Dysphagia
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REVIEW

COVID-19 and Dysphagia in Children: A Review

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Abstract
Coronavirus (COVID-19) infection usually causes mild symptoms in children. However, serious complications may occur as a result of both acute infection or in association with the multisystem inflammatory syndrome (MIS-C). Dysphagia may develop as a sequela of COVID-19. We review the limited data on dysphagia associated with COVID-19 infection in children. Children can develop acute respiratory distress syndrome (ARDS) due to severe COVID-19 infection leading to endotracheal intubation and mechanical ventilation. These children can possibly develop post-intubation dysphagia. Screening for the presence of dysphagia, in an effort to minimize aspiration, in children with active COVID-19 infection must be done carefully to reduce the risk of transmission of the virus. Those children diagnosed with persistent dysphagia after COVID-19 infection has resolved will need further evaluation and management by pediatric subspecialists experienced in treating children with this condition. We recommend, this evaluation and treatment be done by a pediatric aerodigestive team.

Keywords COVID-19 · Dysphagia · Children

Epidemiology of COVID and MIS-C

COVID-19 infections spread from Wuhan, China, in December 2019 [1]. It subsequently became a worldwide pandemic. As of Mar 2022, about 446 million people worldwide have contracted COVID-19 infections resulting in about 6 million deaths. In the USA, as of that date, about 79 million people have contracted COVID-19 infections resulting in more than 950,000 deaths [2]. A small percentage of the total COVID-19 cases have occurred in children.

Some children with COVID-19 can develop a severe inflammatory syndrome called MIS-C. This is a novel systemic inflammatory disease that was first reported in April 2020 [3]. MIS-C was defined by the CDC as an individual aged < 21 years presenting with fever, laboratory evidence of inflammation, and evidence of clinically severe illness requiring hospitalization, with multisystem organ involvement (cardiac, renal, respiratory, hematologic, gastrointestinal, or neurological) with no other alternative diagnosis and a positive SARS-CoV-2 test or exposure to someone with COVID-19 within 4 weeks prior to the onset of symptoms [4]. In the USA, as of the beginning of Mar 2022, a total of 7,459 children have been reported to the CDC with MIS-C resulting in 63 deaths [5].

Dysphagia and COVID-19

Dysphagia, difficult or improper swallowing of liquids, solids, or saliva can result in aspiration, the inhalation of foreign material into the lower airway, which can lead to significant morbidity and occasional mortality, including in children [6].

Some adult patients with severe COVID-19 infections have developed dysphagia as a complication. This was felt to be due to the development of neuropathy of the cranial nerves involved in the swallowing mechanism [7, 8]. Also, the development of post-intubation dysphagia after severe COVID-19 infections has been reported [9].

Development of dysphagia in association with severe COVID-19 infections is not exclusive to adults. It has been reported also in children. There are limited data available about the incidence of the development of dysphagia in children with COVID-19 infection or MIS-C. In 2021, Cheong reported a single center study of 50 children with MIS-C

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who developed various otolaryngologic manifestations. Of those children, 18 required intubation during their acute disease. Thirty-eight of the 50 children developed dysphagia. Fifty-six percent of the children who developed dysphagia had required intubation during their acute illness but 28% did not require intubation. Of those 38 children, 3 subsequently required ongoing swallowing therapy, 2 required a videofluoroscopic swallowing study (VFSS) at presentation and follow-up with oropharyngeal incoordination and weakness, and 1 required a fiberoptic endoscopic evaluation of swallowing (FEES) with the finding of residual thickened fluids coating of the pyriform fossa and pharynx [10]. In a separate study of 137 children with MIS-C in which 28.4% developed neck pain, trismus, or dysphagia, 5 of the children (3.6%) developed drooling, dysphagia, or difficulty swallowing [11]. In a retrospective cohort study of 50 children with MIS-C, four children (8%) required specialist speech-language pathologist assessment and intervention for dysphagia. Each of those children required intubation and one child required ECMO prior to the development of their dysphagia. The median time to resolution of their dysphagia symptoms was 45.5 days (range: 28–127 days) [12].

Proposed Pathophysiology of COVID-19 Induced Dysphagia

Of the children who develop MIS-C, 12%-58% have reported neurological symptoms [13]. The symptoms could be due to direct infection [14, 15] of the nervous system and its vasculature by SARS-CoV-2 accompanied by inflammatory responses secondary to local and or systemic infections [15–17]. Other possible etiologies could be nervous system damage due to cardiovascular complications [18] or due to cerebral hypoxia secondary to respiratory failure [19]. It is not currently known which of these mechanisms predominates in children [15]. Injury to the neurological components that control the swallowing mechanism could lead to dysphagia in children.

Post-intubation Dysphagia

Children with severe COVID-19 infection can develop ARDS often leading to intubation and the initiation of mechanical ventilation. In a series of 70 children who were critically ill with COVID-19 infection in New York City in 2019, 21 (30%) developed ARDS. Also, of those 70 children, 49 (70%) required respiratory support: 14 (20%) noninvasive mechanical ventilation, 20 (28.6%) invasive mechanical ventilation [20]. Intubation and mechanical ventilation are associated with the risk of dysphagia. In adults, one-third of intubated patients after ARDS had dysphagia on discharge from the hospital [9, 21]. Children with severe COVID-19 infections who have pre-existing morbidities or problems caused by MIS-C, who do not have ARDS, can also need intubation and mechanical ventilation. This might increase their risk of developing dysphagia. In a retrospective, observational, cohort study of 372 children who required intubation for various medical and surgical reasons, 108 (29%) of children exhibited postextubation dysphagia. Of the children without a neurologic or neurosurgical diagnosis, 85 of 285 (31%) exhibited postextubation dysphagia. In a further analysis of the study data, patients with dysphagia were significantly more likely to be 0–24 months of age and patients who developed dysphagia were intubated for a significantly greater amount of time than were patients with no dysphagia. Postextubation dysphagia was associated with an increase in the total length of hospital stay of 9.6 days as well as with an increase in time between extubation and hospital discharge of 7.3 days [22]

Six potential mechanisms of the development of post-intubation dysphagia in adults have been proposed. These are as follows: oropharyngeal and laryngeal trauma, neuromuscular weakness, reduced sensitivity, altered sensorium, gastroesophageal reflux (GERD), and impaired respiratory-swallowing coordination [9, 23]. It is possible that the same mechanisms for the development of post-intubation dysphagia in adults also occur in children [9, 10].

Oropharyngeal trauma is associated with the oral and pharyngeal phases of swallowing [9]. Endotracheal intubation can cause multiple types of oropharyngeal trauma: injury to the lips [24]; injury to the dentition [25]; oropharyngeal and laryngeal edema [26, 27]; mucosal abrasion [28]; inflammation, hematomas, and ulcerations of the vocal cords, arytenoids, epiglottis, and base of the tongue [23]; dislocation and subluxation of the arytenoid cartilages [29]; vocal cord paresis [30–33]; incompetence of the laryngeal sphincter [34]; failure of closure of the laryngeal vestibule [35]; impaired elevation of the hyolaryngeal complex [34]; and injury to the recurrent laryngeal nerve [23]. All of these injuries can lead to the development of significant dysphagia with mismanagement of oral liquids, saliva, and food boluses that can lead to aspiration [9, 10].

Neuromuscular weakness caused by endotracheal intubation can be due to atrophy and prolonged non-use of the structures involved in the swallowing act such as the pharyngeal and laryngeal muscles and the nerves [9, 36]. Also, neuromuscular weakness can be due to prolonged analgosedation and long-term use of neuromuscular blocking drugs [9, 37]. Upon extubation, this can lead to slowing of the muscles involved in the swallowing act as well as dyscoordination of the muscles and nerves involved in swallowing. This can significantly change the pharyngeal phase of swallowing [38] leading to dysphagia and an increased risk of aspiration [39].

Reduced sensitivity of the upper respiratory tract can lead to the development of dysphagia after extubation [9, 23]. Limited sensitivity of the food bolus and secretions in the hypopharynx interferes with the protective reflexes of swallowing [40]. This decreased sensitivity of the upper airway chemoreceptors and mechanoreceptors can last for at least 7 days post-extubation [41, 42]. Thus, there is delayed triggering of swallowing [34] that can lead to predeglutive aspiration [43].

Altered sensorium can lead to the development of dysphagia with an increased risk of aspiration [9, 23, 37]. Residual effects of narcotic and anxiolytic medications can cause sensory changes in some patients [36].

The presence of GERD can influence the development of dysphagia in some patients after extubation [9]. The risk of development of GERD is increased by the presence of a nasogastric tube, lying position, high doses of sedation, and the use of paralytic agents in therapy [23]. The presence of a nasogastric tube causes constant opening of the upper and lower esophageal sphincters with a risk of aspiration of gastric contents [44]. Also, GERD adversely affects laryngeal sphincter function increasing the risk of aspiration [45].

If there is impairment of synchronization between respiration and swallowing, dysphagia can occur [9]. During normal swallowing, breathing is briefly interrupted not only because of laryngeal closure, elevation of the soft palate, and epiglottic inversion, respiration is also suppressed at the brainstem level [46]. Prevention of aspiration depends on the accuracy of coordination of laryngeal closure, apnea pause, and opening of the upper esophageal sphincter [23]. Also, if the patient is tachypneic (respiratory rate > 60 breaths per minute in an infant < 2 months of age, 50 breaths per minute for infants 2–12 months of age, and 40 breaths per minute for children 1–5 years of age [47]) after extubation, dysphagia can result [34].

Evaluation of Swallowing in Children with COVID-19

VFSS and FEES are often used to evaluate swallowing function in children [6, 48, 49]. These procedures can generate aerosols [9]. Thus, the risk of transmitting COVID-19 infection is extremely high [50]. It is recommended, that these procedures, if possible, be postponed [51, 52].

In children with COVID-19 infection suspected to have dysphagia, swallowing screening is necessary to determine the need for further swallow examination [53], the safety of oral food intake, and the need for an alternative form of nourishment [54].

Patients with prolonged intubation, both adults and children, should have their swallowing screened before their first oral intake [44] . In adults, the prevalence of dysphagia is up to 56% after 48 h of orotracheal intubation [9] . In adults post-intubation, swallowing screening sensitivity is 81% and specificity is 69%, positive predictive value 77% and negative predictive value 74% [55]. The nurse, speech-language pathologist, or other healthcare professional, standing at a distance of at least 2 m (6.5 feet) [9] from the patient with COVID-19 and wearing appropriate personal protective equipment [56] should perform the swallowing screening 1–5 days after extubation [57]. Dysphagia, in adults, has been associated with drooling, multiple swallows per bolus, cough, and voice change during swallowing [54]. If the patient coughs after swallowing liquid or thickened liquid, that is a reliable clinical sign that dysphagia is present [44, 58]. In infants and children, oral-pharyngeal dysphagia during screening evaluation can manifest as wheezing, rhonchi, cough, stridor, hoarseness, increased congestion, or increased respiratory mucus during feeding, absent or primitive/neurological oral reflexes, a weak or uncoordinated suck, uncoordinated or disordered biting and/or chewing, poor food/liquid bolus containment or propulsion, absent or delayed onset of the swallow reflex, or nasopharyngeal reflux [6, 59]. Patients with suspected dysphagia will need to have a modified or alternative feeding method instituted until further evaluation of their dysphagia can be done after they have recovered from COVID-19 infection. Cheong recommended further evaluation of children whose dysphagia symptoms persist for longer than 6 weeks after MIS-C [10]. This evaluation and treatment of dysphagia should be performed by pediatric subspecialists with significant experience in dealing with this problem. The author recommends, if possible, this evaluation and treatment be done by a pediatric aerodigestive team [10, 60].

Conclusion

COVID-19 can be severe in some children who develop MIS-C or who develop ARDS requiring intubation and mechanical ventilation. Some of these children will develop dysphagia as a sequela of MIS-C or post-intubation. These children with COVID-19 should be screened carefully by the healthcare professional to minimize the transmission of SARS-CoV-2. Children who have persistent symptoms of dysphagia after COVID-19 infection has resolved will need further evaluation and treatment by a pediatric subspecialist experienced in treatment of this condition.

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