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Original Article / Özgün Araştırma

Prevalence of malnutrition and influencing factors in children with congenital heart disease

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Abstract

Background/Aim: Malnutrition is associated with increased mortality and morbidity in children with congenital heart disease (CHD). This study aims to demonstrate the factors that increase the incidence of malnutrition and to emphasize the importance of early intervention in patients with congenital heart disease.

Methods: A total of 215 patients with CHD and 242 healthy children admitted to Dicle Universty Pediatric Cardiology Clinic between November 2017 and May 2018 were included in this study. Patients with additional system diseases, dysmorphic appearance or known genetic anomalies, and premature birth or intrauterine growth retardation were excluded from the study. Nutritional statuses of the patients were questioned. The patients were evaluated by echocardiographic and anthropometric data.

Results: Malnutrition was detected in 92 patients in the patient group (42%) and 24 patients in the control group (10%); the difference was statistically significant (p<0.001). Malnutrition was detected in 26 of the 38 cyanotic patients (68.4%), in 66 of the 177 patients without cyanosis (37.2%). The rate of malnutrition was significantly higher among cyanotic patients compared to patients without cyanosis (p<0.001) and compared to the control group (p<0.001). Malnutrition was detected in 16 of the 21 patients with pulmonary hypertension (76%), and among 76 of the 194 patients without pulmonary hypertension (39%) (p<0.001). There was no significant decrease in the rate of malnutrition in patients who underwent surgical treatment compared to the patient group without surgical treatment (p=0.129). No significant increase in malnutrition rate was found in patients with CHD with left to right shunt (p: 0.190)

Conclusion: The rate of malnutrition was significantly higher among children with CHD who had pulmonary hypertension and cyanosis. There was no relationship between corrective surgery, shunting, and malnutrition development.

Keywords: Congenital heart disease, malnutrition, children

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Konjenital kalp hastalığı olan çocuklarda malnütrisyon prevalansı ve etkileyen faktörler

Öz

Giriş/Amaç: Malnütrisyon, konjenital kalp hastalığı (KKH) olan çocuklarda artmış mortalite ve morbidite ile ilişkilidir. Bu çalışmanın amacı malnütrisyon insidansını artıran faktörleri ortaya koymak ve konjenital kalp hastalığı olan hastalarda erken müdahalenin önemini vurgulamaktır.

Yöntemler: Dicle Üniversitesi Çocuk Kardiyoloji kliniğine Kasım 2017 ve Mayıs 2018 tarihleri arasında başvurmuş toplam 215 KKH hastası ve 242 sağlıklı çocuk bu çalışmaya dahil edildi. Ek sistem hastalıkları, dismorfik görünüm veya bilinen genetik anomalileri olan ve prematüre doğum veya intrauterin büyüme geriliği olan hastalar çalışma dışı bırakıldı. Hastaların beslenme durumları sorgulandı. Hastalar ekokardiyografik ve antropometrik verilerle değerlendirildi.

Bulgular: Hasta grubunda 92 hastada (%42), kontrol grubunda 24 hastada (%10) malnütrisyon saptandı; aradaki fark istatistiksel olarak anlamlıydı (p<0,001). Siyanotik 38 hastanın 26'sında (%68,4), siyanozu olmayan 177 hastanın 66'sında (%37,2) malnütrisyon saptandı. Malnütrisyon oranı siyanotik hastalarda siyanozu olmayan hastalara (p<0,001) ve kontrol grubuna (p<0,001) kıyasla anlamlı derecede yüksekti. Pulmoner hipertansiyonu olan 21 hastanın 16'sında (%76) ve pulmoner hipertansiyonu olmayan 194 hastanın 76'sında (%39) malnütrisyon tespit edildi (p<0,001). Cerrahi tedavi uygulanan hastalarda cerrahi tedavi uygulanmayan hasta grubuna kıyasla malnütrisyon oranında anlamlı bir azalma görülmedi (p=0,129). Soldan sağa şantlı KKH hastalarında malnütrisyon oranında anlamlı bir artış saptanmadı (p:0,190)

Sonuçlar: Pulmoner hipertansiyonu ve siyanozu olan KKH'li çocuklarda malnütrisyon oranı anlamlı derecede yüksekti. Düzeltici cerrahi ve şant ile malnütrisyon gelişimi arasında ilişki saptanmadı.

Anahtar kelimeler: Konjenital kalp hastalığı, malnütrisyon, çocuklar.

INTRODUCTION

Different types of cardiac malformation cause different degrees of developmental delay[1]. Three groups of cardiac disorders have been associated with malnutrition in children, one of which are disorders that cause heart failure, including ventricular septal defect (VSD), patent ductus arteriosus (PDA), atrioventricular septal defect (AVSD), congenital heart diseases that cause single ventricle physiology, and certain acquired heart diseases[2,3]. Left to right shunt congenital heart diseases also take an important place in this group[4,5]. Another group consists of heart diseases that cause pulmonary hypertension, and includes many heart diseases, especially certain left-to-right shunt heart diseases. Another group is cyanotic heart diseases. Diseases in this group mainly contribute to malnutrition due to hypoxia and heart failure that develops in some patients[6].

Malnutrition in children with congenital heart disease (CHD) is associated with increased morbidity and mortality, frequent hospitalization, and poor surgical outcomes[2]. The main causes of malnutrition in congenital heart disease are insufficient calorie intake and increased energy requirement. It has been reported that chronic hypoxia leads to anorexia, and dyspnea and tachypnea due to congestive heart failure causes fatigue and decreased food intake in CHD patients[3,7]. Furthermore, increased energy requirement has been reported in critically ill pediatric patients, and cardiac defect on its own is a factor that increases energy requirement[6,8]. Other main causes of malnutrition, including hypoxia, causes related to the gastrointestinal system, frequent infections, and changes in growth hormone and other growth factors have been reported[1,4,7,9].

This study aims to investigate the effects of factors such as cyanosis, pulmonary hypertension, or complete surgical correction

on malnutrition in patients with congenital heart disease.

METHODS

This study included 215 patients who were admitted to the Dicle University Faculty of Medicine Department of Pediatric Cardiology outpatient clinic between November 1, 2017 – May 30, 2018 due to CHD. The control group consisted of 242 children with similar age and gender. Other than heart disease, patients with neurological disease, chronic rheumatological or gastrointestinal system disease, endocrine and metabolic disease, acute or chronic disease of other systems that cause weight loss, patients with dysmorphic appearance or known genetic disease, premature birth or intrauterine growth restriction were excluded from the study.

Parents of all patients were informed about the study and written consent was obtained. Body weight and height of the parents, and birth weight, current body weight, height, and head circumference of the patients were measured. The same instruments were used for body measurements, and measurements were made by the same nurse at the pediatric cardiology outpatient clinic. The anthropometric measurements of the patients found to have malnutrition were also repeated by a pediatric endocrinology research assistant in the child development and endocrinology outpatient clinic, and the repeated measurement data were taken as the basis. The nutritional characteristics of the patients (breastfeeding time, transition to additional foods, diet) were questioned.

After anamnesis and physical examination, 12-lead surface electrocardiography (ECG) and transthoracic echocardiography (ECO) were performed in all patients. Further investigations were made in cases with indications. Patients with malnutrition were evaluated in the pediatric endocrinology and development outpatient clinic, and other pathologies that could cause or accompany malnutrition were evaluated when deemed necessary. Approval was obtained from the Dicle University Medical Faculty Non-Interventional Clinical Research Ethics Committee before the study (25.01.2018/Decision no: 294).

Echocardiographic Evaluation

Echocardiographic evaluation was performed with the same device (Vivid S5 Pro, GE, Horten, Norway, 3-7 MHz phased-array transducer) in all patients. Two-dimensional (2D), M-mode, pulse and color flow Doppler examinations were performed in all patients. Transthoracic echocardiography was performed through at least five windows (apical four-chamber, parasternal long axis, parasternal short axis, subcostal, and suprasternal windows).

Anthropometric Measurements

Body weights and heights of the patients were evaluated. Children under five years of age were weighed on a digital scale, and children over five years of age were weighed on a scale. The height of children under two years of age was measured lying down, and the height of the older children was measured standing on a height meter. The patients were evaluated for the presence of malnutrition using growth curves appropriate for their age. Body weight (kg) / height (m2) formula was used to calculate body mass index (BMI). The following formula was used to calculate the Z-score: (measured value - median value for age and gender) / (standard deviation for age and gender). Those with a body mass index below the 5th percentile were considered malnourished, and those over the 5th percentile were considered normal. Patients were evaluated according to the Gomez and Waterlow classifications.

Gomez classification: Patients of less than 60% of the weight appropriate for their age were classified as severe, patients between 60-74% as moderate, and patients between 75-90% as

mild malnutrition. Patients between 90-110% were considered normal.

Waterlow classification: Patients with less than 95% of appropriate height for their age were evaluated as having chronic malnutrition. They were also grouped as mild, moderate, and severe: height for age 91-95% as mild, 85-90% as moderate, and <85% as severe chronic malnutrition. In the evaluation of weight according to height: 50th percentile weight appropriate for height was found and this value was considered 100%; <70% of this weight was considered severe, 70-80% moderate, 80-90% mild malnutrition, and >90% as normal. Patients of <95% height and <90% weight according to height were considered acute malnutrition associated with chronic disease.

Statistical Analysis

Descriptive statistics and analyses were performed using R version 3.2.3 (2015-12-10) free software by the R Foundation for Statistical Computing. Descriptive statistics were expressed as mean and standard deviation, while categorical variables were expressed as frequency and percentage values. Normality distribution of continuous variables was assessed using the Kolmogorov-Smirnov test. Independent Student's t-test was used to compare mean values of two groups of continuous data with normal distribution, and Pearson's Chi-square test was used to compare frequencies of categorical variables. The value of $p<0.05$ was considered statistically significant.

RESULTS

Mean age was 74.7±54.6 months in the patient group and 74.9±54.6 months in the control group. In terms of gender, 106 (49%) members of the patient group and 117 (48%) members of the control group were female. Mean body weight was 21.1±13.6 kg in the patient group and 22.6±12.2 kg in the control group. There was no significant difference between the patient group and control group according to age or gender. Diagnoses of the 215 patients were as follows:

• The largest group consisted of CHD with shunt (124 patients): The diagnoses of the patients in this group were VSD (n:39), atrial septal defect (ASD) (n:37), PDA (n:20), VSD + ASD (n:11), AVSD (n:9), and VSD + PDA (n:8).

• Thirty patients had VSD, ASD, or PDA accompanied by aortic coarctation (AC) (n:8), aortic stenosis (AS) (n:8), or pulmonary stenosis (PS) (n:14).

• Sixty-one patients were diagnosed with cyanotic CHD. Patients of this group had diagnoses of tetralogy of Fallot (n:32, 20 patients underwent complete surgical correction), transposition of the great arteries (TGA) (n:7, 3 patients underwent complete surgical correction), tricuspid atresia (n:7), single ventricle (n:6), pulmonary atresia (n:5), Ebstein anomaly (n:2) and double-outlet right ventricle (DORV)+VSD (n:1), and interrupted aortic arch (n:1). Twenty-three patients underwent complete surgical correction, while the remaining 38 patients were cyanotic patients who did not undergo surgical treatment or received palliative surgery.

• Twenty-one patients, most of whom had VSD and/or PDA, had pulmonary hypertension; 6 of them were cyanotic.

• Forty-three of the 215 patients were applied complete surgical correction or total transcatheter correction; 172 patients were not applied surgical treatment or were applied palliative surgery. The postoperative follow-up period of these patients was 1- 133 months with a median of 48 months.

Malnutrition was detected in 92 patients in the patient group (42%) and 24 patients in the control group (10%); the difference was statistically significant ($p<0.001$). The duration of breastfeeding was significantly shorter in the

patient group compared to the control group (p = 0.024). Age, gender, anthropometric measurements and other data of the patients and control groups are shown in Table I.

Table I: Comparison of patient and control groups

	Patients (n: 215)	**Control** (n: 242)	**p value*
Age, months	74.7±54.6	74.9±47.5	0.96
Gender, male	109 (51%)	125 (54%)	0.838
Breastfeeding duration, months	15.2±10.2	17.2±8.4	**0.024**
Body weight (kg)	21.1±13.6	22.6±12.2	0.21
Bodyweight, percentile	24.9±26.8	41.4±25.9	**<0.001**
Height (cm)	110±29.2	113.1±27.1	0.24
Height, percentile	29.8±28.4	43.4±26.8	**<0.001**
Body mass index	15.6±2.5	16.2±2.1	**0.004**
Body mass index (percentile)	29.5±28.9	41.9±27.8	**<0.001**
Body mass index Z-score	-0.8±1.2	0.16±6.6	**0.04**
Body weight/ideal weight	86.9 ±16.3	96.1±13.1	**<0.001**
Weight according to height	94.5±13.7	98.9±11.2	**<0.001**
Height according to age	95.9±5.2	98.5±4.6	**<0.001**
Malnutrition presence	92 (42.7%)	24 (10%)	**<0.001**
Acute malnutrition	46 (37.3%)	33 (56.8%)	**<0.001**
Chronic malnutrition	38 (30.8%)	19 (32.7%)	
Acute malnutrition associated with underlying chronic disease	39 (31.9%)	6 (10.5%)	

**The value of p<0.05 was considered statistically significant. (Pearson Chi-Square tests were used to compare the frequencies of categorical variables.)*

According to the Gomez classification, malnutrition was detected in 129 patients in the patient group (60%) and 79 patients in the control group (32%) (p <0.001). According to the Waterlow classification, malnutrition was detected in 123 members of the patient group (57%) and 58 members of the control group (24%) (p <0.001). Distribution of the severity of malnutrition according to the Gomez and Waterlow classification systems is presented in Table II.

Table II: Comparison of patient and control group according to Gomez and Waterlow classifications

Malnutrition		Groups		*p value
		Patient (n: 215%)	Control (n: 242%)	
Gomez	None	86 (40%)	163 (67.3%)	
	Mild	76 (35.3%)	71 (29.7%)	**<0.001**
	Moderate	49 (22.7%)	6 (2%)	
	Severe	4 (0.2%)	2 (1%)	
Waterlow	None	92 (42.7%)	184 (76%)	
	Mild	70 (32.5%)	44 (18.1%)	**<0.001**
	Moderate	44 (20.4%)	10 (4%)	
	Severe	9 (4.4%)	4 (1.9%)	

**The value of p<0.05 was considered statistically significant. (Independent Student's t was used to compare the means of two groups in continuous variables with normal distribution)*

Thirty-eight (17%) patients had cyanosis. Malnutrition was detected in 26 of the 38 cyanotic patients (68.4%), in 66 of the 177 patients without cyanosis (37,2%), and in 24

subjects in the control group (10%). The rate of malnutrition was significantly higher among cyanotic patients compared to patients without cyanosis (p<0.001) and compared to the control group (p<0.001). Comparison between the patients and the control group according to cyanosis is shown in Table III.

Table III: Comparison of groups according to cyanosis

	Cyanotic patients (A; n: 38, 17.6%)	Acyanotic patients (B, n: 177, 82.3%)	Control group (C; n: 242)	*p (A-C)	*p (B-C)	*p (A-B)
Age, months	57.4±54.1	75.8±54.2	74.9±47.5	0.39	0.87	**0.031**
Breastfeeding duration, months	9.6±9.2	16.4±9.7	17.2±8.4	**<0.001**	0.39	**0.034**
Body weight (kg)	16.1±12.2	21.7±13.9	22.6±12.2	**0.003**	0.51	**0.013**
Body weight (percentile)	13.7±22.3	27.1±27.2	41.4±25.9	**<0.001**	**<0.001**	**0.004**
Height (cm)	97.5±27.9	111.1±29.9	113.1±27.1	**0.001**	0.52	**0.004**
Height (percentile)	15.9±18.6	31.7±29.8	43.4±26.8	**<0.001**	**<0.001**	**0.001**
Body mass index	15±3.2	15.7±2.4	16.2±2.1	**0.003**	**0.04**	0.114
Body mass index (percentile)	22.4±30.4	31.6±29	41.9±27.8	**<0.001**	**0.001**	0.096
Body mass index (Z-score)	-1.20±1.49	-0.71±1.15	0.16±6.60	**<0.001**	**<0.001**	**0.028**
Body weight/ideal weight	80.6±17.2	87.9±16.3	96.1±13.1	**<0.001**	<**0.001**	**0.009**
Weight according to height	91.6±18.3	95.5±13.4	98.9±11.2	**0.02**	0.12	0.145
Height according to age	93.8±3.9	96.2±5.5	98.5±4.6	**<0.001**	**<0.001**	**0.006**
Malnutrition presence	26 (%68)	66 (%37.3)	24 (%10)	**<0.001**	**0.001**	**<0.001**

**The value of p<0.05 was considered statistically significant. (Pearson Chi-Square tests were used to compare the frequencies of categorical variables)*

According to the Gomez classification, the severity of malnutrition among patients with cyanosis was as follows: 36% had mild, 34% moderate, and 6% severe malnutrition. According to the Waterlow classification, 42% of cyanotic patients had mild malnutrition, 34% moderate, and 6% severe malnutrition. Ten of the cyanotic patients had acute malnutrition (26%), 10 had chronic malnutrition (26%), and 11 had acute malnutrition associated with chronic disease; while among patients without cyanosis, 25 had acute (14%), 24 chronic (14%), and 24 acute malnutrition associated with underlying chronic disease (14%).

Malnutrition was detected in 16 of the 21 patients with pulmonary hypertension (76%), and among 76 of the 194 patients without pulmonary hypertension (39%) (p<0.001). The rate of malnutrition was significantly higher among patients with pulmonary hypertension compared to the control group (p<0.001). According to the Gomez classification, among the 21 patients with PH, two had mild malnutrition (9%), 14 moderate (67%), and one severe malnutrition (5%), while five patients had acute malnutrition (24%), three chronic (14%), and 10 acute malnutrition associated with underlying chronic disease.

Data of the patients with and without complete surgical correction and the control group is presented in Table IV. Body weight, height, and BMI values were significantly higher in patients who underwent complete surgical correction compared to patients without complete surgical correction, while there was no significant difference in terms of malnutrition rate (p=0.129). There was no significant difference between patients with and without complete surgical correction in terms of evaluation made

according to Gomez and Waterlow classifications.

Table IV: Comparison of groups with and without complete correction

	Patient group without complete correction (A) (n=172, 80%)	Patient group with complete correction (B) (n=43, 20%)	Control group (C) (n=242)	*p (A-C)	*p (B-C)	*p (A-B)
Age, months	68.8±54.4	80.4±54.7	74.9±47.5	0.26	0.50	0.106
Breastfeeding duration, months	14.3±9.8	16.7±10.3	17.2±8.4	**0.005**	0.72	0.324
Body weight (kg)	19.3±13	23.8±15.3	22.6±12.2	**0.01**	0.62	0.186
Body weight (percentile)	22.7±27.1	28.3±25.6	41.4±25.9	**<0.001**	**0.03**	0.380
Height (cm)	106.2±29.5	113.9±30.9	113.1±27.1	**0.025**	0.85	0.058
Height (percentile)	27.2±27.9	31.3±30	43.4±26.8	**<0.001**	0.07	0.112
Body mass index	15.3±2.6	16.3±2.5	16.2±2.1	**<0.001**	0.90	0.799
Body mass index (percentile)	27.1±29.6	36.9±28.1	41.9±27.8	**<0.001**	0.28	0.910
Body mass index (Z-score)	85±16.6	90.2±16.8	96.1±13.1	**<0.001**	**0.01**	0.576
Body weight/ideal weight	93.3±14.9	98.6±13.2	98.9±11.2	**<0.001**	0.85	0.877
Weight according to height	95.6±5	95.7±6.1	98.5±4.6	**<0.001**	**0.008**	0.100
Malnutrition presence	78 (%45)	14 (%33)	24 (%10)			0.129

**The value of p<0.05 was considered statistically significant. (Pearson Chi-Square tests were used to compare the frequencies of categorical variables).*

Malnutrition was detected in 21 of the 59 patients who did not have cyanosis and/or pH, were not applied complete surgical or total transcatheter correction but with significant left-to-right shunt (35.5%). Malnutrition was also detected in 71 of the 156 patients without shunt (45.5%). There was no significant difference between patients with and without left-to-right shunt in terms of malnutrition rate (p=0.190).

DISCUSSION

Congenital heart disease has an important place among heart diseases detected in the pediatric age group. Children with congenital heart disease are at high risk of developing malnutrition due to high basal metabolic rates, high energy requirement, and low energy intake[1]. Although birth weight of these children is normal, in later periods, decreased weight gain leading to malnutrition occurs depending on the location and extent of the defect[1]. The prevalence of malnutrition in children with CHD has been reported to be between 27-90.4% [2,3,5,10-12]. Malnutrition was detected in 60% of the patients in our study.

In our study, we found that duration of breastfeeding was significantly shorter among the patients compared to the control group. It has been reported that early weaning from breastfeeding may be due to fatigue while breastfeeding, and may be an early indicator of CHD2. In addition, breastfeeding reduces food intolerance that develops secondary to congenital heart disease, especially intestinal congestion[13]. Breast milk is tolerable and well absorbed by the intestinal mucosa; however, it may not provide enough calories. Various studies have shown that the use of high-concentration formulas for support may reduce developmental retardation in patients with CHD[14].

Different types of congenital heart diseases cause different levels of malnutrition. Chronic hypoxia is a greater indicator of growth retardation than pulmonary hypertension in cyanotic patients[1]. Cameron et al.[15] reported

that malnutrition was more common in patients with congestive heart failure and cyanosis. The finding of a positive relationship between serum IGF-1 levels and oxygen saturation in cyanotic CHD is indicative that chronic hypoxia reduces serum IGF-1 levels[16]. One study showed that bone age was significantly retarded in cyanotic CHD patients[17]. Unlike acyanotic CHD, in cyanotic CHD, both height and weight retardation are present[3,15]. Okoromah et al. [2] reported that low arterial oxygen saturation was one of the predictors of malnutrition in children with CHD. Villasís-Keever et al.[18] reported that cyanosis was a significant risk factor for malnutrition, regardless of PH, in children with CHD. In our study, we detected malnutrition in 81.5% of the 38 patients with cyanosis.

Malnutrition is more common among patients with pulmonary hypertension compared to those without PH. Oxygen requirement increases because of hypertrophy development in the right ventricle that works against high pulmonary resistance, requiring higher energy consumption because of chronic cellular hypoxia[19]. As a result of hypoxia, food cannot be adequately broken down. The absorption of nutrients is reduced. Edema forms in intestinal mucosa due to heart failure, affecting the intestinal wall and congestion in the splanchnic region causes malabsorption[20]. Hypoxia and edema that develops in the gastrointestinal system cause malabsorption and gastroesophageal reflux[7]. Menon et al. 19 demonstrated that patients with congestive heart failure and PH had high resting oxygen consumption and used more basal metabolic energy than healthy children, and had less energy left for fat storage. Varan et al. [3] showed that the presence of PH is the most important factor affecting nutrition and growth in children with CHD, and that 56% of patients with cyanotic have moderate-severe malnutrition. Altın et al.[1] detected malnutrition in 172 patients with pH, and 17.2% of 87 patients without PH. In our study, we determined that 85% of the 21 patients with PH had malnutrition.

Increased time without surgery in CHD requiring surgical treatment has adverse effects on growth. Rhee et al. reported that growth significantly increased after operation in ASD patients[21]. Left-to-right shunt patients who are not applied surgical correction experience frequent lung infections and are frequently hospitalized, leading to malnutrition. Cil et al.[22] reported that the main causes of malnutrition in left-to-right shunt CHD patients receiving anti-congestive treatment were inadequate nutrition and frequent lower respiratory tract infections. However, improvement in malnutrition after surgical correction is not only associated with surgical treatment, but is affected by many factors. Vaidyanathan et al. [10] stated that malnutrition continued after surgery in a significant portion of the patients, and this may be related to birth weight, parental height and weight measurements, and nutritional status before surgery. Maximum catch-up growth occurs in the first year. Studies from developed countries show that catch-up growth is mostly completed within two years after surgery[23]. This may suggest that growth is less influenced by the cardiac condition itself after a certain period after correction and that environmental, dietary, and genetic factors may be more important once the cardiac condition is corrected. In our study, although body weight, height, and body mass index were improved in patients who underwent surgical treatment, we found that there was no significant increase compared to patients who did not receive surgical treatment. More accurate data can be obtained with longer follow-up of the patients. The postoperative follow-up period of these patients was 1- 133 months with a median of 48 months. In addition, we believe that improvement of malnutrition in the

postoperative period is not only associated with the operation, but that other accompanying factors also play a role.

Patients with systemic-pulmonary shunt are at high risk of splanchnic ischemia and necrotizing enterocolitis[24,25]. These factors may contribute to malnutrition. In our study, we did not find a significant increase in malnutrition risk in patients with left-to-right shunt compared to the control group. This may be attributed to the early medical or surgical treatment of the patients. In addition, the absence of pulmonary hypertension and/or hypoxia, which are important risk factors for malnutrition in these patients, may explain the lower malnutrition rates.

CONCLUSION

Malnutrition was more common among children with CHD compared to the control group. Malnutrition was especially more common among CHD patients with cyanosis and pulmonary hypertension compared to patients without cyanosis or PH. While there was no significant decrease in malnutrition rate among patients who underwent surgical treatment, longer follow-up is required to evaluate the effect of surgical treatment on the frequency of malnutrition. Malnutrition risk is lower in left-to-right shunt CHD patients without accompanying cyanosis or pulmonary hypertension.

Notes

The prevalence of malnutrition is higher in children with congenital heart disease compared to the control group.

The risk of malnutrition increases in the presence of cyanosis or pulmonary hypertension. Malnutrition risk is less in congenital heart diseases with left-to-right shunts not accompanied by cyanosis or pulmonary hypertension.

Determining malnutrition frequency and its factors in children with congenital heart disease may contribute to the literature.

Ethics Committee Approval: Approval was obtained from the Dicle University Medical Faculty Non-Interventional Clinical Research Ethics Committee before the study (25.01.2018/Decision no: 294).

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