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A Comparative Study of Myocardial Damage Caused by Novel Coronavirus Infection and Influenza A Virus Infection in Children during the COVID-19 Epidemic Period

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Abstract

Objective: To explore the comparative study of myocardial damage in children infected with COVID-19 and influenza A virus during the COVID-19 pandemic. **Method:** Retrospective analysis of myocardial injury caused by COVID-19 infection and influenza A virus infection in children during the COVID-19 from October 2022 to May 2023, including 106 cases of COVID-19 infection, that is, the COVID-19 group; And 164 cases of influenza A virus infection, namely, H1N1 group; Two groups were tested for various indicators of myocardial enzyme spectrum, and the situation of myocardial injury was compared between the two groups. **Result:** In the enrolled cases, there was no statistically significant difference in the prevalence rate of men and women in the COVID-19 group ($P > 0.05$); There was no statistically significant difference in the average age between men and women ($P > 0.05$); The comparison of the incidence rates between males and females in the H1N1 group showed a statistically significant difference ($P < 0.05$); The difference in average age between men and women is statistically significant ($P < 0.05$); The comparison of the incidence rates between two groups of males and females showed a statistically significant difference ($P < 0.05$); The

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difference in average age between the two groups was statistically significant ($P < 0.05$); There was no statistically significant difference in average age between the two groups of boys ($P > 0.05$); There was no statistically significant difference in the average age between the two groups of girls ($P > 0.05$). A comparison between two groups of various indicators of myocardial enzyme spectra showed that the results of AST, α-HBDH and LDH were statistically significant ($P < 0.05$); While there was no significant difference between CK, CKMB and CKMB/CK ($P > 0.05$). **Conclusion:** Both COVID-19 infection and influenza A virus infection in children have different degrees of myocardial damage, but COVID-19 infection causes more myocardial damage than influenza A virus infection, and influenza A virus is more prone to myocardial infarction, which deserves our attention.

Keywords

COVID-19, COVID-19 Infection, Influenza A, Myocardial Damage

1. Introduction

During the pandemic of novel coronavirus infection, due to the invasion of COVID-19, systemic inflammation (cytokine storm), coagulation dysfunction, hypoxemia, endothelial damage, fever, electrolyte imbalance and other pathological mechanisms are prone to occur. COVID-19 infection will affect the cardiovascular system, which can lead to myocardial injury, myocardial infarction, arrhythmia and heart failure. At the same time, patients infected with COVID-19 often have heart-related symptoms such as chest pain, chest tightness, shortness of breath and palpitation [1]. The incidence of myocardial injury associated with COVID-19 infection is high, and 15.0% - 27.8% of patients with severe COVID-19 infection have myocardial injury. During the COVID-19 pandemic, influenza A virus infection is also spreading. Although the severity of myocardial function damage caused by influenza A virus infection has not yet been determined, and there are few reports in current domestic and foreign studies; it can be clear that influenza A virus infection will also cause more or less systemic symptoms in patients, especially the damage of patients' heart and lung function, which brings great difficulties to clinical treatment [2] [3] [4] [5]. Previous studies found that both COVID-19 infection and influenza A virus infection can cause related myocardial injury. The observation effect of cardiac troponin I (cTnI) or cardiac troponin T (cTnT), the markers of myocardial injury, has been clear, and will not be discussed here [3] [6] [7] [8]. This study explored the myocardial injury caused by COVID-19 infection and influenza A virus infection in children during the COVID-19 pandemic through the changes of myocardial enzyme spectrum, in order to provide accurate and reliable laboratory data for clinical treatment. The results are now reported as follows.

2. Materials and Methods

2.1. Research Subjects

106 children who came to see the doctor due to COVID-19 infection during the COVID-19 pandemic from October 2022 to May 2023, namely the COVID-19 group, including 54 males and 52 females, aged 0 - 15 years, with an average age of (5.23 ± 4.99) years, were selected.164 children who came to see the doctor due to influenza A virus infection, including 104 males and 60 females, aged 0 - 15 years, with an average age of (6.19 ± 3.35) years, were also selected. All enrolled cases were carried out with the consent of the child's family and approved by the Medical Ethics Management Committee.

2.2. Research Methods

2 - 3 ml of all the enrolled venous blood of the two groups were extracted on an empty stomach, centrifuged at 4000 rpm for 10 min, and stored in a refrigerator at 4˚C - 8˚C. After all samples were collected, myocardial enzyme profiles were detected together, that is, AST, CK, CK-MB, CKMB/CK, α-HBDH, LDH and other items were detected, and the differences in various indexes between the two groups were compared.

2.3. Statistical Methods

Statistical software SPSS 24.0 was used for statistical analysis. The contents of each index of myocardial enzyme spectrum were expressed as (X mean ± S), X^2 test was used for the comparison of counting units, and t-test was used for comparison of measuring units. $P < 0.05$ was considered statistically significant.

2.4. Reference Range

AST: 15 - 40 U/L; CK: 24.0 - 194.0 U/L; CK-MB: 0 - 25 U/L; α-HBDH: 72.0 - 182.0 U/L; LDH: 109.0 - 245.0 U/L.

3. Results

3.1. Comparison of General Information

In the enrolled cases, the prevalence rate of male and female in the COVID-19 group was $X^2 = 0.0755$, $P = 0.7835$, with no statistically significant difference ($P > 0.05$); The average age comparison between men and women, $t = 0.5446$, $P = 0.2936$, showed no statistically significant difference ($P > 0.05$). The comparison of the incidence rates between males and females in the H1N1 group showed $X^2 = 23.6098$, $P = 0.0000$, and the difference was statistically significant ($P < 0.05$); The average age of males and females was compared, $t = 2.4867$, $P = 0.0071$, and the difference was statistically significant ($P < 0.05$); The comparison of the incidence rates between two groups of males and females showed $X^2 = 4.1253$, $P = 0.0422$, and the difference was statistically significant ($P < 0.05$); The average age of the two groups was compared, $t = 1.7430$, $P = 0.00416$, and the

difference was statistically significant (P < 0.05); The average age of the two groups of boys was compared, t = 1.5944, P = 0.0574, and the difference was not statistically significant (P > 0.05); The average age of the two groups of girls was compared, with t = 0.4609 and P = 0.3229, and there was no statistically significant difference (P > 0.05). The specific results are shown in Table 1 and Table 2 below.

3.2. Comparison of Myocardial Zymogram Test Results between Children Infected with COVID-19 and Influenza A Virus

The detection results of various indexes of myocardial zymogram in COVID-19 group are as follows: AST: 41.05 ± 16.70 U/L, CK: 146.77 ± 126.78 U/L, CK-MB: 20.64 ± 7.41 U/L, CKMB/CK: 0.17 ± 0.07, α-HBDH: 218.66 ± 48.51 U/L, LDH: 272.95 ± 57.88 U/L; The detection results of the H1N1 influenza group are as follows: AST: 36.51 ± 13.30 U/L, CK: 161.11 ± 173.42 U/dl, CK-MB: 21.84 ± 16.84 U/L, CKMB/CK: 0.18 ± 0.12, α-HBDH: 268.45 ± 59.53 U/L, LDH: 223.12 ± 52.41 U/L; After comparing the indexes of myocardial enzyme spectra between the two groups, the test results of AST, α-HBDH and LDH were statistically significant (P < 0.05); However, there was no statistically significant difference in the detection results of CK, CKMB, CKMB/CK (P > 0.05). The specific results are detailed in Table 3 below.

Table 1. Comparison of the number of male and female patients in the COVID-19 group and the H1N1 group.

Groups	Cases	Male	Female	X^2 value	P value
COVID-19 group	106	54	52	0.0755	0.7835
H1N1 group	164	104	60	23.6098	0.0071
X^2value	—	4.1253		—	—
P value	—	0.0422		—	—

Table 2. Comparison of average age between COVID-19 group and H1N1 group.

Groups	Average age	Male	Female	T value	P value
COVID-19 group	5.23 ± 4.99	5.49 ± 4.87	4.96 ± 5.15	0.5446	0.2936
H1N1 group	6.19 ± 3.35	6.67 ± 3.36	5.34 ± 3.19	2.4867	0.0000
t value	1.7430	1.5944	0.4609	—	—
P value	0.0416	0.0574	0.3229	—	—

Table 3. Comparison of myocardial zymogram test results between children infected with COVID-19 and influenza A virus.

Groups	Cases	AST (U/L)	CK (U/L)	CKMB (U/L)	CKMB/CK	α-HBDH (U/L)	LDH (U/L)
COVID-19 group	106	41.05 ± 16.70	146.77 ± 126.78	20.64 ± 7.41	0.17 ± 0.07	218.66 ± 48.51	272.95 ± 57.88
H1N1 group	164	36.51 ± 13.30	161.11 ± 173.42	21.84 ± 16.84	0.18 ± 0.12	268.45 ± 59.53	223.12 ± 52.41
t value	—	2.3572	0.7835	0.8005	0.8638	7.5225	7.3206
P value	—	0.0097	0.2170	0.2121	0.1942	0.0000	0.0000

4. Discussion

COVID-19 infection can increase the risk of plaque rupture and thrombosis based on atherosclerosis, leading to type 1 myocardial infarction, including ST elevation myocardial infarction (STEMI) and non ST elevation myocardial infarction (NSTEMI); Type 2 myocardial infarction occurs in patients infected with COVID-19 due to fever, hypoxia, tachycardia, and sympathetic overexcitement, which lead to mismatch of myocardial oxygen supply and demand [9] [10] [11]. Compared with the non epidemic period, the incidence of acute coronary syndrome with normal or near normal coronary arteries during the epidemic period is higher, and 50% - 60% of patients with myocardial injury have not found serious coronary artery stenosis, which is called acute COVID-19 infected cardiovascular syndrome.

Children with COVID-19 infection-related myocarditis can be manifested as myocardial involvement without cardiac symptoms, mild left and/or right ventricular dysfunction, and cardiogenic shock requiring mechanical circulation support. It is recommended to conduct risk stratification: high-risk patients are manifested as acute heart failure or cardiogenic shock, left ventricular ejection fraction (LVEF) < 40%, with ventricular tachycardia/ventricular fibrillation or severe conduction block and other arrhythmias; Intermediate-risk patients present with mild to moderate acute heart failure symptoms, with LVEF ranging from 30% to 49%, and may be accompanied by severe arrhythmia; Low-risk patients typically have no hemodynamic abnormalities or symptoms of acute heart failure, with only a mild decrease in LVEF (>50%) and no severe arrhythmia. COVID-19 infection-associated fulminant myocarditis is relatively rare, which is a high risk. The patient's condition progresses rapidly, with severe left ventricular dysfunction, cardiogenic shock, or severe arrhythmia; The early mortality rate is high, and treatment should be carried out in an experienced center with mechanical circulatory support (including the use of venous arterial extracorporeal membrane oxygenation). It should be noted that in severely infected patients, if sepsis and/or excessive inflammatory response occur, there may be relatively insufficient effective circulatory capacity, leading to distributed shock [12] [13] [14].

Domestic and foreign studies have shown [15]-[20] that acute respiratory infectious diseases caused by the H1N1 influenza virus are transmitted through droplets, aerosols, direct or indirect contact; The clinical manifestations are mainly influenza-like symptoms, with a few cases showing severe and rapid progression, which can manifest as viral pneumonia, combined with respiratory failure and multiple organ dysfunction, and even death in severe cases. There have been many research reports on the etiology, epidemiology, clinical characteristics, prevention and treatment of influenza A (H1N1) around the world, mainly involving the detection of changes in myocardial enzymes such as LDH, CK, CK.MB, troponin, etc. in patients with influenza A (H1N1) to reflect myocardial injury, which is considered to be related to the virus. However, there is

no comparative study on myocardial injury caused by influenza A (H1N1) and COVID-19 infection in children. Therefore, this study intends to explore the comparative study of myocardial injury caused by COVID-19 infection and influenza A virus infection in children during the COVID-19 pandemic, hoping to achieve good results.

The results of this study found that during the COVID-19 pandemic, the proportion of children infected with influenza A virus was relatively higher than that of COVID-19, the prevalence of COVID-19 infection group was basically the same for boys and girls; While, the proportion of boys and girls infected with influenza A virus was significantly different, and the incidence rate of boys was higher, indicating that boys were more likely to be infected with influenza A virus during the COVID-19 pandemic; The average age of boys among patients with influenza A is higher than that of girls, indicating that girls have a younger age of susceptibility than boys; This study also showed that there was a statistically significant difference between the two groups in the prevalence rate of boys and girls ($P < 0.05$), which also indirectly indicated that boys were more likely to be infected with influenza A virus than girls during the COVID-19 pandemic. The results of this study also found that compared with the detection results of various indicators in the myocardial enzyme spectrum of the two groups, there were statistically significant differences in the results of AST, α-HBDH, and LDH between the two groups ($P < 0.05$); However, there was no statistically significant difference in the detection results of CK, CKMB, CKMB/CK ($P > 0.05$). From the specific test results, the mean values of AST and LDH in the novel coronavirus infection group were higher than those in the influenza A virus infection group, indicating that the degree of myocardial damage caused by novel coronavirus infection was higher than that caused by influenza A virus infection. In addition, the mean value of α-HBDH in the influenza A virus infection group was higher than that in the COVID-19 infection group, and the main significance of the increase of α-HBDH was the susceptibility to myocardial infarction, so the results of this study could also indirectly indicate that the influenza A virus infection group was more prone to myocardial infarction. This study also found that in the collected enrolled cases, two children with COVID-19 infection were found to be accompanied by influenza A virus infection, and their clinical symptoms were mainly COVID-19 infection; Treatment and team entry studies were included in the COVID-19 infection group. In the collected cases, one child with influenza A infection was also found to be accompanied by COVID-19 infection, and the main symptoms were mainly influenza A virus infection; Therefore, treatment and team entry studies were included in the influenza A infection group.

5. Conclusion

The susceptible age of influenza A virus infection in children is older than that of COVID-19 infection, and the susceptible age of influenza A virus infection in boys is also older than that in girls; Both COVID-19 infection and influenza A

virus infection in children have different degrees of myocardial injury, but COVID-19 infection causes more myocardial injury than influenza A virus infection, and influenza A virus infection is more prone to myocardial infarction which is life-threatening, and deserves our great attention.

Limitations of This Study

The cases selected in this study were mainly from people in the local region during the COVID-19 pandemic, and the scope of case collection was narrow, with certain regional limitations. At the same time, the number of cases screened in this study is not large, which cannot represent the overall situation, so there are certain quantitative limitations.

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Conflict of Interest

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

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