J Pediatr Res 2022;9(2):157-63
DOI: 10.4274/jpr.galenos.2021.15046

Original Article

# Distinguishing Kawasaki Disease from Other Febrile Illnesses in Infants

Rumeysa Yalçınkaya[1], Fatma Nur Öz[1], Türkan Aydın Teke[1], Ayşe Kaman[1], Sevgi Yaşar Durmuş[1], Utku Arman Örün[2], Gönül Tanır[1]

[1]University of Health Sciences Turkey, Ankara Dr. Sami Ulus Gynecology, Child Health and Diseases Training and Research Hospital, Clinic of Pediatric Infectious Diseases, Ankara, Turkey
[2]University of Health Sciences Turkey, Ankara Dr. Sami Ulus Gynecology, Child Health and Diseases Training and Research Hospital, Clinic of Pediatric Cardiology, Ankara, Turkey

**ABSTRACT**

**Aim:** Kawasaki disease (KD) is difficult to diagnose in infants, since the disease course is subtle. We aimed to identify whether infants with KD demonstrate significant alterations in laboratory parameters that can be used to distinguish them from other febrile infants.

**Materials and Methods:** In this retrospective case-control study, infants diagnosed with KD between January 2010 and December 2019 were evaluated and compared to a cohort of febrile infants admitted with prolonged fever during the same period. Demographic, clinical, and laboratory features were recorded and compared between these two groups.

**Results:** A total of 42 infants (27 male) with KD (32 incomplete KD) and 84 age-matched febrile infants (57 male) were evaluated. Coronary artery involvement was identified in 20 (47.6%) infants of whom 5 (25%) had coronary aneurysms. All infants with KD were treated with IVIG and high dose acetylsalicylic acid, and 38 (90.5%) responded to treatment. The duration of fever and hospitalization were longer in infants with KD compared to the controls ($p<0.001$). White blood cell (WBC), eosinophil, platelet counts, platelet distribution width, acute phase reactants, alanine aminotransferase, and gamma glutamyl transferase were significantly higher; whereas, mean platelet volume (MPV), hemoglobin, and albumin levels were lower in the KD group compared to the controls. Lower MPV and albumin values were found to be independently associated with a higher likelihood of having a KD diagnosis.

**Conclusion:** It may be difficult to diagnose KD in infants. Our data shows that MPV and albumin may be used as supportive parameters to differentiate KD from other febrile conditions in infants.

**Keywords:** Kawasaki disease, infant, mean platelet volume, albumin

## Introduction

Kawasaki disease (KD) is an acute febrile childhood illness with unknown etiology characterized by systemic inflammation of predominantly the medium arteries. Approximately 80% of patients are younger than five years of age. Classical KD diagnosis is based on clinical criteria in the presence of at least five days of fever. Some infants might only present with an unexplained fever in the absence of other manifestations, which leads to diagnostic difficulties and delays in treatment (1). It is challenging to distinguish KD from other febrile conditions in the infant age group since the incomplete

**Address for Correspondence**
Rumeysa Yalçınkaya, University of Health Sciences Turkey, Ankara Dr. Sami Ulus Gynecology, Child Health and Diseases Training and Research Hospital, Clinic of Pediatric Infectious Diseases, Ankara, Turkey
Phone: +90 312 317 03 53 E-mail: rumeysa_ra@hotmail.com ORCID: orcid.org/0000-0002-0083-0587
**Received:** 13.10.2021 **Accepted:** 06.12.2021

form of the disease [incomplete KD (IKD)] is common, and findings are exceedingly similar to those of other febrile diseases. It is well established that the 'typical' clinical criteria are mostly absent or infrequent in infants with KD (2).

On the other hand, KD is one of the important causes of acquired heart disease in childhood, leading to cardiac and/or coronary abnormalities. It is known that infants with KD more frequently have coronary and cardiac complications, highlighting the importance of prompt diagnosis and treatment (3). Therefore, a well-defined laboratory parameter (or a set of parameters) could help clinicians identify suspected cases of KD in the infant age group, even when typical criteria are not present.

This study aimed to investigate the clinical and laboratory features of infants with KD and to identify whether infants with KD demonstrate significant alterations in laboratory parameters that can be used to distinguish them from other febrile infants.

## Materials and Methods

### Patients and Clinical Data

In this retrospective case-control study, we reviewed the data of infants diagnosed with KD who were younger than 12 months at the time of disease onset between January 2010 and December 2019.

Ethics Committee approval was obtained from University of Health Sciences Turkey, Ankara Dr. Sami Ulus Gynecology, Child Health and Diseases Training and Research Hospital (date: 08.07.2019, approval no: 2019/7).

The control cohort comprised 84 age-matched febrile infants. The cohort was formed by evaluating the medical records of infants admitted with prolonged fever without a known source during the same period. Febrile infants diagnosed with any specific infection, such as tonsillitis, urinary tract infection, pneumonia, etc., or infants with any specific infectious etiology were excluded.

The following data were recorded: (i) Epidemiological and clinical features (gender, age, symptoms, number of positive main diagnostic criteria at admission, length of hospitalization, findings on physical examination, treatment modalities, echocardiography results), (ii) Complete blood count parameters, (iii) Biochemistry results, including serum sodium levels and acute phase reactants [C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR)], and (iv) liver function test panel [alanine aminotransferase (ALT), aspartate amino transaminase (AST), albumin, gamma-glutamyl transferase (GGT)]. Comparisons were performed between these two groups (infants with KD vs febrile controls).

### Definitions and Echocardiographic Analysis

According to American Heart Association guidelines, the patients in this study were classified as either complete KD (cKD) or IKD (2).

Echocardiogram results were classified as Z scores: (i) no involvement: Always <2; (ii) Dilation only: 2 to <2.5; or if initially <2, an increase of ≥1 in *Z* score during follow-up; (iii) Small aneurysm: ≥2.5 to <5; (iv) medium-sized aneurysm: ≥5 to <10 with an absolute dimension of <8 mm; (v) Large or giant aneurysm: ≥10 or absolute dimension of ≥8 mm (2).

Cardiac involvement was defined as the presence of cardiac abnormalities such as coronary artery anomalies, valvular regurgitation, or pericardial effusion.

### Treatment

All infants with KD were treated with intravenous immunoglobulin (IVIG, 2 gr/kg) as a single infusion over 12 hours as soon as possible after diagnosis was confirmed. Resistance to IVIG treatment was defined when persistent or recrudescent fever occurred 36 hours after the first IVIG infusion. Acetylsalicylic acid (ASA) was commenced with a dose of 60 mg/kg/day. Once the fever was absent for 48-72 hours, patients were switched to a low dose of aspirin, 3-5 mg/kg per day, for its antiplatelet effect. The low-dose ASA therapy was terminated 6-8 weeks after diagnosis if the infant had no coronary artery involvement. If coronary artery involvement persisted, ASA was continued as long as the involvement continued. Infants with a positive polymerase chain reaction or rapid antigen test for influenza virus received dipyridamole (2-6 mg/kg/day) instead of ASA.

### Follow-up

The routine echocardiogram follow-up of infants with KD was conducted according to the following schedule: at diagnosis, two weeks after disease onset, 4-6 weeks after disease onset, and in the 3$^{rd}$ and 6$^{th}$ months. After the first year, examinations were scheduled yearly.

### Statistical Analysis

All data obtained in this study were transferred to SPSS (version 25.0) software (SPSS Inc., Chicago, IL, USA). Descriptive results of all variables were determined. Categorical variables are given as frequency (n) and percentage (%). Continuous variables are presented as mean ± SD or median (min-max) depending on their conformity

with normal distribution -which was checked with the Shapiro-Wilk test. Categorical variable analyses were conducted via chi-square tests. Receiver operating curve (ROC) analysis was used to analyze the capability of various parameters in identifying KD according to area under curve (AUC) values. The Youden J Index was calculated for the determination of cut-off values. Multivariable regression with the backward conditional method was performed to determine factors that were independently related to the diagnosis of KD. Only variables that demonstrated significant difference in univariate analyses were included in the model. P-values less than 0.05 were considered to demonstrate statistical significance.

## Results

We included a total of 42 infants [27 (65%) male] with KD and 84 age-matched febrile infants [57 (67.8%) male] as a control group. The median age was nine months (min-max: 1-12 months) in both groups. In the KD group, four (9%) infants were under the age of three months, eight (19%) were between 3-6 months old, and 30 (72%) were older than six months of age. The youngest KD patient was a 1-month-old girl.

Thirty-two (76%) infants were diagnosed with IKD, while 10 (24%) were diagnosed with cKD. Coronary artery involvement was identified in 20 (47.6%) infants, 5 (25%) had coronary aneurysms. All of the infants were treated with IVIG and high dose ASA; 38/42 were responsive to treatment. Four (9%) infants received more than one IVIG infusion, and two received steroid therapy due to IVIG resistance. Five infants (12%) were administered enoxaparin therapy because of coronary aneurysms. The demographic and clinical features of those infants with KD are shown in Table I.

Except for one infant, all of the infants with coronary artery involvement attended follow-up examinations (n=19). Among these infants, five suffered from aneurysms; however, during follow-up, even though coronary artery involvement persisted, the dimensions of the aneurysms reduced to within normal dilatation limits. The longitudinal evaluation showed that 14 infants who had coronary dilatation at the initial assessment demonstrated a return to normal. The time elapsed until the regression of coronary dilatation ranged from 1 month (minimum) to 19 months (maximum) after diagnosis.

A comparison of the KD group to the control group showed that the duration of fever and hospitalization was longer in infants with KD ($p<0.001$). Significantly higher levels of white blood cell (WBC), eosinophil, platelet counts, platelet distribution width, ESR, CRP, ALT, and GGT were identified in infants with KD. Additionally, significantly lower MPV levels, hemoglobin, and albumin were detected in infants with KD in comparison to the febrile controls. Also, echocardiography was performed in 65 of the 82 (79.2%) patients in the control group, and the results were normal. The comparison of demographic features and laboratory findings between infants with KD and the febrile controls is shown in Table II.

Multivariable logistic regression was performed with KD diagnosis as the dependent variable. The parameters found to be statistically significant in univariate analysis

**Table I.** Demographic, clinical, laboratory data, and echocardiographic findings of infants with KD

| | |
|---|---|
| **Infants with KD (n=42)** | |
| Male : female ratio | 1.8 : 1 |
| Full diagnostic criteria, n (%) | 10 (23.8%) |
| Incomplete KD, n (%) | 32 (76.1%) |
| Duration of hospitalization, days, median (min-max) | 7 (2-22) |
| **Major criteria, n (%)** | |
| Rash | 26 (61.9%) |
| Conjunctivitis | 25 (59.5%) |
| Lymphadenopathy | 15 (35.7%) |
| Extremity changes | 10 (23.8%) |
| Mucosal changes | 25 (59.5%) |
| **Other clinical findings, n (%)** | |
| Irritability | 30 (71.4%) |
| Diarrhea | 15 (35.7%) |
| Vomiting | 17 (40.4%) |
| BCG induration | 8 (19%) |
| Arthritis | 1 (0.2%) |
| Aseptic meningitis | 10 (23.8%) |
| Gallbladder hydrops | 5 (11.9%) |
| Sterile pyuria | 7 (16.6%) |
| **Echocardiography findings, n (%)** | |
| Coronary artery involvement | 20 (47.6%) |
| Coronary artery aneurysm | 5 (11.9%) |
| Giant coronary artery aneurysm | 0 |
| Ascendant aortic dilatation | 1 (0.2%) |
| Mitral regurgitation | 3 (0.7%) |
| **IVIG resistance, n (%)** | 4 (9.5%) |

BCG: Bacillus Calmette-Guarin, IVIG: Intravenous immunoglobulin, KD: Kawasaki disease, min: Minimum, max: Maximum

were included in the model. Albumin and MPV values were categorized with regards to the cut-off values obtained via ROC analysis. Lower MPV and albumin values (based on the cut-off values) were independently associated with a higher likelihood of having KD diagnosis. Following this, we used ROC curve data to assess the diagnostic abilities of albumin and MPV to distinguish KD patients from the febrile controls (Figure 1). AUC values, cut-off points determined by the Youden J Index, and sensitivity, specificity, accuracy, and positive and negative predictive values for the parameters are given in Table III.

## Discussion

It is well known that infant KD presents a diagnostic challenge due to its subtle signs and symptoms, often resulting in a diagnosis of IKD. However, in this age group, the cardiac and coronary complications of the disease are also more common, which makes accurate diagnosis crucial (4). The literature shows that infants with KD may present with only two symptoms, namely, irritability and prolonged fever (5). Distinctive laboratory or clinical features that can differentiate KD from other febrile illnesses have not yet been identified in this age group. Therefore, we aimed to evaluate the role of laboratory parameters in distinguishing KD from other febrile cases.

In our study, 76% of patients had IKD. Although there are different frequencies in previous reports, such as 56.6% (6), 68% (7), 88% (8), and 71% (9), it seems that our results are in agreement with the majority of studies showing that IKD is more common among infants. Infants younger than three months of age often present with the incomplete form of the disease (10). This situation is thought to be associated with the immaturity of the immune system in infants. Researchers have argued that the neutralization of superantigens by maternal antibodies transferred through the placenta may be related to the

**Table II.** Comparison of clinical and laboratory features of infants with KD and febrile controls

| | **Infants with KD (n=42)** | **Febrile controls (n=84)** | **p-value** |
|---|---|---|---|
| Age, months | 9 (1-12) | 9 (2-12) | 0.565 |
| Male : female ratio | 1.8 : 1 | 2 : 1 | 0.688 |
| Duration of fever (days) | 7 (1-20) | 5 (2-10) | **<0.001** |
| Duration of hospitalization (days) | 7 (2-22) | 5 (3-10) | **<0.001** |
| **Laboratory parameters** | | | |
| WBC (x10$^3$/mm$^3$) | 15.8 (3.9-36.2) | 13.8 (4.7-28.3) | **0.023** |
| Neutrophil (x10$^3$/mm$^3$) | 8.2 (1.4-20.5) | 7.1 (1.3-17.1) | 0.077 |
| Lymphocyte (x10$^3$/mm$^3$) | 5.1 (1.8-12.4) | 1.05 (4.1-11.1) | 0.084 |
| Monocyte (x10$^3$/mm$^3$) | 1.3 (0.2-3.5) | 1.1 (0.1-3.07) | 0.688 |
| Eosinophil (x10$^3$/mm$^3$) | 0.2 (0.03-2.02) | 0.1 (0-6.3) | **<0.001** |
| Platelet count (x10$^3$/mm$^3$) | 527 (72-1394) | 356 (155-672) | **<0.001** |
| MPV (fL) | 7.8 (6.6-10.7) | 8.7 (6.6-11.5) | **<0.001** |
| Hemoglobin (g/dL) | 10.2 (7.5-12) | 11 (8.8-15.5) | **<0.001** |
| PDW (%) | 39.2 (11.5-60.7) | 16.6 (8.2-66) | **0.005** |
| CRP (mg/L) | 88.1 (3.4-289) | 36.5 (3-179) | **0.002** |
| ESR (mm/h) | 72.5 (1.3-130) | 47.5 (7-108) | **0.002** |
| Aspartate aminotransferase (units/L) | 36 (16-170) | 39 (18-140) | 0.625 |
| Alanine aminotransferase (units/L) | 30.5 (10-184) | 17 (7-120) | **0.001** |
| Gamma-glutamyl transferase (units/L) | 45.5 (10-233) | 23.5 (8-100) | **0.002** |
| Albumin (g/dL) | 3.3 (2-4.8) | 3.8 (3.3-4.6) | **<0.001** |
| Sodium (mEq/L) | 136 (128-139) | 135 (131-143) | 0.851 |

*All values are given as median (min-max)
CRP: C-reactive protein, ESR: Erythrocyte sedimentation rate, KD: Kawasaki Disease, MPV: Mean platelet volume, PDW: Platelet distribution width ratio, WBC: White blood cell, min: Minimum, max: Maximum

higher likelihood of IKD among infants when compared to older children (11).

The possibility of KD should be considered when an infant has prolonged fever, even without other signs (5). In our study, four patients (9%) were admitted with fever and did not initially present with any other criteria. Published case reports also show that it is not uncommon to have an infant present with only fever but subsequently receive a diagnosis of KD after the detection of coronary artery anomalies or aneurysms (1). Classically, it is suggested that fever duration must be at least five days to suspect KD; however, in a recently published revision of KD criteria, it was stated that the requirement for a specific duration of fever should not be considered as a basis for the diagnosis of KD. The Japan Nationwide Surveillance study showed that approximately 9%, 25%, and 35% of KD patients received their first IVIG treatment on the 3rd, 4th, and 5th days of illness. It was noted that the prevalence of coronary artery lesions was low (12).

As KD is a systemic inflammatory disease, laboratory findings include increased levels of acute-phase reactants, thrombocytosis, leukocytosis, and a left shift in WBC; however, these results are not specific to KD. There are currently no laboratory markers that can be used to distinguish KD from other febrile illnesses. In our study, albumin and MPV levels were identified as parameters that could help to differentiate KD from other febrile illnesses. In a study that compared 64 children with KD (of whom 20 were infants) and 16 infants who had at least 5 days of fever, the authors found that ESR, CRP, and the N-terminal prohormone of brain natriuretic peptide were significantly higher in the KD group (13). Another study compared 72 infants with KD who were younger than six months against 50 cases of adenovirus-infected infants; WBC, platelet count, CRP, and neutrophil levels were significantly higher; whereas hemoglobin and serum albumin levels were significantly lower in those infants with KD (14). Our analysis showed that albumin levels below 3.35 g/dL were associated with a KD diagnosis in infants (Odds ratio: 112.073, 95% confidence interval 13.237-948.895). In a relatively large study conducted with 309 KD patients and 160 healthy controls, it was found that those patients with KD had lower MPV than the control subjects (15). Another study supported this by comparing changes in platelet parameters between KD patients and febrile and afebrile controls; the authors found that MPV was significantly lower in those patients with KD than the febrile controls (16). Our analysis found an MPV cut-off value of <7.97, which demonstrated a sensitivity and specificity of 59.5% and 77.4%, respectively, in distinguishing KD from febrile infants. The mechanism causing lower MPV in KD has not been clarified yet; however, it is known that MPV levels are affected by inflammation which is a characteristic of KD. It is thought that parameters that increase during the acute phase of KD, such as interleukin-6, granulocyte colony-stimulating factor, and macrophage colony-stimulating factor, might lead to decreased platelet volume (17). Also, the regulation of thrombopoiesis may be defective in inflammatory diseases, and consumption of activated platelets may cause reduced MPV (18). Since MPV is a component of the routinely performed complete blood count test, its measurement will not lead to any additional costs. Therefore, it is feasible to use this almost-ubiquitous parameter in order to differentiate between KD and other febrile diseases.

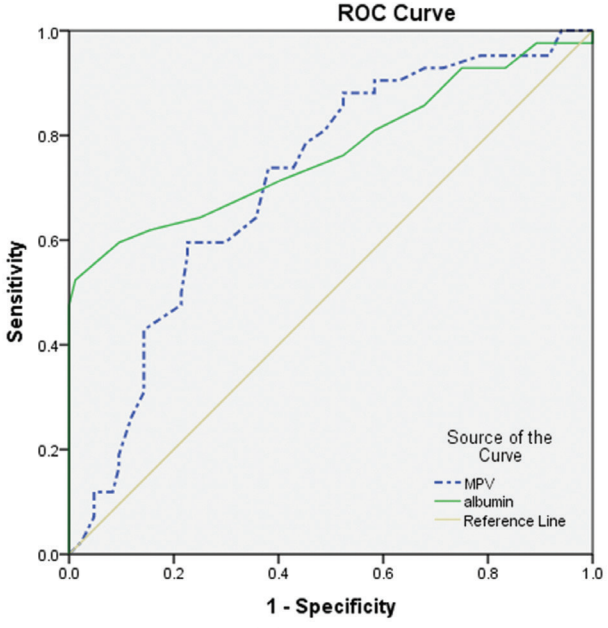


**Figure 1.** ROC curves for the diagnosis of Kawasaki disease with MPV and albumin

*ROC: Receiver operating characteristic, MPV: Mean platelet volume*

In our study, 4 of the 42 infants (9.5%) were not responsive to initial treatment with IVIG. In a study from Italy that analyzed the characteristics of 32 infants with KD, 6 (18%) infants were unresponsive to initial IVIG treatment (7). Furthermore, a study from India reported 3 of their 17 infants (17%) were resistant to initial IVIG and required additional treatment. In support of these findings, a previous study observed that younger children had a relatively higher frequency (19%) of requiring a second IVIG dose than older children (14%), even though the difference between groups was not significant (19). Additionally, it has been noted

that infants with KD might be more resistant to treatment overall (20). However, the frequency of resistance to IVIG was much lower in our group of patients, possibly indicating a difference caused by genetic factors.

The PubMed database was searched using terms such as "infant Kawasaki disease," "Kawasaki disease aged below 1 year" and "Kawasaki disease age". Only studies in the English language and only ones published after January 2000 were included. Eight publications were found in which the characteristics of infants with KD who were younger than 12 months old were compared to those in other age groups. The data from these published studies regarding infants with KD (3,4,7,13,21-24) are summarized in Table IV. Although various case series and studies focusing on infants with KD have been published, our study is among the few that evaluated whether a distinctive laboratory marker can be used to distinguish KD from other febrile conditions in the infant age group.

### Study Limitations

One of the limitations of our study is the limited number of infants included. All evaluated data were drawn from a single center, which may be a limitation even though this center is a tertiary referral center that receives patients from all regions throughout Turkey. The retrospective design is another limitation. Additionally, low albumin is a known diagnostic parameter of IKD, and any results should be interpreted with this in mind.

## Conclusion

It may be difficult to diagnose KD in infants since the disease course is subtle and difficult to differentiate from other febrile diseases. Our data shows that MPV and albumin may be used as supportive parameters to differentiate KD from other febrile conditions in the infant age group. However, more prospective studies are needed to identify specific clinical features, laboratory parameters, and specific criteria in the infant age group.

**Table III.** Parameters associated with the diagnosis of KD with multivariable logistic regression analysis and diagnostic accuracy analysis of parameters

| | OR (95% CI) | p-value | AUC | Sensitivity | Specificity | Accuracy | PPV | NPV |
|---|---|---|---|---|---|---|---|---|
| Albumin <3.35 g/dL | 112.073 (13.237-948.895) | **<0.001** | 0.770 | 52.4% | 98.8% | 83.3% | 95.7% | 80.6% |
| MPV <7.97 fL | 0.153 (0.054-0.432) | **<0.001** | 0.713 | 59.5% | 77.4% | 71.4% | 56.8% | 79.3% |

AUC: Area under curve, CI: Confidence interval, MPV: Mean platelet volume, NPV: Negative predictive value, OR: Odds ratio, PPV: Positive predictive value

**Table IV.** A short literature review of studies including infant KD cases aged below 12 months

| Reference number | Study year, country | Number of KD cases <12 months/ total cohort | Age of infant KD group (months) | M:F ratio | Fever duration (days) | iKD n (%) | IVIG resistance n (%) | Coronary artery involvement n (%) | Coronary aneurysm n (%) | Albumin (g/dL) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 2012, Korea | 52/242 | 8.3§ | 37:15 | 6.7§ | 35 (67) | N/A | Z score: 5.83±1.39† | N/A | N/A |
| 13 | 2015, Korea | 20/64 | 5.65±2.76† | 15:5 | 6.45±1.88† | 13 (65) | 4 (20) | 3 (15) | N/A | 4.2±0.4† |
| 3 | 2018, USA | 80/250 | 7 (1-11)* | 43:37 | N/A | 30 (38) | 15 (16) | Max Z score: 3.37±3.38† | n (48) | 3.11±0.57† |
| 21 | 2019, Korea | 192/859 | 7 (5-9) | 115:77 | 6 (5-7)‡ | 61 (31.7) | 11 (6) | 40 (21) | 4 (2) | N/A |
| 7 | 2019, Italy | 32/113 | 5.7±2.7† | 20:12 | >5 days in all patients | 22 (68.7) | 6 (18.7) | 16 (50) | N/A | 19 patients had hypoalbuminemia |
| 22 | 2020, China | 64/213 | 7 (5-11)* | N/A | N/A | 4 (6.1) | 5 (7.8) | 5 (7.69) | N/A | N/A |
| 23 | 2020, Brazil | 23/301 | N/A | 18:5 | >5 days in all patients | 9 (39.1 ) | 31 (11.4) | 12 (52.2) | N/A | N/A |
| 24 | 2021, China | 62/398 | 8.48±1.12† | 40:22 | 7.4±2.4† | 28 (45.2) | 15 (24.2) | 15 (24.2) | N/A | N/A |

F: Female, IVIG: Intravenous immunoglobulin, IKD: Incomplete Kawasaki disease, KD: Kawasaki disease, M: Male, USA: United States of America
*Median (minimum-maximum), †Mean ± standard deviation, ‡Median (interquartile range), §Mean

### Ethics

**Ethics Committee Approval:** Ethics Committee approval was obtained from University of Health Sciences Turkey, Ankara Dr. Sami Ulus Gynecology, Child Health and Diseases Training and Research Hospital (date: 08.07.2019, approval no: 2019/7).

**Informed Consent:** Retrospective study.

**Peer-review:** Internally peer-reviewed.

### Authorship Contributions

Concept: R.Y., F.N.Ö., T.A.T., A.K., S.Y.D., U.A.Ö., G.T., Design: R.Y., F.N.Ö., T.A.T., A.K., S.Y.D., U.A.Ö., G.T., Data Collection and/or Processing: R.Y., Analysis or Interpretation: R.Y., Literature Review: R.Y., F.N.Ö., T.A.T., A.K., S.Y.D., U.A.Ö., G.T., Edited Manuscript: F.N.Ö., G.T., Writing: R.Y.

**Conflict of Interest:** The authors declared that there were no conflicts of interest.

**Financial Disclosure:** The authors declared that this study has received no financial support.

## References

1. Uchida Y, Iwamoto Y, Urushihara Y, et al. Case of Incomplete Kawasaki Disease with No Symptoms Except Fever Causing the Development of Coronary Aneurysm. Int Heart J 2019; 60:1006-8.
2. McCrindle BW, Rowley AH, Newburger JW, et al. Diagnosis, Treatment, and Long-Term Management of Kawasaki Disease: A Scientific Statement for Health Professionals From the American Heart Association. Circulation 2017; 135:e927-9.
3. Cameron SA, Carr M, Pahl E, DeMarais N, Shulman ST, Rowley AH. Coronary artery aneurysms are more severe in infants than in older children with Kawasaki disease. Arch Dis Child 2019; 104:451-5.
4. No SJ, Kim DO, Choi KM, Eun LY. Do predictors of incomplete Kawasaki disease exist for infants? Pediatr Cardiol 2013; 34:286-90.
5. Correction to: Diagnosis, Treatment, and Long-Term Management of Kawasaki Disease: A Scientific Statement for Health Professionals From the American Heart Association. Circulation 2019; 140:e181-4.
6. Yeo Y, Kim T, Ha K, et al. Incomplete Kawasaki disease in patients younger than 1 year of age: a possible inherent risk factor. Eur J Pediatr 2009; 168:157-62.
7. Mastrangelo G, Cimaz R, Calabri GB, et al. Kawasaki disease in infants less than one year of age: an Italian cohort from a single center. BMC Pediatr 2019; 19:321.
8. Singh S, Agarwal S, Bhattad S, et al. Kawasaki disease in infants below 6 months: a clinical conundrum? Int J Rheum Dis 2016; 19:924-8.
9. Grasa CD, Fernandez-Cooke E, Sánchez-Manubens J, et al. Kawasaki disease in infants 3 months of age and younger: a multicentre Spanish study. Ann Rheum Dis 2019; 78:289-90.
10. Li W, Zhang L, Huang P, Zhang Z. Clinical features and mid-term follow-up in infants younger than 3 months with Kawasaki disease in a Chinese population. J Paediatr Child Health 2019; 55:523-7.
11. Chang LS, Lin YJ, Yan JH, Guo MM, Lo MH, Kuo HC. Neutrophil-to-lymphocyte ratio and scoring system for predicting coronary artery lesions of Kawasaki disease. BMC Pediatr 2020; 20:398.
12. Kobayashi T, Ayusawa M, Suzuki H, et al. Revision of diagnostic guidelines for Kawasaki disease (6th revised edition). Pediatr Int 2020; 62:1135-8.
13. Kang JH, Hong SJ, Seo IA, et al. Early Detection of Kawasaki Disease in Infants. Korean Circ J 2015; 45:510-5.
14. Tang Y, Li X, Cao L, et al. Characteristics and Indications of Kawasaki Disease Among Infants Under 6 Months. Front Pediatr 2020; 8:470.
15. Liu R, Gao F, Huo J, Yi Q. Study on the relationship between mean platelet volume and platelet distribution width with coronary artery lesion in children with Kawasaki disease. Platelets 2012; 23:11-6.
16. Zheng X, Wu W, Zhang Y, Wu G. Changes in and significance of platelet function and parameters in Kawasaki disease. Sci Rep 2019; 9:17641.
17. Igarashi H, Hatake K, Shiraishi H, Samada K, Tomizuka H, Momoi MY. Elevated serum levels of macrophage colony-stimulating factor in patients with Kawasaki disease complicated by cardiac lesions. Clin Exp Rheumatol 2001; 19:751-6.
18. Collins CE, Rampton DS, Rogers J, Williams NS. Platelet aggregation and neutrophil sequestration in the mesenteric circulation in inflammatory bowel disease. Eur J Gastroenterol Hepatol 1997; 9:1213-7.
19. Yoon YM, Yun HW, Kim SH. Clinical Characteristics of Kawasaki Disease in Infants Younger than Six Months: A Single-Center Study. Korean Circ J 2016; 46:550-5.
20. Wu S, Long Y, Chen S, et al. A New Scoring System for Prediction of Intravenous Immunoglobulin Resistance of Kawasaki Disease in Infants Under 1-Year Old. Front Pediatr 2019; 7:514.
21. Kwak JH, Lee J, Ha KS. Significance of Differential Characteristics in Infantile Kawasaki Disease. Korean Circ J 2019; 49:755-65.
22. Shi L, Li J, Qie D, et al. Clinical manifestations of Kawasaki disease in different age groups: retrospective data from Southwest China. Clin Rheumatol 2020; 39:3027-32.
23. Medeiros R de Magalhães C, Coutinho de Almeida F, Gandolfi L, et al. Clinical Manifestations of Kawasaki Disease at Different Age Spectrum: A Ten-Year Study. Medicina (Kaunas) 2020; 56:145.
24. Peng Y, Liu X, Duan Z, Cai S, Duan J, Zhou Y. Age-related differences in clinical characteristics of Kawasaki disease. Braz J Med Biol Res 2021; 54:e10281.