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Multisystem inflammatory syndrome in children(mis-c) associated with Covid-19: longterm sequelae and nursing care

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ABSTRACT

Multisystem Inflammatory Syndrome in Children (MIS-C) represents a severe post-infectious complication intricately linked to SARS-CoV-2. It is distinguished by a state of profound hyperinflammation and the involvement of various organ systems, including the cardiac, gastrointestinal, and hematologic systems. Cardiovascular problems, such as myocarditis and coronary artery anomalies, are particularly concerning. Differentiating MIS-C from other pediatric conditions like Kawasaki disease presents a significant diagnostic challenge. Acute management requires a multidisciplinary approach , often involving Intravenous Immunoglobulin (IVIG) , low-dose dexamethasone, and anticoagulants such as low molecular weight heparin (LMWH). The long-term consequences include the possibility of coronary artery aneurysms (CAA) and persistent cardiac issues like left ventricular dysfunction, necessitating continuous cardiac monitoring. Structured follow-up is crucial, with evaluations recommended at 1, 3, 6, 9, and 12 months after discharge. Nursing professionals play an essential role in the continuum of care, from early detection of clinical signs to acute monitoring, patient and caregiver education, and providing psychosocial support for families. A critical research gap exists in nursing-focused studies regarding standardized care protocols, the unique clinical experiences of registered nurses, and long-term outcomes. Future research and interdisciplinary collaboration are pivotal for developing evidence-based guidelines and optimizing care for children affected by MIS-C.

KEYWORDS: Multisystem Inflammatory Syndrome in Children (MIS-C), COVID-19, SARS-CoV-2, Long-Term Sequelae, Coronary Artery Aneurysms (CAA), Intravenous Immunoglobulin (IVIG).

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INTRODUCTION

Multisystem Inflammatory Syndrome in Children (MIS-C) represents a novel Postinfectious condition that is intricately linked to COVID-19. MIS-C manifests in pediatric populations subsequent to exposure to SARS-CoV-2 and is distinguished by a state of hyper-inflammation alongside the involvement of various organ systems(1).A minority proportion of pediatric patients who contracted the coronavirus exhibited a multisystem inflammatory response, referred to as Pediatric Multisystemic Inflammatory Syndrome Associated with Covid-19 (MIS-C)(2). Children and adolescents constitute a minor segment of COVID-19 cases, comprising approximately 2.1-7.8% of confirmed instances in geographic areas such as Asia, Europe, and North America.The introduction elucidates that the majority of infections among children are asymptomatic and exhibit mild symptoms, resulting in a significant underestimation of the true disease burden within this demographic. It underscores the rising documentation of COVID-19 related Multisystem Inflammatory conditions that seem to manifest subsequent to the infection, rather than during the acute phase of COVID-19(3). The current state of COVID-19 in India, with over 400,000 recorded deaths and over 30 million active cases(4). Hematologic problems, cardiac problems, mucocutaneous problems, and gastrointestinal problems are common disruptions. Myocarditis, coronary artery anomalies, ventricular failure, and cardiogenic shock are examples of cardiovascular problems. The study focuses on the growing knowledge of MIS-C, encompassing cardiac examination, diagnosis, clinical presentation, and treatment(5).

Pathophysiological Insights: Linking SARS-CoV-2 to Hyperinflammation

The exact **pathophysiology of Multisystem Inflammatory Syndrome in Children (MIS-C)** remains under investigation, aiming to understand how **SARS-CoV-2 exposure** triggers the **hyperinflammatory response** seen in affected children. The condition is marked by **significant hyperinflammation** and **involvement of multiple organ systems**, indicating a **complex interplay between the immune system and the virus**. Clinically, MIS-C manifests with severe **gastrointestinal, cardiac, mucocutaneous, and hematologic symptoms**, with **cardiovascular complications** such as **cardiogenic shock** and **myocarditis** being particularly concerning. Although the precise **pathophysiological mechanisms** remain unclear, this highlights the urgent

need for **further research** to identify the **underlying causes and pathways** responsible for hyperinflammation in MIS-C (1). Common pathophysiologic mechanisms such as **intestinal dysbiosis**, **increased gut permeability**, and **immune dysregulation** are observed across the spectrum of post-acute sequelae of COVID-19 in children, including conditions like **Multisystem Inflammatory Syndrome in Children (MIS-C)** and **long COVID**. These mechanisms may contribute to a state of **hyperinflammation** following SARS-CoV-2 infection. Persistent **immune activation**, even after the acute phase of infection has resolved, can lead to **long-lasting symptoms** and **serious health consequences** in affected children. This ongoing dysregulation of the immune response may play a key role in driving **chronic inflammatory processes** (6).

Clinical Spectrum and Diagnostic Challenges

Children diagnosed with **Multisystem Inflammatory Syndrome (MIS-C)** frequently present with a constellation of symptoms, including **high-grade fever**, **cutaneous manifestations**, and **gastrointestinal involvement** such as **vomiting, diarrhea, and abdominal pain**, often accompanied by **hypotension** and **shock**. Differentiating these clinical features from other pediatric conditions, such as **bacterial sepsis**, **appendicitis**, **toxic shock syndrome**, **Kawasaki disease**, and **macrophage activation syndrome**, remains a significant diagnostic challenge. The **absence of standardized treatment protocols** and the **limited understanding of the long-term sequelae** of MIS-C further complicate the diagnostic process. Moreover, MIS-C and Kawasaki disease share **elevated inflammatory biomarkers**, particularly **C-reactive protein (CRP)**, which makes distinguishing between these conditions more complex (4). The diagnostic complexity is further heightened by the fact that some children with MIS-C may **lack a clear history or symptoms of COVID-19**, necessitating heightened clinical vigilance and familiarity with **evidence-based diagnostic algorithms** among pediatricians to ensure timely recognition and appropriate management of the syndrome (7). Given the **multifaceted and evolving nature** of MIS-C, **nursing professionals** encounter unique challenges, including **diagnostic ambiguity** and **frustration regarding unclear care pathways**, which hinder the determination of optimal management strategies (8). Furthermore, **logistic regression analyses** have demonstrated **no significant association between MIS-C and demographic or clinical variables** such as **age, race, sex, the presence of multiple clinical signs or symptoms, or comorbidities**, emphasizing that **MIS-C diagnosis requires a thorough and comprehensive clinical evaluation** rather than reliance on isolated clinical parameters (9).

Acute Management Strategies: A Multidisciplinary Approach

Intravenous immunoglobulin (IVIG) is administered as part of a multidisciplinary approach for the acute management of Multisystem Inflammatory Syndrome in Children (MIS-C) in Patients who have heart involvement, severe disease or who are at risk of hemophagocytic lymphohistiocystosis (HLH) or toxic shock syndrome. A minimum of 12 hours should pass between administering the IVIG, and if there is not a sufficient response, spectrum antibiotics are also advised while Waiting for the results of microbiology tests. Given the elevated risk of thromboprophylaxix with low Molecular Weight Heparin(LMWH) is recommended. Based on D-Dimer levels and other established prothrombotic Variables, risk stratification should be carried out. Patients with noticeably elevated D-Dimer levels should take enoxaparin at a specified dosage(4). A team of specialists from various fields is crucial for effectively managing Multisystem Inflammatory Syndrome in Children (MIS-C), emphasizing supportive care that prioritizes monitoring and maintaining vital organ function, hydration, electrolyte balance, and metabolic health. This collaborative approach ensures that each patient's complex needs are met through comprehensive care. Treatment strategies for MIS-C may involve administering low-dose dexamethasone to suppress the immune response and alleviate inflammatory issues, alongside the use of anticoagulants based on elevated D-Dimer levels. Furthermore, low-dose aspirin for antiplatelet therapy is advised once follow-up echocardiograms have ruled out any coronary artery aneurysm or injury(3).

Long-Term Sequelae: Cardiac, Neurological, and Beyond

One of the long- term consequences of Multisystem Inflammatory Syndrome in Children (MIS-C) is the possibility of coronary artery aneurysms (CAA) during hospitalization, which calls for careful monitoring to keep an eye on cardiovascular health and avoid heart- related problems. Many MIS-C patients have elevated troponin levels, which are indicative of myocardial injury. This can result in arrhythmias and left ventricular dydfunction, indicating that long-term heart health may be affected and necessitating continuous cardiac monitoring and treatment(3). Nursing care for children with MIS-C should include vigilant monitoring of neurological and hydroelectrolytic changes, as these are critical in managing the symptoms and preventing further complications. Improving the standard of care and results for young children with this disease requires a proactive approach(2).

Psychosocial and Developmental Impact on Children and Families

The Registered Nurses (RNs) noticed that children with MIS-C frequently felt scared and anxious, especialy when it came to impending procedures, especially those that involved needles. The frequency of these treatments added to their own care. Families of children with MIS-C were said to be in crisis, with parents finding it difficult to adjust to the significant shift from raising a healthy child to one who is seriously ill. The RNs observed that parents tension and anxiety were increased by their many queries and worries, manyof which lacked definitive answers. In order to assist families during this trying period, registered nurses frequently contacted social workers(8).

Nursing Perspectives in Early Recognition and Acute Care

By keeping an eye out for important clinical signs like hyperthermia, gastrointestinal symptoms, skin manifestations, generalize d lymphadenopathy, and any cardiac or neurological disorders, nurses can help detect Pediatric Multisystemic Inflammatory Sy ndrome Associated with Covid-19 (MIS-C) early.

For prompt action and disease treatment, early detection of these symptoms is crucial.

In order to evaluate the patient's state and avoid complications, nursing carefor MISC in acute care settings requires careful mo nitoring of neurological and hydroelectrolytic changes.To improve their abilities and give pediatric patients with this syndrome the best treatment possible, nurses need to be knowledgeable about MIS-C(2).

Continuity of Care: Nursing Interventions for Long-Term Outcomes

The **uncertain prognosis** and **potential progression of cardiac manifestations** in children with **SARS-CoV-2–associated Multisystem Inflammatory Syndrome (MIS-C)** highlight the critical need for **long-term, structured follow-up**. This follow-up should be coordinated through a **multidisciplinary team**, including **cardiology, rheumatology, intensive care, and infectious disease specialists**, to provide comprehensive care and closely monitor for potential **long-term complications**. Cardiac abnormalities, such as **ventricular dysfunction** and **coronary artery aneurysms**, may resolve or normalize prior to hospital discharge; however, some patients may exhibit **persistent cardiac lesions** or **progression of coronary aneurysms** post-discharge. Consequently, **nursing interventions** play a crucial role and should emphasize **regular assessment of cardiac function**, **patient and caregiver education** on recognizing warning signs of complications, and **guidance regarding safe return to physical activity**, following established **post-myocarditis care protocols** (10). Routine and structured monitoring is essential to ensure **complete recovery** and address any emerging **long-term sequelae**. Follow-up evaluations are recommended at **1, 3, 6, 9, and 12 months** after discharge to assess patient status and promptly manage complications. With appropriate care and monitoring, the majority of MIS-C patients achieve favorable outcomes; however, isolated cases have reported **long-term complications**, such as **ground-glass pulmonary opacities** and **persistent coronary aneurysms**. These findings underscore the importance of **ongoing nursing care plans and targeted interventions** to monitor and support children in managing organ-specific complications associated with MIS-C (11).

Rehabilitation and Quality of Life After MIS-C

In the majority of patients with **Multisystem Inflammatory Syndrome in Children (MIS-C)**, **systemic inflammation** and **cardiac abnormalities** resolve over time, suggesting a generally **favorable prognosis** for **rehabilitation** and **post-recovery quality of life**. Nevertheless, **continuous clinical monitoring** may be necessary to address potential **cardiac sequelae** or other complications that may arise following the acute phase. As clinical understanding of MIS-C evolves, it is important for healthcare providers to also consider the **long-term impact on quality of life**, including potential **psychological consequences** related to prolonged hospitalization and illness, as well as the need for **specialized rehabilitation programs** to support both **physical recovery** and **emotional well-being** (12). Given that MIS-C can lead to significant **neurological**, **gastrointestinal**, and **cardiac complications**, rehabilitation strategies should adopt a **multisystem approach**, targeting the dysfunction of various organ systems. Comprehensive rehabilitation programs should focus on **managing residual symptoms**, **improving cardiovascular health**, and **restoring physical function**. The **extent of organ involvement** and **disease severity** are key determinants of post-recovery **quality of life**. Therefore, **ongoing support and structured follow-up** are essential to address the **long-term effects of the hyperinflammatory response**, ensuring that children receive **appropriate care** to optimize their overall well-being and daily functioning (13). A review of the **prognosis and outcomes of MIS-C** indicates that, despite the incomplete understanding of its **pathogenesis**, the syndrome is associated with **multiorgan dysfunction** and **severe systemic inflammation**, which may have implications for **long-term health** and **quality of life** beyond the recovery phase (14).

Research Gaps and Future Directions in Pediatric Nursing Practice

The **pathophysiology of Post-Acute Sequelae of SARS-CoV-2 infection (PASC)** and **Multisystem Inflammatory Syndrome in Children (MIS-C)** remains **incompletely understood**, highlighting the urgent need for further research to elucidate the underlying mechanisms and **long-term consequences** of these conditions in pediatric populations. Conducting robust **prospective studies** poses additional challenges due to **widespread immunity** resulting from vaccination and prior infections. Given the **significant morbidity associated with PASC**, increased research efforts and resource allocation are essential to identify **effective therapeutic interventions**. Strengthening rapid information sharing and applying insights gained from current clinical experiences can also help guide future management strategies for **post-infectious sequelae beyond COVID-19**, ultimately contributing to the **advancement of pediatric nursing practices** (15). A notable gap exists in the **nursing-focused research** surrounding MIS-C. There is a **paucity of studies** that specifically address the **nursing care aspects**, including the unique challenges and clinical experiences of **registered nurses (RNs)** involved in the management of MIS-C in pediatric settings (16). Future investigations should aim to explore these **nursing perspectives**, which could provide valuable insights into **care delivery**, **workflow adaptations**, and **capacity building** in pediatric care units. In addition, future research could focus on the **ethical dimensions** of pediatric nursing care in the context of MIS-C. This includes examining the **moral dilemmas** and **decision-making processes** faced by healthcare professionals in managing a relatively novel and poorly understood condition. Incorporating the perspectives of **pediatricians** and other members of the multidisciplinary care team will further enhance understanding of the **interprofessional challenges**, improve **team-based care**, and inform **nursing protocols and collaborative communication strategies** (8). Another critical gap lies in the **lack of high-level evidence** regarding **standardized treatment protocols and nursing guidelines** for MIS-C. Developing **evidence-based clinical pathways** remains a priority to ensure consistency and quality in care delivery. Furthermore, the **long-term outcomes** of children affected by MIS-C are still unclear, underscoring the need for **longitudinal studies** to track health trajectories and inform **future pediatric nursing care plans** (17).

CONCLUSION

Multisystem Inflammatory Syndrome in Children (MIS-C) represents a severe post-infectious complication of SARS-CoV-2, marked by profound hyperinflammation and multisystem involvement, which can result in both immediate and long-term health consequences. Although advancements in clinical recognition and multidisciplinary management have improved patient outcomes, significant gaps remain in understanding the precise pathophysiology, establishing standardized treatment protocols,

and developing comprehensive nursing care frameworks. Early detection, timely intervention, and structured follow-up—including long-term cardiac monitoring, rehabilitation, and psychosocial support for children and their families—are crucial to reducing morbidity and promoting full recovery. Nurses play an essential role in this continuum, from identifying early warning signs and guiding moral and ethical decision-making to delivering evidence-based, holistic care. To develop standardized care guidelines, future research must focus on prospective studies, longitudinal follow-up, and nursing-led investigations that address existing knowledge gaps. Strengthening interdisciplinary collaboration, integrating nursing perspectives, and fostering ongoing professional training will be pivotal in optimizing clinical outcomes and improving the overall quality of life for children affected by MIS-C. Ultimately, equipping healthcare teams with targeted knowledge and practical skills will ensure that children receive timely, safe, and comprehensive care while supporting families through complex medical and psychosocial challenges.

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