



## The management of childhood drowning in a tertiary hospital in Indonesia: a case report

Dyah Kanya Wati,<sup>1\*</sup> I Gde Doddy Kurnia Indrawan,<sup>2</sup> Nyoman Gina Henny Kristianti,<sup>3</sup> Felicia Anita Wijaya,<sup>3</sup> Desak Made Widiastiti Arga<sup>3</sup>, Arya Krisna Manggala<sup>3</sup>

<sup>1</sup>Department of Child Health, Faculty of Medicine Universitas Udayana/Sanglah General Hospital, Denpasar, Bali, <sup>2</sup>Department of Child Health, Wangaya General Hospital, Denpasar, Bali, <sup>3</sup>Faculty of Medicine Universitas Udayana, Denpasar, Bali, Indonesia

### ABSTRACT

Submitted: 2020-10-09  
Accepted : 2021-01-28

The World Health Organization (WHO) stated that drowning becomes the third leading cause of death from unintentional injury. Furthermore it was reported more than 372,000 cases of death annually among children due to drowning accident. Inappropriate of resuscitation attempt, delay in early management, inappropriate monitoring and evaluation lead to drowning complications risks even death. However, studies concerning the management of childhood drowning in Indonesia is limited. Here, we reported a case of childhood drowning in Sanglah General Hospital in Denpasar, Bali. An 8 years old girl arrived at the hospital with deterioration of consciousness after found drowning in the swimming pool. The management of the case was performed according to the recent literature guidelines. The first attempt was performed by resuscitation, followed by pharmacological interventions using corticosteroids, non-invasive ventilation and series of laboratory examination. With regular follow up, patient showed good recovery and prognosis.

### ABSTRAK

#### Keywords:

acute respiratory distress syndrome;  
drowning;  
management;  
non-invasive ventilation;  
resuscitation;

Badan Kesehatan Dunia (WHO) menyatakan bahwa tenggelam merupakan penyebab kematian ketiga terbanyak akibat trauma yang tidak disengaja. Selanjutnya, dilaporkan juga bahwa lebih dari 372.000 ribu kematian pada anak akibat tenggelam dilaporkan setiap tahun. Upaya resusitasi yang kurang tepat, penata laksanaan dini yang terlambat, pemantauan dan evaluasi yang kurang tepat menyebabkan meningkatnya risiko komplikasi bahkan kematian. Namun, penelitian tentang penata laksanaan kejadian tenggelam pada anak di Indonesia masih terbatas. Pada laporan kasus ini dipaparkan sebuah kasus tenggelam pada anak di Rumah Sakit Umum Pusat Sanglah, Denpasar, Bali. Seorang anak berumur delapan tahun dibawa ke rumah sakit dengan penurunan kesadaran setelah ditemukan tenggelam di sebuah kolam renang. Tata laksana kasus tenggelam ini dilakukan berdasarkan pedoman literatur terbaru. Upaya pertama dilakukan dengan resusitasi, diikuti dengan intervensi farmakologi dengan kortikosteroid, ventilasi non-invasif dan beberapa pemeriksaan laboratorium. Dengan pemeriksaan tindak lanjut secara teratur, pasien menunjukkan pemulihan dan prognosis yang baik.

### INTRODUCTION

The case of drowning still becomes a neglected public health problem.<sup>1</sup> Globally, the World Health Organization

(WHO) reported that more than 372.000 people are died because of drowning every year.<sup>2</sup> In 2015, the third major cause of death from accidental injury was drowning.<sup>3</sup> It contributes to about

\*corresponding author: dyahpediatric@yahoo.com

7% of all injuries.<sup>3</sup> The Global Report on Drowning in 2014 showed that more than 140.000 cases of death occurred in children less than 15 years old, and frequently reported at ages between 1 to 4 years old.<sup>4</sup>

The current and general protocol for the management of drowning was focused on the initial resuscitation at the accident location, followed by the strategies in the emergency department, such as performing the re-resuscitation, diagnostic evaluation, and prevent the complication.<sup>5-7</sup> The treatment which could be different from the general protocol is the utilization of breathing support or mechanical ventilation such as non-invasive ventilation (NIV), as well as pharmacologic therapy, including antibiotics, corticosteroid, beta-agonist, and furosemide for several indications; such describe in this patient. Therefore, here we reported a case of drowning and the management in the tertiary hospital setting.

**CASE PRESENTATION**

An eight-year-old girl was admitted to the pediatric emergency room (ER) of Sanglah General Hospital, a tertiary hospital in Denpasar, Bali, on April 9 2019 at 09.00 p.m. Four hours before admission, she was found drowning in a swimming pool in a private villa after

slipping from a slide. The duration of the drowning was unknown since she was found not breathing. She had been rescued by her family by being given a mouth breathing for about 10 min. After that, she was taken to the nearest clinic for intubation because of severe shortness of breath with 80% oxygen saturation and deterioration of consciousness. But those procedures were failed. Thus, she only received an oropharyngeal airway insertion, an oxygen face mask and was given 6 mg midazolam due to previous unsuccessful intubation before being referred to the hospital.

Her admission status indicated that she was in deterioration of consciousness due to the effect of midazolam, with a Glasgow coma scale (GCS) score of 8: 2 (eye response), 2 (verbal response), and 4 (motor response). The blood pressure was 100/60 mmHg. The pulse rate was at 136 time per min, regular; the respiratory rate was 52 times per min, regular; body temperature was 36.8°C, and oxygen saturation was 88% in room air. The serial vital signs are presented in TABLE 1. The first attempt of resuscitation in ER included suction to safe airway management, oxygenated with 10 lpm using a face mask, and intravenous line insertion. After re-evaluating the primary survey, a physical examination was conducted.

TABLE 1. The serial vital sign of the patient

Parameters	Day 1	Day 2	Day 3	Day 5	Day 8	Day 10
Glasgow Coma Scale (E: eye, V:verbal, M:motor)	E2V2M4 (due to midazolam)	E4V5M6	E4V5M6	E4V5M6	E4V5M6	E4V5M6
Blood pressure(mmHg)	100/60	100/60	100/60	100/60	100/60	100/70
Heart rate (time per min)	136	112	110	90	90	88
Respiratory rate (times per min)	52	50	52	28	28	22
Oxygen saturation (%)	88	98	98	98	99	99
Axial temperature (°C)	36.8	36.5	36.8	36.7	36.7	36.6

We found hematoma in her right head of the frontal region with a diameter of 4 cm. We also observed isochoric-positive pupils reflect, nostril breathing, retraction of subcostal-intercostal, and rales in both sides of lungs in auscultation. Other physical parts were found in a normal range. The body weight was 35 kg. The body height was 128 cm. The weight per age score based on the Centers for Disease Control and Prevention (CDC) curve was between 90<sup>th</sup>- 95<sup>th</sup> percentile, while height per age was in 50<sup>th</sup> percentile. The weight per height was in between 90<sup>th</sup>- 95<sup>th</sup> percentile. Her nutritional status was obese.

Laboratory examination showed

an increase in leukocyte ( $16.41 \times 10^3/\mu\text{L}$ ), neutrophils (76.06%), and random blood glucose (114 mg/dL). It also showed a decrease in lymphocyte (17.52%) and calcium (9.1 mg/dL). The blood gas analysis revealed respiratory acidosis and metabolic acidosis. Furthermore, based on  $\text{PaO}_2/\text{FiO}_2$  (PF) ratio, which was 208.8, the patient also had acute respiratory distress syndrome (ARDS) (TABLE 2). Chest X-ray examination showed the pulmonary edema pictured by haziness perihilar in both sides of lungs, bat wings appearance, and increased broncho-vascular pattern (FIGURE 1. A). The patient was diagnosed as drowning, pneumonia aspiration, pulmonary edema, and ARDS.

TABLE 2. Blood gas analysis examination results of the patient

Blood gas analysis	Day 1	Day 2	Day 3	Day 5	Reference range
pH	7.26	7.37	7.39	7.43	7.35 – 7.45
$\text{PaCO}_2$ (mmHg)	47.3	39.3	45.8	47.7	35.0 – 45.0
$\text{PaO}_2$ (mmHg)	125.3	155.10	110.80	100.0	80.0 – 100.0
BE (mmol/L)	-6.4	-3.0	1.9	6.4	-2 – 2
$\text{HCO}_3$ (mmol/L)	20.7	22.20	26.9	30.70	22.0 – 26.0
$\text{SaO}_2$ (%)	98	98.9	98	97.6	95 – 100
PF Ratio	208.8	-	275	285	-
SF Ratio	163.3	-	-	-	-

Abbreviation: $\text{PaCO}_2$ : partial pressure of carbon dioxide;  $\text{PaO}_2$ : partial pressure of oxygen; BE: base excess;  $\text{HCO}_3$ : bicarbonate;  $\text{SaO}_2$ : arterial oxygen saturation; PF: ratio; $\text{PaO}_2/\text{FiO}_2$ :(fraction of inspired oxygen); SF: ratio;  $\text{SpO}_2/\text{FiO}_2$ : (oxygen saturation/fraction of inspired oxygen).

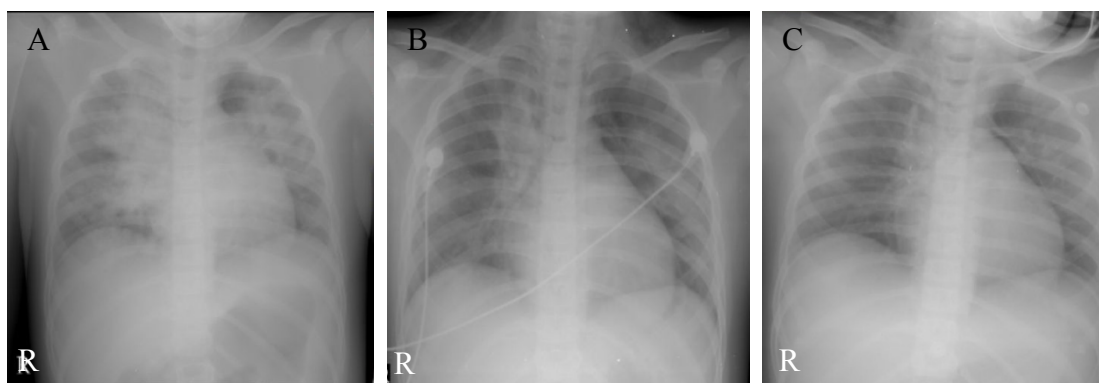


FIGURE 1. Chest radiographic examination. (A) Chest X-Ray revealed haziness perihilar in both sides of lungs, bat wings appearance, and increasing broncho-vascular pattern, which emphasized that the patient had pulmonary edema on the first day of admission. (B) On the third day, the examination showed there was striated-lucent density in right and left mediastinum and pericardium within the heart part. Meanwhile, there was reduced density of consolidation in right and left parahilar, and seen pleural visceral line with avascular area in left hemithorax, consistent of pneumomediastinum and pneumopericardium, reduced intensity of bilateral pulmonal aspiration compared to the previous examination, left pneumothorax, and subcutaneous emphysema region supraclavicular in both right and left. (C) On the fifth day, the heart was seen normal, and in the lungs found perivascular haziness in both sides, increased broncho-vascular pattern concluded that compared to examination of the third day, there was reduction intensity of pulmonary edema and left pneumomediastinum.

After she had been stabilized, she was transferred to the pediatric intensive care unit (PICU) to receive NIV support due to the ARDS. She was also administered within intravenous furosemide 12 mg every 12 h, intravenous dexamethasone 12 mg followed by 4 mg every 8 h, and first-line antibiotics of PICU (cefoperazone sulbactam 50 mg/body weight/times every 8 h and amikacin 25 mg/body weight/times followed by 18 mg/body weight/times every 24 h). In the disease progression of the fifth day, although the shortness of breath was

decreased and retraction was not found, there was wheezing within both sides of the lungs. The patient was changed from NIV support to spontaneous-continuous positive airway pressure support (SPN-CPAP) and received nebulization of beta 2 agonist agent due to the wheezing. She was discharged from the hospital on the tenth day when there was no shortness of breath and she could breathe normally without oxygen support. The scheme of the management is provided in FIGURE 2.

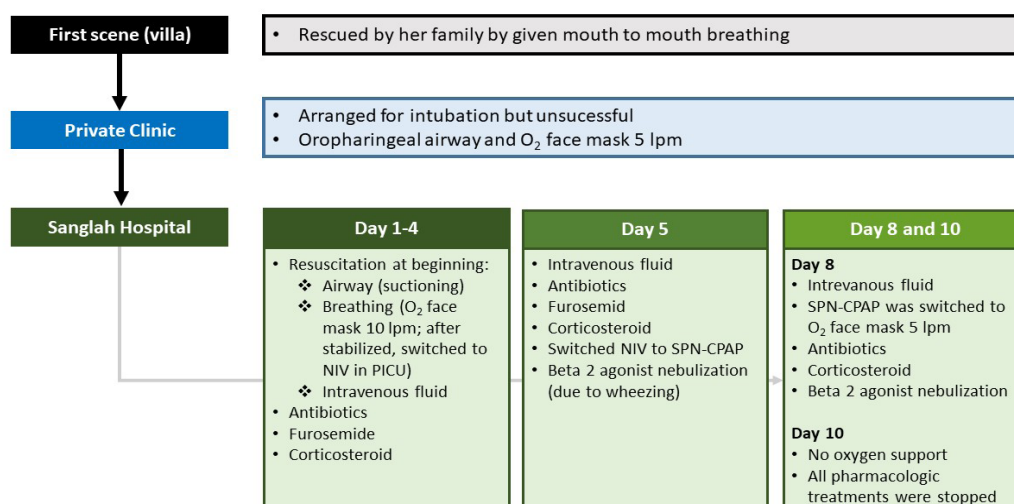


FIGURE 2. Flowchart describing the step-by-step management from early intervention in the scene (swimming pool in the villa) until hospital managements. **Abbreviation:** O<sub>2</sub>:oxygen; lpm: liter per minute; NIV: non-invasive ventilation; PICU: pediatric intensive care unit; SPN-CPAP: spontaneous-continuous positive airway pressure support.

## DISCUSSION

In drowning management, one of the attempts to initiate the resuscitation is by mouth-to-mouth resuscitation breathing.<sup>5</sup> This procedure aims to restore the adequacy of oxygen.<sup>5</sup> In this case, the patient was received mouth breathing from her family. However, because of a slight improvement, she was taken to the nearest clinic. At the ER of a tertiary hospital, the patient was resuscitated based on the protocol. After stabilized, she has received the NIV support. In a review conducted by Fedor,<sup>8</sup> the NIV can improve the functional residual capacity, decrease the breathing effort, increase CO<sub>2</sub> elimination, and show the benefit in ARDS<sup>8</sup> consistent with the previous study, another study conducted by Çağlar and his colleagues<sup>9</sup> regarding three nonfatal drowning cases with pulmonary edema. This study showed the utilization of NIV could improve the parameters of tachycardia, tachypnea, oxygen saturation, radiological findings, and neurologic status in those 3 cases.

Although the routine and/or

prophylactic use of antibiotics is not recommended in drowning patients,<sup>5,10</sup> some indications of antibiotic treatment could be considered, including fever or progression of fever, pulmonary infiltrates on X-ray, bacterial culture, or the sign of hemodynamic instability.<sup>10</sup> The patient in this case was received empirical PICU antibiotics considering the patient had severe aspiration. Beta-agonist inhalation and furosemide could be administered as a bronchodilator to prevent pulmonary edema.<sup>11</sup> In this case, the furosemide was given to reduce the pulmonary edema and the nebulization of beta-2-agonist was given to the sign of bronchospasm. In addition, she received a corticosteroid. Despite having a lack of recommendations regarding the immediate and routine use of corticosteroids for drowning-related lung injury,<sup>6,7,11</sup> Meyer *et al.*<sup>7</sup> in the review stated that the administration of a high corticosteroid dose can be considered for unimprovement or prolonged ARDS.<sup>7</sup> A Wilderness Medical Society Practice Guidelines conducted by Schmidt *et al.*<sup>12</sup> stated that corticosteroids were used

to improve pulmonary function, such as optimizing surfactant production in drowning patients.<sup>12</sup> However, there is a lack of study regarding their recent role either in a randomized trial study or other study design.<sup>12,13</sup>

The prognosis of drowning among children is varied. In a review by Suominen *et al.*<sup>14</sup> the survival rate and outcomes depend on the duration of drowning, involvement of brain hypoxia, the attempt of adequate initial cardiopulmonary resuscitation (CPR), immediate referral to ER, and sufficient management as well as monitoring at hospital care.<sup>14</sup> The Guideline in Queensland,<sup>15</sup> based on the study in Washington conducted by Hess and Campwala,<sup>16</sup> revealed that the duration of drowning less than 5 minutes gave a 91% possibility to have mild or no neurological impairment. If the duration of drowning is more than 25 min, it worsens the prognosis and contributes to severe neurologic impairment or death with 100% probability.<sup>15,16</sup> It also showed if resuscitation is initiated  $\leq 10$  min, there is an 87% probability to have mild or no neurological impairment. The risk of death could be seen if the rescue is started more than 25 min after drowning.<sup>15,16</sup> Furthermore, Kieboom *et al.*<sup>17</sup> highlighted that resuscitation for more than 30 min could worsen the outcome. Although the duration of drowning in the case in the present study was unclear, and the prompt treatment in the tertiary hospital had been given for nearly four hours, the prognosis could be worse. However, the first attempt of the initial resuscitation was given for less than 10 min, and the usage of either NIV or corticosteroid could be beneficial for reducing ARDS.

The collaborative efforts conducted by the community, government, and family, as suggested by the WHO and other guidelines, are needed to tackle and prevent drowning, particularly in children.<sup>2,11,18,19</sup>

## CONCLUSION

Immediate and prompt treatments in managing the drowning cases in children are essential. Our case showing the duration of drowning, the first attempt for resuscitation, pharmacologic agent for underlying conditions, such as corticosteroid, using of ventilation such as NIV, series laboratory examination, and regular follow up might give the good recovery and prognosis for the patient.

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