Epidemiological Study of Pediatric Respiratory Distress and Its Management in Pediatric Emergency Department

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Abstract :

Introduction : Respiratory distress is one of the most common chief complaints for which children seek medical care. Respiratory compromise in children, particularly neonates and infants, must be promptly recognized and aggressively treated because children may become fatigued and/or decompensate quickly. Respiratory arrest is the most common cause of cardiac arrest in children. Factors that exacerbate rapid respiratory compromise in children as compared to adults include smaller airway, increased metabolic demand, decreased respiratory reserve, and inadequate compensatory mechanism. **Methodology :** A prospective study was done on children < 12 years of age presenting with respiratory distress to the pediatric emergency department from April to May 2013 in one of tertiary care hospitals of Ahmedabad. **Results :** A total of 51 (100%) children were included in the study of which 29 (56.8%) were males and 22 (43.2%) were females. 47% of them belonged to the age group of 1 month - 1 year. The commonest cause for presentation was wheeze associated lower respiratory tract infection (WALRI -64.7% including pneumonia) and early onset septicemia 5(9.8%). Most common site of pneumonia was right midzone. Of the total study population, 9 (17.6%) children expired and the major cause of mortality was early onset septicemia seen in 3 (33.3%) children. A total of 10 (19.6%) cases were referred from other hospitals. Average duration of stay was 5 days. **Conclusion :** Overall, in children, WALRI is the commonest manifestation of respiratory distress in ED and has a good prognosis. In emergency department, universal rule of airway, breathing and circulation should be ensured. Empirical treatment with antibiotics should be given based on clinical findings and further decision should be based on culture and sensitivity data. Intubated children should be shifted to nasal continuous positive airway pressure on extubation, then to high flow nasal oxygen. Complete intensive care therapy with ventilator support is compulsory in children not responding to oxygen therapy.

Key Words : Pediatric respiratory distress, pneumonia, pediatric emergency department

Introduction :

Respiratory symptoms comprise 27.5% of pediatric emergency department visits.[1] Respiratory distress may be due either to pulmonary or cardiac disease, generalized sepsis, abdominal pathology, or metabolic derangements. Neonates are obligate nose breathers. So, nasal congestion or choanal stenosis or atresia, can cause respiratory distress. [2] Respiratory distress produces detectable alterations in the pattern of breathing. [3] Respiratory distress is a well-recognized cause of respiratory failure in children and is associated with a high mortality rate. [4] Respiratory distress with dyspnea, agitation, diaphoresis and cyanosis should prompt immediate evaluation and therapy. With this background current study was planned to know the clinical profile of pediatric age group admitted with respiratory distress in emergency department.

Materials and methods :

Study type: This was a descriptive, prospective hospital based study. All the data were recorded in Microsoft Excel sheet and analyzed by Epi-info software Version 7.

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Inclusion criteria :

After taking approval from hospital Ethics committee, all patients under 12 years of age with respiratory distress who were admitted to our hospital's pediatric emergency department between April to May 2013 were included in the study. Consent was taken from the parents or legal guardian of the children. All demographic data and investigation findings were noted.

Exclusion criteria :

Patients not fulfilling inclusion criteria and cases with incomplete data were excluded from the study. In our study, anemia was graded as per WHO classification as follows depending on Hemoglobin percentage [5]:

Table 1: WHO classification of anaemia (grams %)

Grade	6 to 59 months of age	5 to 14 years of age
Normal	>11.0 gram%	>11.5 gram%
I (Mild)	10.0-10.9 gram%	11.0-11.4 gram%
II (Moderate)	7.0-9.9 gram%	8.0-10.9 gram%
III (Severe)	<7.0 gram%	<8.0 gram%

Protein Energy Malnutrition was graded as per classification given by Indian Association of Pediatrics on the basis of Weight for age of the median % [6].

Table 2 : IAP classification 1972

Normal	>80 %
Grade I (Mild)	71-80 %
Grade II (Moderate)	61-70 %
Grade III (Severe)	51-60 %
Grade IV (Very Severe)	<50%

Emergency management of a patient with respiratory distress focused on securing airway if required, maintaining adequate oxygenation and blood pressure by obtaining intravenous access.

In neonates, shoulder pad was given to extend the airway and oxygen was given under hood or through nasal prongs. If the PaO_2 could not be maintained above 50 mm Hg at inspired oxygen concentrations of 60% or more, bubble continuous positive airway pressure at a pressure of 5–10 cm H_2O by nasal prongs was given. If still not maintained, the infant was intubated. In children less than 3 years old with fever and signs and symptoms of infection with maternal transmission as likely cause, early onset septicemia. Neonates with no breathing or Apgar score <3 at 1 minute after birth were classified as neonates with severe birth asphyxia. Intratracheal surfactant was administered in hyaline membrane disease and then extubated to continuous positive airway pressure. Infants and other children who were experiencing respiratory distress were hospitalized and the mainstay of treatment was supportive. The children were kept at 30º head up position and given warm humidified oxygen. In children with wheeze, β_2 agonist (salbutamol) and anticholinergics (ipratropium) were given through nebulization. In a previously healthy infant presenting with a first-time wheezing episode, wheeze associated lower respiratory infection was suspected. [3]

In all the children, frequent suctioning of nasal and oral secretions was done to relieve distress or cyanosis. They were fed through a nasogastric tube. Sedatives were avoided to prevent respiratory depression. Parenteral fluids, 10% dextrose and saline, were given as per need at the rate of 65-75 ml/kg/hour through intravenous line. Inotrope Dopamine was given at the rate of 10 µgrams/kg/minute and increased up to 25 µgram/kg/minute through umbilical catheter in neonates and central venous catheter in older children, or peripheral intravenous line if required. Early supportive care of low birth weight infants, especially in the treatment of acidosis, hypoxia, hypotension and hypothermia were used to lessen the severity of respiratory distress. Patients were diagnosed on the basis of clinical examination and appropriate investigations.

Results :

Of the 51 children under 12 years of age, 29(56.8%) were males and 22(43.2%) were females. Various diagnoses as per age group were as given in Table 3.

Table 3 : Age distribution, diagnosis and hospital stay (n=51)

Age	No. (%)	Diagnosis (in days)=5	Average length of stay
Neonates:			
<1 day	8 (15.7%)	Early onset septicemia, hyaline membrane disease, meconium aspiration syndrome	4
1 day < age < 1 week	1 (1.9%)	Early onset septicemia	1
1 week < age < 1 month	2 (3.8%)	Spinal muscular atrophy	7
Infants:			
1 month < age < 1 year	24 (47.2%)	Post measles pneumonia, septicemia,WALRI	5
Older Children:			
1 year < age < 5 year	13 (25.5%)	WALRI, empyema, acyanotic congenital heart disease (Ventricular Septal Defect) with pneumonia, drowning.	5
5 years < age < 12 years	3 (5.9%)	Pneumonia, pleural effusion, acute exacerbation of asthma.	8

In children less than 1 month old, early onset septicemia was the commonest cause seen in 3 (5.9%) patients of the total population. In children from 1 month - 1 year age group and in children in 1 - 5 years age group, wheeze associated lower respiratory tract infection (WALRI) was the commonest. In children in 5 - 12 year age group pneumonia, pleural effusion and asthma were found in 1 case each.

6(11.8%) children of age between 1 month and 12 years were unvaccinated. Anemia was an associated finding in 34 (66.7%) of the children with 25 (73.5%) presenting with Grade I anaemia, 5 (14.7%) children with Grade II anaemia and 4 (11.8%) children with Grade III anemia. Of these 51 children, 18 (35.2%) had Protein Energy Malnutrition (PEM) of which 12 (66.7%) had Grade I and 6 (33.3%) had Grade II PEM.

While recording vitals, all the children were found to be febrile with associated tachycardia and tachypnea. Pulse oximetry showed hypoxia (SpO_2<90%) in 19 (37.3%) patients.

Complete blood count showed that the white blood cell and differential counts were on a higher range in pneumonia, early onset septicemia and hyaline membrane disease (diagnosed by white out lungs with reticulogranular opacities seen on Chest X Rays) in 34 (66.7%) patients. 25 (49%) children had White blood cell count between 11000-20000/mm^3 while 20 (39.2%) children had White blood cell count in normal range. Differential counts with elevated neutrophils were seen in 24 (47%) children while 10 (19.6%) children had elevated lymphocyte count. Consolidation was seen in 34 (66.7%) chest X rays with the right mid zone as the most common site of pneumonia seen in 22 (43.1%) children followed by right paracardiac consolidation seen in 9(17.6%) children. Arterial blood gas analysis showed hypoxia, hypercapnea and metabolic acidosis. C- Reactive Protein was positive (>0.6) in 15 (29.4%) patients. Blood culture was done in 22 (43.1%) children (children with WALRI and asthma were excluded) and showed no growth in 15 (68.2%) children, 2 (9.1%) children were positive for Methicillin Resistant Staphylococcus aureus and based on sensitivity were given higher antibiotics and results were awaited in 5 (22.7%) children who expired. Sputum smear examinations were done in 3 children of which 1 smear was positive for Acid fast bacilli. Mantoux test was done in 7 children with history of tuberculosis exposure and was positive in 1 child. 26 (51%) children required nebulization. All of them were more than 1 month in age. 41 (80.4%) children required intravenous fluids whereas 13 (25.5%) children required inotropic support with Dopamine at 10 µgram/ kg/ min.

The antibiotics used were as given in Table 4.

Continuous positive airway pressure was required in 2 (3.8%) neonates having severe birth asphyxia 1 (50%) and early onset septicemia 1 (50%). 6 (11.8%) neonates required ventilatory support with early onset septicemia in 3 (50%) children, Hyaline membrane disease, Meconium aspiration syndrome and H_1N_1 pneumonia in 1 child (1.7%) each. Average length of hospital stay was 5 days. Mortality rate in neonates included in our study was 7(13.7%) with early onset septicemia as the commonest cause in 3 children. In children older than 1 month, the mortality rate was 3.8%. Of the total study population, 42 (82.35%) children were discharged and 9 (17.65%) children expired.

Table 4 : Various Antibiotics used among study participants

Antibiotic	Age group	Dose (mg/Kg/day)	Dosage	Rationale	Drug of choice (line)	N0. of patients
Coamoxiclav	<3 months	30	IVq12hr	WALRI other than pneumonia, Asthma, Drowning, Pleural effusion (empirically)	1st	31 (60.8%)
	>3 months	40	IV q8hr			
Ceftriaxone		100	IVq12hr	Pneumonia, Early onset septicemia, Meconium aspiration syndrome	1st	11 (21.6%)
Vancomycin		40	IV q6hr	Empyema (sensitive)	2nd	1
Meropenem		40	IVq8hr	Pneumonia with septicemia	2nd	1
Piperacillin +		80	IVq6hr	Confirmed case of H1N1 pneumonia	1st	1 (1.9%)
Tazobactam		10				
		80	IVq6hr	Pneumonia, Early onset septicemia, Pleural effusion,	2nd	6
		10		Empyema (sensitive), Meconium aspiration syndrome, Hyaline membrane disease		
Ampicillin +		30	IVq12hr	Hyaline membrane disease, Septicemia,	1st	5
Amikacin		15	IVq12hr	Meconium Aspiration, Empyema		(9.8%)
Ampicillin +		100 + 7.5	IVq12hr +	Spinal muscular atrophy		1(1.9%)
Gentamicin			IVq8hr			
Anti Koch's treatment				Pleural effusion (treatment)		2 (3.8%)
Total						51 (100%)

Discussion :

Respiratory distress is difficulty in breathing characterized by increase in rate and depth of breathing. It causes decreased feeding, cyanosis, grunting, nasal flaring, intercostal retractions (increased work of breathing), sweating, fever and wheeze. It may be due to inflammation of the parenchyma of the lungs caused by microorganisms, mostly viruses, but may also be due to aspiration of food or gastric acid, especially in recurrent cases, and is a substantial cause of morbidity and mortality in childhood (particularly among children <5 year of age). It occurs primarily in premature and low birth weight infants usually male, in those who have not been breast-fed, and in those who live in crowded conditions.

Peripheral white blood cell (WBC) count in viral disease is less than 20,000/mm [3] with increased lymphocytes while in bacterial disease is in the range of 15,000-40,000/mm [3] with predominant granulocytes with associated pleural effusion, lobar consolidation, high fever at the onset of the illness, increased erythrocyte sedimentation rate (ESR) and C–reactive protein (CRP). Chest radiography helps confirm the diagnosis and may indicate a complication such as a pleural effusion or empyema with hyperinflation and bilateral infiltrates in viral disease and lobar consolidation in bacterial disease. Definitive diagnosis of a viral infection is done by isolation of a viral antigen or genome with culture, DNA test, RNA test and serological tests while bacterial infection is confirmed by blood culture, sputum smear and isolation of organism from pleural fluid or respiratory secretions.

Suspected bacterial disease is empirically treated by amoxicillin (80 mg/kg/24 hr) with clavulunate or ceftriaxone (100mg/kg/24hr). In viral infection antibiotics are withheld unless there is clinical deterioration.[3] Studies show multi-dose endotracheal instillation of exogenous surfactant to very low birth weight infants requiring 30% oxygen and mechanical ventilation for the treatment (rescue therapy) of respiratory distress syndrome dramatically improves survival and reduces the incidence of pulmonary air leaks if rescue treatment was initiated as soon as possible in the first 24 hours of life with 2 to 4 repeat doses given two to four times per day. [3]

Yu WL et al [7] China, Goh AY et al [8] Malaysia and Oliveira et al [9] Malaysia had admission rates of 1.44%, 4.2% and 6.3% because of respiratory distress, respectively. Martino Alba R et al [10] found in their study that infection with associated inflammation was the predominant event triggering respiratory distress. M. M. Karambin et al [11] found in their study that the most common cause of respiratory distress was pneumonia followed by asthma, croup, and bronchiolitis. Walker TA et al [4] and Goh AY et al [8] found that the leading cause for respiratory distress was sepsis followed by pneumonia in their studies. In a study by Bouziri A et al [12] surfactant deficiency was the primary cause of respiratory distress with caesarean section as a triggering factor. Acute respiratory distress syndrome represented 6.8% of etiology of respiratory distress in infants at term and near term with 95.7% survival rate.

Malnutrition exacerbates respiratory distress by impairing body's immunity and functioning of accessory muscles for respiration used in distress like sternocleidomastoid and paraspinal muscles. [3] In our study, 34% children had mild and malnutrition and they all were discharged. Severe anemia is a known to precipitate respiratory distress. Thomas and Joseph et al [13] found that there were 4 cases of severe anemia in their study that were unresponsive to bronchodilators and blood transfusion resolved their condition. In our study, 4 (7.8%) children with severe anemia improved with packed red cells infusion and were discharged successfully.

In their recent studies, Lu Y[14] ,Wang JD et al [15], Norrashidah AW et al [16] and Pfenninger J et al [17] have suggested that gentle mechanical ventilation care techniques (small tidal volumes and pressure limitation, permissive hypercapnea and high flow oscillometry) are appropriate measures to treat refractory cases and to reduce oxygen toxicity. Titration of positive end expiratory pressure, early employment of high positive end expiratory pressure, adjuvant therapy with sodium nitroprusside (SNP) nebulization and/or inhaled nitric oxide (iNO), prompt recognition and treatment of superimposed infection and careful management of additional organ failure can be used to achieve an improved survival rate if financial and infrastructural constraints are removed. [17]

Conclusion :

Breathlessness with fever, cyanosis, intercostal retraction nasal flaring and grunting and air hunger in children often lead to an Emergency Department (ED) visit. Causes and management differ in neonates and older children. Overall, in children, WALRI is the commonest manifestation of respiratory distress in ED and has a good prognosis. Infection (early onset septicemia and pneumonia) and associated inflammation trigger respiratory distress. In emergency department, universal rule of airway, breathing and circulation should be ensured. Empirical treatment with antibiotics should be given based on clinical findings and

further decision should be based on culture and sensitivity data as it takes time. Intubated children should be shifted to nasal continuous positive airway pressure on extubation, then to high flow nasal oxygen. Complete intensive care therapy with ventilator support is compulsory in children not responding to oxygen therapy.

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