Comparative Study of Postoperative Outcomes of Covid-19 and non-Covid-19 Pediatric Patients Undergoing Emergency Surgery

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Abstract
Introduction: Most of the indicated surgeries in children will be postponed during the pandemic, however, in some cases requiring emergency surgery, surgery must be performed. Pediatric patients with COVID-19 infection who undergo surgery are at higher risk of experiencing complications and complications. **Aim and Objective:** The purpose of this study was to analyze the differences in postoperative outcomes in pediatric patients with COVID-19 compared to non-COVID-19 patients who underwent emergency surgery. Materials and Methods: This was an analytical observational study with a retrospective design that was conducted on pediatric patients who had emergency surgery at the emergency room operating theater of Dr. Soetomo Hospital Surabaya, Indonesia. The samples were categorized into two groups: COVID-19 and non COVID-19. Data was obtained by reviewing the medical records of the patients. A comparison between the COVID-19 and non-COVID-19 groups was made using statistical tests such as Chi-square, Mann Whitney, and Independent t-Test. Results and Conclusion: A total of 34 pediatric patients who underwent emergency surgery (14 COVID-19 and 20 non COVID-19) were included in this study. The median length of stay in the COVID-19 group was 9 days while the non-COVID-19 group was 7.5 days, this was not significantly different (P = 0.608). The percentage of deaths in the COVID-19 and non-COVID-19 groups was 21.4% and 30%, respectively, with a significance value of p = 0.933. There were no significant differences in postoperative outcomes in terms of the incidence of length of stay and the discharge condition of patients whether alive or dead in pediatric patients with COVID-19 compared to non- COVID-19 patients who underwent emergency surgery.
Keywords: COVID-19, Emergency Surgery, Pediatrics

1. Introduction

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection was initially identified in 2019 and has since become a global pandemic (Li et al., 2020), resulting in over 208.470.375 confirmed cases of Coronavirus Disease 19 (COVID-19) and 4.377.979 fatalities worldwide as of August 18, 2021 (WHO, 2021). This coronavirus has resulted in a significantly greater number of infected patients and deaths than the previous coronavirus pandemic (Mohapatra et al., 2020).

COVID-19 infection is not limited to adults but affects children as well. In America, pediatric cases account for 12.6% of all COVID-19 cases (Jenco, 2021). In China, the proportion of COVID-19 cases in pediatrics is 2.2% (Garazzino et al., 2020). In Indonesia, COVID-19 data based on the distribution of pediatric age until March 28, 2021, showed that "2.8% of cases were among children aged 0-5 years and 9.4% among children aged 6-18 years. The incidence of death was around 0.6% for children aged 0-5 years and 6-18 years (Pusdatin Kementerian Kesehatan, 2021)."

While some studies suggest that COVID-19 symptoms in pediatrics are milder than in adults, case studies also show that COVID-19 symptoms in children can range from mild to severe. The available evidence suggests that children who have comorbidities, especially those with complex medical conditions, are more likely to require hospitalization and may even require critical care (Graff et al., 2021). Risk factors that can aggravate COVID-19 infection in children include passive smoking, prematurity, comorbid heart disease, lung disease, neurological disorders, and genetic diseases (Sankar et al., 2020).

Pediatric surgery will mostly be postponed during the pandemic, but emergency surgeries must be performed in some cases. Patients with COVID-19 infection who undergo surgery are at a higher risk for adverse events (Lei et al., 2020). According to a study conducted on pediatric

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patients, those with active COVID-19 infections were found to have a higher risk of experiencing postoperative pulmonary complications. Currently, the available information pertaining to the postoperative outcomes of patients diagnosed with COVID-19 is limited (Nielson et al., 2022).

Recognizing the pediatric characteristics of rapid COVID-19 infection is essential so that surgical preparation can be carried out with the protection of medical personnel and appropriate anesthesia techniques. This study analyzed the postoperative outcomes, including length of stay and hospital discharge, of pediatric patients aged 0-18 years with COVID-19 and non-COVID-19 who underwent emergency surgery. These two groups of patients were compared to determine whether there were any differences in postoperative outcomes.

While the most obvious difference between children and adults is their size, there are also physiological differences that can affect various organ systems including "the heart, lungs, kidneys, liver, blood, muscles, and central nervous system." Newborns, for instance, have a body surface area that is one-ninth that of an adult and are approximately one-third of the length of an adult, despite weighing around 3 kg. This body surface area is a better benchmark for determining basal fluid and nutrient requirements compared to body weight and age (Davis & Cladis, 2017).

Administering general anesthesia to infants can significantly affect the functioning of their organs. The use of anesthesia can cause a loss of inspiratory muscle tone and decrease functional residual capacity (FRC), which may lead to airway obstruction or spasm, atelectasis, and venous blood mixing unless continuous positive airway pressure (CPAP) or positive end-expiratory pressure (PEEP) is used. Inhaled anesthesia during early infancy can be particularly sensitive for the heart, while the central nervous system is relatively insensitive. Hypothermia is also a common side effect of general anesthesia due to environmental exposure, which can result in inhibition of central thermoregulation, redistribution of body heat, and reduction of metabolic heat production by up to 30%. Postoperative hypothermia can be detrimental and lead to increased oxygen consumption, dysoxia, and metabolic acidosis (Davis & Cladis, 2017).

Pediatric surgical emergencies refer to a diverse range of surgical conditions and abnormalities that occur in children, requiring emergency surgical intervention as the sole means of preventing disability, minimizing damage, or saving the child's life. These conditions include a variety of surgical abnormalities with varying incidence across different socio-demographic groups, ages, and times (Firomsa et al., 2018).

Mutations in the genetic makeup of viruses can change their potential for causing disease. Even minor changes, such as the substitution of individual amino acids, can significantly impact a virus's ability to evade the immune system and complicate vaccine development. SARS-CoV-2, like other RNA viruses, is subject to genetic evolution as it adapts to its human host and develops mutations over time. This has led to the emergence of various viral strains with distinct characteristics from their original forms. To detect new genetic variants of SARS-CoV-2 during a pandemic, it's important to conduct periodic genome sequencing of virus samples circulating in the community.

During the initial stages of the pandemic, SARS-CoV-2's genetic makeup underwent limited evolution. However, a single dominant variant, called D614G, emerged and became prevalent worldwide. This variant was linked to increased transmissibility but didn't cause more severe symptoms than the virus's ancestral forms. Additionally, a variant associated with transmission from infected minks in Denmark was identified in humans, but it didn't lead to higher rates of transmission.

Life-threatening conditions and limb surgeries should be treated as usual, with healthcare personnel wearing appropriate personal protective equipment (PPE) during patient evaluations. Emergency surgeries during the pandemic should proceed, with triage conducted in areas with limited COVID-19 testing facilities through temperature checks and questions about travel, cough, fever, breathing difficulties, contacts, and clusters. COVID-19 positive patients must be treated in isolation rooms, and alternative conservative treatment methods should be considered. Adequate PPE should be available, and transmission prevention measures should be in place in the operating room. If possible, general anesthesia requiring intubation should be avoided due to the risk of aerosol contamination.

This study is important because the COVID-19 pandemic has created unique challenges for healthcare systems around the world, including the management of emergency surgeries in children. While it is known that COVID-19 can have serious implications for postoperative outcomes, little is known about how these outcomes compare to those of non-COVID-19 patients. By comparing the postoperative outcomes of pediatric patients with COVID-19 and non-COVID-19 who undergo emergency surgery, this study aims to provide insights into the unique challenges posed by COVID-19 in emergency surgery and inform future treatment approaches. The study will focus specifically on the length of hospitalization and hospital discharge conditions, which are key indicators of postoperative recovery.

2. Research Method

Research Design

This retrospective analytical observational study was conducted at Dr. Soetomo Hospital Surabaya and aimed to investigate the medical records of

pediatric patients who underwent emergency surgery in the emergency room of the hospital and were confirmed with either COVID-19 or non-COVID-19. The target population for this study included all such patients who were treated at the hospital between March 2020 and November 2021, and the affordable population consisted of medical records of pediatric patients who met the inclusion criteria. The study subjects were selected based on inclusion and exclusion criteria and included all pediatric patients with COVID-19 and non-COVID-19 who underwent emergency surgery during the study period. Total sampling was used as the sampling technique in this study. The inclusion criteria for the study subjects include being aged 0-18 years, having undergone emergency surgery in the emergency room of Dr. Soetomo Hospital between March 2020 and November 2021, having SARS-CoV-2 PCR results available in their medical records, and having postoperative outcomes recorded, including length of hospitalization and hospital discharge condition (alive/dead). The exclusion criteria include unavailable medical records and no nasal/nasopharyngeal RT-PCR swab results available.

The research variables for this study include the independent variable of positive and negative SARS-CoV-2 RT-PCR test results and dependent variables of length of hospitalization and hospital discharge condition. The research was conducted at the Medical Record Installation of Dr. Soetomo Hospital, with data collection starting in April 2021. The necessary data was summarized and recorded in several tables for analysis.

Data Collection

The data collection procedure for this study involved obtaining information from medical records of all patients. The first stage of data collection included gathering data on SARS-CoV-2 PCR results, clinical characteristics of subjects, and postoperative outcomes such as length of hospitalization and hospital discharge condition (alive/dead). In the second stage, the collected data were processed and analyzed statistically to determine the differences in postoperative outcomes of COVID-19 and non-COVID-19 patients. The length of hospitalization was tested for data normality using Saphiro Wilk, and the length of stay was tested using Mann Whitney because the data was abnormally distributed. The characteristics and hospital discharge condition were nominal data scale and tested with a chi-square test. If the expected count was less than five, Fisher exact test was used. Confidentiality of all data was maintained, and the data were only used for scientific research purposes. This research was conducted with ethical approval from the Health Research Ethics Committee of Dr. Soetomo Surabaya Hospital (0401/LOE/301.4.2/III/2021).

Conceptual Framework

In pediatrics, surgical interventions during a pandemic require careful consideration of various factors, including the presence or absence of COVID-19 infection as indicated by positive or negative PCR swab results. Additionally, the urgency of the surgery must be taken into account, with elective surgeries often postponed due to the pandemic situation and the patient's COVID-19 status.

Emergency surgeries, on the other hand, cannot be delayed and must be performed immediately, even if the patient is infected with COVID-19. However, COVID-19 infection can significantly impact the perioperative and postoperative processes. The virus binds to the ACE-2 receptor, resulting in the release of cytokines such as IL-6 and IFN, which cause inflammation of the pulmonary alveoli and a decrease in lung compliance. This condition, combined with intubation, can result in high peak pressures and ventilator-induced lung injury (VILI).

Intubation in pediatric patients can often cause airway spasm, making it difficult to ventilate the patient, resulting in negative pressure pulmonary edema and desaturation. Additionally, cytokines released due to COVID-19 infection can cause fever, resulting in vasodilation and bleeding during surgery, which can lead to hypotension and hypoperfusion of organs. Hypotension and desaturation require ICU care, resulting in longer hospitalization, increasing the risk of death upon hospital discharge.

In summary, a clear understanding of the impact of COVID-19 infection on pediatric patients undergoing emergency surgery is critical in ensuring appropriate patient care, minimizing complications, and improving postoperative outcomes.

Research Hypothesis

Pediatric patients who undergo emergency surgery may experience different postoperative outcomes depending on their COVID-19 status, with those who test positive for COVID-19 potentially experiencing greater complications than those who test negative.

3. Results and Discussion

Characteristics of Research Subjects

The research subjects for this study were selected from patient data collected in the emergency room of Dr. Soetomo Hospital between March 2020 and November 2021, according to the established inclusion and exclusion criteria. A total of 34 patients were included in the study. The parameters observed in the study were the length of hospitalization, the hospital discharge condition (alive or deceased), and factors affecting mortality. The data was obtained from the patients' medical records and was processed using statistical methods. Table 1 presents the clinical characteristics of the study subjects

Table 1: The study subjects' clinical characteristics			
	COVID-19 n=14	Non-COVID-19 n=20	P
Gender Female, n (%) Male, n (%)	10 (71,4%) 4 (28,6%)	7 (35%) 13 (65%)	0,081*
Age Neonate, n (%) Infant, n (%) Toddler, n (%) Paediatrics, n (%) Teenagers, n (%)	1 (7,1%) 3 (21,4%) 1 (7,1%) 4 (28,6%) 5 (35,7%)	2 (10%) 4 (20%) 4 (20%) 1 (5%) 9 (45%)	0.368**
Comorbid Yes, n (%) No, n (%)	1 (7,1%) 13 (92,9%)	4 (20%) 16 (80%)	0,299***
Symptoms, n (%) Fever Cough Cold Crowded Vomit Diarrhea	1 (14,3%) 3 (21,4%) 0 (0%) 2 (14,3%) 0 (0%) 0 (0%)	10 (50%) 2 (10%) 1 (5%) 0 (0%) 6 (30%) 3 (15%)	0,066*** 0,627*** 1,000*** 0,162*** 0,031*** 0,251***
Pneumonia on Thorax photo, n (%) Yes Not	4 (28,6%) 10 (71,4%)	9 (45%) 11 (55%)	0,541*
PS-ASA, n (%) I/II III/IV	7 (50%) 7 (50%)	4 (20%) 16 (80%)	0,135***
Anesthesia Type, n (%) General Anesthesia Subarachnoid Block	12 (85,7%) 2 (14,3%)	20 (100%) 0 (0%)	0,162***
Types of Surgery Paediatric/Digestive Surgery, n (%) Neurosurgery, n (%) Obstetric Surgery, n (%) Plastic Surgery, n (%) ENT-KL Surgery, n (%) Orthopaedic Surgery Multidisciplinary, n (%)	5 (35,7%) 4 (28,6%) 2 (14,3%) 2 (14,3%) 0 (0%) 1 (7,1%) 0 (0%)	9 (45%) 5 (25%) 1 (5%) 2 (10%) 1 (5%) 0 (0%) 2 (10%)	0,586**
Description of using statistical type: *Continuity Correction. **Pearson Chi-Square. Fisher's Exact Test			

This study compared the characteristics of patients who underwent emergency surgery at Dr. Soetomo Hospital, with a focus on differences between COVID-19 and non-COVID-19 patients. The study included 14 COVID-19 patients and 20 non-COVID-19 patients.

The study found that "there was no significant difference in age group distribution between the two groups." The COVID-19 group had more female patients compared to the non-COVID-19 group, but "there was no significant difference in gender distribution between the two groups." The COVID-19 group had a lower proportion of patients with comorbidities, fever, and cough compared to the non-COVID-19 group, but these differences were not statistically significant.

The study did find a significant difference in the presence of vomiting symptoms, with no COVID-19 patients reporting vomiting compared to 30% of non-COVID-19 patients. The study also found that "the presence of pneumonia was similar between the COVID-19 and non-COVID-19 groups." There was no significant difference in PS-ASA and the distribution of surgical types between the two groups.

Overall, the study suggests that "there are some differences in symptom presentation between COVID-19 and non-COVID-19 patients undergoing emergency surgery, but these differences are not always statistically significant." The study provides useful information for healthcare providers managing emergency surgery patients during the COVID-19 pandemic.

Postoperative Outcomes of Research Subjects

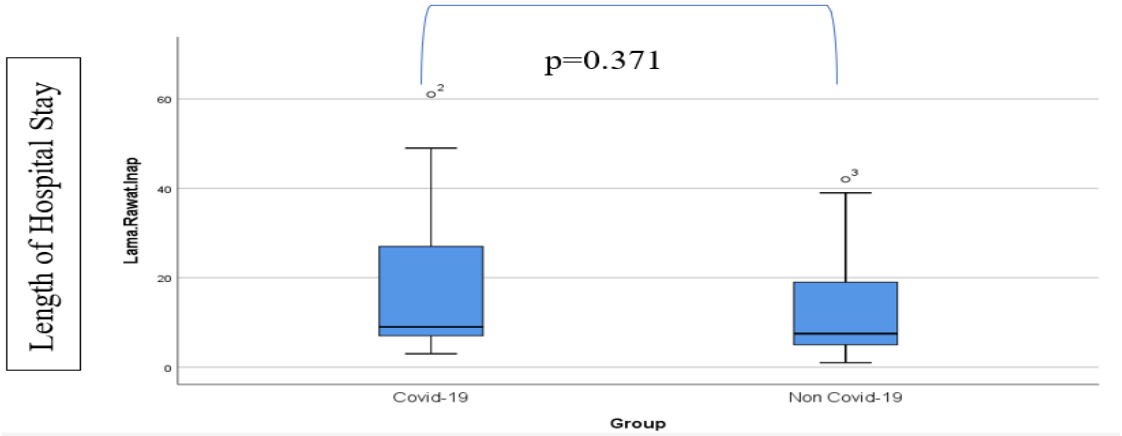

Figure 1: Length of hospital stay

The median length of stay for pediatric patients with COVID-19 was found to be 9 (3-61) days, whereas for non-COVID-19 pediatric patients it was 7.5 (1-42) days. The length of hospitalization for both groups was tested for normality using the Shapiro-Wilk test. The COVID-19 group obtained a Sig. value of 0.003, indicating that the data was not normally distributed. Similarly, the non-COVID-19 group obtained a Sig. value of 0.002, indicating non-normal distribution of data.

Since the data did not follow a normal distribution, a non-parametric statistical method, the Mann-Whitney U test, was performed to compare the hospitalization duration of the two groups. The analysis indicated that "there was no significant difference in the length of hospital stay between the COVID-19 and non-COVID-19 groups, as suggested by the asymp. Sig (2-tailed) value of 0.371."

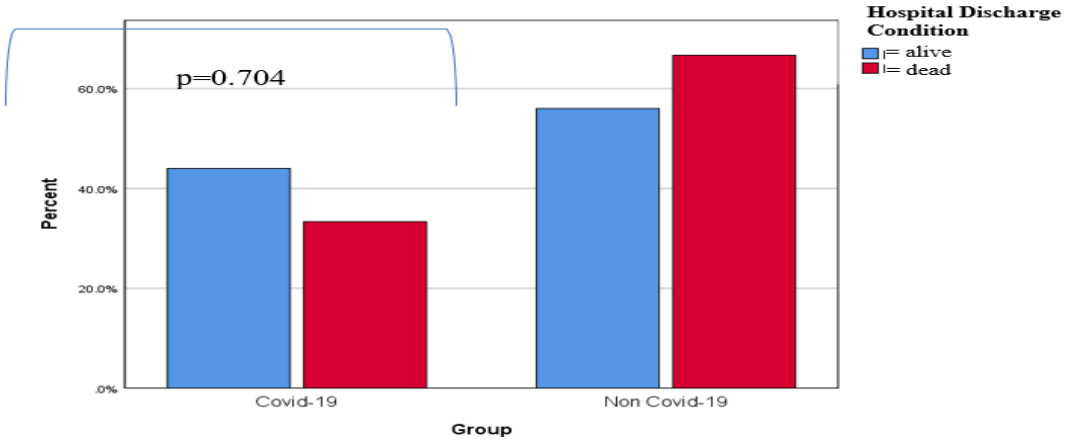

Figure 2: Hospital Discharge condition

Out of the total COVID-19 patients, 3 (21.4%) died, whereas in the non-COVID-19 group, the number was 6 (30%). The hospital discharge condition variables were analyzed using Fisher's exact test, which yielded an exact p-value of 0.704. This indicates that "there is no significant difference between the hospital discharge conditions of patients with COVID-19 and those without COVID-19 who underwent emergency surgery."

Table 2: Types of surgery and hospital discharge conditions in pediatric patients

			Live	Die	Total
COVID-19	Types of Surgery	Digestive Surgery	4 (36,4%)	1 (33%)	5 (35,7%)
		Neurosurgery	3 (27,3%)	1 (33,3%)	4 (28,6%)
		Obstetric Surgery	2 (18,2%)	0 (0%)	2 (14.3%)
		Plastic Surgery	1 (9,1%)	1 (33,3%)	2 (14,3%)
		Orthopaedic Surgery	1 (9,1%)	0 (0%)	1 (7,1%)
	Total		11 (100%)	3 (100%)	14 (100%)
Non COVID-19	Types of Surgery	Digestive Surgery	7 (50%)	2 (33,3%)	9 (45%)
		Neurosurgery	2 (14,3%)	3 (50%)	5 (25%)
		Obstetric Surgery	1 (7,1%)	0 (0%)	1 (5%)
		Plastic Surgery	2 (14,3%)	0 (0%)	2 (10%)
		ENT-KL Surgery	1 (7,1%)	0 (0%)	1 (5%)
		Multidisciplinary Surgery	1 (7,1%)	1 (16,7%)	2 (10%)
	Total		14 (100%)	6 (100%)	20(100%)

Among the COVID-19 patients who underwent digestive, neurosurgery, and plastic surgery, the

mortality rate was 33.3% for each category. On the other hand, among the non-COVID-19 patients who died, the majority (50%) had undergone neurosurgery.

4. Discussion

Characteristics of Research Subjects

This study involved all confirmed and non-COVID-19 pediatric patients who underwent emergency surgical operations at Dr. Soetomo Hospital from March 2020 to November 2021. Patients were screened for COVID-19, and those who tested positive were included in the study. A total of 34 research subjects were included based on the established inclusion and exclusion criteria. The parameters observed were postoperative outcomes, which included length of hospitalization and hospital discharge (life/death) conditions. Data was obtained from the patients' medical records, and statistical analysis was performed.

Although the study was conducted over a relatively long period (from March 2020 to November 2021), only 34 subjects were included in the study due to several reasons. First, pediatric surgical interventions, whether elective or emergency, represent only a small proportion of total surgeries performed. According to a study by Rabbitts & Groenewald (2020) pediatric surgical interventions accounted for only about 4.7% of all surgeries performed. Second, pediatric COVID-19 cases are relatively low worldwide, as the ACE-2 receptor, the location of COVID-19 virus attachment, is less expressed in pediatric nasal epithelium (Bunyavanich et al., 2020; Hoffmann et al., 2020).

The genes that regulate the immune system are located on the X chromosome. Women with two X chromosomes have a higher expression of toll-like receptor-7 (TLR7), which is necessary for resistance to viral infections (Ortolan et al., 2020). Asian women have a higher basal ACE2, which provides more protection against coronavirus infections. The amount of ACE2 is induced by sex hormones (Gemmati et al., 2020). Sex hormones are influenced by the development of internal reproductive structures, so there is no gender difference in the tendency of coronavirus infection in pediatrics who have not entered puberty (Cohen-Bendahan et al., 2005). A literature review found that COVID-19 infection in female and male pediatrics had no significant difference (Han et al., 2021). According to a study on COVID-19 transmission among children, male children are more susceptible to contracting the virus compared to females due to differences in their immune systems. It has been observed that women have a lower vulnerability to viral infections as compared to men (Jin et al., 2020). However, the findings of this study show that most of the female pediatric patients (71.4%) who underwent surgery were infected with COVID-19, while the majority of male patients (65%) non-COVID-19 patients.

Previous research in Indonesia showed that the highest age of pediatric patients with COVID-19 undergoing surgery was over 12 years old (Giwangkancana et al., 2022). The characteristics of this study show that the population of pediatric patients who undergo emergency surgery is mostly in adolescents, specifically those over 12 years old, accounting for 35.7% of COVID-19 patients and 45% of non-COVID-19 patients. The distribution of COVID-19 and non-COVID-19 patients in this study based on age differences did not find significant overall differences based on statistical calculations.

The comorbid data of the subjects in this study did not show any significant differences between pediatric patients with COVID-19 and those without COVID-19. Understanding the comorbidities of these patients is important as it can affect postoperative outcomes.

In this study, it was found that most COVID-19 patients were asymptomatic, with low rates of fever, cough, runny nose, tightness, vomiting, and diarrhea. The definition of pneumonia in this study refers to "patients who display clinical signs and symptoms of lower respiratory tract infections, such as dyspnea, tachypnea, and desaturation, along with abnormal chest X-rays." Patients with abnormal chest X-rays but no symptoms are also included. The severity of the disease was assessed using the National Institutes of Health (NIH) classification system, which classifies the severity of pneumonia into five categories: "asymptomatic, mild (mild symptoms without pneumonia), moderate (pneumonia without desaturation or no symptoms but abnormal chest X-ray), severe (pneumonia with SpO2 <94%), or critically ill (patients requiring mechanical ventilation or vasoactive drugs; acute respiratory distress syndrome; or septic shock) (National Institute of Health, 2022)."

An Indonesian study showed abnormal chest X-ray findings in 29.5% of pediatric COVID-19 patients undergoing surgery, with 12.5% of patients exhibiting congested symptoms (Giwangkancana et al., 2022). However, COVID-19 pneumonia with severe symptoms in pediatric patients was rare, which contributed to the absence of significant differences in pneumonia incidence between the two groups in the study.

The ASA physical status classification system, which is used to assess a patient's physiological status following surgery to predict the risk of the procedure, is also used to determine surgical stratification, insurance reimbursement, and other factors. However, applying this classification system to pediatric patients can be difficult due to the subjective nature of classification and limited description available. According to Ferrari et al. (2021), the use of the ASA physical status classification system in pediatrics is a challenge. In this study, no significant differences in the analysis of PS ASA were found between the two groups, despite more deaths occurring in the subjects due to underlying conditions that required emergency surgery.

Research by Preston et al. (2021) found that deaths due to COVID-19 were higher in male pediatric patients under the age of one year and in adolescents. The findings of this investigation, however, revealed that the COVID-19 group consisted of a higher proportion of female patients.

Postoperative anxiety is a common experience among paediatric patients, with an incidence of 60-65%. According to Kain et al. (2000), several risk factors contribute to anxiety among pediatric patients undergoing surgery. These factors include excessive anxiety levels among parents, experiencing high levels of surgical pain, being in an unfamiliar hospital environment, feeling uncertain about the outcome of the procedure, undergoing repeated surgeries, being separated from parents, feeling anxious around strangers, having previous negative experiences with hospitals and pediatricians, and being over the age of seven (Kain et al., 2000). In this study, the analysis of the type of anesthesia used showed that general anesthesia was the most widely used, and there was no significant difference in the distribution of anesthesia types between the two groups. Two patients, aged 16 and 18 years, underwent cesarean section with subarachnoid block regional anesthesia.

Overall, the analysis of the characteristics of COVID-19 and non-COVID-19 patients was homogeneous, except for vomiting symptoms. This minimizes the occurrence of confusion in the results of this research analysis.

Differences in length of stay

The majority of pediatricians and adolescents with COVID-19 have an asymptomatic or mild illness course. However, a small percentage experience severe symptoms that require hospitalization, usually due to acute COVID-19 or what is commonly referred to as multisystem inflammatory syndrome in children (MIS-C) and post-infection complications resulting from SARS-CoV-2 infection. Fatalities due to COVID-19 among children are infrequent (Whittaker et al., 2022). According to a study conducted by the Center for Disease Control (CDC) in China, which was the first large epidemiological cohort study of pediatrics infected with COVID-19, there was a low incidence of severe and critical illness in pediatrics (5.9%; N = 2135), and only one death was reported (Dong et al., 2020).

Research on pediatrics in surgery showed that the length of hospitalization of patients with COVID-19 was 11.90 ± 13.357 days, while in non-COVID-19 patients, it was 10.83 ± 10.261 days (Giwangkancana et al., 2022). In this study, the average length of hospital stay for COVID-19 patients (9 days with a range of 3 to 61 days) was not significantly different from that of non-COVID-19 patients (7.5 days with a range of 1 to 42 days), indicating that the length of stay was appropriate for both groups. This is because the COVID-19 patients in this study mostly had mild symptoms, in accordance with pediatric COVID-19 symptoms in general.

COVID-19 patients who had an extreme stay of 61 days were neonates with generalized peritonitis, necrotizing grade III enterocolitis, and underwent exploratory laparotomy and terminal ileum exteriorization. These patients' hospital discharge are alive. The COVID-19 patient with a three-day hospitalization was a one-year-old child with a foreign body clip in the hypopharyngeal area, which was extracted through direct laryngoscopy.

Non-COVID-19 patients with a long stay of one day were two-year-old children with communicant hydrocephalus caused by viral meningoencephalitis and Dandy Walker malformations. They underwent ventriculoperitoneal shunt surgery but died one day after being treated. The non-COVID-19 patient treated for 42 days was an 18-year-old with abdominal rupture, third-degree perineal rupture, closed sacrum fracture, left fibula fracture, and left buttock reopen wound due to an accident. This patient underwent surgery for stoma diversion, repair of the perineum, and fixation of the pelvic externa. Unfortunately, he died 42 days after being treated due to sepsis.

Hospital Discharge Condition

A study conducted in Indonesia on pediatric patients who underwent surgery revealed that two (8.3%) COVID-19 patients died after surgery, while twelve (24.5%) non-COVID-19 patients died (Giwangkancana et al., 2022). The analysis of the study results found that hospital discharge conditions in a living state were higher in subjects with COVID-19 (11, 78.6%) than non-COVID-19 patients (14, 70%). Patients who died were more in non-COVID-19 subjects (6, 30%) than COVID-19 subjects (3, 21.4%), but the difference was not significant. This may be due to the fact that most pediatric patients who undergo surgery have mild COVID-19 symptoms, and the incidence of COVID-19 does not significantly affect the length of hospitalization or hospital discharge conditions. A study by Firomsa et al. (2018) suggested that mortality was greatly contributed to by delayed arrival to health facilities, unstable conditions upon arrival, younger age groups, and the nature of underlying pathologies.

During the study period, a total of nine pediatric patients died postoperatively. Of these, three patients with COVID-19 aged eight years, 11 years, and 9 days died. The other COVID-19 patients who died included an eight-year-old with severe burns who died 7 days after treatment due to sepsis, an 11-year-old with noncommunican hydrocephalus caused by pineal tumor who died of respiratory failure after 9 days of treatment, and a one-month-old infant with acute diarrhea, severe dehydration, and kidney failure who died after three days of treatment due to sepsis.

Six non-COVID-19 patients also died, including multitrauma patients aged 18 years who had sepsis and were treated for 42 days (including 5 days of ICU care), a low-weight neonate with congenital gastroschizis who died the day after siloplasty, an 18-year-old with decreased consciousness due to hydrocephalus caused by a brain tumor who died after 6 days of treatment due to sepsis caused by bacterial pneumonia, a pediatric patient with Dandy Walker malformation who developed communican hydrocephalus due to meningoencephalitis and died in less than 24 hours, a two-year-old with moderate

brain injury who underwent craniotomy surgery and died eight days after treatment due to brain stem death, and a neonate with peritonitis caused by gastric perforation who died after 39 days of treatment for sepsis.

Among the COVID-19 patients who died, 33.3% were undergoing digestive surgery, neurosurgery, and plastic surgery, respectively. These deceased patients included those undergoing laparotomy, ventriculoperitoneal shunt surgery, and debridement surgery and wound dressing. In contrast, the non-COVID-19 patients who died most frequently underwent neurosurgery (50% of the total patients who died), including those undergoing external ventricular drain surgery, ventriculoperitoneal shunt surgery, and craniotomy surgery for epidural hematoma evacuation.

5. Conclusion

The study concluded that the length of stay of pediatric patients who undergo emergency surgery is not significantly different between those with COVID-19 and those without COVID-19. Likewise, there is no significant difference in the hospital discharge condition of pediatric patients with COVID-19 and non-COVID-19 who undergo emergency surgery. This suggests that COVID-19 infection does not appear to have a significant impact on the postoperative outcomes of pediatric patients undergoing emergency surgery.

The study suggests that better documentation and record keeping are necessary to ensure that differences between patients with COVID-19 and those without COVID-19 who undergo emergency surgery are accurately captured. This will enable more precise analysis and comparison of postoperative outcomes between these two groups. Additionally, to determine the impact of COVID-19 infection on postoperative outcomes accurately, further research is necessary. This research should focus on minimizing confounding variables, such as similar characteristics and surgeries performed in both COVID-19 and non-COVID-19 groups. By doing so, a more comprehensive understanding of the impact of COVID-19 infection on the postoperative outcomes of pediatric patients undergoing emergency surgery can be achieved.

In sum, the study's findings provide valuable insight into the impact of COVID-19 infection on the postoperative outcomes of pediatric patients undergoing emergency surgery. However, further research with a larger sample size and better documentation is necessary to ensure accurate and comprehensive analysis of these outcomes. By doing so, we can gain a better understanding of the impact of COVID-19 infection on pediatric patients' postoperative outcomes undergoing emergency surgery, which can inform clinical practice and improve patient care.

Conflict of Interest

The researchers involved in this study affirm that there are no conflicts of interest to disclose.

6. Acknowledgement

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Author Contribution

A) Lusianawati -contributed in the study's design, project execution, statistical analysis, and drafting of the manuscript.

B) Arie Utariani -contributed in the study's design, project execution, statistical analysis, proofreading and manuscript correction.

C) Lucky Andriyanto -contributed in designing the study, manuscript drafting, proofreading and manuscript correction.

D) Neneng Dewi Kurniati -contributed in statistical analysis, manuscript drafting, proofreading and manuscript correction.

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