Pediatric Patients and COVID-19

Malini Mahendra, Vibha Mahendra, and Shobana Murugan

12.1 Introduction

The Novel Coronavirus Disease (COVID-19) the World Health Organization (WHO) declared a worldwide pandemic on March 11, 2020 [1]. Although the burden of COVID-19 has fallen largely on adults, there are unique pediatric considerations that clinicians should be aware of. In this section, we will review the impact of COVID-19 on the pediatric population, common disease presentation, physiology, anesthetic considerations, and critical care management of the illness.

12.2 Background

12.2.1 Epidemiology

The SARS CoV2 epidemic was first reported in Wuhan, China, in November 2019. The Chinese Center for Disease Control reported 2% of confirmed COVID cases were in patients <19 years of age. No deaths in children <9 years of age [2]. Similar findings were reported in the Italian outbreak [3]. The United States also reported similar findings with only 1.7% of COVID-19 cases in pediatric patients with a case fatality rate of 0.1%. However, the
incidence of COVID-19 in pediatric patients with chronic illness is unknown. Additionally, like in adults, majority (57%) of cases were male and 91% of cases occurred after exposure at home or in the community [4]. Of pediatric patients with COVID-19, the hospitalization admission rate ranged between 5.7 and 20%. With 15% admitted to an ICU. Children aged <1 year accounted for the highest percentage (15–62%) of hospitalization among pediatric patients with COVID-19 [4]. Although nearly 5% of adults with COVID-19 require admission to the ICU, a case series suggested that 0.6% of pediatric patients had disease progression to acute respiratory distress syndrome or multiple organ dysfunction [5, 6]. The true incidence of the disease is unknown as some studies have reported that up to 10% of children are asymptomatic [7, 8].

12.2.2 Presentation of Symptoms

Case series have reported that the majority of neonatal and pediatric patients have been transmitted from infected family members [7]. Pediatric patients most frequently presented with fever, cough, and shortness of breath. The frequency of reported symptoms in pediatrics was less than what has been reported in adults [4].

A minority of patients who are critically ill have presented with a hyperinflammatory shock that has been described as the pediatric multisystem inflammatory syndrome associated with COVID-19. The literature has commented on the similarity in presentation of this syndrome to Kawasaki disease. In a cohort of eight patients identified in the United Kingdom, patients presented with unrelenting fever, rash, conjunctivitis, peripheral edema, extremity pain, and significant GI symptoms. Interestingly, all patients initially tested negative for COVID [9]. Most children in this case series did not present with respiratory symptoms but did require mechanical ventilation for hemodynamic support. All patients progressed to warm, vasoplegic shock. Common echocardiographic findings were echo bright coronary vessels, with one patient progressing to development of a giant coronary aneurysm. One patient suffered arrhythmias that required support with ECLS. The patient ultimately died from a cerebrovascular infarct.

12.2.3 Special Considerations: Pediatric

There is a growing body of literature that has suggested that the general pediatric population has been less severely affected by COVID-19 than adults. There are several hypotheses that have been proposed to explain this observation. Recent studies have proposed a correlation between the severity of COVID-19 disease with viral load or the duration of viral shedding [8, 10]. Differences in clinical presentation may be related to the differential expression of ACE2 receptors because SARS CoV2 is known to enter cells by binding to the ACE2 receptor. Data show that there is differential expression of the ACE2 receptor in the population: (1) ACE2 receptors are expressed more in adults than children; (2) there is increased expression of
the ACE2 receptor in neonates compared to older children; and (3) circulating levels of ACE2 are higher in males than females. This differential expression may explain part of the reason why COVID-19 is more present in adults, males, and neonates [8].

Children also seem to have a different immune response to the SARS CoV2 virus than adults. Robustness of the immune response may decrease with age. With aging, T-cell distribution shifts from having naïve T cells to a population of mostly memory and effector T cells. This is associated with loss of co-stimulatory molecules that may increase susceptibility to infection [8]. Neonates also may be more susceptible to the SARS CoV2 virus because their immune response is skewed more to the Th2 rather than the pro-inflammatory Th1 response. When compared to younger macaques and mice, aging macaques and mice infected with SARS CoV2 had a more robust pro-inflammatory response associated with worse lung pathology. Because severe COVID-19 infection is associated with a massive proinflammatory response, cytokine storm, and multiorgan failure, it is proposed that differences in inflammatory response between the pediatric and adult patient may also contribute to differences in disease presentation [8].

12.2.4 Special Considerations: Neonatal

Although transmission of the SARS CoV2 virus is thought to occur primarily through respiratory droplets, there is concern that vertical transmission of the virus exists. There has been a case report of a neonate who tested positive via RT PCR at 16 h of life [11]. IgM antibodies have also been detected in the placenta, suggesting transplacental passage of the virus is possible. Testing is recommended for all neonates born to women with confirmed or suspected COVID-19 regardless of symptoms in the neonate via RT-PCR. Serologic testing is not recommended at this time to diagnose an acute infection in the neonate. Testing should occur at 24 h of life. If initial testing is negative or not available, testing should be repeated at 48 h of age [12].

Postnatally, the AAP, ACOG, and Chinese experts have recommended separation of the newborn from COVID-19-positive mothers. However, the CDC recommends that the decision to separate and to breast feed the infant be a shared decision with the mother. If the decision is made to room in with the baby, mothers should wear facemask and practice social distancing as appropriate.

12.3 Anesthetic Consideration

Transmission of aerosolized particles places anesthesiologists at high risk for transmission of the virus. Recorded rates of COVID-19 in healthcare workers range from 3 to 14% [13]. Precautions taken while caring for COVID-19-positive adults should also be applied to the pediatric patient. Because parents may not be able to accompany the child into the operating room, strong consideration should be given to premedicating the child to reduce crying and screaming (which may increase spread
of the virus) [13]. Because the pediatric patient is at increased risk for tube disloge-
ment or obstruction while intubation and laryngospasm after extubation, effort
should be taken to minimize the need to re-intubate patients [13].

12.4 Critical Care Management

Early data has suggested that around 15% of COVID-19 pediatric patients had criti-
cal illness (defined as requiring mechanical ventilation or having ARDS, shock,
 systemic inflammatory response syndrome, or multiorgan failure) [14]. Seventy-
three percent of patients presented with respiratory symptoms, but the remainder of
patients presented with other symptoms (circulatory collapse, seizures, vaso-
occlusive crisis of sickle cell, and DKA). Over 90% of patients admitted to the ICU
had at least one comorbidity, with the most common comorbidity being long-term
dependence on technological support. Over 1/3 of these patients required mecha-
nical ventilation. Thirteen percent of patients required extracorporeal therapies.
Reported case fatality rate was 4.2% at time of the report [14].

Therapeutic management strategies stems from knowledge gained from treat-
ment of other infectious diseases [15]. Treatment of critical illness has been largely
supportive (nutrition, fluids, supplemental oxygen) [7]. Although the WHO and
CDC do not recommend any specific treatment strategies in children because novel
therapies have not been shown clear benefit, pediatric intensivists have used tar-
geted therapy to COVID-19. The most common therapy received was hydroxychlo-
roquine as a single agent. Azithromycin, remdisivir, and convalescent plasma were
also used [14]. At the time of writing, there are no published guidelines on how to
manage multisystem inflammatory syndrome. However, clinicians have used intra-
venous immunoglobulin, corticosteroids, and biologics such as infliximab and
anakinra to treat patients [16].

12.5 Conclusion

Most pediatric patients infected with SARS CoV2 present with mild symptoms. A
minority of patients become critically ill and develop pediatric multisystem inflam-
matory syndrome. Differences in gene expression and the inflammatory response in
neonatal and pediatric patients may explain differences in COVID-19 disease pre-
sentation. Supportive care is the recommended management strategy for patients
with COVID-19 infections. No novel therapeutic strategies in children have been
recommended as there is no clear evidence that there is benefit from use. Anesthetic
management of the COVID-19-positive pediatric patient is similar to what has been
described in the adult anesthetic literature.
1. 5/26/2020 A. World Health Organization-COVID19 situation report-126 [Internet]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200525-covid-19-sitrep-126.pdf?sfvrsn=887dbd66_2.
2. Wu Z, McGoogan JM. Characteristics of and important lessons from the Coronavirus Disease 2019 (COVID-19) outbreak in China summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020;323(13).
3. Livingston E, Bucher K. Coronavirus Disease 2019 (COVID-19) in Italy. JAMA. 2020;323(14):1335. https://doi.org/10.1001/jama.2020.4344.
4. Coronavirus Disease 2019 in Children — United States, February 12–April 2, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(42–426).
5. Lambert V, Matthews A, MacDonell R, Fitzsimons J. Paediatric early warning systems for detecting and responding to clinical deterioration in children: a systematic review. BMJ Open [Internet]. 2017;7(3). Available from: https://search.proquest.com/docview/1876695481.
6. Ong JSM, Tosoni A, Kim Y, Kissoon N, Bs MB, Frcp C, et al. Coronavirus disease 2019 in critically ill children: a narrative review of the literature. Pediatr Crit Care Med. 2020;21:662–6.
7. Zimmerman P, Curtis N. Coronavirus infections in children including COVID-19 an overview of the epidemiology, clinical features, diagnosis, treatment and prevention options in children. Pediatr Infect Dis J. 2020;39(5):355–68.
8. Yuki K, Fujogi M, Koutsogiannaki S. COVID-19 pathophysiology : a review. Clin Imunol. 2020;215:108427.
9. Riphagen S, Gomez X, Gonzalez-martinez C, Wilkinson N, Theocharis P. Correspondence hyperinflammatory shock in children during COVID-19 : PCR screening of asymptomatic health hospital. Lancet. 2020;395(10237):1607–8. https://doi.org/10.1016/S0140-6736(20)31094-1.
10. Yang L, Yan L-M, Wan L, Xiang T-X, Le A, Liu J-M, Peiris M, Leo LM, Poon WZ. Viral dynamics in mild and severe cases of COVID-19. Lancet Infect Dis. 2020;20:656–7.
11. Amatya S, Corr TE, Gandhi CK, Glass KM, Kresch MJ, Mufsce DJ, et al. Management of newborns exposed to mothers with confirmed or suspected COVID-19. J Perinatol. 2020;40(7):987–96. https://doi.org/10.1038/s41372-020-0695-0.
12. Evaluation and management considerations for neonates at risk for COVID-19. CDC [Internet]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/caring-for-newborns.html.
13. Lee-Archer P, Von Ungern-sternberg BS. Pediatric anesthetic implications of COVID-19 — a review of current literature. Paediatr Anaesth. 2020;(April):1–6.
14. Shekerdemian LS, Mahmood NR, Wolfe KK, et al. Characteristics and Outcomes of Children With Coronavirus Disease 2019 (COVID-19) Infection Admitted to US and Canadian Pediatric Intensive Care Units. JAMA Pediatr. 2020;174(9):868–873. https://doi.org/10.1001/jamapediatrics.2020.1948.
15. Castagnoli R, Votto M, Licari A, et al. Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection in Children and Adolescents: A Systematic Review [published online ahead of print, 2020 Apr 22]. JAMA Pediatr. 2020. https://doi.org/10.1001/jamapediatrics.2020.1467.
16. Viner RMWE. Kawasaki-like disease : emerging complication during the COVID-19 pandemic. Lancet. 2020;6736(20):1741–3.