

## Critical paediatric COVID-19: varied presentations but good outcomes

International reports of the COVID-19 pandemic have described the relative sparing of children, both in case frequency<sup>1</sup> and disease severity.<sup>2–4</sup> The major presentation described in children is the paediatric inflammatory multisystem syndrome temporally associated with SARS-CoV-2 (PIMS-TS)—many of these children do not have evidence of PCR-positive viral disease and therefore may represent a postinfectious phenomenon.<sup>5</sup> We describe our single-centre paediatric intensive care unit (PICU) experience of children who tested positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the first 10 weeks of the pandemic in the UK, excluding those who met PIMS-TS criteria as these have been described elsewhere.

A total of 313 children were admitted to our intensive care units (ICUs) from the 26 March 2020 to the 31 May 2020. Ninety-six children were suspected to have COVID-19 of which 24 (25%) children tested reverse transcription (RT-PCR) positive at admission with SARS-CoV-2 on nasopharyngeal aspirate. Thirteen children presented with a PIMS-TS phenotype; here, we describe the characteristics and course of the remaining 11.

The demographic and presenting characteristics are shown in table 1. Comorbidities were present in nine out of eleven children. Four (36%) children were from a black, Asian or minority ethnic background. The clinical characteristics are presented in table 2. Inflammatory markers were raised, but the range of maximum values during admission were widely variable.

Four children had respiratory disease fulfilling the 2015 PALICC (the paediatric acute lung injury consensus conference) criteria for paediatric acute respiratory distress syndrome. Hypoxaemic respiratory failure management included prone ventilation (n=4) and inhaled pulmonary vasodilators (n=3). Two infants were escalated to high frequency oscillation due to refractory hypoxia on conventional ventilation. Median duration of ventilation was 13 days (IQR 10–15.5 days).

The remaining seven children required admission to PICU for reasons other

**Table 1** Presentation characteristics of children presenting to PICU with a PCR-positive diagnosis of SARS-CoV-2 infection. Children who presented with a paediatric inflammatory multisystem syndrome were excluded from this description

Characteristics	Patients (n=11)
Median age, years (IQR)	5 (0.4–11.1)
Male, n (%)	9 (81)
Ethnicity: Black, Asian and minority ethnic, n (%)	4 (36)
PIM3 predicted mortality, n (%)	
<1%	5 (42)
1%–5%	4 (36)
5%–15%	1 (9)
15%–30%	0
>30%	1 (9)
Coexisting disorder, n (%)	
Weight above 91st centile	3 (27)
Cancer	1 (9)
Pre-existing respiratory disease*	2 (18)
Prematurity	2 (18)
Congenital heart disease	1 (9)
Median duration of symptoms before admission, no of days (IQR)	2 (1.5–3)
Primary presenting symptoms, n (%)	
Cough	6 (55)
Apnoea	3 (27)
Fever	10 (90)
Gastrointestinal (abdominal pain/vomiting/diarrhoea)	6 (55)
Seizures†	3 (27)
Microbiology	
SARS-CoV-2 RT-PCR positive on nasopharyngeal aspirate	11 (100)
RSV or influenza RT-PCR positive on nasopharyngeal aspirate	0
Sputum cultures positive for other organisms	2 (10)‡
Blood culture positive for other organisms	0
Chest radiography findings, n (%)	
No new parenchymal changes	3 (64)
Parenchymal changes including acute on chronic changes	8 (36)

\*Pre-existing respiratory disorder included chronic lung disease and non-cystic fibrosis bronchiectasis.

†Two of the children presented had previously defined epilepsy.

‡Equivocal growth of *Staphylococcus aureus* and *Candida albicans*.

PICU, paediatric intensive care unit; PIM3, paediatric index of mortality version 3; RSV, respiratory syncytial virus; RT-PCR, reverse transcription polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

than respiratory failure. Three children presented in status epilepticus (two with known seizure disorders and one with an acquired head injury). All tested negative for SARS-CoV-2 on cerebrospinal fluid analysis. Three children presented with significant new diagnoses (congenital heart disease, leukaemia and diabetes mellitus) which would have required PICU admission regardless of their SARS-CoV-2 status. The other child was undergoing chemotherapy for a malignancy and was on established long-term ventilation but did not require a significant escalation in their ventilator parameters. Two of the cohort were immunocompromised.

Among other therapies, five (45%) children received vasoactive drugs. None received renal replacement therapy or

extracorporeal membrane oxygenation. Five children (45%) received compassionate use of remdesivir following ethics review. Six children (55%) received prophylactic anticoagulation as part of a modification of our usual practice. The two infants developed line-associated thrombosis in the absence of prophylaxis requiring therapeutic anticoagulation.

All children survived to discharge from PICU.

While children can present to PICU with a pattern of illness similar to adult COVID-19 disease, this is rare and three-quarters of them had risk factors for respiratory infections. A larger number of children were found to be SARS-CoV-2 positive coincidentally. While a causal relationship between some presentations and SARS-CoV-2

**Table 2** Summary of clinical characteristics and interventions for children with a PCR-positive diagnosis of SARS-CoV-2 infection. Children who presented with a paediatric inflammatory multisystem syndrome were excluded from this description

Blood markers	Median measurement (range)
Maximum leucocyte count ( $\times 10^9/L$ )	15.4 (6.01–24.75)
Lymphocyte count ( $\times 10^9/L$ )	1.15 (0–2.94)
Maximum ferritin ( $\mu g/L$ )	898 (264–1991)
Maximum LDH (units/L)	1594 (802–4264)
Maximum D-dimer ( $\mu g/L$ )	1655 (162–6742)
Maximum CRP (mg/L)	158 (27–449)
Maximum temperature during ICU admission ( $^{\circ}C$ ), median (IQR)	39.5 (38.4–40)
OSI, median (IQR)	
Day 1	5.2 (4.1–7.0)
Day 2	6.6 (4.3–7.6)
Day 3	5.1 (3.6–6.74)
ICU therapies, n (%)	
Invasive mechanical ventilation	9 (81)
Prone position	4 (36)
Neuromuscular blockade	5 (46)
Inhaled pulmonary vasodilators*	4 (36)
High-frequency oscillation ventilation	2 (11)
Renal replacement therapy	0
ECMO	0
Vasoactive drugs	5 (46)
Anticoagulation, n (%)	
Therapeutic dose	3 (27)
Prophylactic dose	5 (46)
Antiviral medication, n (%)	
Remdesivir	5 (46)
Outcomes	
Survival to ICU discharge	11
Survival to hospital discharge	11
Median length of ICU stay (IQR), days	10 (3.2–13.0)

Entire ranges presented for maximum or minimum blood parameters rather than IQRs.

\*Inhaled nitric oxide or inhaled prostacyclin.

†Leucocyte and lymphocyte counts include results from two children with oncological diagnoses.

‡OSI data exclude data from two children not ventilated and one child prior to correction of cyanotic congenital heart disease.

CRP, C reactive protein; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; LDH, lactate dehydrogenase; OSI, oxygen saturation index; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

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#### ORCID iDs

Samiran Ray <http://orcid.org/0000-0002-3738-4672>

Mae Johnson <http://orcid.org/0000-0003-1560-5689>

Mark J Peters <http://orcid.org/0000-0003-3653-4808>

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infection cannot be ruled out, these cases will have implications for hospital infection control precautions in children with critical illness throughout the pandemic.

Nicholas Lanyon,<sup>1</sup> Pascale du Pré,<sup>2</sup> Timothy Thiruchelvam,<sup>3</sup> Samiran Ray<sup>1,2,4</sup>, Mae Johnson<sup>1,2</sup>, Mark J Peters<sup>1,2,4</sup>

<sup>1</sup>Anaesthetic Department, Great Ormond Street Hospital For Children NHS Trust, London, UK

<sup>2</sup>Paediatric Intensive Care Unit, Great Ormond Street Hospital For Children NHS Foundation Trust, London, UK

<sup>3</sup>Cardiac Intensive Care, Great Ormond Street Hospital, London, United Kingdom

<sup>4</sup>Institute of Child Health, University College of London, London, UK

**Correspondence** to Dr Mae Johnson, Paediatric Intensive Care, Great Ormond Street Hospital for Children, London WC1N 3JH, UK; [mae.johnson@gosh.nhs.uk](mailto:mae.johnson@gosh.nhs.uk)

**Twitter** Samiran Ray @DrSamRay and Mark J Peters @pus27

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