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KAWASAKI DISEASE: A SINGLE CENTER EXPERIENCE

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KAVASAKI SINDROM: ISKUSTVO JEDNOG CENTRA

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ABSTRACT

Objective. To compare clinical symptoms, treatment, and outcomes between typical and atypical forms of Kawasaki disease (KD) in patients treated at our institution.

Methods. A retrospective observational study was conducted at the Pediatric Clinic, University Clinical Center Niš, reviewing medical records of 17 patients diagnosed with KD between September 2017 and February 2024. Clinical characteristics, laboratory results, treatment regimens, and outcomes were compared between typical (n=12) and atypical KD (n=5) groups. Statistical analysis was performed using the R statistical computing environment.

Results. Patients presented with high fever (>38.5 °C) at admission. Diagnosis was delayed in atypical KD cases compared to typical cases (9.6 ± 2.3 days vs. 7.92 ± 2.81 days, respectively). Echocardiographic abnormalities were present in 35% of all cases, including mild left ventricular dysfunction (n=2) and pericardial effusion (n=4). Treatment with intravenous immunoglobulins (IVIg) and aspirin led to significant clinical improvement in most patients. However, corticosteroids were added in 12% (n=2) of cases due to prolonged fever despite initial therapy. One atypical KD patient, diagnosed late, was treated with aspirin alone. Laboratory markers showed notable improvements post-treatment, particularly CRP reduction in typical KD from 77.33 ± 55.92 mg/L to 9.43 ± 7.04 mg/L.

Conclusion. Both typical and atypical KD patients showed good short- and medium-term prognoses, with no significant complications noted during follow-up. However, delays in diagnosis, particularly among atypical cases, highlight the need for improved communication across healthcare levels. A larger, multicenter study is recommended to enhance patient management and outcomes.

Key words: *mucocutaneous lymph node syndrome; vasculitis; therapeutics; diagnosis; child.*

SAŽETAK

Cilj. Uporediti kliničke simptome, lečenje i ishod kod pacijenata sa tipičnim i atipičnim oblicima Kavasakijeve bolesti u našoj ustanovi.

Metode. Retrospektivna opservaciona studija obuhvatila je medicinsku dokumentaciju pacijenata sa Klinike za pedijatriju Univerzitetskog kliničkog centra Niš. Odabrano je ukupno 17 pacijenata sa dijagnozom Kavasakijeve bolesti. Statistička analiza je sprovedena korišćenjem programskog jezika R za statističku obradu podataka.

Rezultati. Pacijenti su stratifikovani prema opštim karakteristikama (uzrast, pol i dužina hospitalizacije). Laboratorijski rezultati i sezonska distribucija prikazani su u vidu grafika. Na prijemu su naši pacijenti imali visoku temperaturu (> 38,5° C). Jedan slučaj atipične Kavasakijeve bolesti bio je pozitivan na Chlamydia pneumoniae. Od 17 pacijenata, šest (35%) njih imalo je neke ehokardiografske karakteristike srčane disfunkcije. Lečenje se sastojalo od primene imunoglobulina i aspirina. Većina dece je pokazala značajno kliničko poboljšanje nakon jedne doze imunoglobulina. U dva slučaja (12%) dodati su kortikosteroidi zbog produžene febrilnosti, nakon čega je zabeležen dobar klinički odgovor. U jednom slučaju atipične Kavasakijeve bolesti primenjen je samo aspirin zbog kasnog upućivanja.

Zaključak. U našoj ustanovi pacijenti su imali dobru kratkoročnu i srednjoročnu prognozu bez značajnih komplikacija. Neophodno je unaprediti vezu i komunikaciju između nivoa zdravstvene zaštite. Primećeni su relativno duži boravak u bolnici i kašnjenje u postavljanju dijagnoze Kavasakijeve bolesti kod atipičnih pacijenata. Da bi se obezbedilo bolje upravljanje, nega i uvid u karakteristike pacijenata sa Kavasakijevom bolešću u našoj zemlji predlažemo multicentričnu studiju.

Ključne reči: *sindrom mukokutanih limfnih čvorova; vaskulitis; terapija; dijagnoza; dete.*

INTRODUCTION

Kawasaki disease (KD) is an acute, self-limiting vasculitis predominantly affecting children under five years old, characterized by inflammation of medium-sized arteries, especially the coronary arteries (1). Despite extensive research, its exact etiology remains unknown; however, genetic susceptibility combined with an infectious trigger leading to aberrant immune activation has been widely proposed. Recent studies emphasize the role of regulatory T-cells and polymorphisms in the inositol 1,4,5-trisphosphate 3-kinase (ITPKC) gene, implicating hyperactivation of calcium channels as a key pathogenic event (1). Clinically, KD diagnosis relies primarily on recognizing a constellation of characteristic symptoms and systematic approach. However, incomplete (atypical) KD forms, presenting without all classical clinical features, frequently complicate timely diagnosis

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and intervention, thereby increasing the risk of cardiac complications, particularly coronary artery aneurysms (CAAs). Emerging diagnostic algorithms aim to improve accuracy and expedite treatment initiation, crucial for minimizing KD-related morbidity and mortality (2). Infants and adolescents more often present with an incomplete KD and are at a higher risk for cardiac complications. Risk stratification tools, such as the Kobayashi criteria, facilitate early identification of patients who might not respond to conventional intravenous immunoglobulin (IVIg) therapy alone (3, 4). Treatment of patients diagnosed with KD involves intravenous immunoglobulins (IVIg) and aspirin with a corticosteroid add-on reserved for high-risk patients with several studies showing their beneficial effect if administered early (4). While KD is well documented globally, epidemiological and clinical data from Serbia and the broader Balkan region remain scarce. Moreover, delays in diagnosis and variability in management practices across primary, secondary, and tertiary healthcare levels may significantly impact clinical outcomes. Therefore, our retrospective observational study aims to evaluate clinical presentations, laboratory characteristics, therapeutic approaches, and outcomes among patients diagnosed with typical and atypical KD at our tertiary pediatric center in Niš, Serbia. By addressing this local knowledge gap, we aim to enhance clinical awareness, diagnostic timeliness, and management efficiency for KD in our region.

PATIENTS AND METHODS

This was a retrospective observational study conducted at the Pediatric Clinic, University Clinical Center Niš. Medical records of pediatric patients diagnosed with Kawasaki disease between September 1, 2017, and February 29, 2024, were reviewed. Inclusion criteria were based on the diagnostic guidelines provided by the American Heart Association, encompassing both typical (complete) and atypical (incomplete) KD presentations. Patients who did not meet these diagnostic criteria or had incomplete or duplicate records were excluded from the analysis. After applying these criteria, 17 patients were selected for the study, while 212 records were excluded.

Patient demographics (age, sex), clinical presentations (e.g., fever duration, conjunctival injection, oral mucosal changes, rash, cervical lymphadenopathy, extremity changes), laboratory results (CRP, WBC count, platelet count, liver enzymes, albumin, ferritin, triglycerides), echocardiographic findings, therapeutic regimens, and clinical outcomes were systematically collected. Echocardiographic assessment included measurements for coronary artery abnormalities (CAAs), pericardial effusion, ventricular dysfunction, and other relevant findings.

Statistical analysis was performed using R software (version 4.3.2). Continuous variables are presented as mean ± SD or median (IQR), depending on distribution. Categorical variables are shown as counts and percentages. Group comparisons used Mann-Whitney U, Fisher's exact, or Chi-square tests, with $p < 0.05$ considered significant.

RESULTS

Seventeen pediatric patients diagnosed with Kawasaki disease (KD) were included, comprising 12 cases (71%) with typical KD and 5 cases (29%) with atypical KD. Five patients were infants under 1 year of age. Both coronary artery aneurysms were observed in patients with typical KD. The mean age at diagnosis, duration from symptom onset to diagnosis, and length of hospital stay were longer in atypical cases compared to the typical cases, although these differences were not statistically significant. Females represented a slight majority (59%) in the cohort. All patients presented with high-grade fever (>38.5 °C) upon admission. Key demographic details are summarized in Table 1.

The most frequently observed clinical signs included polymorphous rash, peripheral extremity changes, oral mucous membrane changes, and conjunctival injection. Cervical lymphadenopathy was less commonly seen, especially in atypical KD patients. Full comparison of clinical features between groups is presented in Table 2.

Typical KD patients demonstrated significant post-treatment improvement in inflammatory and hepatic markers, including CRP, WBC count, AST, and ALT, alongside increased albumin levels. Although atypical KD patients showed similar trends, statistical significance was not reached — likely due to the small sample size. Laboratory values before and after treatment are presented in Table 3.

Ferritin was elevated in 75% of tested patients, and 82% had elevated triglycerides, suggesting their utility as supportive biomarkers in KD diagnosis and monitoring.

Seasonal variation was observed, with most KD cases occurring in summer, followed by spring, autumn, and winter. This pattern differs from the winter-spring peaks commonly reported in international literature.

Cardiac abnormalities were found in 35% of patients (Table 4). These included mild left ventricular dysfunction, pericardial effusion, and coronary artery ectasia. No patients developed giant aneurysms or severe cardiac complications.

Nearly all patients were treated with intravenous immunoglobulins (IVIg) and aspirin, resulting in prompt

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Table 1. Demographics of patients with typical and atypical Kawasaki disease.

Variable	Typical KD	Atypical KD	Total	p-Value
Gender				
Male	6 (86%)	1 (14%)	7 (41%)	
Female	10 (60%)	6 (40%)	10 (59%)	
Mean ± SD				
Age (years)	3.28 ± 2.42	5.39 ± 4.93	3.9 ± 3.33	0.429

Table 2. Clinical characteristics of atypical and typical Kawasaki disease.

Parameter	Whole Group (n=17)	Typical KD (n=12)	Atypical KD (n=5)	p-value
Clinical Signs				
Conjunctival injection	14 (82%)	11 (91%)	3 (60%)	
Oral mucous membrane changes	15 (88%)	11 (91%)	4 (80%)	
Peripheral extremity changes	16 (94%)	12 (100%)	4 (80%)	
Polymorphous rash	16 (94%)	12 (100%)	4 (80%)	
Cervical lymphadenopathy	9 (53%)	8 (67%)	1 (20%)	
CA Pathology*	5 (42%)	4 (33%)	1 (25%)	
Mean ± SD				
Diagnosis made (day)	8.41 ± 2.71	7.92 ± 2.81	9.6 ± 2.3	0.267
Fever duration (days)	9.38 ± 2.92	9.2 ± 3.11	9.67 ± 3.21	
Length of stay (days)	10.06 ± 5.21	8.83 ± 3.68	13 ± 7.48	0.459

*CA pathology: Coronary artery pathology. Significant ectasia above 3SD was noted in four cases, with one showing only minimal ectasia.

Table 3. Laboratory parameters at admission and discharge.

Parameter	Reference Range	Typical KD (Before)	Typical KD (After)	Atypical KD (Before)	Atypical KD (After)
CRP (mg/L)	1 - 5	77.33 ± 55.92	9.43 ± 7.04	80.34 ± 43.88	12.48 ± 10.80
Le* (10^9/L)	5 - 14.5	17.30 ± 7.45	12.58 ± 3.92	14.52 ± 8.13	11.70 ± 5.51
PLT (10^9/L)	140 - 350	411.60 ± 218.70	698.91 ± 260.60	389.20 ± 272.73	648.80 ± 272.73
Albumin (g/L)	35 - 52	26.10 ± 4.00	29.51 ± 3.87	30.25 ± 2.68	31.82 ± 2.93
AST (U/L)	0 - 60	43.27 ± 17.27	36.72 ± 8.33	61 ± 40.04	40.75 ± 24.63
ALT (U/L)	10 - 42	75.36 ± 52.28	37.90 ± 17.38	87.60 ± 55.58	58 ± 44.57

Table 4. Summary of echocardiographic cardiac findings in Kawasaki disease patients.

Patient	Age (years)	KD Type	Time-to-diagnosis (days)	Cardiac Findings	IVIg Response	Steroids Used	Outcome
1	7	Atypical	10	Pericardial thickening	N/A	No	Full recovery
2	1.5	Typical	6	Mild LV dysfunction	Yes	No	Full recovery
3	2	Typical	5	Mild LV dysfunction	Yes	No	Full recovery
4	3	Typical	7	Mild LV dysfunction + CAA	Yes	No	Full recovery
5	1	Typical	7	Separation of pericardial layers	Yes	No	Full recovery
6	12	Atypical	6	Pericardial effusion + CAA	No	Yes	Full recovery

LV: left ventricular; CAA: coronary artery aneurysm; IVIg: intravenous immunoglobulin

resolution of fever and symptoms. Two patients required corticosteroids due to IVIg-refractory fever. One patient, referred late with atypical KD and no cardiac findings, was treated with aspirin alone and recovered uneventfully. No deaths or significant complications were noted on short- to medium-term follow-up.

DISCUSSION

In our study, we tried to describe the clinical and laboratory characteristics of patients with typical and atypical KD treated in our center. In studies comparing the clinical characteristics of typical and atypical KD, a

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slightly longer fever duration was observed in the atypical group, but it wasn't statistically significant. The authors connected this fact to a more timely diagnosis of typical KD (5). This is also noted in our cohort (Table 2). No significant difference in the risk for development of coronary artery aneurysms (CAA) was noted between typical and atypical KD (5,6), but some findings suggest that extremely young patients (i.e. < 1 year old) seem to be more prone to the development of this complication (7, 8). In our cohort, 2 out of 5 infants developed coronary artery aneurysms, highlighting the increased vulnerability of this age group. Giant coronary aneurysms (ie, Z-scores ≥10 or absolute dimension ≥8 mm) that develop in <1% of patients (9) weren't noted in our cohort. However, not every echocardiography finding of CAA should prompt a diagnosis of KD. In rare occasions, Takayasu arteritis should be suspected in a patient not responding well to standard treatment (10).

Although mild myocardial dysfunction and pericardial thickening were seen in some of our patients, none developed severe cardiac complications such as KD shock syndrome, which occurs in <10% of patients with KD (11).

Cervical lymphadenopathy is the least consistent clinical finding in typical and atypical KD, with a more pronounced absence of adenopathy in incomplete cases (5, 12). This is especially correct for patients younger than 1 year of age (12). Approximately 53% of our patients had cervical lymphadenopathy, which roughly corresponds to other studies that found lymphadenopathy in 46% and 35.6% (5, 6). Other clinical findings were present in more than 80% of our cases.

Besides typical clinical signs that invoke the use of diagnostic criteria for KD, other symptoms may occur that include but are not limited to respiratory (ie peri-bronchial and interstitial infiltrates, pulmonary nodules, pleural effusion, empyema), gastrointestinal (i.e. abdominal pain, diarrhea, vomiting), nervous system (ie. behavior changes, irritability, aseptic meningitis, peripheral facial nerve palsy, sensorineural hearing loss, cerebral vascular accidents) (13, 14). Most of these symptoms, except for irritability and interstitial infiltrates in one case, weren't noted in our cohort.

Wang et al in a comprehensive review, mention various viral and bacterial pathogens that can be related to the development of KD (15).

One of our patients had primarily respiratory symptoms indicating pneumonia associated with atypical KD. After a thorough examination, serology was proven to be positive for Chlamydia pneumoniae. The role of C. pneumoniae and M. pneumoniae in the pathogenesis of KD is still unclear (16).

Of our hospitalized patients, 35% (n = 6) experienced KD in the summer, while 17% (n = 3) of cases occurred in the winter. Other articles and current data suggest that most cases occur in spring and winter (5, 7). This can point to either not recognizing the KD at our primary and secondary care centers due to a large pool of febrile children at the time or simply a lack of referral to our center.

Most of our patients had elevated WBC, CRP, ALT, and decreased albumin levels, following the already-known pathophysiologic profile of KD (14). Some laboratory findings have proven useful in predicting the treatment outcome in KD patients. Kobayashi et al found that lower serum sodium, elevated AST, neutrophils, and CRP correspond to a greater chance of IVIg unresponsiveness (17). Serum ferritin with a cutoff value of 120.8 μg/L can help distinguish Kawasaki disease (KD) from other febrile illnesses (18), while a higher cutoff value of 369.6 μg/L is more indicative of systemic juvenile idiopathic arthritis (s-JIA) (19). Ferritin was elevated in 6 out of 8 patients (75%) in our cohort. We encourage physicians to implement measuring ferritin levels in atypical cases of KD and even in typical cases when in doubt. However, markedly elevated ferritin, especially when accompanied by hypertriglyceridemia and signs of consumptive coagulopathy, should prompt evaluation for other hyperinflammatory syndromes, such as systemic lupus erythematosus or hemophagocytic lymphohistiocytosis (HLH), which can mimic KD and require different treatment approaches (20, 21). Blood lipid levels and triglycerides may correspond to a hypercoagulation state in KD and a propensity toward cardiovascular complications (22).

The mainstay treatment of KD implements IVIg and aspirin (13). In our cohort, most patients had a good response to IVIg, and most became afebrile a day after treatment. One patient was admitted due to hand and foot skin desquamation and was referred two weeks after the onset of symptoms of KD. He didn't have CA abnormalities on echocardiography and was treated with aspirin only. On the follow-up, this patient didn't develop CAA or other complications. The lack of varicella vaccination in our country could potentially put KD patients on aspirin at risk for Reye syndrome (1). Two of our patients didn't respond to the IVIg treatment and were subsequently treated with corticosteroids, after which the fever resolved. Although somewhat controversial (heterogeneity of studies regarding dosage and treatment duration), corticosteroids may reduce the risk for CAA in IVIg refractory cases (4, 13, 20). Tumor Necrosis Factor-alpha (TNF-a) inhibitors, Interleukin-1 inhibition, Calcineurin inhibitors, and other immunosuppressive medications can be used and are under investigation for treating IVIg-resistant forms of KD (13).

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The prognosis of KD depends on the degree of cardiovascular complications. In an article describing a long-term prognosis that incorporated the results of 74 studies of mostly Southeast Asian population, survival of >30 years was noted, even though cases of major adverse cardiovascular events (MACE) were reported in patients with CAA (23). A close follow-up is recommended for individuals with evidence of CAA, as functional endothelial injury and vascular remodeling may persist beyond normalization of coronary artery dimensions, as supported by recent data from long-term observational studies (24). Our patients underwent monthly cardiologist control with no significant complications on the follow-up.

This study has several limitations. First, the retrospective design inherently carries a risk of selection and documentation bias, as it relies on the accuracy and completeness of existing medical records. Second, the small sample size limits the generalizability of our findings and the statistical power to detect significant differences between typical and atypical KD groups. Third, the study reflects the experience of a single tertiary care center, which may not represent patient populations or management practices in other regions of Serbia. Lastly, patients treated in secondary care settings or prior to the implementation of our hospital's electronic health record system may have been missed, further limiting the comprehensiveness of our cohort.

In conclusion, in this single-center experience, both typical and atypical Kawasaki disease patients demonstrated favorable short- and medium-term outcomes with standard therapy. However, delayed diagnosis and prolonged hospitalization were more common among atypical cases, highlighting the need for greater clinical vigilance and improved referral pathways. To enhance early recognition and management of KD across all healthcare levels, we recommend nationwide education efforts and the implementation of standardized diagnostic protocols. A multicenter study is warranted to better characterize the epidemiology and clinical spectrum of KD in Serbia and the broader region.

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