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Respiratory Functions, Physical Activity and Quality of Life in A Child with Iron Deficiency Anemia: An Evaluation-Case Report

Demir Eksikliği Anemisi Olan Bir Çocukta Solunum Fonksiyonları, Fiziksel Aktivite ve Yaşam Kalitesi: Bir Değerlendirme- Vaka Raporu

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ÖZET

Çocukluk çağı demir eksikliği anemisi (DEA), yorgunluk ve solunum problemlerine neden olan dünya çapında en yaygın hastalıklardan biridir. Çocukluk çağı DEA'sının bu olumsuz semptomları yaşam kalitesini önemli ölçüde etkilemektedir. Bu olgu sunumunda, DEA'da solunum fonksiyonları, fiziksel aktivite ve yaşam kalitesinin değerlendirilmesi amaçlanmıştır. On yıl önce çocukluk çağı DEA tanısı konulan 13 yaşında bir kız çocuğu hastaneye yatırıldı. Hastanın demografik bilgileri ve hemogram değerleri kaydedildi. Solunum fonksiyon testleri (SFT), solunum kas gücü (SKG) ve 6 dakika yürüme testi (6DYT) yapıldı. Fiziksel aktivite ve yaşam kalitesi sırasıyla Çocuklar İçin Serbest Zaman Aktivite Anketi (ÇSZAA) ve Pediatrik Yaşam Kalitesi Envanteri ile değerlendirildi. Hastanın SFT'leri, SKG ve 6DYT değerleri beklenenden düşüktü. Ek olarak, hastanın yaşam kalitesi olumsuz etkilenmiştir. Bu olgu sunumu, çocukluk çağı DEA hastalarının medikal tedaviye ek olarak fizyoterapi değerlendirmesinden geçmesi ve pulmoner rehabilitasyon programlarına dahil edilmesi gerektiğini göstermektedir.

Anahtar Kelimeler: Anemi, Olgu Sunumu, Egzersiz, Yaşam Kalitesi, Solunum Fonksiyon Testleri.

ABSTRACT

Childhood iron deficiency anemia (IDA) is one of the most common disorders worldwide, causing fatigue and respiratory distress. These negative symptoms of childhood IDA significantly affect the quality of life (QoL). This case report aims to evaluate pulmonary function, physical activity, and QoL in IDA. A 13-year-old girl diagnosed with childhood IDA ten years ago was admitted to the hospital. The patient's demographic information and hemogram values were recorded. Respiratory function tests (PFTs), respiratory muscle strength (RMS), and a 6-minute walk test (6MWT) were performed. Physical activity and QoL were assessed with the Children's Leisure Activities Study Questionnaire (CLASS) and Pediatric Quality of Life Inventory™ (PedsQL) 4.0, respectively. The patient's PFTs, RMS, and 6 MWT values were lower than expected. Additionally, the patient's QoL was negatively affected. This case report suggests that patients with childhood IDA should undergo physiotherapy evaluation in addition to medical treatment and be included in pulmonary rehabilitation programs.

Keywords: Anemia, Case Report, Exercise, Quality of Life, Respiratory Function Tests.

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INTRODUCTION

Anemia is a condition that can be caused by nutritional deficiencies, chronic diseases, and parasitic infections. It is characterized by variations in red blood cell values and insufficient oxygen-carrying capacity to meet the body's physiological needs (1).

Iron deficiency anemia (IDA) is the most prevalent form of anemia, affecting 16.42% of children globally (2).

IDA arises when the body cannot obtain iron from its stores, which is necessary for hemoglobin synthesis. This results in the consumption of more phosphocreatine in the muscles, leading to muscle fatigue (3).

IDA can cause dyspnea, mental and physical fatigue, and a decrease in daily quality of life (QoL) (4). This decrease is due to a decrease in functional capacity (5). Oral iron therapy, blood transfusion, and intravenous iron therapy are frequently employed in the treatment of iron deficiency anemia, which has a significant impact on quality of life. However, there is a paucity of referrals to physiotherapy, which may be due to the physical impact of the condition being underestimated.

It has been demonstrated that exercise and physical activity can lead to an increase in haemoglobin levels (6). Consequently, the incorporation of physiotherapy techniques into the management of childhood IDA may prove beneficial in enhancing the patient's quality of life and reducing the severity of clinical symptoms. In light of the aforementioned evidence, the objective of this case report is to highlight the necessity of physiotherapy in the context of iron deficiency anemia. To elucidate the potential benefits of physiotherapy in this clinical context, we provide a comprehensive description of the patient's demographics, respiratory muscle strength values, pulmonary function values, blood values, quality of life, and physical activity level.

CASE INTRODUCTION

A 13-year-old girl, diagnosed with childhood IDA ten years ago and treated with medication, presented at the university hospital in the region. The patient was referred to physical therapy due to complaints of shortness of breath and fatigue during physical activity and daily life.

Table 1 shows the patient's demographic information, while Table 2 displays their blood levels. The patient's twin sister had IDA, and their mother had alpha thalassemia. The evaluation

included respiratory muscle strength, pulmonary functions, functional capacity, physical activity, and QoL.

Respiratory Muscle Strength

A portable electronic mouth pressure measuring device was used to measure maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP). Table 1 presents the evaluation results of the case.

Pulmonary Functions

The pulmonary function test was conducted using a portable spirometer (miniSpir brand) in accordance with the American Thoracic Society (ATS) and European Respiratory Society (ERS) criteria (7). The recorded values for FEV1, FVC, FEV1/FVC, FEF25-75, and PEF are presented in liters and percentages. Table 1 presents the evaluation results of the case.

Table 1. The Patient's Demographic Information, Respiratory Muscle Strength, and Pulmonary Function Values

	Value
Height (cm)	155
Body Weight (kg)	43
Body Mass Index (percentile)	<3
MIP (cmH_2O / % / expected)	67 / 79.67 / 84.09
MEP (cmH_2O / % / expected)	60 / 38.76 / 110.92
FVC (L / %)	2.17 / 75
FEV_1 (L / %)	2.13 / 83
FEV_1/FVC (L / %)	95.5 / 107
FEF_{25-75} (L / %)	3.7 / 116
PEF (L / %)	4.41 / 77

MIP: Maximum inspiratory pressure; MEP: Maximum expiratory pressure; cm: centimetre; kg: kilogram; cmH_2O: centimetre water; L: Liter; FVC: Forced vital capacity; FEV_1: Forced expiratory volumes in one second; FEV_1/FVC: Forced expiratory volumes in one second / Forced vital capacity; FEF_{25-75}: Forced expiratory flow; PEF: Peak expiratory flow

Table 2. The Patient's Blood Levels

Parameters	Value	Reference Range
RBC (10^6/µL)	**5.16**	3.5-5
HGB (g/dL)	**10.7**	11-15
HCT (%)	**35.5**	37-47
MCV (fL)	**68.7**	80-100
RDW (%)	**17.7**	11-16
MCH (pg)	**20.8**	27-34
MCHC (g/dL)	**30.3**	32-64
FERRITIN (ng/mL)	**1.8**	10-291
CRP (ng)	3.02	0-5
WBC	5.49	4-10
NEU (%)	**43.9**	50-70
LYM (%)	**47.6**	20-40

RBC: Red Blood Cell, HGB: Hemoglobin, HCT: Hematocrit, MCV: Mean Corpuscular Volume, RDW: Red Cell Distribution Width, MCH: Mean Corpuscular Hemoglobin, MCHC: Mean Corpuscular Hemoglobin Concentration, CRP: C-Reactive Protein, WBC: White Blood Cell, Neu: Neutrophils, LYM: Lymphocytes, µL: microlitre, fL: femto liters, g/dL: grams per decilitre, %: percent, pg: picogram, ng: nanogram, ng/mL: nanogram/milliliter.

Functional Capacity

Functional capacity was assessed using the 6-Minute Walk Test (6-MWT). The patient walked along a 30m straight corridor for 6 minutes, and the distance covered was recorded (8).

During the 6-MWT, the participant walked a distance of 570.6 m, which was lower than the expected value. Table 3 shows the pre-test, post-test, and post-test 1-minute values for heart rate, blood pressure, respiratory frequency, oxygen saturation, and fatigue.

Pediatric Quality of Life Inventory™ (PedsQL) 4.0

This is a general QoL scale that assesses the physical and psychosocial experiences of children, independent of their medical condition (9). The Turkish version of the questionnaire, which has been validated and shown to be reliable, was used in this study (10). The scale yields a total score ranging from 0 to 100, with a higher score indicating a better QoL. The scoring process involves three areas: the scale total score, the physical health total score, and the psychosocial health total score. The psychosocial health total score is calculated by evaluating item scores related to emotional, social, and school functionality. Table 3 presents the evaluation results of the case.

Physical Activity

The Turkish version of the Children's Leisure Activity Study Survey (CLASS), which has proven validity and reliability, was used to assess physical activity. It consists of 44 questions, including 30 questions on physical activity and 14 questions on sedentary behavior (11). The results of CLASS showed that the values for moderate, moderate-intensive, and intensive activity were 28.5, 44.5, and 16 MET/hour, respectively (Table 3).

Table 3. Functional Capacity, Quality of Life, and Children's Leisure Activity Study Survey Scores

		Pre-Test	Post-Test	Post-Test 1 Min
Heart Rate (Beats/Min)		100	126	100
Blood Pressure (mmHg)		110/70	110/80	110/80
Respiratory Frequency (Breath/Min)		20	16	20
Oxygen Saturation		99	99	99
General / Leg Fatigue (0-10)		5 / 3	8 / 4	5 / 2
			Score	
PEDSQL™ Parameters	**Scale Total**		73.91	
	Physical Health Total		71.87	
	Emotional Functioning		65	
	Social Functioning		90	
	School Functioning		70	
	Psychosocial Health Summary		75	
Physical Activity Diary	**Inactive**	**Active**		
		Moderate	**Moderate-Intensive**	**Intensive**
METs/week	116.025	55.1	81.083	25.983
METs/hour	12.9	28.5	44.5	16

PedsQL™: Pediatric Quality of Life Inventory, MET: metabolic equivalent, mmHg: millimeters of mercury.

DISCUSSION

The findings of this case report demonstrate that pulmonary function, functional capacity, quality of life, and physical activity level are adversely affected in children with iron deficiency anemia.

The literature suggests a correlation between low iron levels and respiratory system diseases (12). A study of 445 children found a link between decreased lung function and abnormal iron status (13). In the patient diagnosed with iron deficiency anemia in accordance with the literature, pulmonary function tests demonstrated significantly inferior results in

comparison with healthy peers. Despite the patient's adherence to a standardized medication regimen, the observed MIP and MEP values were markedly inferior to the anticipated norms. This indicates that pulmonary rehabilitation should be considered as an additional treatment alongside drug therapy for iron deficiency anemia.

The literature reports that 52 children diagnosed with anemia had IDA. The study concluded that high RDW and low MCV values are crucial for early diagnosis of IDA (14). In our case, the RDW and MCV values were 17.7 and 68.7, respectively, which are consistent with the literature.

Anemia symptoms and fatigue can decrease an individual's walking distance. In our case, the patient's walking distance of 570 m in the 6-MWT is below the expected average. The presence of anemia and associated fatigue may result in a reduction in the distance that an individual is able to walk. In this case, the patient's distance walked on the 6-minute walk test (6-MWT) was below the expected average, with a distance of 570 meters recorded. This may be attributed to the profound fatigue and inadequate respiration. The patient reported a level of fatigue corresponding to a score of 8 out of 10. The high level of fatigue reported by the 13-year-old child suggests that the negative impact on respiratory function has resulted in a significant reduction in functional capacity.

Iron deficiency anemia can cause a range of symptoms, including weakness, fatigue, loss of appetite, decreased functional capacity, and poor academic performance (15). This symptom can significantly impact a patient's QoL. Our patient reported experiencing fatigue during daily activities, particularly when walking. The symptom of fatigue is believed to be responsible for the low QoL.

Due to anemia, many tissues and organs are affected, as well as skeletal muscle, resulting in fatigue. Depending on the fatigue, the exercise capacity and the QoL of the patient decrease. This, in turn, leads to a decrease in exercise capacity and QoL. At this point, in accordance with the literature, our patient's physical, emotional, school functioning, and psychosocial health summary scores were lower than healthy peers.

According to WHO guidelines, children aged 5-17 years should engage in at least 60 minutes of moderate-to-vigorous physical activity per day (16). Our patient, as a result of CLASS, engaged in an average of 44.5 minutes of moderate physical activity per day, which falls short of the WHO recommendation. Exercise has been shown to promote healthy living and prevent 40 chronic diseases. The molecular mechanism behind the relationship between

exercise and QoL has been explained (17). Exercise has been shown to have a healing effect on laboratory findings. Studies have demonstrated that physical activity can improve iron stores and reduce the incidence of anemia (18). The patient's physical activity level was below the WHO criteria, which may have had a negative impact on disease management. Furthermore, the negative impact on respiratory function, increased fatigue levels, and low functional capacity may contribute to a reduced physical activity level.

CONCLUSION

In this case report, respiratory muscle strength, respiratory function values, functional capacity measured by a 6-minute walk test, pediatric quality of life, and physical activity level were found to be below the expected values in a patient with childhood iron deficiency anemia. It is therefore recommended that medical treatment support applications, such as physiotherapy, be included in the treatment process for patients with childhood iron deficiency anemia, with a view to improving respiratory functions, functional capacity, quality of life, and physical activity level.

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