Case Report

Awake proning of a 2-year-old extubated child with severe COVID-19 pneumonitis

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Summary
With the progress of the coronavirus disease 2019 (COVID-19) pandemic, available data suggest lower complications and disease severity in children and young patients. Despite most paediatric cases being mild in severity, some children require intensive care and mechanical ventilation due to the development of paediatric severe acute respiratory distress. The use of adjuvant therapies in severely ill paediatric patients has not been reported widely in the literature. Prone positioning in spontaneously breathing children has, to our knowledge, not yet been described. In our report, the trachea of a 2-year-old child was intubated, and he was mechanically ventilated for severe bilateral pneumonia. The infant and his mother tested positive for severe acute respiratory syndrome coronavirus disease-2 (SARS-CoV-2) infection with reverse transcription-polymerase chain reaction testing from nasopharyngeal swabs. Immediately after tracheal extubation, the child developed severe respiratory distress and refractory hypoxia. Awake prone position was employed as a rescue therapy for the management of post-extubation hypoxia, resulting in a dramatic improvement in oxygenation. Prone positioning in the paediatric patient may improve oxygenation and can be a useful adjuvant for respiratory therapy either before, during or after invasive mechanical ventilation. Awake prone position may be considered as an option for the management of COVID-19 in paediatric patients, but it requires patient cooperation.

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Introduction
The rarity of severe coronavirus disease 2019 (COVID-19) in paediatric patients as compared with adult patients means there is less experience with management strategies and less protocolisation of care. In addition to supportive and specific management strategies, adjuvant therapies are applied for the treatment of respiratory failure associated with COVID-19, including anticoagulant therapy and immunomodulation with steroids. Limited data are available about prone positioning in paediatric COVID-19 patients, especially spontaneously breathing children [1, 2].

Our report describes the application of awake prone positioning as a rescue therapy for post-extubation hypoxia in a 2-year-old child admitted to the paediatric intensive care unit and mechanically ventilated due to severe COVID-19 pneumonitis. Following tracheal extubation, the child developed severe respiratory distress and hypoxia that dramatically improved when awake prone positioning was employed.

Report
A 2-year-old boy was transferred to our hospital with confirmed COVID-19. The child was initially admitted to a peripheral hospital where he presented with manifestations of an acute lower respiratory tract infection. The parents gave a history of

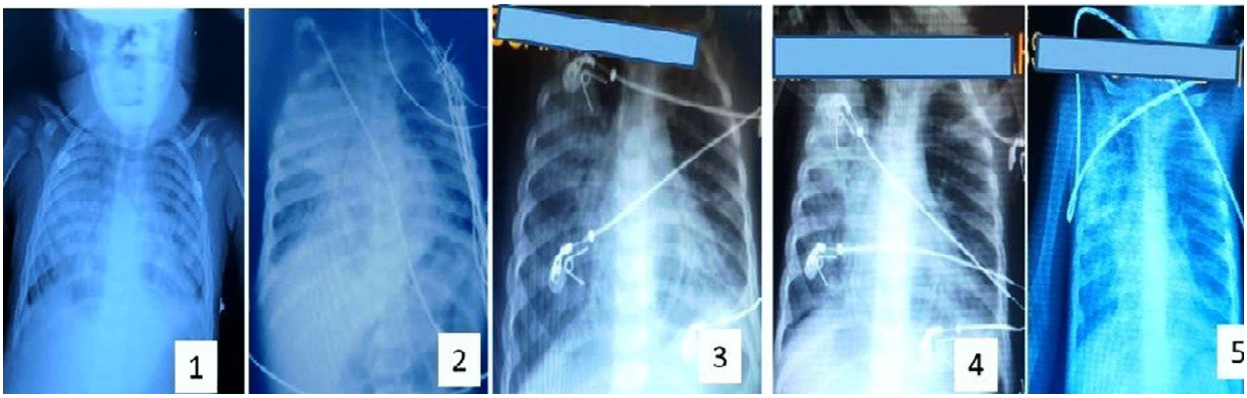

Figure 1 Changes in the chest radiograph during days 1–5 in the intensive care unit in a 2-year-old boy with COVID-19 pneumonitis.

developmental delay (delayed walking and speaking) and recurrent chest infections. Over 2 days, his clinical condition deteriorated and he progressed to acute respiratory failure, with increased work of breathing, tachypnoea and peripheral oxygen saturations of 84% with a medium oxygen concentration facemask. He was suspected to have COVID-19 pneumonitis. His trachea was intubated and he was mechanically ventilated and sedated with peripheral oxygen saturations of 95% and with an FiO_2 of 0.7 and a PaO_2 of 8.7 kPa. We used pressure-controlled ventilation with an inspiratory pressure of 18 cmH_2O, a peak end-expiratory pressure of 7 cmH_2O and a respiratory rate of 25 breaths.min^{-1}. Various other aspects of his care were in accordance with the Egyptian Ministry of Health protocol. His chest radiograph revealed pulmonary infiltrates characteristic of COVID-19 pneumonitis (Fig. 1). Unfortunately, computed tomography imaging was not available in the hospital and the risk of transfer was felt to outweigh any benefit. We used a variety of pharmacological agents during the course of his illness (Box 1).

After 3 days of mechanical ventilation, oxygen saturations reached 97% with an FiO_2 of 0.4 with a PaO_2 of 11.9 kPa; haemoglobin 120 g.l^{-1}; platelets 120 × 10^3 mm^{-3}; leucocytes of 12 × 10^3 mm^{-3}; and lymphocytes 3500 × 10^3 mm^{-3}. Weaning trials were commenced after cessation of sedation using pressure support ventilation. A trial of extubation was attempted after improvement of oxygenation, decreased pulmonary infiltrates on the chest radiograph, and an improved neurological picture. Immediately following tracheal extubation, peripheral oxygen saturations dropped to 84% and he became distressed. During preparation for tracheal re-intubation, the intensive care team discussed the value of prone ventilation in the context of the available reports about its value in COVID-19 cases [3].

Before prone positioning, all lines and connections were secured and assigned to one nurse for observations. A medium concentration oxygen mask with a flow of 10 l.min^{-1} was attached to the patient. His hands were placed up under his sacrum, and then pillows were placed over his chest, pelvis and knees. He was rolled on his left side and then gently pushed over his abdomen while an assistant supported his cervical spine. Prone positioning was maintained for 4 h, then he was turned supine for 1 h and this cyclic rotation continued for 4 days.

The trial of prone positioning resulted in a dramatic increase in peripheral oxygen saturations to 97% and decreased work of breathing. The clinical condition of the child improved gradually and the face mask was substituted with a nasal cannula at

Box 1 Pharmacological strategies employed during the intensive care unit stay.

Intravenous maintenance fluids for the first day then nasogastric feeding commenced.

Subcutaneous enoxaparin 10 mg every 12 h

Intravenous methylprednisolone 2 mg.kg^{-1}. day^{-1} for 5 days

Oral hydroxychloroquine 12 mg.kg^{-1}. day^{-1} on the first day then 6 mg.kg^{-1}.day^{-1} in two divided doses for 5 days

Oral oseltamivir 30 mg twice daily

Intravenous imipenem 250 mg every 8 h

Oral azithromycin 10 mg.kg^{-1} once daily for 5 days

2 $l.min^{-1}$. After testing negative with two successive swabs 48 h apart, the child was transferred back to the referring hospital. He was discharged home the following week.

Discussion

Upon the emergence of the COVID-19 outbreak, the paediatric population was considered to have ‘resistance’ or low susceptibility to severe disease manifestations. However, with the progress of the pandemic, a growing number of children suffering from COVID-19 were reported in the literature. In most cases, disease severity is mild, with no symptoms or fever, cough, fatigue, myalgia or abdominal symptoms, such as diarrhoea [4]. Evidence suggests that only, a very small proprotion of infected children may progress to respiratory failure. In contrast, our patient presented with respiratory failure with bilateral pulmonary infiltrates that resulted in altered conscious level, severe acute respiratory distress syndrome (ARDS) necessitating tracheal intubation and mechanical ventilation. This may be explained by the developmental delay in his history and a delay in seeking medical care for COVID-19 due to social misconceptions and economic burdens. Polymerase chain reaction testing from expectorated sputum, tracheal aspirate or bronchoalveolar lavage is the cornerstone of diagnosis [5], which was delayed in this case.

Supportive treatment and oxygen supplementation are the main treatments for infected children. The aim is to prevent ARDS, organ failure and secondary nosocomial infections. If a bacterial infection is suspected, broad-spectrum antibiotics may be used. Until the results of ongoing clinical trials become available, neither World Health Organization or Centers for Disease Control and Prevention advocates any specific treatment in children or adults [2]. Protocols of ventilatory management in the COVID-19 pandemic relied on previous findings from coronavirus epidemics and lung protective strategies of paediatric ARDS [6].

Despite encouraging results in adult patients with severe ARDS [7], the role of prone positioning in the management of paediatric ARDS is still unclear with insufficient supporting evidence. Curley et al. [8] demonstrated technique safety but did not find a significant improvement regarding ventilator-free days or other clinical outcome measures, including mortality. In a study by Rowan et al. [9], only 10% of paediatric patients with ARDS received proning as adjuvant therapy and most of them received neuromuscular blocking drugs. In a recent report about Canadian and US management of children with COVID-19, proning was utilised in only 4% of patients [10]. To our knowledge, no literature is available reporting the use of proning in spontaneous breathing awake young children suffering from COVID-19.

Our patient improved with mechanical ventilation, reaching tracheal extubation criteria on day 5. After tracheal extubation, oxygen desaturation raised the concern of tracheal re-intubation and invasive mechanical ventilation. Spontaneous breathing in the prone position was triggered by the evolving evidence in severe adult COVID-19. The trial of prone positioning in the spontaneously breathing child resulted in a dramatic improvement of oxygen saturation, relief of respiratory distress, decreased work of breathing and improvement that eliminated the indication for invasive mechanical ventilation. The number of critically ill children suffering from complications related to COVID-19 infection is increasing around the world. Healthcare facilities should exhibit all types of preparedness for the management of these patients. We believe that prone positioning in the paediatric patient may improve oxygenation and should be considered as a potential adjuvant for respiratory therapy either before, during or after invasive ventilation. Patient cooperation is an essential requirement for the technique, which may not be possible in all children and is considered as a limitation of the technique in young age groups.

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