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Application of Echocardiography Combined with Blood SAA, IL-6, PCT, and CRP Detection in the Diagnosis and Treatment of Kawasaki Disease in Children

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Abstract

Objective: To understand the application of echocardiography combined with blood SAA, IL-6, PCT, and CRP detection in the diagnosis and treatment of Kawasaki disease in children. **Methods:** 56 children with Kawasaki disease were selected as the study subjects as the treatment group, and 54 children with other diseases during the same period were selected as the control group. Echocardiography, blood SAA, IL-6, PCT and CRP were detected before and after treatment to observe the results of the two groups. A database was established to compare the changes of various indicators between the two groups, as well as the application value of each indicator in the clinical diagnosis and treatment of Kawasaki disease, and the pros and cons of the application of each indicator in the diagnosis and treatment of children with Kawasaki disease were analyzed, so as to provide a clearer early warning mechanism for the clinical diagnosis and treatment of children with Kawasaki disease. **Results:** There was no significant difference in the results of related imaging indexes in the control group before and after treatment ($P > 0.05$). There was no significant difference in the results of relevant imaging indicators in the treatment group before and after treatment ($P > 0.05$), except for LMCA ($P < 0.05$). The comparison of imaging related indicators before and after treatment between the two groups showed that except for no statistically significant difference in LMCA and RMCA before treatment ($P > 0.05$), all other indicators had statistical significance ($P < 0.05$). The results of relevant laboratory indexes in control group before and after treatment were statistically significant ($P < 0.05$). The results of relevant laboratory indexes before and

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after treatment in the treatment group were statistically significant ($P < 0.05$). The results of relevant laboratory indicators were compared between the two groups, except for the results of SAA, IL-6 and PCT before treatment, which were not statistically significant ($P > 0.05$), the differences in all other indicators were statistically significant ($P < 0.05$). **Conclusion:** The combination of echocardiography with blood SAA, IL-6, PCT, and CRP detection can establish the optimal evaluation plan for accurate and effective diagnosis, treatment, and prognosis of Kawasaki disease in children, providing more accurate and reliable diagnostic and treatment methods and laboratory data for clinical practice, and thus providing strong protection for children's health.

Keywords

Echocardiogram, Kawasaki Disease, SAA, IL-6, PCT, CRP

1. Introduction

Kawasaki disease (KD), also known as mucocutaneous lymph node syndrome, is an acute self-limited febrile disease of unknown origin, with a high incidence in infants and young children under 5 years old, more males than females, and less common in adults and children under 3 months old. It has become one of the main causes of acquired heart disease in children in developed countries [1] [2]. Clinical manifestations may include fever, rash, non-purulent lymph node enlargement in the neck, conjunctival congestion, diffuse congestion of oral mucosa, myrica rubra tongue, palmoplantar erythema, and hard edema of hands and feet. Due to the possibility of serious cardiovascular complications caused by the disease, this disease has attracted people's attention; and the incidence of untreated children ranges from 20% to 25%. In 2017, the American Heart Association (AHA) released the new "Diagnosis, Treatment, and Long-term Management of Kawasaki Disease—American Heart Association Scientific Guidelines for Healthcare Professionals." [3] The guidelines systematically elaborated the evidence-based basis of the epidemiology, pathology, diagnosis, treatment and long-term management of Kawasaki disease. Echocardiography has high sensitivity and specificity in the exploration of proximal coronary artery lesions of Kawasaki disease, at the same time, relevant requirements were put forward for laboratory testing [4] [5] [6] [7]. This study aims to evaluate the diagnosis, treatment, and prognosis of Kawasaki disease in children through the results of echocardiography combined with blood SAA, IL-6, PCT, and CRP testing, with the hope of achieving good results.

2. Materials and Methods

2.1. Research Subjects

56 patients with Kawasaki disease were all diagnosed by clinical doctors based on the results of echocardiography related indicators combined with the relevant indicators of the laboratory and clinical examination; Among them, There were

35 males and 21 females, ranging in age from 1 to 11 years, with an average age of (4.46 ± 2.62) years; 54 patients with other diseases were all diagnosed as respiratory tract infections by clinical doctors based on the results of echocardiography related indicators combined with laboratory related indicators and clinical examination analysis; Among them, there were 35 males and 19 females, aged between 1 - 14 years, with an average age of (6.91 ± 3.33) years. All enrolled cases were approved by the Ethics Management Committee of the hospital and obtained the consent of the patient's guardian before conducting the study.

2.2. Research Methods

56 patients clinically diagnosed with Kawasaki disease in children were selected as the study subjects as the treatment group, and 54 children with other diseases during the same period were selected as the control group. Echocardiography, blood SAA, IL-6, PCT and CRP were detected on both groups before and after treatment to observe the results of the two groups. A database was established to compare the changes of various indicators between the two groups, as well as the application value of each indicator in the clinical diagnosis and treatment of Kawasaki disease, and the pros and cons of the application of each indicator in the diagnosis and treatment of children with Kawasaki disease were analyzed, so as to provide a clearer early warning mechanism for the clinical diagnosis and treatment of children with Kawasaki disease.

2.3. Echocardiographic Manifestations and Major Infection Indicators in Patients with Kawasaki Disease

The main manifestations of echocardiography in patients with Kawasaki disease were: 1) left anterior descending (LAD) or right coronary artery (RCA) with a Z-value ≥ 2.5; 2) Coronary artery aneurysm; 3) Diagnostic features: decreased left ventricular function, mitral regurgitation, pericardial effusion, left anterior descending branch or right coronary artery with the Z-value 2.0 - 2.5; Laboratory indicators of Kawasaki disease patients showed an increase in the main infection indicators, such as blood SAA, IL-6, PCT and CRP tests.

2.4. Statistical Processing

Establish a database of all enrolled cases and use statistical software SPSS 24.0 for analysis. Comparison of the number of cases and gender between the treatment group and the control group was statistically analyzed by X^2 test; Comparison of the rest such as average age, echocardiography related indicators and laboratory related indicators was statistically analyzed by t test; $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison between the Total Number of Cases, Gender and Age between the Two Groups

There was no statistically significant difference in the number of selected cases

between the two groups (P > 0.05); There was no statistically significant difference between genders (P > 0.05); The difference between the average ages was statistically significant (P < 0.05). The control group had a relatively large average age, while the treatment group had a relatively small average age, with an average age of less than 5 years, which is consistent with the onset age of Kawasaki disease. Please refer to Table 1 for details

3.2. Comparison of the Results of Imaging and Laboratory Related Indicators in the Control Group before and after Treatment

The imaging related indicators EF (%), AO (mm), LMCA (mm), and RMCA (mm) of the control group before and after treatment were (71.22 ± 6.06)%, (18.59 ± 6.36) mm, (2.5 ± 0.54) mm, (2.3 ± 0.48) mm, and (69.59 ± 5.99)%, (17.67 ± 6.52) mm, (2.37 ± 0.47) mm (2.16 ± 0.41) mm, respectively; There was no statistically significant difference in all examination indicators before and after treatment (P > 0.05); The specific results are shown in Table 2. The laboratory related indicators SAA, IL-6, PCT, and CRP before and after treatment were (100.81 ± 98.66) mg/L and (107.78 ± 108.58) μG/L, (0.71 ± 1.26) ng/mL, (29.47 ± 46.17) mg/L, and (13.93 ± 27.59) mg/L, (15.31 ± 29.2) μG/L, (0.09 ± 0.17) ng/mL, (7.87 ± 11.09) mg/L, respectively; Compared before and after treatment, all examination indicators showed statistically significant differences (P < 0.05), as shown in Table 3.

3.3. Comparison of Imaging and Laboratory Related Indicators before and after Treatment in the Treatment Group

The imaging related indicators of EF (%), AO (mm), LMCA (mm), and RMCA (mm) before and after treatment in the treatment group were (65.14 ± 5.79)%, (12.87 ± 2.85) mm, (2.32 ± 0.63) mm, (2.16 ± 0.65) mm, and (65.64 ± 5.37)%, (13.14 ± 2.36) mm, (2.12 ± 0.49) mm (2.03 ± 0.51) mm, respectively; Compared before and after treatment, except for the statistically significant difference in LMCA test results (P < 0.05), there was no statistically significant difference in all other test indicators (P > 0.05); The specific results are shown in Table 4. The inspection results of the laboratory related indicators SAA, IL-6, PCT, and CRP before and after treatment were (126.45 ± 118.63) mg/L and (132.80 ± 132.67), μg/L, (1.15 ± 1.64) ng/mL, (73.55 ± 85.08) mg/L, and (24.24 ± 31.64) mg/L,

Table 1. Comparison of age and gender between the control group and the treatment group.

Group	Number of cases	Gender		Age
		Male	Female	
Control group	54	35	19	6.91 ± 3.33
Treatment group	56	35	21	4.46 ± 2.62
X^2or t	—	0.0637		4.2969
P	—	0.8008		0.0000

Table 2. Comparison of the results of relevant imaging indicators in the control group before and after treatment.

Group	Cases	EF (%)	AO (mm)	LMCA (mm)	RMCA (mm)
Before treatment	54	71.22 ± 6.06	18.59 ± 6.36	2.5 ± 0.54	2.3 ± 0.48
After treatment	54	69.59 ± 5.99	17.67 ± 6.52	2.37 ± 0.47	2.16 ± 0.41
t	—	1.4057	0.7423	1.3344	1.6297
P	—	0.0814	0.2298	0.0925	0.0531

Table 3. Comparison of the results of relevant laboratory indicators in the control group before and after treatment.

Group	Cases	SAA	IL-6	PCT	CRP
Before treatment	54	100.81 ± 98.66	107.78 ± 108.58	0.71 ± 1.26	29.47 ± 46.17
After treatment	54	13.93 ± 27.59	15.31 ± 29.2	0.09 ± 0.17	7.87 ± 11.09
t	—	6.2320	6.0435	3.5834	3.3428
P	—	0.0000	0.0000	0.0003	0.0006

Table 4. Comparison of examination results of relevant imaging indicators before and after treatment in the treatment group.

Group	Cases	EF (%)	AO (mm)	LMCA (mm)	RMCA (mm)
Before treatment	56	65.14 ± 5.79	12.87 ± 2.85	2.32 ± 0.63	2.16 ± 0.65
After treatment	56	65.64 ± 5.37	13.14 ± 2.36	2.12 ± 0.49	2.03 ± 0.51
t	—	0.4738	0.546	1.8752	1.1775
P	—	0.3183	0.2931	0.0317	0.1208

(26.01 ± 33.31) μ G/L, (0.31 ± 0.52) ng/mL, (14.91 ± 19.09) mg/L; Before and after treatment, the differences in all examination indicators were statistically significant ($P < 0.05$), and the specific results are shown in Table 5. The above results of imaging and laboratory related indicators are consistent with the characteristics of auxiliary diagnosis of Kawasaki disease.

3.4. Comparison of the Results of Imaging and Laboratory Related Examination Indicators before and after Treatment between the Two Groups

The comparison of imaging indicators before and after treatment between the two groups showed that except for no statistically significant differences in LMCA (mm) and RMCA (mm) before treatment ($P > 0.05$), all other examination indicators had statistically significant differences ($P < 0.05$); Please refer to Table 6 for details. Compared with the results of laboratory related indicators before and after treatment in the two groups, except for no statistically significant differences in SAA, IL-6, and PCT before treatment ($P > 0.05$), all other test indicators showed statistically significant differences ($P < 0.05$). Please refer to Table 7 for details.

Table 5. Comparison of examination results of relevant laboratory indicators before and after treatment in the treatment group.

Group	Cases	SAA	IL-6	PCT	CRP
Before treatment	56	126.45 ± 118.63	132.80 ± 132.67	1.15 ± 1.64	73.55 ± 85.08
After treatment	56	24.24 ± 31.64	26.01 ± 33.31	0.31 ± 0.52	14.91 ± 19.09
t	—	6.2298	5.8422	3.6537	5.0326
P	—	0.0000	0.0000	0.0002	0.0000

Table 6. Comparison of the results of imaging related indicators before and after treatment between the control group and the treatment group.

Group	Before EF (%)	After EF (%)	Before AO (mm)	After AO (mm)	Before LMCA (mm)	After LMCA (mm)	Before RMCA (mm)	After RMCA (mm)
Control group	71.22 ± 6.06	69.59 ± 5.99	18.59 ± 6.36	17.67 ± 6.52	2.5 ± 0.54	2.37 ± 0.47	2.3 ± 0.48	2.16 ± 0.41
Treatment group	65.14 ± 5.79	65.64 ± 5.37	12.87 ± 2.85	13.14 ± 2.36	2.32 ± 0.63	2.12 ± 0.49	2.16 ± 0.65	2.03 ± 0.51
t	5.3812	3.6445	6.0492	4.8108	1.6063	2.7292	1.6562	1.4702
P	0.0000	0.0002	0.0000	0.0000	0.0556	0.0037	0.0503	0.0722

Table 7. Comparison of the results of relevant laboratory indicators between the control group and the treatment group before and after treatment.

Group	Before SAA	After SAA	Before IL-6	After IL-6	Before PCT	After PCT	Before CRP	After CRP
Control group	100.81 ± 98.66	13.93 ± 27.59	107.78 ± 108.58	15.31 ± 29.2	0.71 ± 1.26	0.09 ± 0.17	29.47 ± 46.17	7.87 ± 11.09
Treatment group	126.45 ± 118.63	24.24 ± 31.64	132.80 ± 132.67	26.01 ± 33.31	1.15 ± 1.64	0.31 ± 0.52	73.55 ± 85.08	14.91 ± 19.09
t	1.2301	1.8188	1.0802	1.7889	1.5738	3.0039	3.3934	2.3752
P	0.1107	0.0359	0.1412	0.0382	0.0592	0.0017	0.0005	0.0097

4. Discussion

Kawasaki disease is a heart crisis that causes continual fever in children, and it is the primary cause of acquired heart disease in children, which may cause myocardial infarction or even sudden death in children; However, this disease is good at disguising and is not easy to detect and diagnose [8] [9] [10]. The clinical symptoms of Kawasaki disease mainly include: 1) fever for more than 5 days; 2) Conjunctivitis: the conjunctival membranes (whites of the eyes) are red and bloodshot, but there is no eye poop; 3) Changes in oral mucosa: red lips, dry cracks, sometimes bleeding, strawberry tongue (taste buds protruding, turning red); 4) Skin rash: There is a slightly raised rash on the body, usually not too itchy, and no blisters; 5) Exfoliation of limbs: redness and swelling of the palms and feet, followed by peeling of the fingertips, toe tips, palms and feet, and around the anus (7 - 14 days of fever); 6) Swollen lymph nodes in the neck. If there is the first symptom mentioned above, plus four of the symptoms in items 2 - 6, it can be diagnosed as Kawasaki disease. Professor Wu Meihuan from the Department of Pediatric Cardiology at National Taiwan University Hospital reminds that Kawasaki disease has a significant characteristic; Some children may

have red scars from getting vaccinated with BCG during the onset of the disease; If a young patient has a fever for two to three days, it is important to check if their scars from getting vaccinated with BCG have turned red, which can lead to an early diagnosis of Kawasaki disease. In addition, the incidence of Kawasaki disease reaches its peak in spring and summer from April to June, which seems to be related to the later season of the enterovirus epidemic; Kawasaki disease also has gender differences, and boys are more prone to getting sick, with an incidence rate 1.6 times higher than girls; After getting Kawasaki disease, 1% - 4% of people will relapse.

Kawasaki disease may be unfamiliar to many parents of children, but it is now the most common cause of acquired heart disease in children. Does a child experience a heart attack? If it is Kawasaki disease, there is a possibility of sudden death. Professor Wu Meihuan from the Department of Pediatric Cardiology at National Taiwan University Hospital pointed out that Kawasaki disease can cause a systemic inflammatory response, but symptoms in other organs will gradually improve; Only when the coronary artery of the heart is hit, some children will have scars on their hearts. The coronary artery is responsible for supplying blood to the heart, and the coronary artery of a normal child's heart is about 0.2 to 0.3 centimeters thick, like the thickness of a toothpick; Due to Kawasaki disease, the coronary artery becomes inflamed, swollen, disrupts the normal shape of blood vessels, and becomes a coronary artery aneurysm, causing blood flow here to be prone to turbulence , and the blood flow is not smooth, which can lead to thrombosis; Once the blood flow is blocked, some of the coronary aneurysms will burst. In particular, huge coronary aneurysms with an enlargement of more than 0.8 cm and the thickness of about four toothpicks are more threatening to myocardial infarction and sudden death [11] [12] [13]. But Kawasaki disease is not an easily defeated opponent, and it is probably not an exaggeration to say that it is good at disguise. Since the discovery of this disease by Dr. Fujio Kawasaki in Japan over forty years ago, there has not been a specific examination that can help doctors diagnose a patient with Kawasaki disease; Instead, it is necessary to rely on the symptoms to see if they meet at least five diagnostic criteria; In addition, patients may not necessarily have every symptom, which inevitably leads to misdiagnosis or delayed diagnosis. Wu Meihuan described that the symptoms of Kawasaki disease in the first few days were not significantly different from those of a typical cold. Initially, there was a high fever of 39 or 40 degrees Celsius, followed by red eyes. After a few days, there were red rashes on the skin (but not itching), red mouth, dry cracks, swollen tongue, and the tongue appeared with small particle bumps similar to the surface of a strawberry; Most doctors could diagnose Kawasaki disease. Also about 70% of children with Kawasaki disease initially coughed and had a runny nose like a cold (unlike Kawasaki disease, which can persist in high fever), and about 50% of children had mild diarrhea, which was like being infected with a virus. Especially Kawasaki disease can cause inflammatory reactions throughout the body, inevitably leading anxious parents to seek medical attention in a panic, and even doctors may confuse or delay di-

agnosis. For example, some small patients may be taken by their family to see a dermatologist due to a rash on their body (which is also a reaction to skin vascular inflammation), or have a fever and be taken to see an ear, nose, and throat specialist. They may be diagnosed with otitis media due to a red eardrum. Urinary tests may reveal a high number of white blood cells and proteinuria, which can be mistaken for urinary tract infections. Some may also experience stomach pain, gallbladder edema, liver dysfunction, and be mistaken for gastroenteritis caused by a cold. Some children may not be diagnosed with Kawasaki disease until one or two weeks after their fever subsides, and when they are about to be discharged or return home, their bodies appear to have improved. However, small pieces of peeling may occur on their fingertips and toe tips, and they seek medical attention again before being told that it may be Kawasaki disease. Wu Meihuan reminds that the most feared coronary artery disease in Kawasaki disease is not the most obvious change during fever, but gradually invades the heart about 7 - 10 days after fever subsides, and reaches its peak about two weeks after fever. Some diseases have symptoms similar to Kawasaki disease, challenging the clinical experience and judgment of doctors; The most important thing to distinguish is scarlet fever, which can also have symptoms similar to Kawasaki disease, such as fever, rash, strawberry tongue, peeling, etc; But scarlet fever does not cause redness in the eyes or swelling in the hands and feet; In addition, children who suffer from the disease are usually older and have already attended kindergarten or elementary school; The patient's tonsils will be very red and can cultivate Group A streptococci; In addition, blood tests can detect antibodies against scarlet fever. If the child continues to have a fever for an unknown reason, the doctor can perform a cardiac ultrasound at an appropriate base point to see if it is Kawasaki disease. Although the medical community at home and abroad has been continuously exploring for decades, the cause of Kawasaki disease still cannot be found. Currently, it is only known that it should be transmitted to people with special physical conditions through pathogens, which produce a special immune response. But what kind or what different pathogens are viruses or bacteria? Who have special physical conditions that can cause serious coronary artery problems? There is still no answer. Although the cause cannot be identified and there is no way to prevent getting sick, as long as the child (especially under 5 years old) has a fever for more than 5 days, it is possible to consider actively asking the doctor if it is Kawasaki disease, as a common sense [14] [15] [16] [17].

At present, there are established treatment methods for Kawasaki disease in the medical field. As long as "immunoglobulin" is injected intravenously during the period of fever to regulate the immune response in the body, for most patients, it can not only reduce the fever, but also effectively reduce the harm to the heart. Except "immunoglobulin", all patients with Kawasaki disease should take low-dose aspirin for at least two months, and then observe the recovery of coronary artery by ultrasound. Most children with Kawasaki disease, the inflammatory reaction of the body will gradually disappear, and there will be no coronary

artery problems. After recovery, they will live a normal life. They should temporarily refrain from receiving active vaccines such as chickenpox and MMR for 11 months after receiving immunoglobulin to avoid failure [18] [19] [20].

The results of this study showed that the clinical symptoms, echocardiography, and laboratory related indicators of the treatment group were consistent with the clinical characteristics of Kawasaki disease, and were consistent with the characteristics of high incidence under the age of 5. The control group accords with the clinical diagnosis of children with respiratory tract infection, and the average age is over 5 years old. The comparison of imaging related indicators before and after treatment in the control group showed no statistically significant difference ($P > 0.05$); The comparison of imaging related indicators before and after treatment in the treatment group showed that except for the difference in LMCA, which was statistically significant ($P < 0.05$), all other indicators were not statistically significant ($P > 0.05$); The comparison of imaging related indicators before and after treatment between the two groups showed that except for no statistically significant difference in LMCA and RMCA before treatment ($P > 0.05$), all other indicators had statistical significance ($P < 0.05$). The comparison of laboratory related indicators before and after treatment in the control group showed statistically significant differences ($P < 0.05$); The comparison of laboratory related indicators before and after treatment in the treatment group showed statistically significant differences ($P < 0.05$); The comparison of the results of two groups of laboratory related indicators showed that except for the test results of SAA, IL-6, and PCT before treatment, which were not statistically significant ($P > 0.05$), the differences in all other indicators were statistically significant ($P < 0.05$); Kawasaki disease has certain sensitivity and specificity in imaging and related inflammatory and infectious index examinations, which is worth promoting and applying.

5. Innovation and Advancement of Research

In this study, echocardiography combined with blood SAA, IL-6, PCT and CRP detection was used to assist in the diagnosis of Kawasaki disease in children. According to the results of technical research in the subject Library of Guangxi Medical University, there have been no reports of echocardiography combined with blood SAA, IL-6, PCT and CRP detection in the auxiliary diagnosis of Kawasaki disease in children. Therefore, this research is innovative and advanced.

The inflammatory and infectious indicators used in this study include SAA, IL-6, PCT and CRP. In the auxiliary diagnostic examination related to Kawasaki disease in children, no relevant report has been found through the scientific and technological novelty search results of the library of Guangxi Medical University. Therefore, this study is innovative and progressiveness.

6. Research Conclusion

This study found that echocardiography combined with blood SAA, IL-6, PCT,

and CRP detection combined with clinical symptom characteristics has important practical significance in the clinical diagnosis of Kawasaki disease in children. After physical examination, relevant clinical symptoms can be detected and a clear diagnosis can be made by combining ultrasound electrocardiogram with laboratory major inflammatory and infection indicators, providing strong auxiliary diagnostic basis for early detection and treatment of Kawasaki disease in children.

7. Limitations of Research

Because the Kawasaki disease patients collected in this study have the particularity of their diseases, they need to be combined with clinical symptoms and comprehensive analysis of the results of echocardiography combined with inflammatory and infectious indicators to make a clear diagnosis, so it takes a long time to collect cases, and it is impossible to make statistical analysis in time, which delays the completion time, so there are certain limitations.

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Conflicts of Interest

The authors declare that there is no conflict of interest in the publication of this article.

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