ECRONICON OPEN ACCESS

EC PAEDIATRICS
Research Article

Retrospective Review of Patients with Kawasaki Disease from a Single Center in United Arab Emirates

Nazima Chaudhary[1]*, Mohammed Wajid Chaudhary[1], Naavarasu Sundaramurthy[1], Anas Abu Hazeem[2] and Dinesh Banur Onkarappa[1]

[1]*Department of Pediatrics, NMC Royal Hospital, Abu Dhabi, United Arab Emirates*

[2]*Pediatric Cardiology, KidsHeart Medical Center, Abu Dhabi, United Arab Emirates*

***Corresponding Author:** Nazima Chaudhary, Department of Pediatrics, NMC Royal Hospital, Abu Dhabi, United Arab Emirates.

Received: January 19, 2023; **Published:** January 28, 2023

Abstract

Introduction: Kawasaki disease (KD) is a small- and medium-vessel vasculitis of unknown etiology leading to myriad of symptoms and signs mostly affecting children between 6 months and 5 years of age, and has become the number one cause for acquired heart disease in children in the developed world.

Methods: Here we report a retrospective review of clinical features and laboratory investigations of 15 consecutive cases in a single center in the United Arab Emirates.

Results: The CAAs were present in 46.6% of the patients with no significant difference in the incidence of CAAs between patients with typical versus atypical KD, though the most severe CAAs were seen in patients with atypical KD. All the CAAs were present on the first echocardiographic assessment except for one patient, who developed later. Significantly higher levels of the ALT (p-value=0.010), AST (p-value-0.028) and GGT (p-value=0.034) were found in those with CAA in our study. Increased ALT >24.5, predicted the presence of CAAs (area under the curve {AUC} =0.940, sensitivity=0.80 and specificity= 0.80). The levels of AST >23.5 (AUC =0.920, sensitivity=0.80 and specificity= 0.80), and for GGT >34.0 (AUC =0.840, sensitivity= 0.80 and specificity=0.40) predicted the same. There were no other difference between typical versus atypical KD, or patients with or without the CAAs.

Conclusion: The CAAs are more likely in those with higher hepatic enzymes, and patients with evidence of CAA need more frequent and longer cardiology follow up as they are more at risk of long-term complications.

Keywords: *Kawasaki disease, Coronary artery abnormality, transaminases, United Arab Emirates*

Introduction

Kawasaki disease (KD) is a small- and medium-vessel vasculitis of unknown etiology leading to myriad of symptoms and signs mostly affecting children between 6 months and 5 years of age. The KD is markedly more prevalent in Japan where it was described for the first time in 1967, and other Asian populations compared to the rest of the world [1,2]. Currently, it is one of the leading causes of acquired heart disease in pediatric population in the developed countries [3].

There is no definitive diagnostic laboratory test available for the KD. "Classical/complete" KD is defined as the presence of fever for ≥ 5 days, with at least four of the following five symptoms: polymorphous rash, bilateral non-purulent conjunctival injection, oral changes including cracked and erythematous lips and strawberry tongue, cervical lymphadenopathy, and extremity changes such as erythema or desquamation of palms and soles [3]. "Atypical/Incomplete" KD is considered in any infant or child with prolonged unexplained fever, < 4 principal clinical findings, and compatible laboratory or echocardiographic findings [3].

Laboratory tests, although non-specific, provide support for a diagnosis of KD in patient with non-classical but suggestive clinical features. KD is unlikely if the erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) and platelet count are normal at day 7 of the illness [3]. Echocardiography (ECHO) is considered positive if any of the three conditions are met: Z score of left anterior descending coronary artery (CA) ≥ 2.5; CA aneurysm is observed; or ≥ 3 other suggestive features exist, including decreased left ventricular function, mitral valve regurgitation, pericardial effusion, or Z score in left anterior descending (LAD) CA or right CA of 2 to 2.5 [3].

The mainstay of therapy is intravenous immunoglobin (IVIG) which prevents development of coronary artery abnormalities (CCAs) and has limited role, if any, in curing the established coronary damages. Failure to initial treatment put the patient at higher risk of CAAs. Other risk factors associated with development of CAA are described in different population groups. There is no study reported from the United Arab Emirates. Here we report a retrospective review of clinical features and laboratory investigation of 15 consecutive cases in a single center in United Arab Emirates, which is a multi-ethnic society with expatriates far outnumbering the local residents.

Materials and Methods

All the cases of KD admitted to the hospital from February 2017 to July 2019 were included in the study to describe the characteristics as retrieved from the database of hospitalized children. The study has been performed according to the standards of Helsinki Declaration.

The diagnostic criteria used were as described in the American Heart Association (AHA) scientific on diagnosis, treatment, and long-term management of KD. Clinical features, laboratory results and treatment administered were carefully evaluated. Apart from the medical history and detailed physical examination findings other investigations including electrocardiography (ECG), trans-thoracic ECHO and chest X-ray (CXR) were also reviewed and documented. Various laboratory test results were collected for the patients as suggested by the AHA guideline. All those laboratory tests were carried out by the standard methods.

Data collected from Clinical, laboratory reports are reported as the mean ± standard deviation (SD) (continuous variables) or as Frequencies and percentages (categorical variables). ECHO findings regarding dimensions of the CAs were reported as by Kobayashi., *et al*. using Lambda-mu-sigma method of regression analysis of body surface area [4]. Categorical data were compared using the chi-square test or the Fisher exact test, while continuous variables were compared using the independent-samples t-test or Mann Whitney U test. P values < 0.05 was considered for statistical significance. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY.

Results

Clinical characteristics

The study group consisted of 15 patients with slight female preponderance (Table 1). The cases ranged from 8-months to 5-year-11-months of age (median 31 months) with 14/15 patients (93.3%) being < 5 years. The ratio of Typical: atypical KD was 1.14:1 and so was the female to male ratio. Median duration of fever at presentation was 6 days (min. 4; max. 14 days) and at the beginning of treatment with IVIG was 8 days (min. 5; max. 16 days). Admitting diagnosis was suspected/confirmed KD in 60%, tonsillo-pharyngitis in 20%, and pneumonia, gastroenteritis and possible connective tissue disease (6.7% each). The median time of hospitalization was 5 days (min. 4; max. 8 days). There was no difference in the length of stay between patient without or with CAAs.

The most consistent diagnostic features, apart from mandatory fever, were oral mucosal changes (100%) and non-exudative conjunctivitis (93.3%). The less frequent findings were rash (80%), cervical lymphadenopathy (60%) and extremity changes (53.3%). Of those having oral mucosal changes cracked/chapped lips was seen in 80%, strawberry tongue and pharyngeal congestion in 46.7% each, follicular tonsillitis in 20%, and gingival swelling, ulceration and gum bleeding in one patient (6.7%). The rash was mainly blanchable maculopapular (MP) over the trunk and limbs except three (one patient each had MP rash of valval and perianal area only, MP rash with

Variables	Whole group n = 15	CAA absent n = 8	CAA present n = 7	p-value
Gender				
Male, n (%)	7 (46.6)	2 (25)	5 (71.4)	NS
Female, n (%)	8 (53.3)	6 (75)	2 (28.6)	
Age at presentation (months)				
Median (range)	31 (8-71)	31 (15-46)	31 (8-71)	NS
Age at presentation (months)				
≤ 12, n (%)	2 (13.3)	2 (25)	0	NS
> 12 - 36, n (%)	7 (46.6)	3 (37.5)	4 (57.1)	
> 36, n (%)	6 (40)	3 (37.5)	3 (42.8)	
Days of fever on admission				
Median (range)	6 (4-14)	6 (4-14)	7 (4-8)	NS
Day of fever on admission				
< 5 days, n (%)	2 (13.3)	1 (12.5)	1 (14.2)	NS
5 - 10 days, n (%)	12 (80)	6 (75)	6 (85.7)	
> 10 days, n (%)	1 (6.7)	1 (12.5)	0	
Oral mucosal changes, n (%)	15 (100)	8 (100)	7 (100)	NS
Conjunctival changes, n (%)	14 (93.3)	7 (87.5)	7 (100)	NS
Rash, n (%)	12 (80)	7 (87.5)	5 (71.4)	NS
Lymphadenopathy, n (%)	9 (60)	5 (62.5)	4 (57.1)	NS
Changes of hands and feet, n (%)	8 (53.3)	5 (62.5)	3 (42.9)	NS
Typical/ Classic KD, n (%)	8 (53.3)	4 (50)	4 (57.1)	NS
Day of fever on IVIG treatment				
Median (range)	8 (5-16)	8 (5-16)	8 (6-9)	NS
Days of hospitalization				
Median (range)	5 (4-8)	6 (4-8)	4 (4-6)	NS
Days of hospitalization				
Up to 4 days, n (%)	6 (40)	2 (33.3)	4 (66.7)	NS
> 4 days, n (%)	9 (60)	4 (57.1)	3 (42.8)	
IVIG resistance, n (%)	1 (6.6)	0	1 (14.3)	NS

Table 1: *Demography and clinical features.*

some becoming purpuric, and generalized macular rash with sandy texture). The rash in one had subsided before coming to us. Cervical lymphadenopathy when present was unilateral in two-thirds and bilateral in one-thirds with one of them having bilateral multiple tender lymph nodes. Extremity changes were swelling of dorsum of hands and feet (4/8 patients), palmar erythema (3/8 patients), both (1/8 patient), and swelling of interphalangeal joints of fingers (1/8 patient). There was no significant difference regarding the cardinal clinical features between those without and with CAA. Other features observed were hepatomegaly in 4 patients, and significant diarrhea and vomiting, persistent cough, and radiological evidence of pneumonitis with otitis media in one case each.

Laboratory investigations

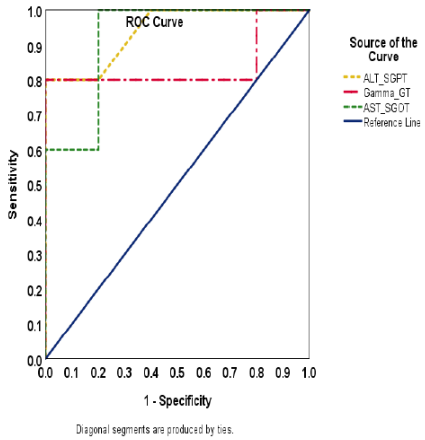
The laboratory investigations were analyzed and presented in table 2. Statistically significant difference was found in the alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gamma-glutamyl transpeptidase (GGT) levels between those without and with CAA. Rest of the investigation results were not significantly different between two groups. We analyzed the demographic features, clinical symptoms and laboratory results to look for variables associated with the duration of fever and hospitalization, and we found none (data not shown).

Variables	Whole group n = 15	CAA absent n = 8	CCA present n = 7	p-Value
CRP (mg/l) (Mean ± SD)	171.3 ± 231.8	123.3 ± 19	226.1 ± 344	NS
CRP ≥ 30, n (%)	14 (93.3)	8 (100)	6 (85.7)	NS
CRP ≥ 100, n (%)	11 (73.3)	7 (87.5)	4 (57.1)	NS
ESR (mm/hour)	80 ± 32.0	81 ± 36.5	80.5 ± 29.1	NS
ESR ≥ 40, n (%)	13 (86.6)	6 (75)	7 (100)	NS
Hemoglobin (g/l) (Mean ± SD)	10.7 ± 1.45	10.58 ± 1.46	10.86 ± 1.55	NS
Anemia for age, n (%)	9 (60)	5 (62.5)	4 (57.1)	NS
White cell count ($x10^9$/l) (Mean ± SD)	17.3 ± 6.00	17.7 ± 7.44	16.8 ± 4.34	NS
White cell count ≥ $15x10^9$/l, n (%)	9 (60)	5 (62.5)	4 (57.1)	NS
Neutrophil count ($x10^9$/l)	11.7 ± 5.61	12.1 ± 6.94	11.2 ± 4.10	NS
Neutrophil: lymphocyte ratio (Mean ± SD)	3.84 ± 2.89	4.75 ± 3.31	2.81 ± 2.09	NS
Platelet Count ($x10^9$/l) (Mean ± SD)	363.8 ± 125.6	406.5 ± 146.3	315 ± 81.6	NS
Platelet Count > 450 $x10^9$/l at ≥ 7^{th} day of illness, n (%)	11 (84.6)	7 (87.5)	4 (80)	NS
Total bilirubin (µmol/l), n=12 (Mean ± SD)	5.58 ± 3.57	4.03 ± 1.75	7.13 ± 4.38	NS
Elevated bilirubin (n, %)	0	0	0	NS
ALT (U/l), n = 14 (Mean ± SD)	65.2 ± 74.2	17.8 ± 5.93	112.5 ± 81.6	0.010
AST (U/l), n = 13 (Mean ± SD)	36.6 ± 16.21	26.5 ± 8.73	45.4 ± 16.4	0.028
GGT (U/l), n = 10 (Mean ± SD)	68.7 ± 66.16	26.6 ± 9.18	110.8 ± 73.04	0.034
Albumin (g/l), n = 11 (Mean ± SD)	27.4 ± 3.87	26.0 ± 4.26	28.5 ± 3.71	NS
Albumin ≤ 3.0 g/dl, n (%)	9 (81.8)	4 (80)	5 (83.3)	NS
Na (mmol/l), n = 15 (Mean ± SD)	137.2 ± 2.96	137.6 ± 3.11	136.8 ± 2.97	NS
Na < 135 mmol/l, n (%)	3 (20)	2 (25)	1 (14.2)	NS

Table 2: *Laboratory investigations and risk scores.*

ROC CURVE

Test Result Variable(s)	AUC	Std. Error	P value	Lower Bound	Upper Bound	Cutoff value	Sensitivity	Specificity
ALT_SGPT	0.940	0.076	0.022	0.791	1.00	24.50	0.80	0.80
Gamma_GT	0.840	0.151	0.076	0.544	1.00	23.50	0.80	0.40
AST_SGOT	0.920	0.093	0.028	0.738	1.00	34.00	0.80	0.80



Cardiac assessment showed 46.6% of the patients with KD had CAA on ECHO. There was no significant difference between the typical and atypical KD regarding CAA. Of those who developed CAA had it present on the initial scan except one, this patient's scan at 2 weeks showed aneurysm in the right coronary artery (z-score 8.3). The only patient with IVIG resistance in our study had bright edematous coronary arteries' openings which normalized after re-treatment with second dose of IVIG. Two patients had bicuspid aortic valves and one had small persistent foramen ovale with mild mitral regurgitation. ECG abnormality was found in 3 (20%) of cases with sinus tachycardia in 2, and biventricular hypertrophy in one with normal ECHO.

Treatment and outcome

The treatment was standard dose of IVIG (2 gram/kg infused over 24 hours) in all cases except our 1st patient, who received 1 gram/kg of the same, once daily over two consecutive days. All patient received high-dose aspirin initially as per AHA guidelines. One patient was successfully treated with a repeat dose as fever was still present at 48 hours 1st dose of IVIG. Seven patients (46.6%) have already been discharged from the pediatric cardiology services after normalization of the ECHO findings, if any, and six (40%) are still in follow up while the rest 2 have been lost to follow-up. The total follow-up duration of the study was 101 patient-months. Mean number of ECHO in the study was 2.73. One of the patient in the study had recurrent KD and there were no mortalities.

Discussion and Conclusion

The incidence of KD is increasing worldwide with highest annual incidence in Japan, rising from 243.1 per 100,000 population aged 0 to 4 years in 2011 to 264.8 in 2012 [5]. There is no data from the United Arab Emirates. The mean age of KD is 3 years worldwide, similar

to our study cohort (31 months of age) [6]. In our study population the male: female ratio was 1:1.14, though it is reported more frequently in boys than girls (1.31:1) [5]. One patient in our study (6.6%) had a recurrent KD after 14 months of index episode. The recurrence of KD is seen in 3-5% of case, highest being within the first 2 years of index episode [7]. The case fatality rate in KD in Japan is 0.015%, virtually all deaths resulting from its cardiac sequelae [5].

Involvement of coronary arteries (CAs) is a hallmark complication of KD and this may develop in 15 - 25% of untreated patients. Approximately 4% may develop CAAs even after administration of IVIG optimally as single high-dose (2 gram/kg), within the first 10 days of illness [8]. The risk of CAA is even higher in infants with KD, though it was not seen in our study.

Atypical KD accounted for 46.6% of the total cases in our study which is consistent with other reports [9-11]. This is higher than approximately 20% atypical KD reported in earlier studies [5]. Diagnosis of KD should be considered in children with fever of ≥ 5 days and 2 or 3 compatible clinical criteria or infants with fever for ≥ 7 days without other explanation. The diagnosis is unlikely if CRP < 30 mg/l and ESR < 40 mm/hour [3]. Published AHA guidelines, including supplementary laboratory criteria and use of ECHO has resulted in better recognition of atypical KD [12,13] Atypical presentation of KD tends to delay in diagnosis and treatment. Delayed treatment > 10 days of illness is associated with higher incidence of CAAs [3]. This may partly explain the high rate of CAAs in later studies comprising higher proportion of atypical case. The CAA was identified in 46.6% of our patients with similar rates reported earlier [13]. Though the incidence of CAAs was not different between typical and atypical KD, the most severe abnormalities (z-score of 8.24 and 8.3) were found in two atypical KD patients (data not shown).

Majority of children with CAAs had some abnormalities on their initial ECHO but initially unremarkable ECHO does not rule out CAA [9]. One of our patients developed aneurysm a week after an unremarkable scan at the time of diagnosis. This patient had the highest levels of inflammatory markers in our study with CRP of 993 mg/l. The AHA recommends ECHO at diagnosis and repeat scans both within 1 to 2 weeks and 4 to 6 weeks after treatment for uncomplicated patient, and more frequent for others [3]. Since abnormalities in CAs are rarely detected at 6 weeks in patients with KD who have normal measurements at baseline and 2 weeks of illness, the 6-week ECHO imaging may be unnecessary in patients with uncomplicated KD and *z*-scores < 2.0 in the first 2 weeks of illness [14]. In another study all patients with persistent CAAs at 1 year already had an abnormal initial ECHO [15].

Acute coronary dilatation of exceeding ~ 5.0 mm can lead to late abnormalities of the coronary artery wall including CA calcification which increases with age [16]. These calcifications are likely to develop approximately 10 years onwards following KD [17]. All patients who develop CAA carry a lifelong increased risk for coronary thrombosis and stenotic coronary lesions that may result in myocardial ischemia, infarction, and sudden death [18]. 'Missed" KD in childhood have been attributed to many cases of both fatal and non-fatal myocardial infarction in young adults [19].

Hepatic dysfunction represents systemic inflammation in all the medium- and small-sized arteries and multiple other tissues including liver. Significantly higher levels of the ALT (p-value = 0.010), AST (p-value-0.028) and GGT (p-value = 0.034) were found in those with CAA in our study. Hepatic dysfunction including hypoalbuminemia, elevated AST, low total protein, low albumin/globulin ratio and hyperbilirubinemia is commonly reported in KD [20]. A lower albumin/globulin (A/G) ratio with a cut-off value of < 1.48 has been suggested as independent predictor of CAA [20]. All of our patients (n = 12, with complete liver function results) had A/G ratio ≤ 1.16 irrespective of presence or absence of CAA. In a nationwide epidemiological survey in Japan involving 11,900 cases of complete KD showed elevated ALT at initial examination, before starting salicylate treatment, associated with the development of cardiac disorders [21]. A significantly higher average value of ALT was observed in the group of patients presenting earlier leading to initiation of IVIG treatment < 5 days and this group had significantly higher rate of aneurysms [22].

Other inflammatory markers including higher WBC, increased CRP, increased ESR have been associated with CAA in other studies [23,24]. We did not find any difference between those without and with CAA regarding these variables as also reported in some other

studies [23-25]. Male gender, delayed treatment >10 days and IVIG resistant KD are associated with CAA [23,24]. In our study there was no difference male and female regarding incidence of CAA, and only one patient each had delayed treatment and IVIG resistance make any inference difficult in this regard.

Major limitation of the present study is smaller number of patients. Other limitation is retrospective review from a single center. Larger multi-centric study will elucidate more about KD in this part of the world.

To summarize, KD should be considered in the those with incomplete clinical features. By following AHA guidelines more patients are picked up early in the course of disease leading to treatment within 10 days of fever onset. The CAAs are more likely in those with higher liver transaminases and patients with evidence of CAA need more frequent and longer cardiology follow up as they are more at risk of long-term complications.

Funding Support

None/Not applicable.

Conflicts of Interest/Competing Interests

None/Not applicable.

Ethics Approval

Obtained.

Consent to Participate

None/Not applicable.

Consent for Publication

None/Not applicable.

Availability of Data and Material

Available.

Code Availability

None/Not applicable.

Authors' Contributions

All the authors contributed equally to the article.

Bibliography

1. Kawasaki T. "Acute febrile muco-cutaneous lymph node syndrome in young children with unique digital desquamation". *Japanese Journal of Allergology* 16 (1967): 178-222.
2. Uehara R and Belay ED. "Epidemiology of Kawasaki disease in Asia, Europe, and the United States". *Journal of Epidemiology* 22.2 (2012): 79-85.
3. McCrindle BW., *et al*. "Diagnosis, treatment, and long-term management of Kawasaki disease: a scientific statement for health professionals from the American Heart Association". *Circulation* 135 (2017): e927-e999.

4. Kobayashi T., *et al*. "A New Z Score Curve of the Coronary Arterial Internal Diameter Using the Lambda-Mu-Sigma Method in a Pediatric Population". *The Journal of the American Society of Echocardiography* 29.8 (2016): 794-801.

5. Makino N., *et al*. "Descriptive epidemiology of Kawasaki disease in Japan, 2011-2012: from the results of the 22nd nationwide survey". *Journal of Epidemiology* 25.3 (2015): 239-245.

6. Holman RC., *et al*. "Hospitalizations for Kawasaki syndrome among children in the United States, 1997–2007". *The Pediatric Infectious Disease Journal* 29 (2010): 483-488.

7. Nakamura Y., *et al*. "Incidence rate of recurrent Kawasaki disease in Japan". *Acta Paediatrica* 83 (1994): 1061-1064.

8. Mori M., *et al*. "Meta-analysis of the results of intravenous gamma globulin treatment of coronary artery lesions in Kawasaki disease". *Modern Rheumatology* 14 (2004): 361-366.

9. Dominguez SR., *et al*. "Preventing coronary artery abnormalities: a need for earlier diagnosis and treatment of Kawasaki disease". *The Pediatric Infectious Disease Journal* 31.12 (2012): 1217-1220.

10. Gorczyca D., *et al*. "The clinical profile of Kawasaki disease of children from three Polish centers: a retrospective study". *Rheumatology International* 34.6 (2014): 875-880.

11. Al-Ammouri I., *et al*. "Kawasaki disease in Jordan: demographics, presentation, and outcome". *Cardiology in the Young* 22.4 (2012): 390-395.

12. Ghelani SJ., *et al*. "Increased incidence of incomplete Kawasaki disease at a pediatric hospital after publication of the 2004 American heart association guidelines". *Annals of Pediatric Cardiology* 33 (2012): 1097-1103.

13. Heuclin T., *et al*. "Increased detection rate of Kawasaki disease using new diagnostic algorithm, including early use of echocardiography". *The Journal of Pediatrics* 155.5 (2009): 695-699.

14. De Ferranti SD., *et al*. "Association of Initially Normal Coronary Arteries with Normal Findings on Follow-up Echocardiography in Patients with Kawasaki Disease". *JAMA Pediatrics* 172.12 (2018): e183310.

15. Chbeir D., *et al*. "Kawasaki disease: abnormal initial echocardiogram is associated with resistance to IV Ig and development of coronary artery lesions". *Pediatric Rheumatology* 16.1 (2018): 48.

16. Tsujii N., *et al*. "Late Wall Thickening and Calcification in Patients After Kawasaki Disease". *The Journal of Pediatrics* 181 (2017): 167-171.

17. Kahn AM., *et al*. "Calcium scoring in patients with a history of Kawasaki disease". *JACC Cardiovasc Imaging* 5 (2012): 264-272.

18. Kato H., *et al*. "Long-term consequences of Kawasaki disease. A 10- to 21-year follow-up study of 594 patients". *Circulation* 94.6 (1996): 1379-1385.

19. Burns JC., *et al*. "Sequelae of Kawasaki disease in adolescents and young adults". *Journal of the American College of Cardiology* 28 (1996): 253-257.

20. Mammadov G., *et al*. "Hepatic dysfunction secondary to Kawasaki disease: characteristics, etiology and predictive role in coronary artery abnormalities". *Clinical and Experimental Medicine* 20.1 (2020): 21-30.

21. Uehara R., *et al*. "Serum alanine aminotransferase concentrations in patients with Kawasaki disease". *The Pediatric Infectious Disease Journal* 22.9 (2003): 839-842.

22. Nomura Y., *et al*. "Patients diagnosed with Kawasaki disease before the fifth day of illness have a higher risk of coronary artery aneurysm". *Pediatrics International* 44.4 (2002): 353-357.

23. Tang Y., *et al*. "Epidemiological and Clinical Characteristics of Kawasaki Disease and Factors Associated with Coronary Artery Abnormalities in East China: Nine Years Experience". *Journal of Tropical Pediatrics* 62.2 (2016): 86-93.

24. Yan F., *et al*. "Risk Factors of Coronary Artery Abnormality in Children with Kawasaki Disease: A Systematic Review and Meta-Analysis". *Frontiers in Pediatrics* 7 (2019): 374.

25. Printz BF., *et al*. "Pediatric heart network investigators. Noncoronary cardiac abnormalities are associated with coronary artery dilation and with laboratory inflammatory markers in acute Kawasaki disease". *Journal of the American College of Cardiology* 57 (2011): 86-92.

Volume 12 Issue 2 February 2023