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# Corona Lungs and Strawberry Tongues

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**Abstract** Multisystem inflammatory syndrome in children (MIS-C) is one of several severe complications of COVID-19 seen in children. The United States Center for Disease Control diagnostic guidelines for MIS-C include age <21 years, 24-hour history of fever ≥38.0ºC, severe illness necessitating hospitalization, two or more organ system involvement, laboratory evidence of inflammation, laboratory or epidemiologic evidence of SARS-CoV-2, and a lack of alternative diagnosis. This case report focuses on one patient who met six out of the seven cardinal features of MIS-C but fell outside the average age range. Unfortunately, the patient died from complications of COVID-19. Since our patient had multiple risk factors, including obesity and Hispanic ethnicity the pathogenesis of the disease occurring in our patient was likely identical to that which occurs in MIS-C. Due to a significant chance of mortality in patients with MIS-C and COVID-19, it is important to consider this diagnosis in older adolescents and young adults. This patient's unfortunate outcome urges prompt greater suspicion for this rare and life-threatening complication, even though this patient is older than the typical MIS-C patient.

***Keywords:*** *COVID-19, MIS-C, SARS-CoV-2, Multisystem Inflammatory Syndrome in Children*

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## 1. Introduction

Coronavirus disease 2019 (COVID-19) is a multisystemic disease caused by the novel coronavirus SARS-CoV-2. The disease affects people of all ages with a wide range of symptoms. In the pediatric population, a large proportion of children infected with SARS-CoV-2 typically remain asymptomatic [1]. However, fever and cough are the most common complaints in children who present with symptoms. In contrast to the adult population, rhinorrhea, sore throat, myalgias, fatigue, and gastrointestinal symptoms are found to be less common in children [2].

Rarely, severe complications in children can arise as a constellation of symptoms known as Multisystem inflammatory syndrome in children (MIS-C). The incidence according to Payne et al is approximately 1 to 10 cases per 1,000,000 people under the age of 21. Payne et al mentions that over the age of 16 years the incidence drops, however this could be due to the majority of data being reported from children's hospital [3].

This syndrome presents similarly to other multisystemic conditions in children, such as Kawasaki disease, Toxic Shock Syndrome, and Macrophage Activation Syndrome. The United States Center for Disease Control diagnostic guidelines for MIS-C include age <21 years, 24-hour history of fever ≥38.0ºC, severe illness necessitating hospitalization, two or more organ system involvement, laboratory evidence of inflammation, laboratory or epidemiologic evidence of SARS-CoV-2, and a lack of alternative diagnosis [4]. This case report focuses on one patient who meets the cardinal features of MIS-C but falls outside the recommended by the guidelines age range.

## 2. Clinical Presentation

Here we would like to present a 23-year-old male who arrived in the emergency department with complaints of shortness of breath. He was found to also have a fever of 103ºF and sinus tachycardia (HR ~ 120). While not initially revealed by the patient, his family noted that he had been experiencing abdominal pain, nausea, diarrhea, and a dry cough for one week before admission and was diagnosed with COVID-19 just three days prior to his presentation. The patient also had exposure to two confirmed COVID-19 positive members at home and had not been vaccinated as this had occurred before COVID-19 vaccines became widely available.

On physical examination, the patient was morbidly obese (BMI 56.2) with facial flushing, bilateral bulbar conjunctival injection, fissuring of the lips, and erythema of the tongue (Figure 1). There were also discrete edematous and erythematous plaques and numerous serpiginous eruptions on his abdomen (Figure 2).

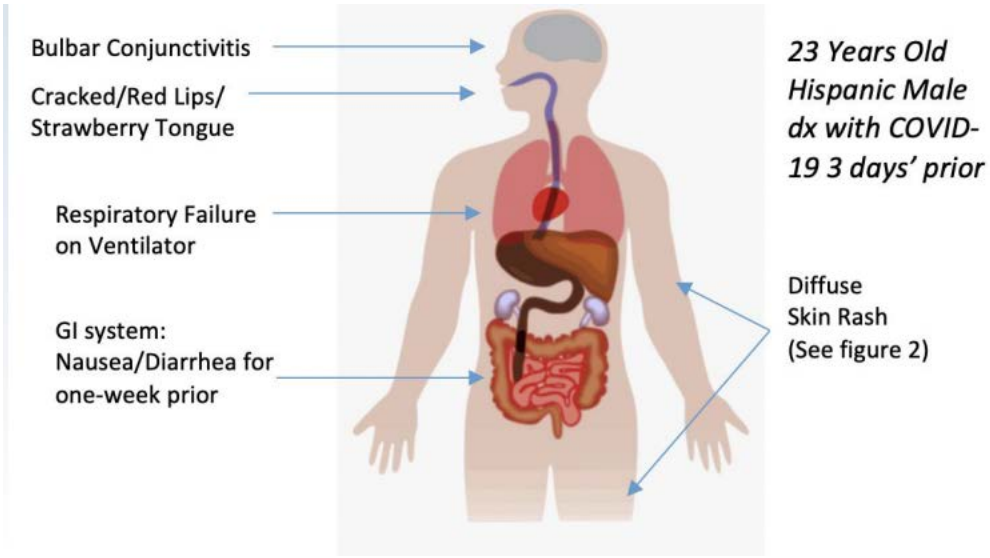


**Figure 1.** Clinical Picture of Our Patient

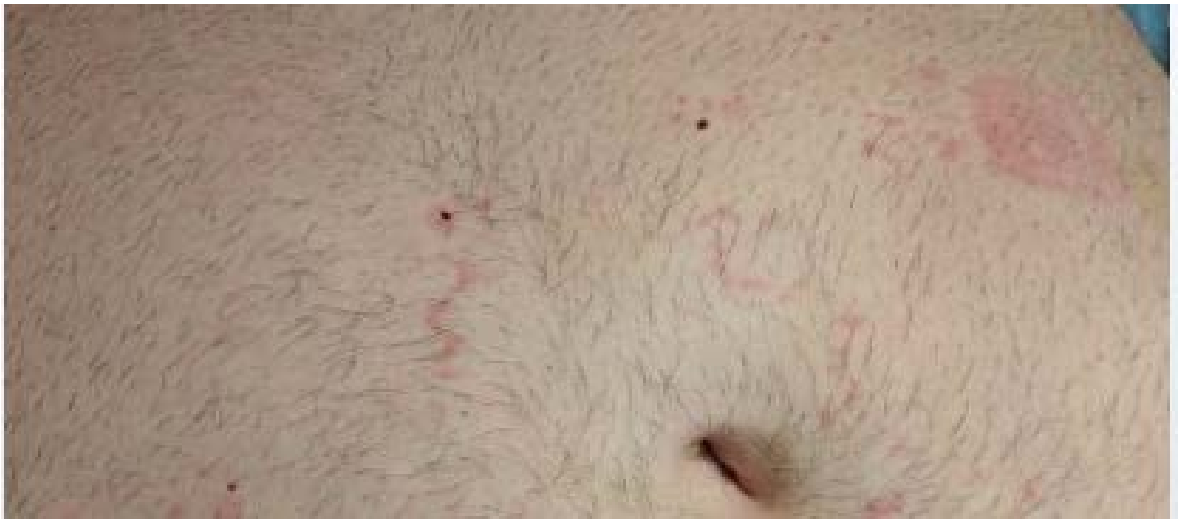

**Figure 2.** Discrete Edematous and Erythematous Plaques as well as Numerous Serpiginous Eruptions

Notable labs include: WBC 11.3 [Reference Range: 3.6-11.2 10*3/ml], Hgb 15.9 [Reference Range 12.5-16.3 g/dL], LDH 1094 [ Reference Range:140-271 [iu]/:L], BUN/CR 14/1.09 [Reference Range BUN 7-25 mg/dL and 0.7-1.3 mg/dL], AST/ALT 91/76 [Reference Range 13-39 [iu]/L/7-52 U/L]. Multiple inflammatory lab markers were elevated which included: C-Reactive protein (CRP) (Peak 9.4 mg/dl, Reference range: <0.1 mg/dL) and D-dimer (peak 1720 ng/ml, Reference Range <230 ng/ml). His ABG showed respiratory acidosis with hypoxemia: pH 7.35 pCO2 45 HCO3 22.8 pO2 35. He was subsequently intubated and placed on pressure control with an FiO2 100% PEEP 15 to maintain his oxygenation.

Confirmatory testing for COVID-19 was positive with both PCR based as well as IgG immunoglobulin assays. His Chest X-ray showed severe diffuse bilateral peribronchial opacifications; all other bacterial cultures were negative.

The patient was treated with intensive therapy, including convalescent plasma, remdesivir, tocilizumab, inhaled steroid, and intravenous dexamethasone, as well as therapeutic doses of enoxaparin during the course of his hospitalization. As a result, there was a significant initial improvement in his oxygenation. However, despite the initial improvement in his oxygenation he rapidly decompensated on day 6. Ultimately, the patient unfortunately expired due to multisystem organ dysfunction and cardiopulmonary arrest.

## 3. Discussion

Within the United States, the incidence of MIS-C was 316 individuals per 1,000,000 SARS-CoV-2 infections in patients younger than 21 years old between the months of April-June 2020 [5]. In June 2020, the Boston Children's Hospital led a national study on patients aged 25 or less with COVID-19 and MIS-C. Surveillance of this data shows a strong temporal link between COVID-19 and MIS-C, with a mean age of 8.3 years and the highest proportion occurring in Hispanics or Latinos [6]. Obesity was found to be the most frequent co-morbidity described, while extremes of age and elevated CRP were found to be independent risk factors for more severe disease [7,8,9].

The pathophysiology of MIS-C appears to occur in three stages [10]. In the initial infectious stage, patients can present as asymptomatic or mildly symptomatic with

only nasopharyngeal colonization of SARS-CoV-2. The second stage of pulmonary infection is often skipped in children. However, children are more likely to experience the third stage involving a delayed-type hypersensitivity reaction, resulting in multisystemic inflammation. Thus, MIS-C is thought to be a postinfectious process rather than a direct effect of viral infection.

The classic presentation of MIS-C includes fever, gastrointestinal symptoms, rash, conjunctivitis, cheilitis, neurocognitive symptoms, upper and lower respiratory symptoms, edematous hands and feet, lymphadenopathy, and myalgia [11]. Complications include shock, myocardial dysfunction and arrhythmias, respiratory failure, acute kidney injuries, liver damage, and encephalopathy.

MIS-C presents similarly to other multisystemic conditions such as Kawasaki Disease, Toxic Shock Syndrome, or Macrophage Activation Syndrome, although the outcome in MIS-C can be more severe [4]. Due to this similarity, current treatments for MIS-C often overlap with Kawasaki disease and include IV immunoglobulins, glucocorticoids, anakinra, broad-spectrum antibiotics, acetylsalicylic acid, proton pump inhibitors, and thromboprophylaxis [12].

## 4. Conclusion

Our patient met 6 out of 7 diagnostic criteria for MIS-C. However, because he fell outside of the age range, he does not qualify for diagnosis. Since our patient had multiple risk factors, including obesity and Hispanic ethnicity, the pathophysiology of the disease was likely identical to that which occurs in MIS-C. In addition, obesity is a well-known pro-inflammatory state evidenced by an increase in IL-6 and TNF-alpha as well as decreased levels of adiponectin [13]. Due to the small but significant chance of mortality in patients with MIS-C, it is important to consider this diagnosis in older adolescents and young adults. This patient's unfortunate outcome prompts greater suspicion for this rare and life-threatening complication even though the patient was older than the typical MIS-C patient beyond the adolescent population.

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