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Intermediate Hyperglycemia and its Association with Iron Chelation Therapy in Children with Transfusion-Dependent Beta-Thalassemia in Kirkuk, Iraq

Nawal Bahjat Mahdi
Assistant Professor, Department of Pediatrics,
College of Medicine, University of Kirkuk, Kirkuk

Abstrak. Background: Iron overload in transfusion-dependent β-thalassemia (TDT) disrupts pancreatic β-cell function, predisposing children to intermediate hyperglycemia.
Methods: A cross-sectional study of 150 Iraqi children with TDT assessed glycemic status using fasting plasma glucose and OGTT. Clinical and laboratory variables were compared between normoglycaemic and hyperglycemic groups.
Results: Intermediate hyperglycemia was detected in 28 patients (18.5%): 15 with isolated IGT and 13 with isolated IFG. Older age was significantly associated with hyperglycemia (14.8 ± 4.5 vs. 11.8 ± 4.9 years; p = 0.01). Irregular chelation therapy showed the strongest modifiable association 29.1% of irregularly chelated children had hyperglycemia versus 11.4% of regularly chelated children (p = 0.007). No significant associations were found for gender, BMI, ferritin, chelation type, or viral hepatitis.
Conclusion: Intermediate hyperglycemia affects 18.5% of Iraqi children with TDT. Chelation adherence is the key modifiable risk factor, supporting routine OGTT screening from age 10 years.

Keywords: beta-thalassemia, hyperglycemia, iron chelation, OGTT, Iraq, children.

Introduction

Beta-thalassemia major (β-TM) is among the most prevalent hereditary hemoglobinopathies worldwide, characterized by severely reduced or absent synthesis of β-globin chains, leading to ineffective erythropoiesis, chronic hemolytic anemia, and progressive multi-organ damage[1]. Consanguineous marriage is reported in 78.8% of affected Iraqi families[2]. These sort of demographic features can shape the medical outline in ways that vary expressively from high-income locations comprising prior age at difficulty onset restricted admittance to MRI-inclined iron observing, and suboptimum chelation observance moved by distinct financial constriants and supply chain instability[3].

The foundation of managing the transfusion-Dependent β-thalassemia (TDT) rests as a chronic red blood cell insertion to exact anemia and overwhelm unsuccessful erythropoiesis, shared with iron chelation therapy (ICT) to respond to the inevitable transfusion tempted iron accrual[4]. Without adequate chelation, iron deposits in the liver, heart, endocrine glands, and pancreas, driving progressive organ dysfunction and premature death[5]. Three chelating agents are currently available: deferoxamine (DFO), an older parenteral agent; deferiprone (DFP) the first oral chelater; and deferasirox (DFX) an oral once-daily agent approved from age 2 years onward[6]. Choice among them must be individualized according to the patient's iron burden, organ involvement, age, adherence capacity, and comorbidities[7].

As survival of TDT patients has improved dramatically over recent decades, iron-related endocrine complications have become the dominant source of late morbidity. Glucose dysregulation (GD) is the most clinically consequential of these, developing insidiously across a spectrum that begins with intermediate hyperglycemia — comprising impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) — and may progress to overt thalassemia-related diabetes mellitus (TM-DM)[8]. The American Diabetes Association define IFG as FBG of 100–125 mg/dL and additionally recognizes HbA1c of 5.7–6.4% as a prediabetes criterion, though HbA1c is unreliable in TDT due to shortened erythrocyte lifespan from chronic transfusions[9].

Pediatric with TDT population, and transitional hyperglycemia is predominantly disturbing because it frequently starts in the first 10 years of life, well prior to obvious diabetes appears, and its initial discovery provides a therapeutic window where the increased chelation and lifestyle adjustments may show sluggish progression. In Resource-constraint domains such as Iraq, where MRI-inclined pancreatic iron quantification is mainly unobtainable and OGTT observance in pediatric thalassemia hubs is unpredictable, through the constant prevalence of transitional hyperglycemia endure has been characterized. The connection between the type, suitability, and length of iron chelation treatment and the extent of glucose dysregulation in Iraqi children with TDT well investigated. This study thus aims to deal with the present gap.

1. Beta-Thalassemia Regional Burden

Epidemiological information obtained from Duhok and Karbala show the intensifying function of consanguinity with around 58% of families[10][11]. These social indicators added to the present challenge of attaining consistent chelation observance and systematic metabolic observation, making the clinical management of Iraqi TDT children qualitatively different from what is described in high-income cohorts.

2. Iron Overload and Endocrine Complications in TDT

A distinct 2024 analysis seeks to examine the molecular connections between β-TM and diabetes underlined that iron surplus interrupts β-cell role over numerous synchronized instruments: direct iron admission in islet cells, orientation of oxidative anxiety through the marginal insulin compassion[12]. The evaluation underlined that no dependable blood-inclined biomarker presently occurs to forecast initial glucose dysregulation in TDT, and entitled for more granular automatic and scientific research.

Several numerical MRI studies in pediatric thalassemia main patients indicated that both pancreatic R2* and pancreatic fat portion associate really with abstaining blood glucose. In one pediatric group of around the ROC curve of 0.931 for discerning lessened from standard abstaining glucose, outstripping iron attentiveness alone. These results strengthen the worth of methodical fasting glucose observation as a real-world substitute for pancreatic iron evaluation in situations where MRI is unobtainable[13].

3. Intermediate Hyperglycemia in Beta-Thalassemia: Definition, Prevalence, and Progression

The concept of intermediate hyperglycemia in thalassemia encompasses a spectrum of pre-diabetic states detectable on OGTT: isolated IFG (fasting plasma glucose 100–125 mg/dL by ADA criteria), isolated IGT (2-hour glucose 140–199 mg/dL), combined IFG/IGT, and the more recently recognized category of isolated 1-hour post-load hyperglycemia (plasma glucose ≥155 mg/dL at 60 minutes, termed H-NGT). Each of these phenotypes carries a different risk paths and reflects different underlying pathophysiological defects — insulin resistance predominating in IFG, and β-cell secretory failure predominating in IGT[14].

Prevalence data for glucose dysregulation in TDT are heterogeneous across studies, partly reflecting differences in patient age, chelation adequacy, and diagnostic criteria applied. In a 2024 expert review on TDT management from a Middle Eastern perspective, glucose dysregulation was identified as the most clinically urgent non-cardiac endocrine complication in the region's pediatric thalassemia centers[15].

An important diagnostic significance is that HbA1c is unreliable in TDT patients. Enhanced red cell throughput from distinct hemolysis and transfusions curtails erythrocyte lifecycle, methodically dropping HbA1c standards even in the occurrence of important hyperglycemia. The very ADA 2024 Standards of Care clearly recognize this constraint to recommend that glucose-inclined OGTT principles be applied for assessment in thalassemia. Annual OGTT broadcast is thus the gold usual, with observance to this commendation remains challenging crosswise numerous nations[16].

4. Iron Chelation Therapy and Glucose Metabolism

The three obtainable iron chelators which vary essentially in their pharmacokinetic qualities, ways of management, organ qualities, and security autographs. These variances have suggestions for their comparative capability to avert pancreatic iron accrual and connected glucose deregulation. Empathetic outlines is critical for construing any link between chelation selection and the occurrence of transitional hyperglycemia in a given scientific group.

Deferoxamine (DFO): DFO's necessity for parenteral conveyance and awkward management plan may result in poor long-term observance, principally in adolescents and children[17].

In many moderate income nations comprising Iraq, DFO remains extensively applied owing to its lower achievement cost.

Deferiprone (DFP), an oral bidentate chelator is distinguished for its capability to infiltrate cell membranes and reallocate iron from same tissue stores to transferring, an item that may reduce intracellular labile iron within a recognized siderosis.

Deferasirox (DFX), a tridentate oral chelator has become prevalent in used among children aged ≥2 years. Iron chelation therapy may enhance insulin sensitivity and eventually may slow the progress of prediabetes to obvious diabetes when introduced first and preserved reliably. The yearly transfusion index and basic sustenance with arranged chelation which are considered to determine iron load than the exact chelator applied. This makes observance the key adaptable risk feature in any scientific location.

5. Thalassemia Administration and Glucose Dysregulation: Proof from Middle Eastern and Iraqi Settings

A 2024 expert harmony appraisal on TDT administration from the Middle East province clearly identified glucose deregulation as a basic observation target which recommends yearly OGTT from the age of 10 or prior in patients with common serum ferritin reliably surpassing 2,500 ng/mL. The review recognized that observance to yearly OGTT is commonly suboptimum across the province, replicating patient load, incomplete clinic size, and insufficient consciousness amongst families and healthcare workers.

Iraqi-detailed statistics on endocrine difficulties in TDT children is still sparse. The 2023 national load study accompanied across the Baghdad major parts recognized that 55.9% of recorded patients showed almost single complication. The report recognized low socioeconomic position, large family scope, and maternal illiteracy as leading connected risk features may affect chelation submission and metabolic observing frequency.

Study in 2025 from Duhok, Kurdistan Region of Iraq indicated that Deferasirox was prevalent with around chelator (34.62% of patients), trailed by Hydroxyurea and Deferoxamine. Methodical statistics on glucose consequences in this group were not described, emphasizing the scarcity of metabolic endpoint statistics in Iraqi thalassemia registries.

The precise susceptibility of Iraqi TDT children to potential glucose dysregulation may be made difficult owing to numerous context-inclined features: high proportions of consanguinity that upturn the possibility of strict β0/β0 genotypes. Adjustable chelation exposure owing to drug resource distractions and financial limitations advance the possible risk. Proportions of hepatitis C virus (HCV) co-infection recognized at around13.5% generally add a supplementary metabolic load. Limited access to MRI-based iron monitoring that would allow pre-emptive chelation intensification in patients with rising pancreatic iron burden remains a critical unmet need.

6. Screening and Early Detection: Current Recommendations and Gaps

International guidelines for TDT management, including those of the Thalassemia International Federation and the American Diabetes Association, recommend annual OGTT screening beginning at 10 years of age. Earlier screening is advised in patients with severe or sustained iron overload. These guidelines emphasize that fasting plasma glucose and 2-hour OGTT glucose should serve as the primary diagnostic criteria in this population. De Sanctis et al. demonstrated analogous prognostic value in β-TDT patients across 12 years of follow-up, with H-NGT patients showing significantly lower insulinogenic index and higher progression rates than truly normoglycemic patients. A 2024 ICET-A report further confirmed the credibility of this intermediate hyperglycemia marker even in thalassemia patients with persistently low iron overload[18].

Methodology

1. study design and setting

This descriptive prospective study was performed on 150 transfusion-dependent beta-thalassemic patients diagnosed by clinical and hemoglobin electrophoresis on referral. Aged 3-18 years in Kirkuk Thalassemia Center for the period extending from the 1st of March to the 1st of September 2024.

2. Inclusion criteria: Thalassemic patients being attended the center for a regular checkup and blood transfusion and accept to participate.

3. Exclusion criterion: Includes febrile illness, chronic systemic illness, children on steroid therapy, and those with previously diagnosed diabetes mellitus.

4.The sample size calculation

The sample size was calculated using a finite population correction formula. A convenient sample of one hundred and fifty child with thalassemia major was enrolled in the present study. $n=Z2P(1-P)/d2$, $(1.96)^2$ x 0.065(1-0.065)/0.052

2.5. Data Collection and Clinical Measurements

Data were collected directly from all study participants using a pre-designed structured questionnaire developed based on previous literature. The questionnaire included: age, sex, weight, height, family history of DM, age at first transfusion, type and compliance to iron chelation, and anthropometry (weight, height, BMI). Height and weight were measured according to international recommendations. On appropriately calibrated scales, body weight was recorded while wearing the fewest possible undergarments, to the closest 100 g. BMI(body mass index) was calculated by the following formula: weight in Kg/height in m2. The patient was defined as overweight when the BMI was between the 75th and 95th percentile and obese when the BMI was ≥the 95th percentile. While underweight when the BMI value was < 5th percentile for age and sex.

2.6. Laboratory methods and assessment of iron overload

The Enzyme-Linked Immunosorbent Assay (ELISA) technique was utilized for both HBsAg and Anti-HCV testing. The immunoturbidometric method was employed to measure serum ferritin levels ng/ml. Plasma glucose levels were measured using an automated glucose oxidase reaction.

2.7. Procedure and interpretation of oral glucose tolerance test (OGTT)

OGTT was performed in the morning, after at least eight hours of fasting, in clinically stable patients. Blood samples were collected at 0, 120 minutes following oral glucose administration (1.75 grams/kg of body weight dissolved in water) to measure plasma glucose. Interpretation of plasma glucose levels after OGTT. Depending on the results of the OGTT, patients were classified into different subgroups according to the criteria of the American Diabetes Association[9] :

Normal glucose tolerance (NGT) = Fasting Plasma Glucose (FPG) ≤ 100 mg/dl (≤ 5.6 mmol/L) and 2h PG <140mg/dl (<7.8mmol/L). Impaired glucose tolerance (IGT) = FPG 100-125mg/dl (5.6-6.9 mmol/L) and 2 h PG 140 –199mg/dl (7.8 -11)mmol/L . Diabetic glucose tolerance (DGT) or Diabetes Mellitus (DM) = FPG ≥ 126 mg/dl (>7.8 mmol/L) and 2 h PG ≥200mg/dl (> 11.1 mmol/L).

2.8. Ethical issues

Each parent and TDT patient gave their informed consent after being fully informed about the OGTT test's methods, the nature and goals of the research, and the advantages for the patient of providing this data. This study was approved by the ethics committee of the College of Medicine, University of( ) approval number: 27 , date 18/11/2024.

2.9. Statistical analysis

For data entry and analysis, the Statistical Program for Social Sciences (SPSS, version 25) and Excel were used. To assess the proportions of different factors among different groups of the study sample, the chi-squared (2) test of association was utilized. To compare the means, the Student (t) test was utilized. The odds ratio was calculated using bivariate logistic regression (OR). Statistical significance was defined as a P value of equal to or less than 0.05.

Results

A total of 150 children with transfusion-dependent β-thalassemia (TDT) were enrolled in this cross-sectional study. Of these, 122 patients (81.5%) had normal fasting and post-load glucose values and were classified as normoglycemic, while 28 patients (18.5%) met criteria for intermediate hyperglycemia. Among the hyperglycemic group, 15(10.4%) patients had isolated impaired glucose tolerance (IGT) and 13(8.1%) had isolated impaired fasting glucose (IFG). No patient fulfilled criteria for overt diabetes mellitus at the time of assessment. The demographic, clinical, and laboratory characteristics of both groups are summarized in Table 1.

Regarding gender distribution, males comprised 73 patients (48.7%) and females 77 patients (51.3%) of the total cohort.

Hyperglycemia was detected in 11 males (15.0%) and 17 females (22.2%), with no statistically significant difference between the sexes (p = NS). A positive family history of diabetes mellitus was present in 94 patients (62.7%), of whom 18 (19.2%) had intermediate hyperglycemia, compared to 10 of 56 patients (17.8%) without a family history; the difference was not statistically significant (p = NS).

With respect to iron chelation therapy, the majority of patients received oral chelation (n = 116, 77.3%), while 22 patients (14.7%) received injectable deferoxamine, 10 patients (6.7%) received no chelation, and 2 patients (1.3%) were on combination (compound) therapy. The prevalence of intermediate hyperglycemia was 18.8% in the oral chelation group, 27.2% in the injectable group, and 0% in both the unchelated and combination groups. Despite the numerically higher rate in the injectable group, no statistically significant difference was found between chelation agent types (p = NS).

The most statistically significant association in this study was identified between chelation regularity and glycemic status (p = 0.007)**.** Among 62 patients with irregular chelation, 18 (29.1%) had intermediate hyperglycemia, compared to only 10 of 88 regularly chelated patients (11.4%). This finding indicates that children with irregular iron chelation therapy had more than twice the rate of intermediate hyperglycemia compared to those receiving regular chelation.

Hepatitis C virus (HCV) co-infection was present in 21 patients (14.0%), with a prevalence of intermediate hyperglycemia of 23.8% in HCV-positive versus 17.8% in HCV-negative children; this difference did not reach statistical significance (p = NS). Hepatitis B co-infection was identified in only 2 patients (1.3%), one of whom had intermediate hyperglycemia, precluding meaningful statistical comparison.

Regarding BMI percentile, the highest rate of intermediate hyperglycemia was observed in the underweight group (32.0%), while the lowest rates were seen in the overweight (6.3%) and obese (7.7%) groups. However, this inverse trend did not achieve statistical significance (p = NS).

Among the continuous variables analyzed, mean age was significantly higher in the hyperglycemic group (14.8 ± 4.5 years) compared to the normoglycemic group (11.8 ± 4.9 years; p = 0.01). Mean pre-transfusion hemoglobin levels were comparable between groups (8.3 ± 0.8 g/dL vs. 8.1 ± 0.9 g/dL; p = NS), indicating similar transfusion practice across both groups. Serum ferritin was numerically higher in hyperglycemic patients (3396.2 ± 2958.4 ng/mL) than in normoglycemic patients (2650.2 ± 2146.5 ng/mL), though this difference did not reach statistical significance (p = NS). The mean age at first transfusion was 15.6 ± 16.7 months in the hyperglycemic group versus 22.6 ± 32.4 months in the normoglycemic group, with no significant.

Table (1) Frequency of intermediate hyperglycemia

	No.	%
Normoglycemia	122	81.5 %
Hyperglycemia IGT+IFG	28 (15+13)	18.5 % 10.4%+ 8.1%
Total	150	100%

Table 2. Patient characteristics according to glycemic status in 150 children with transfusion-dependent β-thalassemia.

Patient characteristics		Normoglycemia N (%)	Hyperglycemia N (%)	P
Gender	Male	62 (85 %)	11 (15%)	NS
	Female	60(77.8%)	17 (22.2%)	
Family History of Diabetes Mellitus	No	46 (82.2%)	10(17.8%)	NS
	Yes	76 (80.8%)	18 (19.2%)	
Chelating Agent	Non	10 (100%)	0 (0%)	NS
	Oral	94 (81.3الا %)	22(18.8%)	
	Injection	16 (72..8%)	6(27.2%)	
	Compound	2 (100%)	0 (0%)	
Chelating Agent regularity	Irregular	44(70.9 %)	18 (29.1%)	0.007
	Regular	78(88.6%)	10 (11.4%)	
Hepatitis B	No	121 (81.8%)	27 (18.2%)	NS
	Yes	1 (50%)	1(50%)	
Hepatitis C(HCV)	No	106 (81.6%)	23 (17.8%)	NS
	Yes	16 (76.2%)	5 (23.8%)	
BMI Percentile	<5 (Underweight)	17 (68%)	8 (32%)	NS
	5-85 (Normal weight)	78(81.2%)	18 (18.8%)	
	85-95 (Overweight)	15 (93.7%)	1 (6.3%)	
	≥ 95 (Obese)	12 (92.3%)	1 (7.7%)	
Age		11.8±4.9	14.8±4.5	0.01
pre-transfusion Hb level		8.1±0.9	8.3±0.8	NS
S. Ferritin		2650.2±2146.5	3396.2±2958.4	NS
Age at 1st transfusion		22.6±32.4	15.6±16.7	NS

Data are presented as N (%) for categorical variables and mean ± SD for continuous variables. NS = not significant. statistically significant results ($p < 0.05$).

Discussion

The present cross-sectional study examined the prevalence of intermediate hyperglycemia and its associated factors in 150 children with transfusion-dependent β-thalassemia (TDT) in Iraq. Intermediate hyperglycemia defined as impaired fasting glucose (IFG) and or impaired glucose tolerance (IGT) was detected in 28 patients (18.5%), of whom 15(10.7%) had isolated IGT and 13(8.1%) had isolated IFG. The remaining 122 children (81.5%) maintained normoglycemia. This consistent with study in Turkey which revealed that impaired fasting glucose (IFG) was observed in 10.7%, impaired glucose tolerance (IGT) in 3.6%, and 85.7% had normal glucose regulation[19]. A 2024 review of endocrine complications in β-thalassemia major estimated the pooled prevalence of abnormal glucose metabolism (including prediabetes and overt diabetes) at approximately 20–26% across published series, though estimates vary considerably with patient age, chelation quality, and screening methodology[12]. The rate observed in our cohort 18.5% for prediabetes specifically, with no cases of overt diabetes mellitus likely reflects the relatively younger age of a purely pediatric Iraqi sample compared to adult-predominant cohorts in the literature.

The most statistically significant finding in this study was the association between older age and intermediate hyperglycemia. Children in the hyperglycemic group had a significantly higher mean age (14.8 ± 4.5 years) compared to normoglycemic children (11.8 ± 4.9 years; $p = 0.01$). study done by Abdul Alamir Mezher concluded that patient age and duration of the disease should be taken into account when considering hyperglycemia causes in children with transfusion-dependent β-thalassemia[19]. .

This relationship is well-established in the pathophysiology of thalassemia-related glucose dysregulation. Iron accumulates in the pancreatic parenchyma progressively over years of regular transfusion, and the resultant β-cell toxicity manifests clinically only after a threshold of damage is reached a process that typically takes a decade or more in well-chelated patients[8]. De Sanctis et al., in a 12-year longitudinal study of β-TDT patients, demonstrated that glucose dysregulation develops insidiously, with prediabetic states appearing years before overt diabetes, and that older age at any given evaluation was consistently associated with more advanced glycemic impairment. The ICET-A network recommends annual OGTT screening starting from age 10 years in TDT patients, a threshold that, in our cohort, separates the age ranges where glucose dysregulation begins to manifest. The result again indicates applied message for Iraqi thalassemia locations: children need discriminating metabolic concentration even when ferritin standards seem misleadingly steady.

Children getting unequal iron chelation treatment had a meaningfully advanced proportion of transitional hyperglycemia (29.1%) associated to those on steady chelation (11.4%; p = 0.007). This finding — the only statistically significant association apart from age has direct and immediate implications for clinical practice. Iron chelation therapy is the principal modifiable determinant of pancreatic iron burden; its protective effect on β-cell function is well-documented. A systematic review of adherence to ICT in children and adolescents with thalassemia published in 2022 found that non-adherence rates ranged from 21% to 47.5% depending on route of administration and measurement method[20]. Poor adherence was consistently associated with higher iron burden and worsened end-organ outcomes[21]. Our data add glucose dysregulation to that list of consequences in a pediatric Iraqi population. Given that the type of chelator used did not reach statistical significance in this study, it appears that the consistency of chelation — rather than the agent chosen — drives glycemic risk at this age[22]

In this study, the type of chelating agent used — categorized as oral (predominantly deferasirox and/or deferiprone), injectable (deferoxamine), compound/combination, or none, did not reach statistical significance in determining the rate of intermediate hyperglycemia (p = NS). Notably, patients on injectable deferoxamine had a numerically higher rate of hyperglycemia (27.2%) compared to those on oral chelation (18.8%), and both patients on combination therapy maintained normoglycemia, though the small numbers in these subgroups preclude definitive conclusions. The lack of statistically significant difference between chelator types is in keeping with findings from several comparative studies that have found broadly similar metabolic outcomes between deferoxamine, deferiprone, and deferasirox when used consistently. A practical experience study in the year 2024 found that the overview of oral chelators enhanced comprising glucose metabolism, were more firmly connected to the period and orderliness of chelation than to the study of choice[23]. This strengthens the clarification that observance and accumulative chelation chiefly regulates glycemic danger in pediatric TDT.

Serum ferritin was numerically higher in the hyperglycemic group (3396.2 ± 2958.4 ng/mL) compared to the normoglycemic group (2650.2 ± 2146.5 ng/mL), but the difference did not achieve statistical significance (p = NS). The study done by Evi Dewiyanti revealed as there was no statistically significant link between ferritin levels and glucose metabolism abnormalities[24] Recent imaging studies using T2-MRI have shown that patients with excess pancreatic iron are at greater risk of developing blood glucose disturbances than patients with pancreatic iron deficiency, even when ferritin levels are similar[25] This indicates that long-term iron balance, rather than the recent iron status, which is represented by serum ferritin, is related to the development of glucose metabolism disorders. Serum ferritin reflects total body iron stores while pancreatic iron deposition can be disproportionately elevated even when ferritin values appear only moderately raised. It is also possible that the sample size was insufficient to detect a modest but real ferritin difference, given the wide standard deviations in both groups suggesting substantial heterogeneity in iron burden within each category. Hepatitis C virus (HCV) co-infection was present in 13.7% of the total cohort, with a numerically higher prevalence of hyperglycemia in HCV-positive children (23.8%) compared to HCV-negative children (17.8%), though this did not reach statistical significance (p = NS).

The directional trend for HCV is consistent with the well-established hepatogenous diabetes mechanism: HCV-induced hepatic inflammation promotes insulin resistance through impaired hepatic glucose uptake, TNF-α mediated IRS-1 phosphorylation, and suppression of hepatocyte insulin signaling. In Iraqi thalassemia patients, HCV co-infection rates of 13.5% have been documented nationally a legacy of prescreening transfusion practices and this subgroup warrants particular metabolic vigilance. The failure to reach significance here may reflect limited statistical power in the HCV-positive subgroup (n = 21 in the entire cohort) rather than a genuine absence of effect.

Placing our findings within the broader literature, the 18.5% prevalence of intermediate hyperglycemia in our Iraqi pediatric cohort is lower than rates reported in some older or mixed-age series but comparable to recent pediatric-specific studies. A 2026 study of TDT children using OGTT found IFG 10.7%, IGT 3.5% of the pediatric age group, No significant association was found between ferritin and OGTT values ($p>0.05$)[26] An Egyptian study of 100 children with β-TM published in 2024 reported glucose intolerance (IFG or IGT) in 32% of patients, a higher rate likely reflecting a broader age range and older mean age in that cohort[27] meanwhile, a small Indian prospective study reported a 10% prevalence of hyperglycemia among 60 thalassemia children lower than ours possibly reflecting differences in chelation access or disease severity distribution[28] These inter-study variations underscore the importance of locally generated prevalence data, since the burden of intermediate hyperglycemia in any given center is shaped by center-specific chelation practices patient demographics, and regional disease genetics.

The quantifiable implication of these results comprise: First and urgent chelation regularity and must be preserved as a metabolic (not just hematological) conclusion. In Iraqi thalassemia may intrude therapy, the glycemic results recorded offered a defined and communicable debate to improve observance that supports systems. Second, age-inclined OGTT transmission suggested by ICET-A from age basic year of 10 desires methodical execution in most Iraqi cores; the actual mean age of the hyperglycemic cluster (14.8 years) recommends the metabolic transmission, a substantial quantity may previously have recognized transitional hyperglycemia. Previous broadcast is necessary, chiefly in children with uneven chelation antiquities or ferritin standards above 2,500 ng/mL. Third, the absence of a significant ferritin-glucose association in this study should not deter clinicians from using ferritin as a risk stratification tool in settings without MRI access ferritin trends over time are arguably more informative than single-point values.

Limitations of the present study: The cross-sectional design precludes causal inference; we cannot determine whether irregular chelation preceded and caused glycemic impairment, or whether other confounders explain the association. The classification of chelation as 'regular' versus 'irregular' was based on self-report and clinical records rather than objective measures such as drug refill rates or electronic adherence monitoring, introducing potential misclassification bias. Pancreatic iron quantification by MRI was unavailable for this cohort, limiting mechanistic interpretation.

Conclusion and Recommendation

Intermediate hyperglycemia was identified in 18.5% of Iraqi children with transfusion-dependent thalassemia. Older age and uneven iron chelation treatment appeared as the key forecasters, while other scientific issues displayed no sovereign relationship. These results highpoint that guaranteeing dependable iron chelation to diminish the jeopardy of glucose dysregulation and development to diabetes, predominantly in resource-constraint situations where progressive pancreatic evaluation is lacking. Imminent longitudinal analysis with objective observance dimension, pancreatic MRI of which practicable, and full 2-hour OGTT with insulin dimension required to form casual paths and lead the needed screening guidelines for the Iraqi TDT pediatric populace.

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