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ORIGINAL ARTICLE

Clinical Characteristics and outcomes of adults with COVID-19 admitted to a Pediatric Intensive Care Unit

Características y resultados clínicos de adultos graves hospitalizados por COVID-19 en una Unidad de Cuidados Intensivos Pediátricos

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What do we know about the subject matter of this study?

Worldwide, the COVID-19 pandemic has been a challenge for healthcare systems due to the extremely high requirement for ICU beds. In this regard, PICUs have been a mainstay around the world.

What does this study contribute to what is already known?

We describe a cohort of adult patients infected with COVID-19 managed in a PICU. Although this is not a comparative study, the patients in our work presented a mortality and complication rate similar to what has been reported internationally.

Abstract

Objective: To describe a cohort of critically ill adult patients suffering from COVID-19, admitted to a pediatric intensive care unit managed by a pediatric intensive care team (ICU-MP). **Patients and Method**: Retrospective observational study of adults admitted to the ICU-MP due to COVID-19 from May 11 to July 26, 2020. Demographic, clinical, biochemical, ventilatory support characteristics, and complications were recorded. Disease severity was characterized by Acute Physiology and Chronic Health Evaluation II score (APACHE II) using data from the first 24 hours of admission to the ICU-MP. **Results**: Ninety-three patients over 18 years with suspected or confirmed COVID-19 were admitted to the ICU-MP. The median age was 60.3 years (SD 13.9), and 59 (63.4%) patients were male. Eighty-two (88.1%) patients had at least 1 medical comorbidity. The median APACHE II score was 9.4 points (SD 5.6). Fifty-one (54.8%) patients were invasively ventilated, for a median of 13.7 days (SD 17.9). Inotropic support was used in 45 (48%) patients. Thirty-three (35.5%) patients presented acute kidney injury (AKI) and 14 (15.1%) patients received continuous renal replacement

Keywords:
Adults;
COVID-19;
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therapy. Twenty-nine (31.2%) patients had healthcare-associated infections. The median ICU-MP stay was 10.8 days (SD 11.8). 25 (26.9%) patients died, ten of them (40%) had adequacy of therapeutic effort. **Conclusions:** The mortality rate of critically ill patients with COVID-19 is high. Older patients (> 70 years), those who require invasive mechanical ventilation and who develop AKI are at increased risk of death. Although this is not a comparative study, our mortality rate and complications seem to be similar to those reported in adult case series.

Introduction

On March 11, 2020, the World Health Organization (WHO) qualified as a pandemic the global spread of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) associated with Coronavirus disease 2019 (COVID-19)[1]. Patients with SARS-CoV-2 may progress to severe COVID-19, leading to high rates of hospitalization and intensive care unit (ICU) admission for respiratory support. On March 3, 2020, the first patient with COVID-19 infection was diagnosed in Chile. Since then, there was an increasing number of cases, reaching more than 1,000 cases per day by the end of April and more than 6,000 by June 2020[2]. Along with the diagnosis of new cases, there was an increase in the requirements for critical ICU beds, challenging the responsiveness of the Chilean healthcare system.

In order to adapt the healthcare system to the needs of the pandemic, public and private healthcare providers increased the number of available adult ICU beds from 430 at the beginning of the pandemic to 1,753 at the end of May. This increase was carried out by converting beds from the Emergency Department, Pediatric Intensive Care Units (PICU), and Post-Anesthesia Care Units[3]. On June 22, 100% of ICU beds were in use, representing 408% of the previous baseline capacity[3].

In April 2020, all our PICU staff members (physicians, nurses, nurse technicians, and respiratory physical therapists) completed training at the local adult ICU. On May 11, 2020, our PICU was turned into a 16-bed pediatric intensivist-managed adult ICU (ICU-PM) exclusively dedicated to the treatment of adults with COVID-19 infection. Although PICU to ICU-PM conversion has occurred worldwide[4-6], available reports are limited to a description of the number of beds allocated for adult use and very early clinical outcomes[7-9].

The objective of this study was to describe the demographic characteristics, clinical presentation, management, and outcome of adult critically ill patients with COVID-19 managed by pediatric intensivists.

Patients and Method

Patients

A descriptive and retrospective study was performed on adult patients with suspected or confirmed severe COVID-19 infection, using the definition proposed by the Chilean Ministry of Health (MINSAL) (table 1)[10], admitted to the ICU-PM in a healthcare center in Santiago, from May 11, 2020, to July 26, 2020.

Study variables

We recorded demographic data (age, sex, comorbidities including hypertension, dyslipidemia, diabetes mellitus (DM), and obesity) and clinical presentation (fever, cough, dyspnea, duration of symptoms). Disease severity was defined according to the Acute Physiology and Chronic Health Evaluation II score (APACHE II) using data from the first 24 hours of admission to the ICU-MP. The APACHE II score is a disease severity grading system designed by Knaus et al. in 1985. It is one of the most used scores in adult ICUs, consisting of a whole number from 0 to 67 calculated based on various measures and is applied within 24 hours of admission. The higher the score, the higher the risk of death.

Laboratory results were also recorded, including lymphocyte count, procalcitonin, C-reactive protein (CRP), ferritin, triglycerides, glutamic-oxaloacetic transaminase (GOT), fibrinogen, D-dimer, and creatinine. Two levels were recorded, one on admission to the ICU-PM and another one at the worst level reached while the patient was in the unit.

Regarding the treatment, the following characteristics of ventilatory support were recorded: type of ventilation [invasive mechanical ventilation (IMV), noninvasive mechanical ventilation (NIMV), high-flow nasal cannula (HFNC), extracorporeal membrane oxygenation (ECMO)], prone position, awake prone position, neuromuscular blockade, duration of IMV, need for tracheostomy, ratio of partial pressure arterial oxygen and fraction inspired oxygen (PaO2/FiO2), use of vasoactive drugs, specific treatment for COVID-19 infection (hydroxychloroquine, azithromycin, lopinavir/ritonavir, steroids, and hyperimmune plasma), and anticoagulation with low molecular weight heparin (LMWH).

Finally, all complications occurring during the ICU-PM stay [including cardiac, renal, hematological, and neurological events, and healthcare-associated infections (HAIs)], adequacy of therapeutic effort (ATE), mortality, and length of stay were recorded.

Table 1. Definition of suspected, probable and confirmed case according to the Ministry of Health of Chile[10]

Suspicious case

Patient with ≥ 2 of the following symptoms consistent with COVID-19: fever (≥ 37.8°C), cough, dyspnea, chest pain, odynophagia, myalgia, chills, headache, diarrhea, sudden loss of smell (anosmia) or taste (ageusia)).
or
Patient with severe acute respiratory infection (requiring hospitalization).

Confirmed case

Patient who meets the definition of a suspected case with "positive" PCR for SARS-CoV-2.

Probable case

Patient who meets the definition of suspected case with "indeterminate" PCR for SARS-CoV-2
or
People who have been in close contact with a confirmed case and develop ≥ 1 symptom consistent with COVID-19 within the first 14 days after contact.

Statistical analysis

Descriptive data were expressed as mean and standard deviation (SD) for continuous variables, and as total number and percentage (%) for categorical variables. Comparison between deceased and surviving patients was performed with the Pearson/Fisher χ^2 test or the t-student test. Statistical analyses were performed with IBM SPSS Statistics v23.0 software. All tests considered a $p < 0.05$ as statistically significant.

Ethical aspects

The study was approved by the Scientific Ethics Committee of the *Universidad Andrés Bello*. The database was anonymized in two steps according to the guidelines of the Council for International Organizations of Medical Sciences (CIOMS).

Results

Ninety-three adults with COVID-19 infection were admitted to the ICU-PM. Of these, 19 (20.4%) were initially admitted to an adult ICU and subsequently transferred to the ICU-PM. 25 patients (26.9%) died, establishing ATE in 10 of them (40%). ATE was determined in 3 patients (30%) in an adult ICU before transfer to our ICU-PM; and in the remaining 7 patients (70%), it was established throughout their evolution while staying in the ICU-PM, however, in the case of having had access to advanced life support therapies, it was established at the beginning of their stay.

Demographic characteristics and clinical presentation

The mean age of the patients was 60.3 years (SD 13.9), with a minimum and maximum age of 20 years and 89 years, respectively. Patients who survived were significantly younger (mean difference 13.4 years, $p < 0.01$). 59 patients (63.4%) were male. 82 patients (88.1%) had at least one comorbidity; 55.9% hypertension (52 patients), 12.9% dyslipidemia (12 patients), 36.5% DM (34 patients), and 33.3% obesity (31 patients). No statistically significant differences in sex and comorbidities were found between the groups of deceased and surviving patients (table 2).

The mean APACHE II score was 9.4 (SD 5.6). Patients who survived showed significantly lower values (mean difference 5.2 points, $p < 0.01$).

Sixty patients (64.5%) tested positive for SARS-CoV-2 infection by RT-PCR and 32 (34.4%) by serology tests. We also included one patient (1.1%) with negative tests, but who met the definition criteria of a "suspected" case of COVID-19 infection according to the MINSAL.

The most frequent symptoms were fever (80 patients, 86%), cough (89 patients, 95.7%), and dyspnea (91 patients, 97.8%). The mean duration of symptoms before admission to the ICU-PM was 7.1 days (SD 3.7). There were no statistically significant differences in either type or duration of symptoms between the deceased and surviving patients.

Table 3 shows the results of laboratory tests. The most common findings at the time of admission to the ICU-PM were lymphopenia, increased procalcitonin, CRP, ferritin, GOT, fibrinogen, and D-dimer, with no significant differences between survivors and non-survivors, except for CRP which was higher in the deceased group (mean difference 6.6 mg/dL, $p < 0.01$). Regarding the worst value of laboratory tests during ICU-PM stay, all parameters except creatinine were statistically different between both groups ($p < 0.01$).

Treatment

Table 4 details the description of patient management. 51 patients (54.8%) received IMV (mean duration 13.7 days, SD 17.9), 18 patients (19.4%) received NIMV, and 24 patients (25.8%) received HFNC. 13 of 51 patients (24%) required tracheostomy due to prolonged mechanical ventilation. Prone position was used in 80 patients (86%), with 35 of them in awake prone position (42%). Neuromuscular blockade was used in 30 (32.2%) of the patients with IMV.

The mean PaO2/FiO2 ratio was 119.9 (SD 50.2). No patient required ECMO. In the survivor group, the proportion of patients requiring IMV, neuromuscular blockade, and prone position was significantly lower (39.7% vs 100%; 18.2% vs 72%; 80.9% vs 100%, res-

pectively; all $p < 0.01$). The mean PaO2/FiO2 ratio was significantly higher (mean difference 54, $p < 0.01$) in the survivor group. 45 patients (48%) were treated with vasoactive drugs, with a statistically significant difference between the survivor and deceased groups (29.4% vs 100%; $p < 0.01$).

61 patients (65.6%) received hydroxychloroquine, 93 (100%) azithromycin, and 58 (62.4%) an antibody protease inhibitor (lopinavir/ritonavir). Steroids were used in 72 patients (77.4%) and hyperimmune plasma in 21 patients (22.6%). As observed with other therapies, in the survivor group, the proportion of patients requiring antivirals and hyperimmune plasm a was significantly lower (56.9% vs 88%, 14.7% vs 44%, respectively, both $p < 0.01$). No statistically significant differences were found in the use of hydroxychloroquine, azithromycin, or steroids between the two groups. All patients received antithrombotic prophylaxis with LMWH and, in those cases that presented thrombosis, the dose was increased seeking therapeutic levels of anti-activated factor X.

Complications

Table 5 shows the complications of the patients analyzed.

Twenty patients (21.5%) developed cardiac arrhythmias, and, among these, 3 (3.2%) patients presented QT interval prolongation. Twelve patients (12.9%) presented cardiopulmonary arrest during their stay in the ICU-PM. 33 patients (35.5%) suffered acute kidney injury (AKI). Fourteen patients (15.1%) received continuous renal replacement therapy (CRRT) and 10 (71.4%) of them died. In the survivor group, AKI occurrence and use of CRRT were significantly lower (19% vs 80%; 5.9% vs 40%, respectively; both $p < 0.01$).

Regarding infections, one HAI was observed in 29 patients (31.2%), two HAIs in 26 patients (27.9%), and three HAIs in 13 patients (14%). Regarding the type of HAI, there were 29 cases of CVC-related bloodstream infection (CRBSI), 23 cases of catheter-associated urinary tract infection (CAUTI), and 16 cases of ventilator-associated pneumonia (VAP).

Regarding hematological complications, two patients (2.1%) developed deep vein thrombosis (DVT), ten (10.7%) pulmonary embolism (PE), and 5 patients (5.3%) presented significant bleeding (3 gastrointestinal bleeding and 2 epistaxis).

Neurological complications were also found. Twenty-five patients (26.9%) presented delirium, ten (10.7%) critical illness myopathy, three (3.2%) deve-

Table 2. Demographic characteristics and clinical presentation of patients admitted to an adult intensive care unit managed by pediatric intensivists (ICU-MP)

Variable		All patients (n = 93) Nº. (%) / mean (SD)	Deceased (n = 25) Nº. (%) / mean (SD)	Survivors (n = 68) Nº. (%) / mean (SD)	p	
Age. years		60.6 (13.8)	70.4 (8.3)	57.0 (13.9)	< 0.01	
Gender	Males	59 (63.4)	16 (64.0)	43 (63.2)	0.58	
	Feales	34 (36.6)	9 (36.0)	25 (36.8)		
Comorbili-dity	DM	34 (36.5)	13 (52.0)	21 (30.9)	0.08	0.45
	Obesity	31 (33.3)	7 (28.0)	24 (35.3)	0.62	
	Hipertension	17 (68.0)	35 (51.5)	52 (55.9)	0.17	
	Dyslipidemia	12 (12.9)	3 (12.0)	9 (13.2)	1.00	
APACHE II. points		9.4 (5.6)	13.2 (7.1)	8.0 (4.2)	< 0.01	
PCR SARS-COV-2	Negative	32 (34.4)	7 (28.0)	25 (36.8)	0.24	0.72
	Positive	60 (64.5)	17 (68.0)	43 (63.2)	0.64	
	Indeterminate	1 (1.1)	1 (4.0)	0 (0.0)	0.72	
SARS-COV-2 positive serology		32 (34.4)	7 (28.0)	25 (36.8)	< 0.01	
Fever		80 (86.0)	20 (80.0)	60 (88.2)	0.33	
Cough		90 (96.8)	25 (100.0)	65 (95.6)	0.56	
Dyspnea		91 (97.8)	25 (100.0)	66 (97.1)	0.53	
Duration. days		7.1 (3.8)	6.7 (3.4)	7.3 (3.9)	0.55	

APACHE II score: Acute Physiology and Chronic Health Evaluation II score; DM: diabetes mellitus; PCR: polymerase chain reaction; SARS-COV-2: Severe Acute Respiratory Syndrome Coronavirus 2; SD: standard deviation.

Table 3. Laboratory values on admission to the ICU-PM and worst value during the stay in the ICU-PM

Variable	VALUES AT ICU-PM ADMISSION					WORST VALUE DURING HOSPITALIZATION IN ICU-PM				
	All patients (n = 93) Mean (DS)	Deceased (n = 25) Mean (DS)	Survivors (n = 68) Mean (DS)	Mean differ-ence	p	All patients (n = 93) Mean (DS)	Deceased (n = 25) Mean (DS)	Survivors (n = 68) Mean (DS)	Mean differ-ence	p
Linfocites, mm^3	1.414.2 (1.414.2)	1.314.6 (1.462.5)	1.462.6 (1.770.9)	148	0.71	721.9 (365.2)	561.1 (231.1)	804.3 (395.1)	243.2	< 0.01
Procalci-tonin, ng/mL	0.5 (1.4)	0.5 (0.5)	0.5 (1.6)	1.0	0.02	8.0 (20.1)	25.1 (33.1)	1.8 (5.0)	23.2	< 0.01
CRP, mg/dL	14.8 (9.9)	19.6 (11.4)	13.0 (8.7)	6.7	< 0.01	23.5 (13.8)	34.4 (13.5)	19.5 (11.7)	14.9	< 0.01
Ferritin, ng/mL	1.401.4 (1226.1)	1.366.5 (1452.1)	1.417.2 (1.143.3)	50.7	0.86	2399.5 (2778.8)	3977.6 (4652.0)	1810.7 (1217.6)	2166.9	< 0.01
Triglycer-ides, mg/dL	148.6 (54.7)	163.9 (51.2)	144.6 (54.2)	19.5	0.20	259.9 (139.4)	337.2 (160.8)	229.2 (117.9)	107.9	< 0.01
GOT, U/L	68.1 (51.2)	72.1 (66.39	67.0 (44.7)	5.1	0.69	113.4 (149.19	189.6 (256.3)	85.4 (63.6)	104.2	< 0.01
Fi-brinógen, mg/mL	551.7 (143.7)	577.3 (157.4)	548.3 (128.9)	28.9	0.40	620.2 (163.6)	716.4 (165.5)	584.3 (149.3)	132.1	< 0.01
Ddimer, mcg/ mL	1.6 (3.6)	1.7 (1.5)	1.6 (4.2)	0.109	0.90	4.9 (6.9)	10.3 (8.9)	2.8 (4.7)	7.5	< 0.01
Creati-nine, mg/dL	1.1 (1.1)	1.4 (0.9)	1.0 (1.2)	0.3	0.23	1.5 (0.56)	2.5 (1.5)	1.3 (0.48)	1.2	0.06

CRP: C-reactive protein; GOT: glutamic oxalocetic transaminase; ICU-PM: pediatric intensivist-managed adult ICU; SD: standard deviation. Normal values: Lymphocytes: 1,500-4,000/mm3; Procalcitonin: < 0.05ng/mL; CRP: < 3mg/dL; Ferritin: 15-150 ng/mL; Triglycerides: < 75 mg/dL; GOT: 10-40 U/L; Fibrinogen: 200-400 mg/dL; D-dimer: < 0.5 mcg/mL; Creatinine: 0.5-1.3 mg/dL.ss

Table 4. Treatment received in patients admitted to the pediatric intensivist-managed adult ICU (ICU-PM)

Variables		All patients (n = 93) Nº. (%) / mean (DS)	Deceased (n = 25) Nº. (%) / mean (DS)	Survivors (n = 68) Nº. (%) / mean (DS)	p
Ventilatory support					
IMV		51 (54.8)	25 (100)	26 (39.7)	< 0.01
IMV duration, days		13.7 (17.9)	14.7 (14.5)	13 (19.9)	0.72
Tracheostomy		13 (13.9)	6 (24.0)	7 (10.3)	0.87
NIMV		18 (19.4)	0 (0.0)	18 (26.4)	--
High flow nasal cannula		24 (25.8)	0 (0.0)	24 (35.3)	--
ECMO		0 (0.0)	0 (0.0)	0 (0.0)	--
Prone	Awake	35 (37.6)	--	35 (51.5)	0.02
	IMV	45 (48.4)	25 (100.0)	20 (21.5)	
Neuromuscular blockade		30 (32.2)	18 (72.0)	12 (18.2)	< 0.01
PaO2/FiO2		119.9 (50.2)	80.7 (23.6)	134.6 (49.8)	< 0.01
Drugs					
Vasoactive drugs		45 (48.0)	25 (100.0)	20 (29.4)	< 0.01
Hidroxicloroquine		61 (65.6)	16 (64.0)	45 (66.2)	1.00
Azitromicine		93 (100.0)	25 (100.0)	68 (100.0)	--
Lopinavir/Ritonavir		58 (62.4)	22 (88.0)	36 (56.9)	< 0.01
Corticoesteroids		72 (77.4)	23 (92.0)	49 (72.1)	0.05
Hyperimmune plasma		21 (22.6)	11 (44.0)	10 (14.7)	< 0.01
HBPM		93 (100.0)	25 (100.0)	68 (100.0)	--

SD: standard deviation; ECMO: extracorporeal membrane oxygenation; LMWH: low molecular weight heparin; NIMV: non-invasive mechanical ventilation; IMV: invasive mechanical ventilation; PaO2/FiO2: ratio of partial pressure of oxygen and inspired fraction of oxygen.

loped swallowing disorders, two (2.1%) seizures, and two (2.1%) non-specific encephalopathy.

Mean ICU-PM stay was 10.8 days (SD 11.8), with a minimum and maximum of 1 day and 67 days, respectively. Patients in the deceased group had a significantly higher length of stay (mean difference 6.7 days, $p < 0.01$).

Discussion

The COVID-19 pandemic has been a challenge for health systems worldwide, with an enormous consumption of resources, especially due to the extremely high requirement of ICU beds. This fact, along with the rare presentation of severe COVID-19 infection in children[11], has led to PICUs and their staff becoming an essential resource during the pandemic. Admission of adult patients to PICUs has become widespread worldwide. Since the onset of the pandemic, training programs and clinical practice guidelines focused on the management of adults with COVID-19 infection have been published for pediatric intensivists[6]. Despite this training and effort, the management of critically ill adult patients has been a challenge for all PICU workers because, while there may be some similarities, critically ill adult COVID-19 patients are not "*big kids*."

In the past year, we have been exposed to an information overload, with thousands of publications on this new disease. However, although there have been a significant number of publications on the experience and outcomes of patients admitted to the ICU, there are almost no publications describing the outcomes of those patients who could not be treated by adult intensivists due to this overwhelming pandemic.

Data on adults with COVID-19 infection treated in ICU-PM are limited. In the Netherlands, Kneyber et al. reported the adaptation of 6 beds in their PICU for the care of adults with COVID-19 infection, admitting 98 adult patients; twelve of them were treated by pediatric nurses and pediatric intensivists and all but one survived[7]. In New York, the Children's Hospital at Montefiore organized and staffed a 40-bed ICU-PM and published their first 100 cases. However, all patients intubated in the ICU-PM (13 patients) were transferred to an adult ICU[8]. Yager et al. reported their experience with a 14-bed ICU-PM with 20 patients, with only one death[9]. In a multicenter publication of 180 PICUs from the USA and Canada, 24% of patients treated due to COVID-19 infection were older than 18 years, with a mortality rate of 40% in the group older than 30 years[12].

A quarter of our patients (26.9%) died from COVID-19 infection, with a mean age of 70.4 years (SD 8.3) and with one or more comorbidities. No statistically significant differences were found between comorbidities, but a higher mortality trend was observed for DM and obesity. In a systematic review, Quah et al. found in patients with COVID-19 infection treated by adult intensivists in China, Europe, and the USA, a similar mortality rate, between 23% and 37.7%, comparable to our cohort[13].

In our patients, the mean age was 60.3 years, with a slightly higher number in males, similar to that reported in the literature for patients hospitalized in adult ICUs[14,15]. In our cohort, 88% of patients had at least one comorbidity, with hypertension and DM as the most frequent. The literature also reports a high percentage of patients with comorbidities (40-73%), but lower than in our series, with hypertension and DM also being the most frequent[15-17]. In our series, the mean APACHE score was 9.4, similar to that described by Chen et al.[16].

Regarding symptoms and days of evolution, our series also presented similarities to those described in the literature for patients with COVID-19 infection treated by adult intensivists[17-19]. Jain et al.[20] defined dyspnea as a predictor of ICU admission in patients with COVID-19 infection. This finding is consistent with the fact that all patients admitted to our ICU-PM presented this symptom.

Concerning ventilatory support, our series had a lower IMV rate than that reported in a series of patients treated by adult intensivists (54.8% vs 70-91.3%). However, there were no differences in days of IMV, ventilation in prone position, or neuromuscular blockade[16-18,20-24]. Our mean PaO2/FiO2 ratio was 119.6, while Grasselli et al. reported a mean of 160[22].

Among the deceased group, there was a higher proportion of patients who received hyperimmune plasma and lopinavir/ritonavir, but this difference could be because these treatments were used only in the most severely ill patients.

During the first month, the use of corticosteroids was restricted to the most critical patients, which explains their low rate of use in our sample. Subsequently, after the publication of the RECOVERY trial[24], dexamethasone was used in all patients hospitalized in our ICU-PM. Remdesivir was not used since it is not available in Chile. During the first months of the pandemic, drugs such as hydroxychloroquine, azithromycin, and lopinavir/ritonavir were used until later studies showed their inefficacy[13,21,22]. Fortunately, no significant side effects were detected. Current protocols have been adapted based on the most recent and highest level of scientific evidence.

One-third of our patients (35.5%) developed AKI, similar to that described in most series (29% to 49.8%)[14,19,20]; however, Argenziano et al. reported a higher rate of AKI (78%) with a need for dialysis of 32.5%[25].

Table 5. Complications in patients admitted to pediatric intensivist-managed adult ICU (ICU-PM).

Variables		Todos los pacientes (n = 93) Nº. (%) / media (DE)	Fallecidos (n = 25) Nº (%) / media (DE)	Supervivientes (n = 68) Nº. (%) / media (DE)	p
Cardiac events	Arrythmias	17 (18.3)	11 (44)	6 (8.8)	< 0.01
	QT prolonged	3 (3.2)	0 (0.0)	3 (4.4)	0.56
	CPA	12 (12.9)	10 (40)	2 (2.9)	< 0.01
Renal events	AKI	33 (35.5)	20 (80.0)	13 (19.1)	< 0.01
	TRRC	14 (15.1)	10 (40.0)	4 (5.9)	< 0.01
HAI (one episode)		29 (31.2)	11 (44.0)	18 (26.5)	0.11
	CRBSI	21 (14)	8 (32.0)	13 (19.1)	0.30
	CAUTI	4 (4.3)	1 (4.0)	3 (4.4)	0.56
	VAP	4 (4.3)	2 (8.0)	2 (2.9)	1.00
HAI (two episodes)		26 (27.9)	14 (56.0)	12 (17.6)	< 0.01
	CRBSI	7 (7.5)	2 (8.0)	5 (7.3)	0.45
	CAUTI	13 (14)	7 (28.0)	6 (8.8)	0.78
	VAP	6 (6.4)	5 (20.0)	1 (1.5)	0.06
HAI (three episodes)		13 (14.0)	5 (20.0)	8 (11.8)	0.08
	CRBSI	1 (1.1)	1 (4.0)	0 (0.0)	--
	CAUTI	6 (6.4)	3 (12.0)	3 (4.4)	1.00
	VAP	6 (6.4)	1 (4.0)	5 (7.3)	0.65
Hemato-logical events	Bleeding	5 (5.4)	2 (8.0)	3 (4.4)	0.06
	CVT	2 (2.1)	0 (0.0)	2 (2.9)	--
	PE	10 (10.8)	3 (12.0)	7 (10.3)	1.00
Neurologi-cal events	Delirium	25 (26.9)	9 (36.0)	16 (23.5)	0.30
	CPM	10 (10.7)	3 (12.0)	7 (10.3)	0.82
	SDi	3 (3.2)	1 (4.0)	2 (2.9)	0.81
	Convulsion	2 (2.1)	1 (4.0)	1 (1.5)	1.00
	NE	2 (2.1)	1 (4.0)	1 (1.5)	1.00
UCI-PM stay, days		10.8 (11.8)	15.7 (14.7)	9.0 (10.0)	< 0.01

CRBSI: CVC-related bloodstream infection; SD: standard deviation; NE: nonspecific en-cephalopathy; AKI: acute kidney injury; GI: gastro-intestinal; CAUTI: catheter-associated urinary tract infection; HAI: healthcare-associated infections; CPM: critical patient myopa-thy; VAP: ventilator-associated pneumonia; CRA: cardiorespiratory arrest; SDi: swallowing disorder; PE: pulmonary embolism; CRRT: continuous renal replacement therapy; DVT: deep vein thrombosis; ICU-PM: pediatric intensivist-managed adult ICU.

Almost one-third of our patients (31.2%) presented HAIs. Although this is a high number, these results agree with those summarized by Antinori et al. who included 17 case series from China, Spain, Italy, and the USA finding an incidence of HAIs between 5 and 38.9%[26].

Regarding hematologic complications, there were 2.1% DVT, 10.7% PE, and 5.3% major bleeding complications, while the literature from adult ICUs reports 12-20%, 7%, and 3.9%, respectively[27,28]. The difference in DVT between our data and the literature is remarkable and could be explained by the strict application of the thromboprophylaxis protocol, although we have no convincing arguments to support this.

The incidence of delirium was significantly lower in our series compared with the 84% described by Helms et al.[29]. This finding could be explained by the limited experience that pediatric intensivists have in this area.

The mean length of stay in our ICU-PM was 10.8 days, which coincides with that described in adult

case series (mean 11 to 23 days)[17,19,22,26]. As expected, patients with IMV had a longer hospital stay, but the presence of HAIs was not significantly related to a longer duration of hospitalization. In our series, none of the treatments caused a reduction in hospital stay days, IMV, or mortality.

The COVID-19 pandemic has raised ethical and medicolegal issues, including the equitable allocation of health resources, especially in relation to patient prioritization and resource rationing[30]. However, of all the case series reviewed for this discussion, only one analyzes the limitation of therapeutic effort, accounting for 33.3% of the patients who died, which is consistent with our findings.

This study has the limitations of a retrospective design. In addition, 20% of the patients were initially treated in an adult ICU and were subsequently transferred to the ICU-PM.

Conclusion

We analyzed a cohort of adult patients with COVID-19 infection admitted to a PICU-PM. The mortality rate of critically ill patients infected with COVID-19 was similar to that reported in other series. Patients older than 70 years, those requiring IMV, and who develop AKI or arrhythmias are at increased risk of death.

The management of critically ill adult patients with COVID-19 infection has been a challenge for pediatric intensivists. Although this is not a comparative study, our mortality and complication rates seem to be similar to those reported in other studies.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: This study was approved by the respective Research Ethics Committee, which, according to the study's characteristics, has accepted the non-use of Informed Consent.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Financial Disclosure

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