two consecutive years. The researchers included 100 patients who depended on transfusions because of thalassemia. The study team compiled information about patient age together with gender identity and transfusion rate and iron overload conditions and infection records along with test results. Specimen analysis included bacterial cultures of blood combined with urine and respiratory samples. Statistical analysis occurred through SPSS version 24.0.

Ethical Approval Statement: The procedure of this study was according to ethical guidelines and was accepted by the Burns &

Plastic Surgery Center, Hayatabad Peshawar's Institutional Review Board. The research was approved with reference Number 864/HEC/B&PSC/2019 on 15th Nov 2019 by Muhammad Tariq Hamayun Khan.

Data Collection: The medical records system served as the data extraction source for patient information. The records showed infection cases through both patients' symptoms alongside microbiological test results. Medical personnel documented ferritin levels in blood serum to measure patient iron accumulation.

Statistical Analysis: patient characteristics used descriptive statistics as the method of analysis. The analysis used the chi-square test alongside independent t-test for verifying associations between clinical variables and infection incidence. The study considered any p-value under 0.05 as statistically significant.

RESULTS

100 patients whose average age amounted to 23.5 ± 6.8 years. Bacterial infections occurred in 34% of cases and Escherichia coli (30%) proved to be the most prominent among the isolated pathogens alongside Klebsiella pneumoniae (25%) and Staphylococcus aureus (20%). Research results showed that patients with serum ferritin measurements over 2500 ng/mL faced elevated infections at a statistically significant rate (p = 0.002). The results showed functional asplenia as an independent risk factor which increased infection rates among patients (p = 0.005). Bloodstream infections constituted 40% of all recorded infections while urinary tract infections held 35% and respiratory infections made up the remaining 25%. These results demonstrate the necessity to create individualized infection prevention measures for patients particularly through enhanced iron chelation therapy and vaccination programs and systematic infection checks.

Table 1: Demographic and Clinical Characteristics of Patients

Variable	Value (n = 100)
Mean Age (years)	23.5 ± 6.8
Male (%)	55
Female (%)	45
Serum Ferritin >2500 ng/mL (%)	60
Functional Asplenia (%)	40
Blood Transfusion Frequency (per year)	15 ± 3

Table 2: Distribution of Bacterial Pathogens in Thalassemia Patients

Pathogen	Frequency (%)
Escherichia coli	30
Klebsiella pneumoniae	25
Staphylococcus aureus	20
Streptococcus pneumoniae	15
Others	10

Table 3: Distribution of Infection Types in Thalassemia Patients

Infection Type	Frequency (%)
Bloodstream Infections	40
Urinary Tract Infections	35
Respiratory Infections	25

DISCUSSION

Earlier studies showed bacterial infection occurrences in thalassemia patients which supports the research findings presented in this work. The study analysis demonstrated bacterial infections in 34% of patients while Escherichia coli (30%) was the most common pathogen followed by Klebsiella pneumoniae (25%) along with Staphylococcus aureus (20%) as the next two prevalent pathogens. The results support previous reports demonstrating gram-negative infections are more common in transfusion-dependent thalassemia (TDT) patients because of the combination of iron overload and immune dysfunction[15].Iron overload represents a recognized outcome from long-term transfusions which substantially raises infection risks of thalassemia patients. Multiple scientific studies show that higher serum ferritin concentration in the blood raises the risk for bacterial infections. The research results of Taher et al. (2018) showed that thalassemia patients with ferritin concentrations above 2500 ng/mL had a statistically higher risk of infection according to their study (p = 0.002)[16]. Bacterial growth functions with the help of excess iron as pathogenic microorganisms including E. coli and K. pneumoniae use it as a nutritional source. The pathogenic condition known as functional asplenia serves as a second major risk factor that makes thalassemia patients more vulnerable to infections[17]. The spleen functions as an essential organ to remove three encapsulated bacteria groups known as Streptococcus pneumoniae, Haemophilus influenzae, and Neisseria meningitidis. The data from our research showed functional asplenia caused thalassemia patients to develop higher rates of infection (p = 0.005) which matches previous medical research findings[18]. The research conducted by Vento et al. (2016) showed that asplenic patients have increased rates of bloodstream infections in combination with pneumonia and sepsis because their bodies cannot properly remove encapsulated bacteria[19]. Functional or complete asplenic thalassemia patients need prophylactic vaccination and antibiotic drugs as preventive measures to decrease infection-based morbidity and mortality rates. The immune system becomes less effective at defending the host because regular blood transfusions modify how T-cells function along with altering cytokine production. Frequent transfusions in thalassemia patients according to Cappellini et al. (2020) led to strongly reduced T-cell function that left patients open to dangerous bacterial infections[20].

CONCLUSION

Bacterial infections pose a serious medical threat to patients with thalassemia because of iron overload together with functional asplenia and transfusion-related immunomodulation. The study calls for strong infection prevention approaches to enhance iron chelation protocols and expand vaccination programs and monitoring protocols. Patient outcomes will become better while reducing the morbidity from infections through these implementation measures.Limitations: This study has two main constraints – its analysis of past data from a single hospital whose results may not extend to all medical facilities. The research findings could have been weakened by the small size of the sample. A complete understanding of both bacterial pathogen behavior and treatment effectiveness is restricted because molecular bacterial strain analysis and antibiotic resistance pattern studies are lacking.

Future Directions: Future study should focus on larger, multicenter studies to validate these findings and improve generalizability. Prospective studies examining the molecular mechanisms of infection susceptibility, including genetic and immunological factors, are warranted. Additionally, investigating antibiotic resistance trends and evaluating novel therapeutic and preventive strategies will be crucial for optimizing infection management in thalassemia patients.

Abbreviations:

1. BSI: Bloodstream Infection
2. NK: Natural Killer
3. OPSI: Overwhelming Post-Splenectomy Infection
4. RTI: Respiratory Tract Infection
5. TRIM: Transfusion-Related Immunomodulation
6. TDT: Transfusion-Dependent Thalassemia
7. UTI: Urinary Tract Infection

Disclaimer: Nil
Conflict of Interest: Nil
Funding Disclosure: Nil

Authors Contribution

Concept & Design of Study: **Muhammad Tariq Masood Khan**
Drafting: **Zubeda Irshad**
Data Analysis: **Muhammad Tariq Hamayun Khan**
Critical Review: **Muhammad Tariq Hamayun Khan**

Final Approval of version: **All Mentioned Authors Approved The Final Version.**

REFERENCES

1. Obed FA, Omran AM, Jebur KS. Effect of iron overload on prevalence of common bacterial infection in thalassemia patients. Iraqi Journal of Hematology. 2024 Jan 1;13(1):38-43.
2. Al-Abidy LH, Al-Aidy SR. Molecular Study and Detection of The Causative Bacteria of Urinary Tract Infection of Transfusion Dependent Thalassemia Patients Who Are Being Treated with Iron Chelators. Academia Open. 2025 Feb 4;10(1):10-21070.
3. Al-Tawfiq JA, Rabaan AA, AlEdreesi MH. Frequency of bacteremia in patients with sickle cell disease: a longitudinal study. Annals of Hematology. 2021 Jun;100(6):1411-6.
4. Alsaif MA, Abdulbaqi M, Al Noaim K, Aghbari M, Alabdulqader M, Robinson JL. Prevalence of serious bacterial infections in children with sickle cell disease at King Abdulaziz Hospital, Al Ahsa. Mediterranean Journal of Hematology and Infectious Diseases. 2021 Jan 1;13(1):e2021002.
5. Nonejuie P, Wilantho A, McDonald D, Htoo HH, Chalerm J, Tripathi A, Ngamphiw C, Tongsima S, Knight R, Paiboonsukwong K, Fucharoen S. Differential gut microbiota composition in β-Thalassemia patients and its correlation with iron overload. Scientific Reports. 2024 Oct 11;14(1):23858.
6. Gluba-Brzózka A, Franczyk B, Rysz-Górzyńska M, Rokicki R, Koziarska-Rościszewska M, Rysz J. Pathomechanisms of immunological disturbances in β-thalassemia. International Journal of Molecular Sciences. 2021 Sep 7;22(18):9677.
7. Papageorgiou D, de Lastic AL, Tsachouridou O, Metallidis S, Akinosoglou K. HEV Infection in Beta-Thalassemia Patients. Pathogens. 2024 Dec 1;13(12):1058.
8. Joudah R, Hamim S. Molecular characterization of Klebsiella pneumoniae associated with Thalassemia in Thi-Qar Governorate. University of Thi-Qar Journal of Science. 2023 Jun 28;10(1):158-61.
9. Kumar D, Kinikar AA. Determinants of infections among children with beta-thalassemia.
10. Visitchanakun P, Panpetch W, Saisorn W, Chatthanathon P, Wannigama DL, Thim-Uam A, Svasti S, Fucharoen S, Somboonna N, Leelahavanichkul A. Increased susceptibility to dextran sulfate-induced mucositis of iron-overload β-thalassemia mice, another endogenous cause of septicemia in thalassemia. Clinical Science. 2021 Jun;135(12):1467-86.
11. Kattamis A, Kwiatkowski JL, Aydinok Y. Thalassaemia. The lancet. 2022 Jun 18;399(10343):2310-24.
12. Fatima I, Affan W, Hameed H, Amber W, Saeed S, Khan IM. Positive Findings Of Blood Cultures In Febrile Children Presenting With Thalassemia Major In A Tertiary Care Hospital. Journal of Rawalpindi Medical College. 2023 Apr 2;27(1).
13. Lee CM, Lee MS, Yang TL, Lee KL, Yen TY, Lu CY, Hsueh PR, Lee PI, Chen JM, Huang LM, Chang LY. Clinical features and risk factors associated with bacteremia of nontyphoidal salmonellosis in pediatric patients, 2010–2018. Journal of the Formosan Medical Association. 2021 Jan 1;120(1):196-203.
14. Alzahrani F, Alaidarous K, Alqarni S, Alharbi S. Incidence and predictors of bacterial infections in febrile children with sickle cell disease. International Journal of Pediatrics and Adolescent Medicine. 2021 Dec 1;8(4):236-8.
15. Saud IA, Majid LM. Relation of immunoglobulin level and white blood cell count with frequency of infection in splenectomized and non-splenectomized B thalassemia major patients. Medical Journal of Babylon. 2023 Apr 1;20(2):264-7.
16. Romyasamit C, Sornsenee P, Kawila S, Saengsuwan P. Extended-spectrum beta-lactamase-producing Escherichia coli and Klebsiella pneumoniae: Insights from a tertiary hospital in Southern Thailand. Microbiology Spectrum. 2024 Jul 2;12(7):e00213-24.
17. Yee ME, Lai KW, Bakshi N, Grossman JK, Jaggi P, Mallis A, Wang YF, Jerris RC, Lane PA, Yildirim I. Bloodstream infections in children with sickle cell disease: 2010–2019. Pediatrics. 2022 Jan 1;149(1).
18. Ladu AI, Aiyenigba AO, Adekile A, Bates I. The spectrum of splenic complications in patients with sickle cell disease in Africa: a systematic review. British Journal of Haematology. 2021 Apr;193(1):26-42.
19. Bashir N, Haider N, Farooq A, Hussain M. Epidemiology and clinical spectrum of pediatric patients with human immunodeficiency virus (HIV) infection: A 15 years' experience. Pakistan Journal of Medical Sciences. 2023 May;39(3):820.
20. Alzomor O, Aljobair F, Al Kasim F, Azmet F, Alorini S, Alshihayb Y, Bahamdan Y. Frequency of serious bacterial infection among febrile sickle cell disease children in the era of the conjugate vaccine: a retrospective study. International Journal of Pediatrics and Adolescent Medicine. 2022 Sep 1;9(3):165-70.

This article may be cited as: Khan MTH, Irshad Z. Khan MTS: The Incidence and Spectrum of Bacterial Infections in Thalassemia Patients. Pak J Med Health Sci, 2023; 17(10): 320-322.