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Original Research Article

Hematological evaluation of splenectomized and non-splenectomized transfusion dependent patients with thalassemia

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ABSTRACT

Background: Thalassemia is a group of blood disorders caused by decreased or absent synthesis of globin chains, with β-thalassemia leading to ineffective erythropoiesis, severe anemia, and the need for lifelong transfusions. Frequent transfusions can cause iron overload, and many transfusion-dependent patients require splenectomy to manage hypersplenism, though the procedure carries potential risks and its benefit on transfusion reduction remains debated. The aim of the study was to compare the hematological profile and iron overload status between splenectomized and non-splenectomized transfusion-dependent patients with thalassemia.

Methods: This cross-sectional comparative study at the department of transfusion medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, from December 2021 to October 2022, included 60 transfusion-dependent thalassemia patients (30 splenectomized, 30 non-splenectomized). Sociodemographic, nutritional, clinical, transfusion, and laboratory data (CBC, PBF, serum ferritin) were collected and analyzed using SPSS version 24 ($p<0.05$).

Results: Among 60 patients, splenectomized individuals were more often underweight (76.7% versus 46.7%), had higher hemoglobin (7.26 versus 6.78 gm/dl), MCV (75.64 versus 69.99 fl), WBC (12.24 versus 9.31×10^3/l), platelets (556 versus 210×10^3/l), and ferritin (5843.98 versus 3253.32 ng/ml), while non-splenectomized patients required more frequent transfusions ≤4 weeks (83.3% versus 40%) and had more severe anemia (63.3% versus 36.7%).

Conclusions: Splenectomy in transfusion-dependent thalassemia improves hemoglobin and blood counts but does not reduce iron overload, highlighting the need for continued monitoring and management.

Keywords: Iron chelation, Serum ferritin, Splenectomy, Splenomegaly, Thalassemia, Transfusion dependent thalassemia

INTRODUCTION

Thalassemia is a heterogeneous group of blood disorders characterized by decreased or absent synthesis of one or more of the normal globin chains. Based on the affected globin genes, thalassemias are classified into α- and β-thalassemias. In β-thalassemia, excess α chains damage red blood cells and their precursors, resulting in ineffective erythropoiesis and profound anemia requiring lifelong transfusions, whereas anemia in α-thalassemia is hemolytic rather than dyserythropoietic due to excess β chains.[1]

β-thalassemia exhibits a wide spectrum of clinical severity and is classified into thalassemia major, thalassemia intermedia, and thalassemia minor. Thalassemia major manifests as severe anemia early in life and necessitates lifelong transfusions and iron chelation therapy. Thalassemia minor presents with mild anemia and is largely asymptomatic. Thalassemia intermedia comprises a diverse group with varying clinical severity, requiring none, intermittent, or chronic transfusions depending on the level of severity.

Several treatment options exist depending on disease severity, including blood transfusion, iron chelation, splenectomy, and bone marrow transplantation.[2,3] The clinical classification of thalassemia has evolved to categorize patients as transfusion-dependent thalassemia (TDT) or non-transfusion-dependent thalassemia (NTDT).[4,5] Correct classification requires careful clinical evaluation of baseline hemoglobin and other hematological parameters.

Transfusion therapy suppresses ineffective erythropoiesis and improves quality of life. Pre-transfusion hemoglobin values influence erythroid activity, with 1-2 times normal activity at 10-11 gm/dl, 1-4 times at 9-10 gm/dl, and 2-6 times at 8.6-9 gm/dl.[4] However, frequent transfusions from early childhood may cause iron overload, affect metabolism and result in tissue and organ damage. The use of iron-chelating agents has been shown to improve survival in TDT patients, though transfusional iron intake may vary depending on spleen size or splenectomy.

Thalassemia increases red blood cell destruction via the reticuloendothelial system and spleen, often causing splenomegaly. Many TDT patients thus require splenectomy, although the current transfusion regimen, including optimized pre-transfusional hemoglobin and appropriate intervals, has reduced the incidence of splenomegaly and splenectomy.[6] Splenectomy is indicated in transfusion-dependent patients when hypersplenism increases transfusion requirements, impairs iron control despite chelation therapy, or elevates infection risk.[7] However, an enlarged spleen without increased transfusion requirement is not necessarily an indication for surgery. Patients with hypersplenism may present with splenomegaly, neutropenia, or thrombocytopenia.

Splenectomy can be partial or total, performed via open or laparoscopic techniques, and may prolong red blood cell survival by reducing clearance, potentially affecting transfusion needs. Nonetheless, it carries short- and long-term risks, including infections, hypercoagulability, and thromboembolism, and residual splenunculi may cause recurrent anemia. The benefit of splenectomy in reducing transfusion frequency remains debated, with some advocating caution due to complications, while others emphasize careful patient preparation.

In Bangladesh, approximately 100,000 thalassemia patients exist, with an estimated 1,040 β-thalassemia major and 6,443 HbE β-thalassemia births annually.[8] WHO reports that 3% of the population are β-thalassemia carriers, and 6.1% are HbE carriers.[9] High consanguinity rates and prevalent genetic defects necessitate management via transfusions, iron chelation, and splenectomy when needed.

Given this context, the present study was designed to evaluate the hematological profiles and iron overload status of transfusion-dependent thalassemia patients, both splenectomized and non-splenectomized, attending the Department of Transfusion Medicine at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. The findings aim to guide optimization or modification of management protocols, including transfusions and iron chelation, for improved patient care.

Objective

To compare the hematological profile and iron overload status between splenectomized and non-splenectomized transfusion-dependent patients with thalassemia.

METHODS

This cross-sectional comparative study was conducted at the department of transfusion medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from December 2021 to October 2022. A total of 60 transfusion-dependent thalassemia patients were included in the study, comprising 30 splenectomized and 30 non-splenectomized patients. Participants were selected based on specific inclusion and exclusion criteria to evaluate the hematological profile, transfusion requirements, and iron overload status between the two groups.

Inclusion criteria

Transfusion-dependent thalassemic patients above 5 years of age. Both male and female patients. Splenectomized thalassemic patients who were dependent on regular transfusions and had received 10 or more transfusions. Non-splenectomized thalassemic patients (with hypersplenism or splenomegaly) receiving blood transfusions for at least 2 years.

Exclusion criteria

Thalassemic patients aged less than 5 years. Thalassemic patients not dependent on regular blood transfusions. Thalassemic patients without splenectomy or hypersplenism. Patients with bleeding tendencies due to causes other than thalassemia. Patients or guardians unwilling to provide informed consent

The study assessed sociodemographic (age, sex, residence, economic status, education), nutritional (height, weight, BMI, dietary history), and clinical/laboratory variables (type of thalassemia, age at first transfusion, transfusion duration and frequency, transfusion interval, use and route of iron chelation therapy, hemoglobin, hematological indices, and serum ferritin levels). After obtaining ethical approval from the IRB of BSMMU, data were collected using a semi-structured questionnaire, detailed transfusion histories, medical reports, laboratory results, and clinical assessments. For laboratory evaluation, 5 ml of venous blood was collected under aseptic conditions: serum ferritin was analyzed by chemiluminescent immunoassay (CLIA) using the Liaison XL automated analyzer at the department of biochemistry and molecular biology, and complete blood count (CBC) with peripheral blood film (PBF) was analyzed using fluorescence flow cytometry (FFC) on the Sysmex XN-2000 autoanalyzer at the department of laboratory medicine, BSMMU. All data were recorded in case record forms, compiled on a master chart, and analyzed using SPSS version 24; continuous variables were expressed as mean±SD and categorical variables as frequency and percentage, with student's t-test and chi-square test used for between-group comparisons ($p<0.05$ considered significant). Ethical compliance included informed written consent, confidentiality, voluntary participation, and the right to withdraw, with no financial benefit to participants. The study was conducted under direct supervision of the guide and co-guide, with monthly progress reviews and standardized laboratory protocols to ensure quality. The findings are intended for publication and may guide clinicians in optimizing management of transfusion-dependent thalassemia patients.

RESULTS

Table 1 summarizes the baseline characteristics of the study population. Most patients were aged 11-20 years [31 (51.7%)], with comparable mean age between splenectomized and non-splenectomized groups (17.78±6.57 versus 18.87±10.95 years; p = 0.644). Males comprised 37 (61.7%) of participants, and residence was nearly equally urban [29 (48.3%)] and rural [31 (51.7%)], with no significant group differences. Middle-class status predominated [26 (43.3%)], and education up to primary level was most common [35 (58.3%)]. Mean height and weight were similar between groups; however, underweight BMI was significantly more frequent in splenectomized patients [23 (76.7%)] compared with non-splenectomized patients [14 (46.7%)] (p=0.034). Most patients consumed a normal diet [46 (76.7%)]. HbE-β thalassemia was the most prevalent diagnosis [32 (53.3%)], followed by β-thalassemia [25 (41.7%)]. The mean age at first transfusion and mean transfusion duration did not differ significantly between groups (p>0.05).

Table 1: Baseline sociodemographic, nutritional, and clinical characteristics of the study population (n=60).

Variables		Group A (splenectomized) n=30 (%)/Mean±SD	Group B (non-splenectomized) n=30 (%)/Mean±SD	Total n=60 (%)/Mean±SD	P value
Age (years)	5-10	3 (10)	7 (23.3)	10 (16.7)	0.345
	11-20	18 (60)	13 (43.3)	31 (51.7)	
	21-30	7 (23.3)	6 (20)	13 (21.7)	
	31-40	2 (6.7)	2 (6.7)	4 (6.7)	
	>40	0 (0)	2 (6.7)	2 (3.3)	
	Mean±SD	17.78±6.57	18.87±10.95	18.32±8.96	0.644
Sex	Male	21 (70)	16 (53.3)	37 (61.7)	0.184
	Female	9 (30)	14 (46.7)	23 (38.3)	
Area of residence	Urban	15 (50)	14 (46.7)	29 (48.3)	0.796
	Rural	15 (50)	16 (53.3)	31 (51.7)	
Economic status	Poor	12 (40)	5 (16.7)	17 (28.3)	0.067
	Middle class	9 (30)	17 (56.7)	26 (43.3)	
	Upper class	9 (30)	8 (26.7)	17 (28.3)	
Educational status	Uneducated	5 (16.7)	9 (30)	14 (23.3)	0.257
	Up to primary	18 (60)	17 (56.7)	35 (58.3)	
	Up to SSC	3 (10)	4 (13.3)	7 (11.7)	
	Up to HSC	3 (10)	0 (0.0)	3 (5)	
	Graduate	1 (3.3)	0 (0.0)	1 (1.7)	
	Height (cm)	136.38±12.00	138.04±12.50	—	0.603

Continued.

Variables		Group A (splenectomized) n=30 (%)/Mean±SD	Group B (non-splenectomized) n=30 (%)/Mean±SD	Total n=60 (%)/Mean±SD	P value
Nutritional status	Weight (kg)	35.20±8.92	34.97±11.46	—	0.930
	BMI- Normal	6 (20)	10 (33.3)	16 (26.7)	0.034
	BMI- Underweight	23 (76.7)	14 (46.7)	37 (61.7)	
	BMI- severe malnutrition	1 (3.3)	6 (20)	7 (11.7)	
Dietary history	Normal diet	22 (73.3)	24 (80)	46 (76.7)	0.542
	Iron-restricted	8 (26.7)	6 (20)	14 (23.3)	
Hb electrophoresis	β-thalassemia	16 (53.3)	9 (30)	25 (41.7)	0.065
	HbE-β thalassemia	14 (46.7)	18 (60)	32 (53.3)	
	Thalassemia trait	0 (0.0)	3 (10)	3 (5)	
Transfusion history (baseline)	Mean age at 1st transfusion (years)	5.97±3.24	8.30±6.48	—	0.085
	Mean duration of transfusion (years)	12.83±5.86	10.70±6.47	—	0.186

Table 2: Comparison of transfusion characteristics between splenectomized and non-splenectomized patients (n=60).

Transfusion variables		Group A (splenectomized) n=30 (%)	Group B (non-splenectomized) n=30 (%)	Total n=60 (%)	P value
Transfusion interval (weeks)	≤4 weeks	12 (40)	25 (83.3)	37 (61.6)	0.001
	>4 weeks	18 (60)	5 (16.7)	23 (38.3)	
Regularity of transfusion	Regular	19 (63.3)	19 (63.3)	38 (63.3)	1.000
	Irregular	11 (36.7)	11 (36.7)	22 (36.7)	
Total number of transfusions (approx.)	10-50 units	10 (33.3)	6 (20)	16 (26.7)	0.502
	51-100 units	7 (23.3)	8 (26.7)	15 (25)	
	>100 units	13 (43.3)	16 (53.3)	29 (48.3)	

Table 3: Transfusion history of splenectomized patients before splenectomy (n=30).

Transfusion history of group A patients		Frequency	Percentage
Regularity of Transfusion before splenectomy	Regular	19	63.3
	Irregular	11	36.7
Pre-transfusion Hb level before splenectomy (gm/dl)	<3.0	3	10.0
	3.0-4.9	14	46.7
	5.0-6.9	13	43.3
	7.0-8.9	0	0.0
	9.0-10.0	0	0.0

Table 2 shows transfusion-related characteristics of the study participants. A significantly higher proportion of non-splenectomized patients required transfusions at intervals of ≤4 weeks [25 (83.3%)] compared to splenectomized patients [12 (40%)] (p=0.001). Overall, regular transfusion was observed in 38 (63.3%) patients, with identical proportions in both groups (p=1.000). Nearly half of the patients received more than 100 transfusions [29 (48.3%)], with no statistically significant difference between splenectomized and non-splenectomized groups regarding total transfusion burden (p=0.502).

Table 3 describes the transfusion history of splenectomized patients prior to surgery. Among group A patients, most received regular transfusions before splenectomy [19 (63.3%)], while 11 (36.7%) had irregular transfusion schedules. Pre-transfusion hemoglobin levels were predominantly between 3.0-4.9 gm/dl in 14 (46.7%) patients, followed by 5.0-6.9 gm/dl in 13 (43.3%), whereas only 3 (10%) patients had hemoglobin levels below 3.0 gm/dl, and none had levels ≥7.0 gm/dl prior to splenectomy.

Figure 1 illustrates the distribution of transfusion intervals among patients in the splenectomized group before

splenectomy. Nearly half of the patients, 14 (47.0%), received transfusions at 15-day intervals. Transfusions at intervals of 1-2 months were reported in 11 patients (37.0%), while less frequent transfusions were noted in smaller proportions, including 2-3-month intervals in 4 patients (13.3%) and 3-4-month intervals in 1 patient (3.3%).

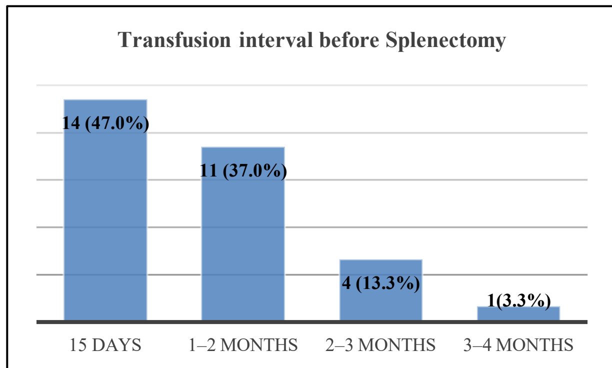

Figure 1: Distribution of transfusion interval before splenectomy among group A patients (n=30).

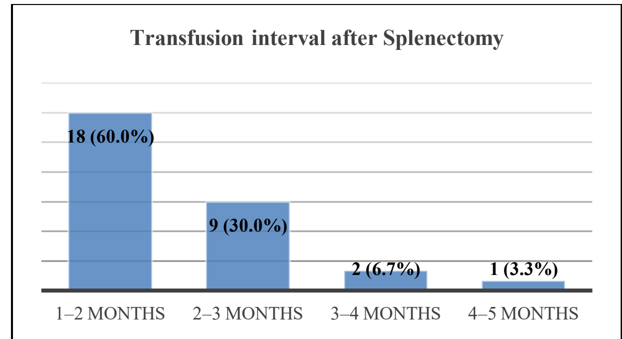

Figure 2: Distribution of transfusion interval after splenectomy among group A patients (n=30).

Figure 2 shows the distribution of transfusion intervals among patients in the splenectomized group after splenectomy. The majority of patients, 18 (60.0%), received transfusions at intervals of 1-2 months. Transfusion intervals of 2-3 months were observed in 9 patients (30.0%). Longer intervals were less common, with 3-4-month and 4-5-month intervals reported in 2 (6.7%) and 1 (3.3%) patient, respectively.

Table 4: Iron chelation therapy among splenectomized and non-splenectomized patients (n=60).

Iron chelation variables		Group A (splenectomized) n=30 (%)	Group B (non-splenectomized) n=30 (%)	Total n=60 (%)	P value
Use of iron chelation	Yes	19 (63.3)	20 (66.7)	39 (65)	0.787
	No	11 (36.7)	10 (33.3)	21 (35)	
Route of iron chelation	Deferoxamine monotherapy	4 (21.1)	1 (5)	5 (12.8)	0.191
	Deferiprone monotherapy	4 (21.1)	7 (35)	11 (28.2)	
	Deferasirox monotherapy	4 (21.1)	8 (40)	12 (30.8)	
	Deferoxamine + Deferasirox	7 (36.8)	4 (20)	11 (28.2)	
Regular use of iron chelation	Yes	15 (78.9)	13 (65)	28 (71.8)	0.333
	No	4 (21.1)	7 (35)	11 (28.2)	

Table 5: Comparison of hematological parameters between splenectomized and non-splenectomized patients (n=60).

Group A (n=30) Mean±SD	Group B (n=30) Mean±SD	P value
7.26±1.57	6.78±1.83	0.285
75.64±6.93	69.99±8.89	0.008
23.31±2.94	25.21±12.99	0.441
30.83±2.83	30.93±2.15	0.874
26.13±6.07	27.93±5.87	0.248
25.21±9.95	26.79±24.45	0.744
12.24±5.35	9.31±3.88	0.019
556.0±255.91	210.34±116.15	<0.001

Table 4 summarizes iron chelation therapy among splenectomized and non-splenectomized patients. Overall, 39 (65%) patients were on iron chelation, with similar proportions in group A [19 (63.3%)] and group B [20 (66.7%)] (p=0.787). Among chelated patients, deferoxamine monotherapy was used in 5 (12.8%), deferiprone in 11 (28.2%), deferasirox in 12 (30.8%), and combined deferoxamine + deferasirox therapy in 11 (28.2%), with no significant intergroup difference (p=0.191). Regular use of iron chelation was observed in

28 (71.8%) patients, with comparable adherence in group A [15 (78.9%)] and group B [13 (65%)] (p=0.333).

Table 5 presents hematological parameters. Mean hemoglobin levels were 7.26±1.57 gm/dl in splenectomized and 6.78±1.83 gm/dl in non-splenectomized patients (p=0.285). Splenectomized patients had significantly higher mean corpuscular volume (MCV) [75.64±6.93 fl versus 69.99±8.89 fl, p=0.008]. Other red cell indices, including MCH, MCHC, RDW, and HCT, showed no significant differences. White blood cell counts were elevated in splenectomized patients [12.24±5.35 $\times 10^3$/l versus 9.31±3.88$\times 10^3$/L, p=0.019], while platelet counts were markedly higher in splenectomized patients [556.0±255.91$\times 10^3$/l versus 210.34±116.15$\times 10^3$/l, p<0.001].

Table 6 shows serum ferritin levels. Splenectomized patients had significantly higher mean ferritin [5843.98±4162.00 ng/ml] compared to non-splenectomized patients [3253.32±2247.28 ng/ml, p=0.004]. Distribution across categories revealed 15 (50%) splenectomized patients had ferritin >5000 ng/ml, compared with 4 (13.3%) non-splenectomized patients. Ferritin levels between 2500-5000 ng/ml were observed in 8 (26.7%) splenectomized and 15 (50%) non-splenectomized patients, while <1000 ng/ml was noted in 1 (3.3%) versus 4 (13.3%) patients, respectively.

Table 6: Serum ferritin levels among splenectomized and non-splenectomized patients (n=60).

Group A (n=30) (%)	Group B (n=30) (%)	Total (n=60) (%)	P value
1 (3.3)	4 (13.3)	5 (8.3)	0.004
6 (20)	8 (13.3)	14 (23.3)	
8 (26.7)	15 (50)	23 (38.3)	
15 (50)	4 (13.3)	19 (31.7)	
5843.98 ± 4162.00	3253.32 ± 2247.28	—	0.004

Table 7: Peripheral blood film findings in splenectomized and non-splenectomized patients (n=60).

Group A (n=30) (%)	Group B (n=30) (%)	Total (n=60) (%)	P value
3 (10.0)	2 (6.7)	5 (8.3)	0.117
16 (53.3)	9 (30.0)	25 (41.7)	
11 (36.7)	19 (63.3)	30 (50.0)	

Table 7 presents peripheral blood film (PBF) findings. Mild microcytic hypochromic anemia with target and nucleated cells was observed in 5 (8.3%) patients, moderate microcytic hypochromic anemia with anisopoikilocytosis and target cells in 25 (41.7%), and severe microcytic hypochromic anemia with fragmented and teardrop cells in 30 (50%). Severe forms were more common in non-splenectomized patients [19 (63.3%)] than splenectomized patients [11 (36.7%)], although mild forms showed no significant intergroup difference (p=0.117).

DISCUSSION

Thalassemia is one of the inherited disorders characterized by abnormal production of haemoglobin, associated with low Hb production and excessive destruction of red blood cells [10]. It is the most common hereditary blood disorder worldwide with wide geographical variation in incidence, including Bangladesh. It is presumed that approximately 6,000 thalassemic children are born each year in Bangladesh. Unfortunately, only a few cases are diagnosed. β-Thalassemia/hemoglobin (Hb) E is a compound heterozygosity giving rise to varying degrees of severity of anaemia.[11] Thalassemia disorder leads to the weakening and destruction of red blood cells (RBCs), which results in microcytic anaemia.[12] If the bone marrow becomes insufficient to counteract the anemia, the spleen works as an extramedullary organ and hypersplenism develops in β-thalassemia, and hypersplenism caused by extramedullary hematopoiesis often necessitates splenectomy.[13]

In this cross-sectional comparative study, we assessed the haematological aspects between splenectomized and non-splenectomized transfusion-dependent thalassemic patients and their impact on iron overload and transfusion requirements, which could inform new management approaches. A total of 60 transfusion-dependent thalassemic patients, above 5 years of age, were selected and categorized into two groups: group A included splenectomized patients and group B included non-splenectomized patients.

In our study, the majority of participants from both splenectomized and non-splenectomized thalassemic patients belonged to 11-20 years of age (60% of group A and 43.3% of group B). However, there were no significant differences between the two groups regarding age (p>0.05). In a similar study by Zhou et al, there were 21 males and 29 females, with a mean age of 28.5 years (range, 18.3–47.7 years).[14] The mean age of the 25

splenectomized patients at the time of surgery was 24.0 years (range, 8-44 years), and the mean time from splenectomy to enrolment in this study was 5.0 years (range, 1-16 years). Another study by Ayyash et al, included 65 transfusion-dependent β-thalassemia patients, 32 males with a mean age of 20.3 years, and 33 females with a mean age of 20.8 years.[15] The mean age in both cases was higher than in our study. In another study, Khawaji et al, the mean age of the patients was 18.56±6.89 years, which is relatively closer to the mean age of our study.[16]

The patients in our two groups were predominantly male, 70% from group A and 53.3% from group B, while 30% and 46.7% were female, respectively. A similar study conducted by Memon et al., included 70.3% male patients and only 29.6% female patients.[17] Atichartakarn et al, conducted a study on E/β-thalassemia patients where 46% of participants were male and 54% female, which contrasts with the gender distribution in our study.[10]

The majority of the patients, 50% from group A and 53.3% from group B, resided in rural areas. In terms of education, the majority of the study population was educated up to the primary level in both groups (60% and 56.7%, respectively); 43% of the study patients belonged to the middle-class income group. No significant association was found with the area of residence or education level. According to Alsalman et al, socio-demographic variables such as age group, sex, area of residence, and educational level did not significantly influence the splenectomy procedure (all p values >0.05), as more than half of the patients were women (51.4%) and half (53.6%) had a high school education level or below.[18] Regarding economic condition, 43% of patients were middle-class, 28.3% were poor, and 28.3% were from the upper class.

Our study found no significant association with height, weight, and dietary history. However, BMI status showed a significant difference between the two groups. Most participants had normal dietary history, while an iron-restricted diet was followed by 26.7% of group A and 20% of group B. According to BMI status, the majority of participants were underweight in both groups, 76.7% in group A and 46.7% in group B. In a study by Alsalman et al, approximately half of the participants had a normal BMI (47.4%), whereas the others were either overweight (29.3%) or obese (13.8%), which does not coincide with our research.[18] Ammar et al, reported significant associations between BMI, height, and weight, unlike our findings.[19]

In our study, most splenectomized patients had β-thalassemia major (53.3%), while the majority of non-splenectomized patients had Hb E-β thalassemia (60%). According to Uddin et al, the most common form of hemoglobin disorder observed was β-thalassemia minor (21.3%), with E-β-thalassemia and HbE traits also being fairly common (13.5% and 12.1%, respectively).[20] Isa et al, showed Hb E-β thalassemia in 52.9% of patients and β-thalassemia in 47.1%.[7] None of these studies agree with our findings, and we also observed no association between the type of thalassemia in either group. The study by Sari et al, found β-thalassemia major in 50% of non-splenectomized patients and Hb E-β thalassemia in 53.4%, which is relatively similar to our findings.[21]

The mean age at first transfusion was 5.97±3.24 years in group A versus 8.30±6.48 years in group B, and the mean duration of receiving transfusions was 12.83±5.86 years versus 10.70±6.47 years, respectively. In a similar study by Casale et al., blood transfusion in splenectomized patients peaked around 7 years of age (186±38 ml/kg/year) and then gradually decreased until adulthood (94±14 ml/kg/year); in non-splenectomized patients, transfusions peaked at around 7 years (177±27 ml/kg/year) and decreased more slowly until adulthood (134±15 ml/kg/year).[6] According to Ammar et al, the mean age at first transfusion was 9.62±5.25 years among splenectomized patients and 10.23±7.52 years in non-splenectomized patients.[19] These studies, like ours, did not show significant differences between the groups regarding age at first transfusion.

In group A, 60% of splenectomized patients received transfusions at intervals greater than four weeks, whereas 83% of group B patients received transfusions at intervals less than four weeks. Before splenectomy, 47% of patients received transfusions at 15-day intervals, but after splenectomy, 60% required transfusions after one or two months. This indicates that splenectomy delays transfusion requirements and reduces the cumulative iron burden. While 63.3% of group A patients received regular transfusions post-splenectomy, the number requiring 10-50 units doubled to 33.3%, and 23.3% required 51-100 units, showing a reduction in transfusion burden. Isa et al, also observed that splenectomy decreased blood transfusion frequency from 12-14 times per year to 6-8 times per year (p<0.001), consistent with our findings.[7] However, according to Ammar et al, the interval of blood transfusion was 34.26±8.18 days in splenectomized patients versus 31.60±13.91 days in non-splenectomized patients, which does not completely align with our results.[19]

To survive, most thalassemic patients require regular blood transfusions with iron-chelating drugs to reduce iron overload. In our study, 65% of patients received iron chelation therapy: 63.3% in group A and 66.7% in group B. Among splenectomized patients, 36.8% used deferoxamine and deferasirox, while 40% of non-splenectomized patients used deferasirox monotherapy. Regular iron chelation was reported in 78.9% and 65% of patients, respectively, with no significant difference between groups. Easa et al, reported similar use of iron chelation therapy in both splenectomized and non-splenectomized patients, while Uygun et al, reported deferasirox (64%), deferiprone (17.7%), and combination therapy (18.3%).[22,23] These findings differ from our study.

Comparing haematological variables between the groups, mean hemoglobin was 7.26±1.57 gm/dl in group A versus 6.78±1.83 gm/dl in group B, with no statistical significance (p=0.285). Ammar et al, reported mean Hb of 6.74±1.27 gm/dl in splenectomized patients versus 5.75±1.02 gm/dl in non-splenectomized patients.[19] Ayyash et al, also reported higher Hb in splenectomized patients (7.4±1.3 gm/dl) compared to non-splenectomized patients (7.0±0.7 gm/dl).[15] Zhou et al, reported 9.1±1.1 gm/dl in splenectomized patients and 8.0±1.3 gm/dl in non-splenectomized patients.[14] Unlike those studies, our results did not show statistical significance. Aziz et al, reported mean Hb of 7.21±0.54 gm/dl in splenectomized patients versus 7.23±0.84 gm/dl in non-splenectomized patients (p>0.05).[24] In our study, pre-transfusion Hb ranged from 3-6.9 gm/dl, while post-splenectomy Hb was >7 gm/dl, indicating improved Hb levels, reduced transfusion requirements, lower iron overload, fewer hospital visits, and reduced cost of therapy.

WBC and platelet counts were higher in group A ($12.24\pm5.35\times10^3/\mu l$ and $556.0\pm255.91\times10^3/\mu l$) than in group B ($9.31\pm3.88\times10^3/\mu l$ and $210.34\pm116.15\times10^3/\mu l$). Khawaji et al, reported similar findings: WBC and platelets were significantly higher in splenectomized β-thalassemia major patients ($25.84\pm16.56\times10^3/\mu l$ and $488.56\pm145.90\times10^3/\mu l$, p=0.006) than in non-splenectomized patients ($7.94\pm2.83\times10^3/\mu l$ and $247.55\pm65.60\times10^3/\mu l$).[16] Aziz et al, also showed higher platelet counts in splenectomized children ($453\pm149\times10^3/mm^3$) compared to non-splenectomized children ($335\pm0.84\times10^3/mm^3$), with a statistically insignificant increase in total WBC count.[24] These findings align with our research. Higher platelets in splenectomized patients reflect absence of splenic destruction, increasing the risk of thrombocytosis and thromboembolism, while higher WBC counts may increase infection risk.

Peripheral blood film analysis showed no significant difference between groups. Moderate microcytic hypochromic anemia was observed in 53.3% of splenectomized patients, while 63.3% of non-splenectomized patients had severe anemia and 30% had moderate anemia, indicating improvement in splenectomized patients without statistical significance.

Serum ferritin levels were higher in splenectomized patients (mean 5843.98±4162.00 ng/ml) compared to non-splenectomized patients (3253.32±2247.28 ng/ml), with a significant association (p=0.004). Aziz et al, also reported higher ferritin in splenectomized patients, while Isa et al, found mean ferritin 7,755 ng/ml post-splenectomy versus 1,887.7 ng/ml pre-splenectomy.[7,24] Zhou et al, reported ferritin of 643.8±482.1 ng/ml in non-splenectomized versus 1,219±1,032.5 ng/ml in splenectomized patients.[14] Conversely, Casale et al, found no significant difference.[6] Higher ferritin in our splenectomized patients likely reflects greater pre-splenectomy transfusion, leading to iron accumulation in the macrophage system and higher risk of organ damage. The spleen also acts as a reservoir for excess iron, which may explain higher serum ferritin and the need for ongoing chelation therapy post-splenectomy, indicating that splenectomy does not alleviate iron burden in thalassemia patients.

This study had some limitations. All samples were collected from a single center. Samples were selected deliberately, without randomization. Long-term follow-up was beyond the scope of the study.

Direct measurement of iron overload, such as magnetic resonance studies or liver biopsy, is needed to better understand the effect of splenectomy on iron balance parameters; in our study, serum ferritin was used as a more affordable alternative.

CONCLUSION

In this study, the mean hemoglobin was 7.26±1.57 gm/dl in the splenectomized group and 6.78±1.83 gm/dl in the non-splenectomized participants. WBC and platelet counts were also higher in splenectomized patients, increasing the risk of thrombocytosis and infections. Splenectomized participants had significantly higher serum ferritin levels, indicating that splenectomy did not reduce the iron burden. These results are largely consistent with previous studies, with slight variations. Therefore, further multicenter studies with longer follow-up are recommended to provide more information on the impact of splenectomy on the hematological profile in transfusion-dependent thalassemia, aiding clinicians in more effective patient management.

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