Original Research Article

Clinical Profile and Outcome of Acute Respiratory Failure in Children: A Prospective Study in a Tertiary Care Hospital, Nellore, Andhra Pradesh

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Abstract

Background: It was to study the clinical history of acute respiratory failure in children aged between 1 month and 16 years, and to determine the outcome of respiratory failure with respect to the underlying etiology and possible causes.**Methods:** A prospective, hospital-analysis was conducted on 128 children aged between one month and 16 years. The study time was 24 months. In each patient with respiratory arrest or respiratory failure with SpO2 < 90 per cent, an acute respiratory failure was recorded. In all cases with signs of respiratory distress/altered breathing rhythm, the arterial blood gas (ABG) was administered, and if the cases study involved $PaCO_2$ > 60 mm and/or Hg PaO_2 < 50 mm Hg. **Results:** In the 1 month to 1 year age range a median of 78 (60.93 percent) patients were observed, and the majority were males. Pulmonary disorders accounted for most of the 77 (60.15%) cases led by the 31 (24.21%) nervous system, sepsis 11 (10.16%), and coronary system disorders 7 (5.47%). Based on an ABG study, respiratory failure was divided into three groups, of which 95 (75.00 percent) were the most frequent hypoxic respiratory failure (type 1). The most frequent source of respiratory failure and mortality was bronchopneumonia 52 (40.62 percent). Around one-third of 39 patients (30.47%) needed ventilation support; total mortality rates were 9.37%. In the highest number of undernourished children, there was grade four malnourishment and rates of mortality increased with malnourishment.**Conclusion:** Hypoxic type was the most common type of respiratory failure, and bronchial pneumonia was the most common cause of mortality.

Keywords: Respiratory failure; bronchial pneumonia; Ventilator support

Introduction

Acute respiratory failure may be characterised as an obstruction of the respiratory system's operation, seriously impairing the supply of sufficient oxygen or extracting carbon dioxide from the lung's capillary pad, or both. It has multiple etiological mechanisms, and has a high risk of death in the paediatric age group [1].The diagnosis of respiratory failure is based mainly on an arterial blood gas (ABG) study. The doctor who has a high level of skepticism and who is aware of the health conditions where the risk of respiratory failure is likely to occur will make an early diagnosis. If sound clinical judgment and detailed understanding of the natural history of the condition can be paired with a clear evaluation of the base state of oxygenation, breathing, and acid, it can be extraordinarily beneficial to treat multiple patients [2]. The diagnosis can be confirmed by a diligent background review, full physical inspection, and laboratory test evaluation. Serial tests of the sensory symptoms, respiratory symptoms, ABG, and reaction to medication offer useful answers to the require for interference [3]. Medical symptoms of respiratory arrest include tachypnea, impaired breathing rate, retraction of the chest wall, flaring alae nasal, and reduced sounds of air, grunting, and cyanosis. Apart from heart symptoms such as tachycardia, stroke, or bradycardia, there can also be hypotension and cardiac arrest. The diagnosis is confirmed by ABG [4].

In modern hospitals, the identification of respiratory failure as a life-threatening problem led to the introduction of the definition of the Intensive Care Unit (ICU). ICU personnel and facilities assist critical roles in supplying patients with the highest chance of recovery [5]. Enhanced capabilities ICU facilities evolved as physicians and scientists learned more and more about the cause of respiratory failure and how to use their new mechanical life-support devices to handle it. In recent years, the rapid growth of pediatric ICU (PICU) has prompted a growing need to consider the types of patients being cared for in such units, their diagnosis, and the resources they need. In a developed world such as India, very few facilities are in a position to send critically ill babies intensive care. The latest study has been undertaken to determine the causes, clinical symptoms, and outcomes of children with acute respiratory failure.

Materials and methods

The prospective study, admitted to the Department of Pediatrics at Narayana Medical College, Nellore, Andhra Pradesh, India with acute respiratory failure, was performed over 24 months on children aged 1 month to 16. Both patients admitted to the pediatric emergency were diagnosed with respiratory arrest and/or trouble breathing or within 4-6 h of admission.Any patient with cardiac arrest or cardiac collapse with SpO_2 (Peripheral capillary oxygen saturation) < 90% has acute respiratory failure criteria [6]. Both patients had the ABG done. The concept of acute respiratory failure changes in breathing rate, breathing activity, and respiratory function. It also involved the development of head bobbing, grunting, stridor, excessive exhalation, subcostal, and intercostal contraction, and reduced chest expansion due to insufficient action or airway obstruction. Heart symptoms such as slow and still sweating, capillary refill times > 3s, wet, mottled, dark or cyanotic peripherals, weak mucous membranes or nail beds, tachycardia, hypertension, and neurological indications such as restlessness, irritability, fatigue, nausea, somnolence, and seizures are often suggested for respiratory failure. Arterial blood gas (ABG) has been given in all patients with respiratory distress/altered breathing pattern symptoms and included

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in the study if $PaCO_2$ > 60 mm Hg and/or (partial carbon dioxide pressure) PaO_2 < 50 mm Hg [7]Both patients were originally treated in a pediatric emergency, and then transferred to PICU. Moving to hospital from healthy care. Both patients with respiratory failure signs were attached to a pulse oximeter and were included in the sample if < 90 percent of SpO2 was in room air. Survival / death outcomes were assessed and related to gender, age, nutritional status, length of the Ambu bag/mechanical ventilation, complications of mechanical ventilation and the primary mechanism involved. The nutritional status was evaluated by IAP PEM groups. Two proportions of patients were compared with Z-test, and P-value was collected to determine the importance.

Results

Of the 128 causes of respiratory failure, a maximum of 78 (60.93%) cases were observed in the 1 month to 1 year age group followed by 27 (21.09%) in the 1 to 5 year age group, 14 (10.93%) in the 5 to 10 year age group and the remaining 09 (7.03%) in the > 10 year age group. At presentation, the median age was 35.98 months. There were 97 (75.78 percent) males and 31 (24.21 percent) females, with a ratio of 3.12:1 for males: females. The most common clinical feature was fever in 87 (67.96 percent) cases followed by 83 (64.84 percent) irritability and 53 (41.40 percent) cough. Tachypnea and nasal flaring were among the most frequent symptoms of respiratory failure observed in 98 (76.56 percent) cases. Chest retraction was a phenomenon in 92 (71.87 percent) patients, and 89 (69.53 percent) patients had headed bobbing. Both patients have a light skin color. In 32.81 percent (42) cases, cyanosis was observed. Even the capillary filling time was measured and in 91 (71.10 percent) patients it was > 3 s.Bronchopneumonia in 52 cases (40.62 percent), sepsis 11 (10.16 percent) (Table 1) was the most serious respiratory failure in our study. (Table1).

Table 1:Diagnosis relationship to the type of respiratory failure

The primary system involved/underlying disease	Number of cases
Respiratory system	
Bronchopneumonia	52
Asthma	06
Aspiration pneumonia	03
Aspiration of foreign body	01
Acute pancreatitis with lobar pneumonia	02
Bronchiolitis	04
Laryngotracheobronchitis	03
Pneumothorax	01
Pleural effusion	02
SLE with lupus lung	02
Thalassemia major with lobar pneumonia	01
Cardiovascular system	
FTT with anemia with CCF	01
Myocarditis with pulmonary edema	03
VSD with pulmonary edema	03
Central nervous system	
Acute diarrhoeal disease with Severe dehydration with meningitis	01
Cerebral malaria	03
DKA with cerebral edema	05
Encephalitis	04
Guillain-barre syndrome	01
Head injury	02
Meningitis	03
Status epilepticus	07
Viral hepatitis with encephalopathy	05
Others	
Sepsis	13
Total Number of cases	128

The most common type 96 (75.00 percent) was a hypoxic respiratory failure (type 1), followed by hypercapnic (type 2) respiratory failure in 24 (18.75 percent). There were 08 (6.25%) cases of varied respiratory failure (type three respiratory failure/above 2 combinations) (Figure 1).

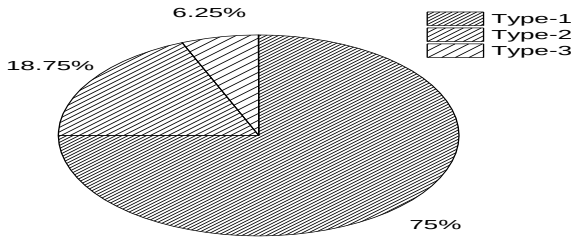

Fig 1: Chart of the distribution of type of respiratory failure.

Summarized table 2 for the findings of acute respiratory failure. Of the overall 128 patients, only 94 (73.43 percent) survived in the age range < 1 year and > 10 years with a survival rate of 76.92 percent and 55.55 percent, respectively.

Table2: The outcome of Acute Respiratory Failure

Feature	Outcome*					*P*-value
	No. of cases	Survived	%	Died	%	
Age						
1 month - 1 year	78	60	76.92	05	6.41	0.10
1 year - 5 years	27	18	66.66	01	3.70	
5 years - 10 years	14	11	78.57	03	21.43	
> 10 years	09	05	55.55	02	22.22	
Nutritional status						
Normal	82	78	95.12	01	1.21	0.05
Grade I PEM	05	04	80.00	01	20.00	
Grade II PEM	06	03	50.00	01	16.66	
Grade III PEM	11	04	36.36	04	36.36	
Grade IV PEM	24	06	25.00	09	37.50	
Type of respiratory failure						
Type 1	96	74	77.08	13	13.54	0.10
Type 2	24	18	75.00	01	3.57	
Type 3	08	05	62.50	01	12.50	
Duration of ventilation						
No ventilation	89	78	87.64	03	3.37	0.05
1 - 24 h	08	01	12.50	05	62.50	
24 - 72 h	14	08	57.14	02	14.28	
> 72 h	17	12	70.58	02	11.76	
Inotropes						
Yes	35	16	45.71	08	22.85	0.01
No	93	78	83.87	05	5.37	

The highest number of undernourished infants had IV-grade malnutrition, and of these 37.50 percent had died, only 25.00 percent had been released, and 37.50 percent had been returned to psychiatric therapy. Ambu was on IPPV with patients who departed seeking medical advice. Type 1 respiratory failure has a higher death rate of 13.54 percent compared with people with type 2 or type 3 respiratory failure. Of the estimated 128 patients, only 39 (30.46 percent) received ventilating help with 43.59 percent survival. Of those 17 (43.59 percent) patients with 70.58 percent survival got > 72 h ventilation assistance, which was greater than those with less ventilation. This relation was important for P-value < 0.05. 46 patients were malnourished out of the number of 128 patients. Of the estimated number of undernourished infants, i.e. 24 (52.17 percent) cases had IV-grade malnutrition and elevated malnutrition mortality rates (P < 0.05).

Discussion

Respiratory failure is defined as the inability to fulfil one's requirement for tissue oxygenation and removal of carbon dioxide, often but not generally synonymous with pain. Respiratory failure happens when gas exchange concentrations between the atmosphere and blood cannot satisfy the body's physiological demands [8]. It is diagnosed when the patient is unable to supply the blood with enough oxygen and experiences hypoxemia, or when the patient is unable to ventilate sufficiently and hypercarbia develop. Acute respiratory failure is a significant cause of morbidity and death, especially in adolescent and adult populations [9]. Latest findings of ARDS (acute respiratory distress syndrome) in children show a mortality rate of 60-75 per cent [10-12]. Multiple-organ system sepsis and disease contribute greatly to the high mortality and morbidity found in both adults and children with ARDS. In our sample, the overall number of patients in the age group was between 1 month and 1 year. In our survey the cumulative number of age group patients ranged from 1 month to 1 year. This is consistent with Karande *et al* [13] study, of which the majority of cases (52 percent) were in this age group. Another Newth study [14] has showed that in nearly two-thirds of cases, respiratory failure happened within the 1st year of life. This high prevalence of child respiratory failure may be attributed to systemic immaturity in the chest wall, pulmonary muscles and airways. This can also be clarified by understanding anatomical compartments in pediatric patients and their differences

in development which affect the vulnerability to acute respiratory failure. In our sample males were more frequently affected than females 3.4 times.Analysis by Fresca *et al* showed identical findings, who reported a ratio of 1.27:1 male : female, i.e. male predominance [15]. Our research, however, has shown a high ratio, which may be attributed to gender differences, i.e. more male patients admitted to hospital. In 74.78 percent of cases, hypoxic respiratory failure (type 1) was characterised by PaO_2 < 50 mm Hg which was the most commonly observed condition. Similar studies by Fresca et al in 128 non-neonate paediatric patients found that 94.50 percent of total cases were the most prevalent cause of hypoxic respiratory failure (Type 1) [16]. The most typical clinical symptoms of fever and irritability accompanied by cough and cyanosis were In 52 percent of cases, Karande *et al* found cyanosis, and 64 percent irritability [13].Related Singhi study also concluded that fever; coughing and cyanosis often find symptoms of respiratory failure [17]. Tachypnea, nasal flares, bobbing of the head and chest retractions were typical symptoms of respiratory distress, most often seen in patients with tachypnea and nasal flaring. Karande et al had made similar findings in one study [13]. Acute bronchopneumonia was the most common cause of the respiratory failure. Mortality rates were 14.14 percent. This is not in line with the separate results published by Ferring *et al* [18] and Hussain *et al* [19] in patients with respiratory failure who registered high mortality rates of 28% and 52%, respectively. The low mortality in this study was likely due to factors such as early childhood diagnosis and thus early treatment, less diarrhoea cases, and timely ventilation compared to other studies. Survived 58.62 percent of patients in need of ventilator assistance. In the other hand, 97.14 per cent prevailed in the patients who did not need ventilatory assistance. The relation between ventilator support and the effect was statistically important. There was slightly higher mortality associated with coexisting starvation (P-value < 0.05).This is consistent with previous studies demonstrating that the reaction to therapy and outcome is affected by underlying malnourishment, i.e. with growing malnourishment; there is a decreased reaction to therapy and poor outcome [20]. In summary, acute respiratory failure was independent of the child's age, and its outcome. The poor outcome has been associated with malnutrition and type 1 failure.

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