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Clinical and laboratory characteristics of patients with paediatric inflammatory multisystem syndrome temporally associated with COVID-19 (PIMS-TS)

Analiza kliniczna i laboratoryjna pacjentów z wieloukładowym zespołem zapalnym czasowo związanym z COVID-19 (PIMS-TS)

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STRESZCZENIE

ANALIZA KLINICZNA I LABORATORYJNA PACJENTÓW Z WIELOUKŁADOWYM ZESPOŁEM ZAPALNYM CZASOWO ZWIĄZANYM Z COVID-19 (PIMS-TS)

Wstęp. PIMS-TS jest rzadkim powikłaniem zakażenia SARS-CoV-2 u dzieci. Wiodącym objawem jest gorączka. Obserwowane są również dolegliwości ze strony układu pokarmowego (wymioty, biegunka, bóle brzucha), zapalenie spojówek, bóle głowy, obrzęki dłoni oraz stóp i inne.
Cel pracy. Celem pracy jest jest ocena kliniczna i laboratoryjna pacjentów spełniających kryteria PIMS-TS wg RCPCH.
Materiał i metoda. W pracy dokonano retrospektywnej analizy dokumentacji szpitalnej 29. pacjentów hospitalizowanych z powodu PIMS-TS w Wojewódzkim Szpitalu Dziecięcym w Bydgoszczy w okresie od XI 2020r. do VIII 2021r.
Wyniki. U 100% pacjentów występowała gorączka. Odnotowano również dolegliwości ze strony układu pokarmowego, ból głowy, apatię, zmiany zapalane jamy ustnej i inne. U co 4. pacjenta wykazano zmiany śródmiąższowe płuc w postaci drobnoplamistych lub smużastych zagęszczeń. U pozostałych badanych nie zaobserwowano zmian w obrazie RTG. W badaniu echokardiograficznym wykazano obniżoną funkcję skurczową lewej komory serca u 10. pacjentów (34,5%). Zmniejszenie frakcji skurczowej lewej komory serca (FS) poniżej 28% stwierdzono u 4. pacjentów (13,8%), a frakcji wyrzutowej (EF) poniżej 55% u 5. pacjentów (17,2 %). U co drugiego dziecka (55%) zaobserwowano zmiany w USG brzucha (m.in. powiększenie węzłów chłonnych krezki, płyn w jamie otrzewnej, powiększoną wątrobę). Odnotowano również zmiany w badania laboratoryjnych. Pacjenci z PIMS-TS wykazywali podwyższone wartości wykładników stanu zapalnego (CRP, PCT, ferrytyna, LDH) oraz podwyższone poziomy markerów dysfunkcji mięśnia sercowego (TNT, NTproBNP).
Wnioski. Długoterminowe rokowania PIMS-TS pozostają nadal niejasne, nie wiadomo czy choroba nie powoduje odległych powikłań. Kluczowe znaczenie dla uzyskania tych informacji, jak również zdefiniowania faktycznych patomechanizmów choroby jest prowadzenie dalszych badań i obserwacji.

Słowa kluczowe: PIMS-TS, objawy kliniczne, badania laboratoryjne, dziecko, COVID-19

ABSTRACT

CLINICAL AND LABORATORY CHARACTERISTICS OF PATIENTS WITH PAEDIATRIC INFLAMMATORY MULTISYSTEM SYNDROME TEMPORALLY ASSOCIATED WITH COVID-19 (PIMS-TS)

Introduction. Paediatric Inflammatory Multisystem Syndrome Temporally Associated with COVID-19 (PIMS-TS) is a rare complication of SARS-CoV-2 infection in children. There are also problems with the digestive system (vomiting, diarrhea, abdominal pain), conjunctivitis, headaches, swelling of the hands and feet, and others.
Aim. The aim of the study is the clinical and laboratory evaluation of patients meeting the PIMS-TS criteria according to the RCPCH. This study aimed to determine the clinical and laboratory characteristics of patients meeting criteria for PIMS-TS.
Material and methods. The study was a retrospective analysis of hospital records of 29 PIMS-TS patients of the Provincial Paediatric Hospital in Bydgoszcz hospitalised between November 2020 and August 2021.
Results. Fever was found in 100% of the patients. Other symptoms re-ported were gastrointestinal problems, headache, apathy, oral inflammation, and more. Every fourth patient was diagnosed with pulmonary interstitial lesions in the form of smudgy or fine patchy thickening. Echocardiographic tests showed decreased left ventricular contractility in 10 patients. Reduced left ventricular fractional shortening below 28% was found in four patients and ejection fraction below 55% in five patients. In every second child, abdominal ultrasound imaging showed lesions such as enlarged mesenteric lymph nodes, peritoneal effusion, or enlarged liver. Changes were also confirmed by laboratory tests.

Conclusions. Patients with PIMS-TS showed increased levels of inflammatory and myocardial dysfunction markers. The long-term prognosis for PIMS-TS is still uncertain. Further research and observation are needed to determine long-term complications and the actual pathomechanisms of the disease.

Key words: PIMS-TS; clinical symptoms; laboratory tests; child; COVID-19

INTRODUCTION

Paediatric Inflammatory Multisystem Syndrome Temporally Associated with COVID-19 (PIMS-TS), also known as Multisystem Inflammatory Syndrome in Children (MIS-C), is the most severe complication of SARS-CoV-2 infection in children [1,2]. The first definition of PIMS-TS was announced by the Royal College of Paediatrics and Child Health (RCPCH) on May 1, 2020 [1,3,4]. Another definition – that of MIS-C – was provided by the Centers for Disease Control and Prevention (CDC) and the World Health Organisation (WHO) [1,3,5]. Contrary to PIMS-TS, the definition of MIS-C requires a confirmed infection with SARS-CoV-2 or exposition to COVID-19.

PIMS-TS is associated with immune dysregulation and is a consequence of SARS-CoV-2 infection developed 2–4 weeks prior [6,7]. The peak of described PIMS-TS cases approached a few weeks after the peak of COVID-19 cases. Patients were more frequently found to have positive SARS--CoV-2 antibody results and negative SARS-CoV-2 RT-PCR test results [8–10]. The pathophysiology of PIMS-TS has not been fully explored yet, but there are differences as compared to COVID-19 complications in adults [3,11,12]. The main symptom of PIMS-TS is fever and the course of the disease resembles that of other autoimmune disorders: Kawasaki disease, toxic shock syndrome (TSS), sepsis, haemophagocytic syndrome, or systemic juvenile idiopathic arthritis [13–15]. It needs to be stressed that none of the enlisted disorders has been associated with one specific pathogen [16].

The aim of the study was to determine the clinical and laboratory characteristics of patients meeting criteria for PIMS--TS as defined by RCPCH and hospitalised in the J. Brudziński Provincial Paediatric Hospital in Bydgoszcz, Poland.

MATERIALS AND METHODS

This retrospective study was based on the analysis of medical records of 29 patients hospitalised for PIMS--TS in the Provincial Paediatric Hospital in Bydgoszcz in the period from November 2020 until August 2021. The analysis involved clinical symptoms as well as results of laboratory and imaging tests of the hospitalised children. The criterion of inclusion was being qualified as having PIMS-TS as defined by RCPCH. Table 1. presents detailed characteristics of the study population.

Tab. 1. Sociodemographic characteristics of patients with PIMS-TS

		number	%
sex	boys	20	69.0
	girls	9	31.0
age group	0-5 years old	10	34.5
	6-11 years old	14	48.3
	12-18 years old	5	17.2
medical history	confirmed infection	4	13.8
	quarantine due to contact with a COVID-19 patient	10	34.5
	non-specific symptoms of a viral infection	5	17.2
	asymptomatic patients	10	34.5

Most of the patients were boys – 20 persons (69.0%). The largest age group were 6–11 year olds – 14 persons (48.3%), while the smallest were 12–18 year olds – 5 persons (17.2%). Mean age of the patients was 7.5 years. Standard deviation amounted to over 56.0% of the mean value, which was indicative of a considerable diversity of age. Out of 29 patients, only 8 were diagnosed with comorbidities: bronchial asthma (3), obesity (3), drug-resistant genetically determined epileptic encephalopathy (1), agranulocytosis, Langerhans cell histiocytosis (1). The period of hospitalisation of children with PIMS was 3–30 days (average 11 days). Nasopharyngeal swabs were taken from each patient for testing towards SARS-CoV-2 infection.

The results of RT-PCR tests for SARS-CoV-2 performed on admission were negative for all patients in the study population. Epidemiological records revealed that 4 patients had a history of SARS-CoV-2 infection confirmed by an RT-PCR test, 10 patients underwent quarantine due to contact with a person diagnosed with COVID-19, 5 patients had non-specific symptoms of a viral infection, and the remaining 10 patients did not show any symptoms.

The presence of IgG antibodies to SARS-CoV-2 was detected using the enzyme-linked immunosorbent assay (ELISA). All patients were found to have increased levels of those antibodies. The levels of SARS-CoV-2 antibodies in the examined children were in the range of 9.73 to 212.0 RU/mL, mean value was 97.6 [NV>11 RU/mL].

The study was carried out upon approval of the Bioethics Committee at Ludwik Rydygier Collegium Medicum in Bydgoszcz of the Nicolaus Copernicus University in Toruń (consent no. KB 154/2021 of 16 February 2021).

The null hypothesis (H0) was that there was no difference between the study groups and the level of statistical significance was set to $p \leq 0.05$.

All calculations and figures were made using standard features of the Statistica 10.0 software and Microsoft Excel spreadsheets.

RESULTS

Clinical symptoms

Figure 1. presents the distribution of clinical symptoms in patients with PIMS-TS.

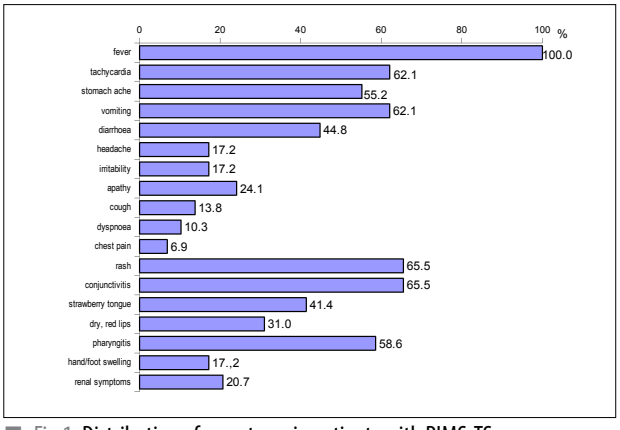

Fig 1. Distribution of symptoms in patients with PIMS-TS

The most common symptom was fever (hyperthermia over 39°C lasting more than three days), which was found in all of the patients (100%). Patients also complained of gastrointestinal symptoms, that is stomach ache (55.2%), vomiting (62.1%), and/or diarrhoea (44.8%). Conjunctivitis was observed in 65.5% of the patients.

Most of the patients showed changes in the oral mucosa, including pharyngitis (58.6%), strawberry tongue (41.4%), and dry/red lips (31.0%). Polymorphic skin rash was diagnosed in 65.5% of the children, mostly aged 6-11. Hand or foot swelling was observed in five patients (17.2%).

Symptoms related to the nervous system, that is headache (17.2%), irritability (17.2%) and apathy (24.1%), were identified in a total of 17 patients, mainly boys.

Two patients suffered from disturbance of consciousness and disorientation, as well as symptoms of stiff neck and hyperaesthesia.

Symptoms related to the respiratory system in the form of dyspnoea were reported by three boys. Four patients had cough. Two patients reported chest pains.

Symptoms related to the urinary system in the form of decreased urine output, erythrocyturia, and elevated renal parameters (urea, creatinine) were found in six patients (20.7%).

Osteoarticular and muscle pain was a rare symptom reported by two patients only (6.9%).

Statistical analysis with regard to age showed a significant difference in the frequency of stomach ache (p=0.020), vomiting (p=0.022) and headache (p=0.044) in hospitalised patients aged 6-11, and of chest pains (p=0.007) in children aged 12-18 (Figure 2a).

Data analysis with regard to sex showed a higher frequency of vomiting (p=0.038), apathy (p=0.049) and strawberry tongue (p=0.003) in boys (Figure 2b).

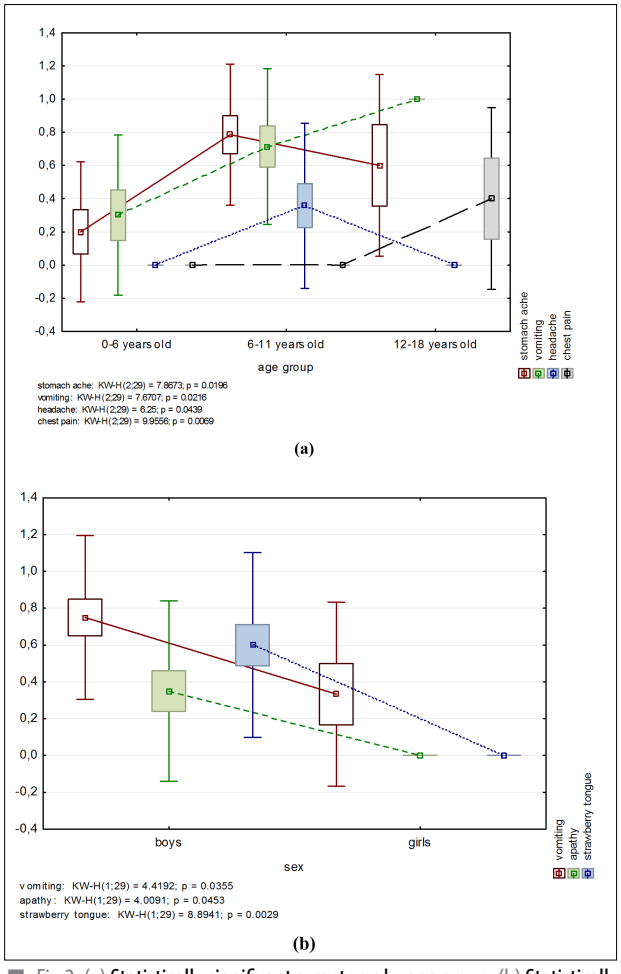

Fig 2. (a) Statistically significant symptoms by age group; (b) Statistically significant symptoms by sex group

Imaging test results

All patients with PIMS underwent a chest x-ray, abdominal ultrasound (US), echocardiography (ECHO) and electrocardiography (ECG); some patients had computed tomography (CT) and magnetic resonance (MR) scans of the head.

Results of echocardiography (ECHO) showed normokinesis in 19 patients (65.5%) and reduced left ventricular systolic function in 10 patients (34.5%). Reduced left ventricular fractional shortening (FS) below 28% was found in four patients (13.8%) and ejection fraction (EF) below 55% in five patients (17.2%). Changes in coronary arteries in the form of segmental widening of both the right and left coronary artery were found in three patients (10%). Small amounts of fluid in the pericardium were diagnosed in five patients (17.2%). ECHO findings also showed mitral valve regurgitation in four patients and separation of pericardial layers in eight patients. Cardiac lesions were more often identified in children aged 6-11. Seven patients in that age group suffered from impaired left ventricular contractility, two had coronary artery ectasia, and four were diagnosed with mitral valve regurgitation and separation of pericardial layers.

Electrocardiography (ECG) results showed normal readings and images in 19 patients (65.5%). The remaining children were diagnosed with impairments of cardiac electrical function in the form of: sinus tachycardia (6.9%),

intraventricular conduction disorders (13.8%), repolarisation time abnormalities (10.3%), as well as ventricular and supra-ventricular arrhythmias (13.8%). The above disorders applied mostly to patients aged 12-18.

In order to present pulmonary lesions and abnormalities, patients with PIMS-TS underwent a chest x-ray. Every fourth patient was diagnosed with interstitial changes in the lungs in the form of smudgy or fine patchy thickening. X-ray findings of the remaining patients showed no lesions.

Abdominal ultrasound (US) was performed in all patients, 13 of whom (44.8%) had normal findings. Abnormalities in the form of enlarged mesenteric lymph nodes were found in seven patients (24.1%), presence of fluid in the peritoneal cavity in 11 patients (37.9%), and enlarged liver in four patients (13.7%). Other pathological lesions found through US were as follows: thickening of intestinal loops in the lower and middle abdomen with inflammatory infiltration of the adipose tissue in two patients, urinary retention (after emiction) in one patient, and inflammation of the end section of the ileum in one patient.

Two patients with severe disturbance of consciousness were examined using magnetic resonance (MR) and computed tomography (CT) of the head. In one of them, findings showed a non-specific lesion in the back part of the splenium and in the trunk of the corpus callosum, which might be associated with PIMS-TS.

Clinical symptoms corresponded with abnormal laboratory findings.

Laboratory test results

Table 2. presents the results of laboratory tests of patients with PIMS-TS.

Patients with PIMS-TS demonstrated elevated values of inflammatory markers. All patients had increased levels of C-reactive protein (CRP), value > 100 mg/L was found in 13 patients (44.8%); levels of procalcitonin (PCT) exceeding reference values were found in 22 patients (75.9%), of ferritin in 38%, and of lactate dehydrogenase (LDH) in 28% of the patients.

As regards myocardial dysfunction markers, elevated values of troponin T (TnT) were identified in 41% and of N-terminal pro-B-type natriuretic peptide (NT-proBNP) in 69% of the patients. The highest TnT levels, even up to 500 ng/mL, were found in patients aged 12-18. The mean value of TnT for this group of patients was 165.25 ng/mL, while for the group of 0-5 year olds the mean value was 10.5 ng/mL. The values of NT-proBNP ranged from 47.9 to 35000 pg/mL.

With respect to the level of significance ($p<0.05$), statistically significant differences were found between boys and girls with regard to the levels of white blood cells (WBC), TnT and NT-proBNP. Their values were significantly higher in boys than in girls (A.M. WBC – 10.05:9.30; TNT – 74.84:9.88; NT-proBNP – 7418.59:792.16) (Figure 3a-c).

Tab. 2. Laboratory characteristics of patients with PIMS-TS

item	mean	SD	min	max	Q25	median	Q75
IgG antibodies to SARS CoV-2	97.64	52.988	9.73	212.00	59.75	107.80	137.15
CRP	140.81	109.621	1.51	488.73	80.15	113.77	159.02
PCT	9.40	18.086	0.12	84.96	0.62	4.32	9.05
FERRITIN	655.00	592.834	106.00	2463.00	194.00	445.00	948.00
LDH	322.50	81.028	233.00	591.00	272.00	301.50	355.50
WBC	9.80	6.168	3.59	34.04	6.28	8.64	11.34
LYMPH	1.70	1.094	0.36	4.46	0.85	1.38	2.43
NEUT	7.53	5.414	1.36	25.68	4.53	5.62	8.64
Hb	11.31	1.112	9.10	13.00	10.10	11.60	12.20
PLT	207.89	146.741	66.00	828.00	126.00	161.00	245.00
TnT	55.59	122.652	4.00	550.00	8.00	12.00	42.00
NT-proBNP	5761.99	9100.020	47.90	35000.00	1163.00	2648.00	5693.00
APTT	32.72	5.937	20.60	45.30	28.90	31.50	36.30
PT	15.07	2.059	11.80	19.00	13.75	15.05	16.50
INR	1.35	0.184	1.03	1.69	1.23	1.31	1.48
FIBRINOGEN	5.94	2.472	3.23	13.58	4.70	5.12	6.23
DD	6262.27	11288.814	1000.00	52634.00	1673.00	2428.00	4432.00
ALBUMIN	3.36	0.476	2.40	4.00	3.10	3.60	3.70
TG	170.87	79.569	75.00	317.00	108.00	146.00	242.00
UREA	29.02	23.873	0.47	108.40	18.70	26.20	31.90
CREATININ	0.51	0.211	0.19	0.90	0.37	0.43	0.61
AST	42.42	21.026	19.00	90.00	26.00	32.50	55.00
ALT	32.70	16.910	10.00	69.00	18.00	29.00	49.00

CRP- c-reactive protein, PCT- procalcitonin, LDH- lactate dehydrogenase, WBC- white blood cells, LYMPH- lymphocytes, NEUT- neutrophils, Hb- haemoglobin, PLT – platelets (thrombocytes), TnT- troponin T, NTproBNP- N-terminal pro-B-type natriuretic peptide, APTT- activated partial thromboplastin time, PT- prothrombin time, INR- international normalised ratio, DD- D-dimers, TG-triglycerides, AST- aspartate transaminase, ALT- alanine transaminase

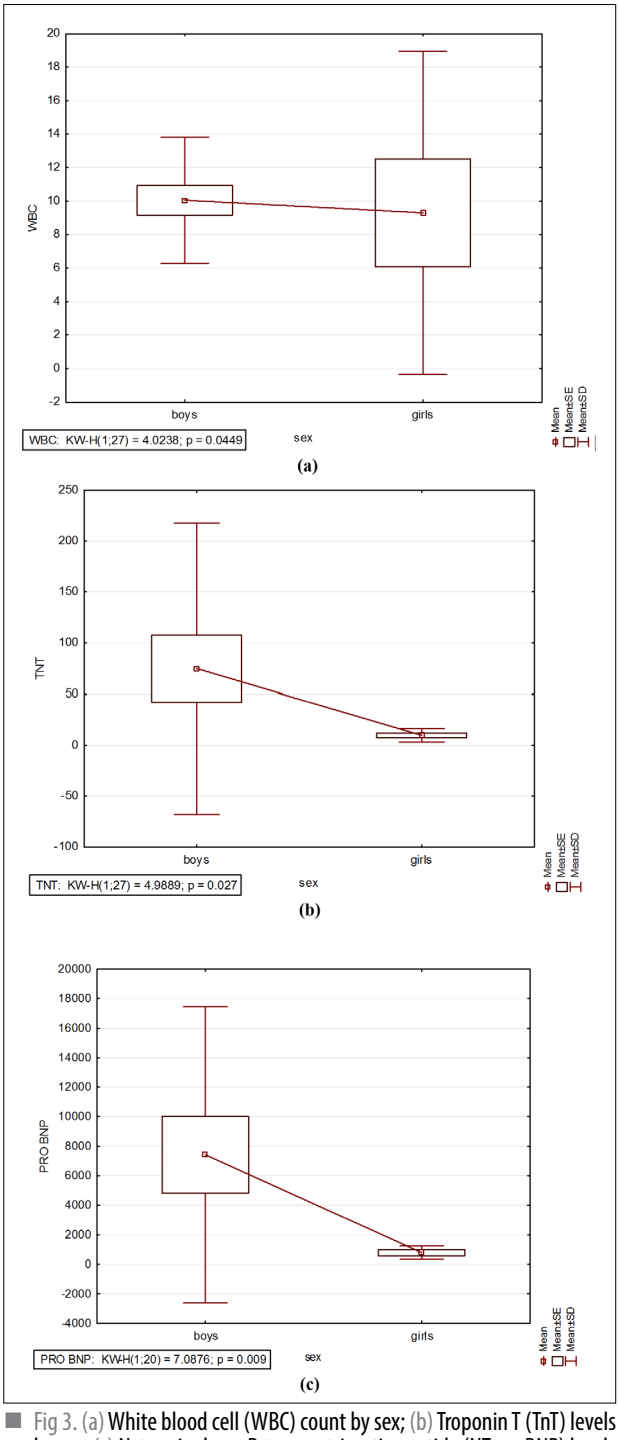

Fig 3. (a) White blood cell (WBC) count by sex; (b) Troponin T (TnT) levels by sex; (c) N-terminal pro-B-type natriuretic peptide (NT-proBNP) levels by sex

Most of the patients were diagnosed with neutrophilia (34%) and anaemia (48%). Two patients underwent a transfusion of red blood cell concentrate. Statistically significant differences were found only with regard to haemoglobin levels. The significance concerned the age group of 12-18 (A.M. Hb 12.4) and 0-5 (A.M. 10.58) year olds. Other haematological disorders found were lymphopoenia in 27% and thrombocytopoenia in 41% of the patients.

Analysis of coagulation parameters showed a significant increase in the levels of D-dimers in the entire study population. In boys, D-dimer concentration ranged between 1000.0 and 52634.0 ng/mL FEU (A.M. 6437.24), and in girls between 1547.0 and 16055.0 ng/mL FEU (A.M. 5667.40), at NV<500 ng/mL FEU. The international normalised ratio (INR) was elevated in 13 patients (44.8%) and ranged from 1.03 to 1.69. Increased fibrinogen levels were found in 15 patients (51.7%) and elevated activated partial thromboplastin time (APTT) only in two patients (6.9%).

Biochemical tests in the study population showed hypoalbuminaemia in eight patients (27.6%) and hypertriglyceridaemia in 11 patients (37.9%). Abnormal results of liver function tests (aspartate transaminase, AST; alanine transaminase, ALT) were found in nine patients (31.0%). A small percentage of the study population showed abnormal results of renal function tests (urea, creatinine). Two children with PIMS (6.9%) had increased levels of those parameters.

A statistically significant difference was identified with regard to haemoglobin (p=0.001) in the age group 12-18 versus 0-5 year olds.

DISCUSSION

The pathogenesis and symptoms of PIMS-TS as well as laboratory test results are similar to those associated with Kawasaki disease, macrophage activation syndrome (MAS), toxic shock syndrome (TSS), sepsis, and systemic juvenile idiopathic arthritis (sJIA) [13–17].

Study results published in JAMA Pediatrics by researchers from the Centers for Dis-ease Control and Prevention (CDC) demonstrate that 75% of PIMS-TS patients were asymptomatic COVID-19 cases [10,18,19]. Most children diagnosed with PIMS-TS have negative results of SARS-CoV-2 RNA tests performed using the RT-PCR method, while in 80–100% of those children the results of tests for antibodies against viral antigen are positive [5,18,20]. In the present study, the RT-PCR test for SARS-CoV-2 was negative in all patients, while the IgG antibody test for SARS-CoV-2 infection was positive. The rates of positive SARS-CoV-2 test results (RT-PCR, antigen test, SARS-CoV-2 antibody test) were different in reports of studies carried out in Europe and in the USA. Around 45–58% of reported patients with PIMS had positive results of RT-PCR tests, 54–75% had positive results of SARS-CoV-2 antibody tests, and 7–33% had positive results of both tests. Contact with COVID-19 was confirmed in 38–52% of the study population [9,21]. In the present study, 34.5% of the patients were in contact with a person with COVID-19 and 13.8% were confirmed to have a SARS-CoV-2 infection.

Just like the virus itself, IgG antibodies may exacerbate organ damage and intensify the immune response through the activation of interleukin 6 (IL-6), interleukin 8 (IL-8), monocytes, lymphocytes, and natural killer (NK) cells, as well as the chemotaxis of marrow cells. Through the binding of antibodies to SARS-CoV-2 spikes, the resulting immune complexes trigger macrophage activation, inflammatory response, and vascular damage [3,22]. This is evidenced by the overexpression of intercellular adhesion molecules and Fc-gamma receptors

in neutrophils and macrophages, as well as a decrease in the number of monocytes, T cells and NK cells in peripheral blood [3,11,22].

In patients with PIMS-TS, the presence of autoantibodies against gut endothelial cells and immune cells was also found [22]. Most patients with PIMS-TS have been reported to suffer from gastrointestinal rather than respiratory symptoms, which suggests that SARS-CoV-2 might cause a secondary red blood cell infection and replicate in the gastro-intestinal tract [14,22,23]. In studies by Malviya & Mishra [10], Opoka-Winiarska et al. [16], and Davies et al. [24], 10-15% of patients with PIMS-TS were diagnosed with comorbidities: obesity, overweight, asthma, impaired immunity. In the present study, 27.6% of the study population was diagnosed with comorbidities such as obesity, bronchial asthma, and inhaled allergy.

In this study, nearly half of the PIMS patient population (48.3%) were patients aged 6-11, most of whom were boys (34.5%). The smallest age group were patients aged 12-18 (17.2%). These numbers correspond with epidemiological data presented in both Polish and international publications. In the study by Davies et al. [24] the median age of patients with PIMS-TS was 11 and two-thirds were boys. Similarly, the study by Malviya & Mishra [10] reported more cases among children aged 8-10 with a slightly higher prevalence among boys. The median age of children with PIMS registered for the Multiorgan Inflammatory Syndromes COVID-Related Study (MOIS-CoR) is 8.6 years old and boys constitute 64% of the study population [26].

The percentage distribution of symptoms reported by patients with PIMS-TS in the present study was similar to that described in reports by Dufort et al. [9] and Feldstein et al. [8]. The most common conditions were: fever (100%), gastrointestinal symptoms (60-80%), skin rash (42-58%), and oral mucosa lesions (23-59%). Cardiovascular disorders were diagnosed in 34-82% of the patients. Symptoms related to the respiratory system and the kidneys were reported by a small percentage of patients, just like in the present study. Lack of severe symptoms within the lungs or the kidneys in patients with PIMS constitutes a factor differentiating it from viral sepsis in adults. A study by Feldstein et al. [8] on a group of 186 patients showed different frequencies of occurrence of mucocutaneous symptoms with respect to age: 79-80% in children aged 12 and 56% in older children. Duford et al. [9] determined that the frequency of those symptoms was the highest among children aged 0-5. In the present study, mucocutaneous problems were more often diagnosed in children from the age group of 6-11 year olds.

Analysis of laboratory test results showed elevated levels of inflammatory markers (CRP, PCT, LDH, ferritin), D-dimers, and myocardial damage markers (TnT, NT-proBNP). Biomarker levels peaked in the second and third day of hospitalisation and normalised afterwards. High levels of the said diagnostic markers correlated with the severity of the disease and their decrease preceded the normalisation of echocardiographic lesions and the restoration of left ventricular function. This corresponds with the findings of Davies et al. [24]. Most patients were diagnosed with neutrophilia and anaemia, and some with thrombocytopoenia and lymphopoenia.

Studies and observations to date have shown that even though the post-COVID syndrome is a rare complication of SARS-CoV-2 infection, it can lead to severe consequences. Data presented by CDC showed that over 90% of patients with PIMS experienced symptoms affecting at least four organs, while 58% required treatment in an intensive care unit [10]. The reported mortality rates ranged between 0 and 4% [26]. In the present study, over 80% of the patients presented gastrointestinal, cardiovascular and mucocutaneous symptoms occurring simultaneously. Only two patients required treatment in an intensive care unit due to aggravation of cardiovascular problems. In our study population, no deaths from the inflammatory multisystem syndrome associated with SARS-CoV-2 infection were reported.

Follow-up tests performed in all the patients after about one month showed evidence of the restoration of myocardial function, normalisation of heart dysfunction markers, and stabilisation of the remaining laboratory parameters.

Symptoms reported during the follow-up visits included: impaired exercise tolerance and cough following small physical effort (one patient), exacerbation of allergic reaction in a child with bronchial asthma (one patient), temporary mimic muscle weakness on the right side and difficulty in closing the eye, which resolved spontaneously after a few days (one patient).

Limitations of the study

The present paper concerns children hospitalised due to PIMS-TS at a regional hospital during the SARS-CoV-2 pandemics. The retrospective analysis covers a period during which various restrictions and lockdowns were successively implemented – epidemiological safety measures, closed schools, restaurants, shopping centres, cultural establishments, and suchlike. The risk of transmission of the SARS-CoV-2 virus, development of COVID-19, and occurrence of the here described PIMS-TS, was therefore greatly reduced. As authors, we are perfectly aware of the fact that 29 patients do not constitute a large study group. However, the problem was presented in a comprehensive manner and the findings are consistent with those of other authors. We hope that a significant increase in the number of cases will not be observed, though the latest epidemiological reports do not give cause for optimism.

CONCLUSIONS

PIMS-TS is a serious complication of SARS-CoV-2 infection in children which requires an interdisciplinary approach involving all members of the therapeutic team: physicians, nurses, physiotherapists, laboratory diagnosticians, electroradiology technicians, and psychologists.

The growing understanding of PIMS-TS among medical professionals is of crucial importance for making a quick diagnosis and implementing effective treatment methods.

The long-term prognosis for PIMS-TS is still uncertain, as it remains to be determined whether the disease causes any future complications. Further research and observation are needed to answer this question and to define the actual pathomechanisms of the disease.

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