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Myocarditis in children and adolescents: a literature review

Zapalenie mięśnia sercowego u dzieci i młodzieży — przegląd piśmiennictwa

Agnieszka Tomik, Anna Chanas, Bożena Werner

Clinic of Paediatric Cardiology and General Pediatrics, Warsaw Medical University, Warszawa, Poland

Abstract

Myocarditis is defined by the World Health Organization as an inflammatory disease involving cardiomyocytes, interstitial tissue, vessels and occasionally the pericardium. In this article, literature from the past 5 years regarding epidemiology, diagnostic tests, treatment and prognosis in myocarditis in young children and adolescents was analyzed. For this purpose the Pubmed database was screened using the key words "myocarditis" and "children", yielding 117 articles. This list of was narrowed down to those in which the study group consisted of at least 5 people and included information about: symptoms and signs, abnormalities in additional tests, etiology, treatment, length of hospitalization and mortality. Finally, the review included 17 studies, describing 1891 children with a diagnosis of myocarditis. The analysis shows that myocarditis is a rare disease. Two peaks of the disease are observed: the first in newborns and infants, the second one in adolescents. Age less than 2 years is a predictor of severe prognosis. In reported cases the most common symptoms were: fatigue, chest pain, palpitations or irregular heart rhythm. Tachycardia, tachypnoe, hypotension and hepatomegaly dominated among findings in physical examination. The interview, the result of physical examination and additional tests (troponin levels, electrocardiogram, echocardiogram) are helpful in making a diagnosis. Cardiac magnetic resonance imaging is used to confirm the diagnosis. In the analyzed group, 65–90% of children were treated in the Intensive Care Unit. Extracorporeal membrane oxygenation was used in 168 cases, a ventricular assist device was implanted in 35 children and 38 children underwent heart transplantation. The mortality rate in myocarditis remains high (25–35% in analyzed studies). Up to 25% of children may develop chronic heart failure. Due to the unpredictable course of this disease, patients in the acute period of the disease should be hospitalized, and after being discharge from the hospital undergo further cardiological check-up.

Key words: myocarditis, heart failure, children, adolescents

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Introduction

Myocarditis is a disease of varied etiology and course — from asymptomatic to fulminant — which can quickly lead to the death of the patient. According to the World Health Organization (WHO), myocarditis is defined as an inflammatory disease involving cardiomyocytes, intersitial tissues, vessels and sometimes also the pericardium. It is diagnosed on the basis of histological (*i.e.* the Dallas criteria), immunological (anticardiac antibodies) and immunohistochemical criteria.

The diagnostic procedure is based on the criteria for clinical suspicion of myocarditis developed by the Working Group on Myocardial and Pericardial Diseases of the European Society of Cardiology in 2013 [1], while in cardiovascular magnetic resonance (CMR) myocarditis is diagnosed on the basis of the Lake Louis criteria [2, 3]. Treatment of myocarditis should be mainly focused on inhibiting

Address for correspondence: prof. dr hab. n. med. Bożena Werner, Klinika Kardiologii Wieku Dziecięcego i Pediatrii Ogólnej, Warszawski Uniwersytet Medyczny, ul. Żwirki i Wigury 63a, 02–091 Warszawa, Poland, e-mail: bozena.werner@wum.edu.pl

cardiomyocyte damage. All patients in acute phase of the disease should limit their physical activity to a minimum (bed regime). It is believed that in myocarditis of viral etiology physical effort may increase the replication of the virus. The mortality rate of myocarditis is high and is estimated at 25% in children and as much as 75% in infants [4, 5]. In addition, constant deterioration of myocardial function with progression to dilated cardiomyopathy is observed in approximately 25% of patients after myocarditis.

The aim of the paper was to analyze the literature on the course of myocarditis in children and adolescents, published within the last 5 years.

Materials and methods

A review of a medical database, Pubmed, with the use of key words children and myocarditis was performed. The search strategy enabled the obtaining of 117 articles in total. The following inclusion criteria were adopted: study group involving at least 5 children, containing demographic data, prodromal symptoms, clinical symptoms, myocardial damage markers [troponin, B-type natriuretic peptide (BNP)/N-terminal pro-B-type natriuretic peptide (NT-proBNP)] and deviations in imaging: chest X-ray, electrocardiography (ECG)/Holter ECG, echocardiography (ECHO), CMR i endomyocardial biopsy (EMB), determination of etiological factors and description of the applied treatment broken down into pharmacological treatment of heart failure, mechanical respiratory and circulatory support, the application of intravenous infusions of immunoglobulins (IVIg) and steroids, the time of hospitalisation and data on the number of deaths. Final analysis included 17 articles published between the years 2015 and 2020.

Results

In total, the summary covers 1,891 children diagnosed with myocarditis (Table 1) [6–22]. It is, therefore, a rare disease. It is estimated that the disease occurs in one or two children per 100,000 annually. Usually, two peak incidences are observed. The first takes place in the neonatal period and early infancy, and the second — during puberty [6–13]. According to Rodriguez et al. [12], the age < 2 is a factor of poor prognosis. The disease most often affects boys, especially in older groups; they constitute 52–60% of patients. According to Matsuura et al. [14], the trend is not characteristic in early infancy. The cited authors indicate that the course of myocarditis is more severe in girls, and Wu et al. [15] demonstrate that extracorporeal membrane oxygenation [ECMO] is more frequently used in boys than girls.

Prodromal symptoms of acute myocarditis occur a couple or a dozen or so days earlier. As works by Howard et al. [12] and Rodriguez-Gonzalez et al. [13] indicate, history of respiratory infection or gastritis plays a very important role in the diagnosis of the disease. Symptoms of respiratory infection — cough, difficulty breathing, dyspnea — is observed in 57–84% of children, in 20–60%, especially younger ones, vomiting or other dyspeptic symptoms. Fever occured in 28–68% of patients (in 100% children with myocarditis, in the course of the flu). Older children had breathing difficulties, and in primarily reported intolerance to physical effort and weakness (12–73%). Chest pain was observed in 12–53% of patients, fainting occurred in 1–15% and the sense of uneven heartbeat and palpitation was reported by 5–53% of children. On admission to hospital, the most frequently observed deviations on physical examination were: tachypnoe 18–68% and tachycardia, observed in over 50% of patients, and in some groups in 90% of patients. Other symptoms included: hypotension in 24–51% of patients, hepatomegalia — in 28–58%, more rarely murmur above the heart and peripheral oedema, and irregular heartbeat with accompanying arrhythmia. Signs of cardiogenic shock and respiratory failure were observed in children with fulminant myocarditis.

Further proceedings in patients with suspected myocarditis consisted in the estmiation of the level and severity of myocardial damage in subsequent examinations such as: myocardial damage markers, ECG, chest X-ray and ECHO. Determination of the concentration of troponins, released during cardiomyocyte damage, was necessary for the diagnosis. At the time of admission, they were released in 62–100% of children. They are observed in the majority of children with myocarditis, however, their presence does not always correlate with the degree of the damage and further prognosis and normal does not rule out inflammation. As the observations made by Butto et al. [16] indicate, children with higher troponin concentration more frequently required treatment with the use of ECMO, but there was no such correlation with the level of their mortality. The concentration of BNP or NT-pro-BNP was another marker of cardiovascular performance that was evaluated. It was significantly elevated in more than 50% of patients. In the assessment of Rodriguez-Gonzales et al, the values of NT-pro-BNP exceeding 2,000, especially 5,000 pg/mL, should be considered as a factor of poor prognosis [12]. According to clinicists, monitoring of the concentration of the peptide is particularly useful in the assessment of the applied treatment.

In approximately 90% of children hospitalized due to myocarditis, abnormalities in ECG were observed. Most frequently, it was sinus tachycardia (in 64–85%), and in 50% — repolarization abnormalities [6–22]. These changes are similar to changes occuring in patients with acute coronary syndrome (ACS). Further evolution thereof is also similar. Other deviations recorded in ECG included: low QRS voltage and signs of atrial and/or ventricular hypertrophy. Abnormalities of the electrocardiogram are non-specific; they vary

Table 1. Data on age and sex, clinical picture, and abnormalities in additional examinations of children with myocarditis

Author Year of publication Main topic Country	Patients N = number Age Sex	Medical history	Most common symptoms	Elevated myocardial damage markers	Abnormal ECG	Abnormal chest X-ray	Abnormal ECHO	CMR Number of examined persons %	EMB Number of children
Howard et al. 2020 [13] Algorithm USA	N = 12 16 days– –17 years B 58% G 42%	4 ± 5.2 days Infection 91%: respiratory sys. 50% digestive sys. 41% Chest pain 41%	Tachypnoe 58% Tachycardia 58% Fever 41%	Troponin 100% 8,8 ± 11 ng/mL NT-proBNP 24,110 ± ± 31,296.96 pg/mL	91% Tachycardia 64% ST-T 64%	Enlarged heart 75% Fluid 41% Stasis 8%	92% LVEF 32 ± 0.17% SF% 19 ± 0.1% On discharge 33%		
Rodriguez- -Gonzales et al. 2019 [12] Symptoms Spain	N = 42 1.5–12 years B 69% G 31%	2–10, medium 5 days Respiratory sys. 38% Digestive sys. 34% Chest pain 40% Fever 38% Palpitations 16% weakening 21% fainting 4%	Tachycardia 57% Tachypnoe 52% Murmur 26% Hypotension 24% Hepato. 20% Edemas 7%	Troponin 62%, medium 91 pg/mL NT-proBNP > 600 pg/mL in 40%	93% Tachycardia 61% ST-T 57% Voltage 50% SVT 2.5% VT 7% CAVB 2.5% LQT 2.5%	Enlarged heart 33% Stasis 28% Fluid 2.5%	88% LV dysfunction 50%, both 10% Dysfunctions segmental 38% Enlargement 43% IMV 69% Pericardial effusion 59%	50% 3–9 within a day Mainly > 10 years	
Chang et al. 2019 [9] ECHO Taiwan	N = 94 10 ± 5.3 years B 54% G 46%	2.2 ± 2.7 days Digestive sys. 23% Respiratory sys. 14% Fever 28%	HF 38% Hypotension 51%	TnI 94% CPK-MB 81% BNP 57%			< LVEF% 82% On discharge 17%		
Lv et al. 2019 [8] FMC/CMR China	N = 20 3–16 years B 60% G 40%	0–7 days Digestive sys. 60% Chest pain 20% Fainting 15% Palpitations 5%		Troponin 100% NT-proBNP 100% max in 3– –7 days	CAVB 50% AAVB 5% VT 5% RBBB + 1st AVB 5%		90% Enlargement 75% < LVEF% 85% Thickening 50% Pericardial effusion 65% IMV 85%	80%	

Table 1. (**cont.**) Data on age and sex, clinical picture, and abnormalities in additional examinations of children with myocarditis

Author Year of publication Main topic Country	Patients N = number Age Sex	Medical history	Most common symptoms	Elevated myocardial damage markers	Abnormal ECG	Abnormal chest X-ray	Abnormal ECHO	CMR Number of examined persons %	EMB Number of children
Lin et al. 2019 [22] IVIg Steroids Taiwan	N = 579 < 11 years, medium 2.6 years (PSM) Steroids 104/208 IVIg 89/178							3%	1 EMB
Butto et al. 2018 [16] Troponin ECMO USA	N = 149 Teenagers 48% Infants 20% B 61% G 39%			Sampled 100% Elevated 81% TnI elevated in 113 cases TnT elevated in 36 cases					
Aykac et al. 2018 [20] Influenza Turkey	N = 5/241 1–17 years B 40% G 60%	2–20 days Fever 100% Cough 100% Vomiting 40%	Tachycardia Hepato. Hypotension	Troponin 100% BNP 69–3840 pg/ /mL	ST-T QRS		LVEF% 30–69% Trace of fluid 2		1 EMB not performed
Arola et al. 2017 [10] Report Finland	N = 213 Median 14 years Older B > G B 77% G 23%	Referred due to myocarditis 86% Respiratory sys. 7% Digestive sys. 1%							
Butts et al. 2017 [6] Report USA	N = 171 Medium 13 years < 2 years 24% > 13 years 46% B 58% G 42%	Infection 68% Respiratory sys. 84% Digestive sys. 46% Weakening 41%	Hepato 45% Dyspnea 44% Tachycardia 42%	TnI 0.17–21.6 ng/mL BNP 144–2241 pg/ /dL			< LVEF% 87%	29%	45/171 26%

Table 1. (**cont.**) Data on age and sex, clinical picture, and abnormalities in additional examinations of children with myocarditis

Author Year of publication Main topic Country	Patients N = number Age Sex	Medical history	Most common symptoms	Elevated myocardial damage markers	Abnormal ECG	Abnormal chest X-ray	Abnormal ECHO	CMR Number of examined persons %	EMB Number of children
Martinez-Villar et al. 2017 [11] ACS-like CMR Spain	N = 7 7/33 21% 12–15 years, medium 14 years B 71% G 29%	3 days Infection 57%	Good condition Without HF	100%	100% ST-T		Thickening 43% < LVEF% 33%	100%	
Messroghli et al. 2017 [7] Register Germany	N = 149 B 66% G 34% Most < 2 and > 12 years	16.1 ± 41.8 days Infection 54% Respiratory sys. 37% Digestive sys. 8% Fever 36% Weakening 71% Chest pain 42% Palpitations 30% Fainting 12%	NYHA I 53% NYHA II 20% NYHA III 7% NYHA IV 18% Arrhythmia 36% SCA 4/148	Troponin 97% BNP or NT-proBNP 88%	ECG 98% Holter ECG 53% Monitor ECG 99%	70%	99% LVEF% < 30 23% < 44 15% < 54 19% > 55 42%	54%	RV 69 LV 10 53%
Wu et al. 2017 [15] ECMO Taiwan	N = 60 8.8 ± 6.3 years B 53% G 47%	Fever 68% Cough 57% Chest pain 53% Palpitations 16%		Troponin I 4.88 < 25.4 ng/mL CK-MB 32 < < 122 ng/mL NT-proBNP 5938–8560 pg/ml	100%	100%	< LVEF% 67%		
Matsuura et al. 2016 [14] AMC/FMC Japan	N = 221 6.5 ± 5.3 years Newborns 4% B 52% G 48%	3–60 days, medium 3 days Other diseases 12%	Acute 66% Fulminant 34%						EMB 25 autopsy 12–17%

Table 1. (**cont.**) Data on age and sex, clinical picture, and abnormalities in additional examinations of children with myocarditis

Author Year of publication Main topic Country	Patients N = number Age Sex	Medical history	Most common symptoms	Elevated myocardial damage markers	Abnormal ECG	Abnormal chest X-ray	Abnormal ECHO	CMR Number of examined persons %	EMB Number of children
Casadonte et al. 2016 [19] FMC USA	N = 12/128 23% FMC 1 day–7 years Medium 11.4 kg	Chest pain 3 Fainting 2	SCA 46% HF 100% Respiratory failure 53%		ST-T 92% Tachycardia 85% QRS 59% Hypertrophy 40%		< LVEF% Median 21% IMV 79%	25%	4/12
Haider et al. 2016 [18] Report Pakistan	N = 62 Median 12 months B 55% G 45%	Weakening 73% Respiratory sys. 65% Digestive sys. 60% Fever 73%	Tachycardia 90% Tachypnoe 68% Hepato 58% Crackles 57% Hypotension 50%						
Vigneswaran et al. 2016 [17] PVB12 UK	N = 17 0.4–15.4 years, medium 1.3 years B 59% G 41%	1–14 days, medium 6 days Respiratory sys. 59% Digestive sys. 29% Chest pain 12%	HF acc. to Ross class 4 100%		59% PR 1 STT 29% QRS 1		100% < LVSF% Enlargement 80% IMV 41%		6/17 35% 5/6 PVB19
Abrar et al. 2016 [21] Report India	N = 62 6.36 ± 3.48 years B 56% G 44%		NYHA I 10% NYHA II 27% NYHA III 40% NYHA IV 23% Hypotension 47%	TnI 27% CK-MB 48% BNP 52%			Medium LVEF% 45.66 ± 8.76%		

ECG — electrocardiography; ECHO — echocardiography; CMR — cardivascular magnetic resonance; EMB — endomyocardial biopsy; USA — United States of America; B — boys; G — girls; hepato — hepatomegaly; NT-pro BNP — N-terminal pro-B-type natriuretic peptide; LVEF — left ventricular ejection fraction; SF — fractional shortening; SVT — supraventricular tachycardia; VT — ventricular tachycardia; CAVB — complete atrioventricular block; LQT — long QT syndrome; LV — left ventricle; IMV — mitral valve insufficiency; HF — heart failure; CPK-MB — creatine phosphokinase-myocardial bound; BNP — B-type natriuretic peptide; FMC — fulminant myocarditis; AAVB — advanced atrioventricular block; RBBB — right bundle branch block; AVB — atrioventricular block; PSM — propensity score matching; IVIG — intravenous immunoglobulin; ECMO — extracorporeal membrane oxygenation; TnI — troponin I; TnT — troponin T; ACS-like — acute coronary syndrome-like; RV — right ventricle; NYHA — heart failure class according to the New York Heart Association; SCD — sudden cardiac death; AMC— acute myocarditis; CK-MB — creatine kinase-myocardial bound; PVB12 — parvovirus B12; UK — United Kongdom; LVSF — left ventricular fractional shortening

in time and require repeating of the examinations in the following days. ECG and Holter ECG are performed in order to detect arrhythmia and differentiate its type. The most dangerous arrhythmias in the published studies included: ventricular tachycardia, requiring electric or pharmacological cardioversion, more rarely — supraventricular tachycardia. Disturbances of conduction and complete atrioventricular block occurred more rarely. In the group analyzed by Lv et al. [8], however, they occurred in 50% of children. All patients required periodic electrical stimulation.

Chest X-ray was normal in 50% of patients. In others, it revealed enlargement of the cardiac silhouette, more rarely — signs of pulmonary congestion or pleural fluid were observed.

ECHO, which was abnormal in 80–100% of patients, was of greater diagnostic value in myocarditis. The changes included the enlargement of the left ventricle with impairment of contractility (both global and sectional), changes in ventricular geometry, disorders in cardiac wall movement, mitral regurgitation or presence of fluid in the pericardial sac. It is significant that thickening of the myocardial walls, while the size of the ventricle remained normal, was observed in some patients with fulminant myocarditis [8, 11]. Echocardiographic imaging is, therefore, non-specific, and ECHO, particularly in little children, is helpful in differential diagnosis of heart failure in terms of the exclusion of such causes as, for example, congenital coronary artery defect.

In order to unambiguously confirm the disease in adults, myocardial biopsy is recommended [1]. However, as an invasive examination, requiring cardiac catherization in general anaesthesia, it is performed less and less frequently. According to the reports, in the case of fulminant myocarditis, it was performed in 26% of children in the United State of America (USA), in 11% in Japan, in 50% of children in Germany, in 35% of children in the United Kingdom [6, 14, 17]. It is currently performed mainly in the case of the symptoms of acute heart failure resistant to pharmacological treatment, simultaneously with the implantation of myocardial support devices). According to the literature, EMB complications concern 1–16% children, and they reach 40% in small infants [23].

CMR is the current "gold standard" in myocarditis diagnosis in children. The examination, however, was not broadly available and was not performed in all analyzed groups. In centres where it was possible, it was performed in 20–80% of patients. According to the researchers, the most typical sign of active myocarditis is the presence of late post-contrast enhancement and tissue edema located intramuscularly or subepicardially [24]. In older children with clinical suspicion of acute myocarditis and history of myocarditis, CMR should constitute the first line examination. The necessity of the application of general anaesthesia in hemodynamically unstable patients constitutes a certain limitation in small children. In the study groups, diagnosis was frequently made without EMB/CMR, on the basis of clinical data and abnormalities in laboratory tests, ECG and/or ECHO, after other causes were ruled out.

The conducted studies confirm the current data providing that the most frequent cause of myocarditis in children are viral infections [25]. The most frequently detected ones included entero(*Coxackie* grup B)-, echo- and adenoviruses in the USA, and herpesviruses [*e.g.* human herpesvirus 6 (HHV6)] and parvovirus B19 in Europe. In the analyzed groups, the etiology was determined in the analysed groups. It has recently been observed that myocarditis occurs in severe acute respiratory syndrome coronavirus (SARS-CoV-2) infection as well, also in the absence of respiratory symptoms characteristic of coronavirus disease 2019 (COVID-19) [26].

Due to the necessity of constant monitoring of cardiovascular performance parameters, all children with myocarditis were hospitalized. The higher percentage of children in the Intensive Care Units, ranging from 14- to, more frequently, 65–90%, proves the severity of the disease. Most of these children required respiratory support as well as intravenous inotropic medication, such as catechol amines and/or phosphodiesterase inhibitors. Apart from bed regime, more than 50% of children were treated with diuretics, angiotensin converting enzyme (ACE) inhibitors and beta-blockers. In some centres, mostly American and Asian, intravenous immunoglobulin infusions or steroids administered intravenously or systemically were applied. However, no significant impact on the course of the disease and mortality was observed [27–30].

If the patient remained unstable despite pharmacological treatment, mechanical circulatory support was implemented [7, 31]. ECMO was applied in 168 children, Which constituted, depending on the described group, from 17–41% of patients, especially with fulminant myocarditis [6, 7, 16]. According to Wu et al. [15] from Taiwan, female sex, vomiting, seizures and, primarily, ventricular tachycardia and decreased ejection fraction of the left ventricle as well as higher concentrations of troponins occurred significantly more frequently in the group of children requiring ECMO [15] Typical mechanical cardiovascular support, the so-called ventricular assist devices (VAD) were temporarily implanted in 35 patients. Children with complete atrioventricular block required period transvenous stimulation, and children with ventricular tachycardia required electric cardioversion. Single patients had implantable cardioverter-defibrillator (ICD) implanted.

In the group of 1,891 patients, heart transplant was performed in 38 children, mainly in the USA. Single transplants were carried out in Germany and Japan [6, 7, 14].

The period of hospitalisation ranged from 6 to 35 days. Depending on the group, from several to even 35–40% of children died. Most children recovered completely from

myocarditis, however, approximately 25% of patients myocardial dysfunction was present on the day of discharge. Given the lack of data, further course of the disease cannot be evaluated on the basis of the above-cited studies. All authors, however, indicated the need of conducting further observation of patients.

Summary

The analysis of the literature on myocarditis in children from the last 5 years indicates that myocarditis is a rare disease, in the case of which two incidence peaks occur — in early infancy and in adolescents. In most cases, it is etiologically associated with either ongoing viral infection of the respiratory or gastrointestinal tract, or a history thereof, combined with cardiac symptoms that depend on the age of the child. According to the experts, the clinical image of myocarditis may resemble other cardiac diseases and takes the form of acute or chronic heart failure (occurring in patients who were not previously diagnosed with a cardiac disease), life-threatening arrhythmia (including sudden cardiac death) or a form resembling acute coronary syndrome [1]. In the analyzed groups of patients, younger children suffered from acute hear failure and dangerous arrhythmia, while in older children, the disease caused chest pain syndrome (with ST-T changes in ECG and elevated troponin level).

Initial diagnosis is made on the basis of clinical symptoms and results of additional examinations: myocardial damage markers, ECG, X-ray and ECHO. Elevated troponin levels are observed in most patients, while in children with symptoms of heart failure the level of NT-pro-BNP is also elevated. The number of myocardial biopsies has been decreasing in recent years. CMR is becoming the basis for the diagnosis of myocarditis.

Treatment involves mainly bed regime, pharmacological treatment of heart failure and arrhythmia. Constant point-of-care monitoring of the heart rhythm in hospital conditions is necessary. Some patients with fulminant myocarditis require mechanical circulatory support: ECMO, VAD and even heart transplant. Mortality rate is high, it reaches as much as 25–30%. At the acute stage of the disease, patients should be hospitalized. Later on, even if the signs of inflammation have subsided, they should remain under the care of a cardiologist. Due to the diversity of clinical course of the disease, the applied diagnostic methods and definitions of the disease, it seems that the incidence of myocarditis in the population of children is underestimated.

Conflict of interest

The authors declare no conflict of interest.

Streszczenie

Zapalenie mięśnia sercowego (ZMS) według Światowej Organizacji Zdrowia definiuje się jako chorobę zapalną obejmującą kardiomiocyty, tkankę śródmiąższową, naczynia, a czasem również osierdzie. W poniższym opracowaniu przeanalizowano piśmiennictwo z ostatnich 5 lat dotyczące epidemiologii, badań diagnostycznych, leczenia i rokowania w ZMS u dzieci i młodzieży. W tym celu dokonano przeglądu medycznej bazy danych *Pubmed*, używając słów/zwrotów kluczowych: „dzieci" (ang. *'children'*), „zapalenie mięśnia sercowego" (ang. *'myocarditis'*) — strategia ta pozwoliła uzyskać łącznie 117 artykułów. Spośród nich wyodrębniono prace, w których badana grupa obejmowała co najmniej 5 dzieci, a w opisie zawarto dane dotyczące objawów klinicznych, odchyleń w badaniach laboratoryjnych oraz badaniach obrazowych, identyfikacji czynników etiologicznych, zastosowanego leczenia oraz czasu hospitalizacji i liczby zgonów. Do analizy końcowej włączono 17 artykułów; zestawienie obejmuje łącznie 1891 dzieci, u których rozpoznano ZMS. Z analizy wynika, że ZMS jest chorobą rzadką. Obserwuje się dwa szczyty zachorowań: w wieku noworodkowym i wczesnoniemowlęcym oraz w okresie dojrzewania, przy czym wiek poniżej 2. rż. jest niekorzystnym czynnikiem rokowniczym. W raportowanych przypadkach najczęstszymi objawami podmiotowymi były: osłabienie, ból w klatce piersiowej, kołatania serca. Wśród objawów przedmiotowych dominowały: *tachypnoe*, tachykardia, hipotensja, hepatomegalia. Wywiad, wynik badania przedmiotowego oraz wyniki badań dodatkowych (stężenia troponin, elektrokardiogram, echokardiogram) przybliżają do rozpoznania, natomiast „złotym standardem" do ustalenia diagnozy jest badanie rezonansu magnetycznego serca. W analizowanej grupie 65–90% dzieci wymagało leczenia na oddziale intensywnej terapii, u 168 dzieci zastosowano ciągłe pozaustrojowe natlenianie krwi, a 35 dzieciom wszczepiono tak zwane sztuczne komory. U 38 pacjentów wykonano przeszczepienie serca. Śmiertelność w ZMS jest wysoka (w przeanalizowanym piśmiennictwie wyniosła 25–35%). U około 25% dzieci dysfunkcja mięśnia sercowego pozostała trwała. Ze względu na nieprzewidywalny przebieg choroby pacjent w ostrym okresie choroby powinien być hospitalizowany, a po wypisaniu ze szpitala podlegać dalszej kontroli kardiologicznej.

Słowa kluczowe: zapalenie mięśnia sercowego, niewydolność serca, dzieci, młodzież

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