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Clinical Profile of Acute Bronchiolitis and Risk Factors for Severe Disease and Mortality in Children 31 Days to 24 Months of Age Admitted in a District Hospital

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Abstract: ***Background:*** *Acute bronchiolitis, an acute infectious illness of the lower respiratory tract.It is predominantly a viral respiratory disease. An infant with bronchiolitis typically presents with illness during the winter months. General supportive measures are the mainstay of management. Most of these children begin to improve within one or two weeks. But it can lead to severe disease and mortality in some children.* ***Objective:*** *To describe the clinical profile and risk factors for severity and mortality in children 31 days to 24 months of age presenting with acute bronchiolitis at district hospital. Subjects and methods: This Descriptive study / Nested case control study was done at Government District Headquarters Hospital, Namakkal between January 2017 and December 2018. 215 children between the age group of 31 days to 24 months who meet the case definition for acute bronchiolitis were included in this study. All cases of severe disease and those who have died were taken as cases and those who had mild and moderate disease were taken as controls in a ratio of 1: 2 and various environmental, demographic and clinical factors were compared between these groups. Statistical analysis was done using SPSS software with 17.0 version. Proportions and mean with standard deviation of outcome measures will be arrived at as applicable and to compare the risk factors among cases and controls, Odds ratio with 95% Confidence Interval will be calculated. To adjust for confounding factors, adjusted OR with 95% Confidence Interval will be arrived by multivariate analysis.* ***Results:*** *Totally 215 children were included in this study. The male to female ratio was 1.7:1. 92 (42.8%) children were between 3 and 6 months of age with a mean age 4.6 months. Most of these cases (83.3%) were reported between the months of October and January. Mean duration of hospital stay was 3.52 days. All children in our study had upper respiratory illness followed by breathlessness. Fever was documented in 69.8% children. Chest x ray showed bilateral hyperinflation in 182(84.65%) children and it was normal in 33(15.35%) children. 97(45.10%) children in our study population, required intravenous hydration. Treatment with adrenaline, salbutamol and hypertonic saline aerosol therapy were given in 123(57.20%), 84(39.10%) and 8(3.70%) children respectively. infants with fever, caesarean delivery, mechanical ventilation in the newborn period and upper respiratory illness in the family were independently associated with increased risk of developing severe disease.* ***Conclusion:*** *If a child with acute bronchiolitis with risk factors, severity should be anticipated and the child should be monitored closely for signs of clinical deterioration. Proper antenatal and neonatal care and creating awareness to the public regarding the separation of family members having upper respiratory illness from young infants will reduce severity of bronchiolitis.*

Keywords: Bronchiolitis, children, RSV

1. Introduction

Acute bronchiolitis is an acute infectious disease of the lower respiratory tract. It is predominantly a viral disease. Respiratory syncytial virus has been isolated from 50% to 75% of children younger than 2 years of age hospitalized with bronchiolitis [1]. Other common respiratory viral pathogens, such as influenza, parainfluenza, and adenovirus, have been isolated from children with bronchiolitis [2, 3]. It is one of the leading causes of hospitalization in infants and young children.It occurs usually between 1 month and 24 months of age with a peak incidence between 3 to 6 months of age. Each year in the United States, approximately 2 per 100,000 infants die as a result of complications associated with bronchiolitis [4]. In young children, the clinical diagnosis of bronchiolitis may overlap with virus-induced wheezing and an acute viral-triggered asthma event. In temperate climates, hospital admissions because of bronchiolitis are most common from December to May. Early in the illness, infants usually experience copious rhinorrhea. Typically, infants develop a tight cough associated with poor feeding 4 to 6 days after the initial onset of symptoms. In healthy infants and young children acute bronchiolitis is usually a self-limiting disease. Treatment in most of these cases consist only supportive measures. Most of these children begin to improve within one or two weeks. But it can lead to severe disease and mortality in some children. This study describes the clinical profile of acute bronchiolitis in our hospital and risk factors for severe disease and mortality in children 31 days to 24 months of age.

2. Subjects and Methods

This descriptive study / Nested case control study included 215 children between 31 days to 24 months who were diagnosed as bronchiolitis at Government District Headquarters Hospital, Namakkal between January 2017 and December 2018. Children with chest X ray findings like consolidation, patch, cyst and children with known immunodeficiency were excluded. Children with mild and moderate bronchiolitis were taken as controls. Children with

severe disease and those who have died were included in case group.

Statistical analysis: Mean and proportion of outcomes of interest arrived at as applicable. To compare the risk factors among cases and controls, Odds ratio with 95% Confidence Interval was calculated. To adjust for confounding factors, adjusted OR with 95% Confidence Interval was arrived by multivariate analysis. Statistical analysis was done using SPSS software.

Figure 1: Assessment and treatment of bronchiolitis [5]]

Diagnosis: bronchiolitis

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Assessment of severity		
Mild	Moderate	Severe
• Normal ability to feed • Little or no respiratory distress • Oxygen saturation 92 per cent or more in room air.	• May appear short of breath during feeding. • Moderate respiratory distress, with some chest wall retractions, nasal flaring. • Apnoeic episodes, usually brief, self-limiting. • Usually hypoxemic, corrected (to SaO2 92 per cent or higher) by oxygen.	Symptoms of acute bronchiolitis with one or more of the following conditions, • Poor feeding / Need for intravenous hydration • Severe respiratory distress with marked retractions, nasal flaring, grunting • hypoxemic, not corrected (to SaO2 92 per cent or higher) by oxygen. • Need for mechanical Ventilation

↓↓

Treatment:		
Mild	Moderate	Severe
1. Treat at home. 2. Inform the parents when to return. 3. Review after 2days.	1. Admit 2. Maintain spo2>92% with oxygen supplementation. 3. Careful oral feeds/IV fluids 4. Chest X ray 5. 5. Watch for any deterioration	1. Admit in ICU. 2. Maintain spo2 by oxygen supplementation. 3. Mechanical ventilation if needed. 4. NPO 5. IV fluids. 6. Chest x ray/ABG. 7. Cardiorespiratory monitoring.

3. Results

Totally 215 children were diagnosed as bronchiolitis from January 2017 to December 2018. Out of whom 137(63.7%) children were males, 78(36.3%) children were females with male to female ratio of 1.7:1. Among them, 33 (15.3%) belong to less than 3 months of age group, 92 (42.8%) children were between 3 and 6 months of age, 83(38.6%) were between 6 and 12 months of age group, 7(3.3%) were belong to more than one year of age group. Lowest age reported was 35 days. The mean age reported in this study is 4.6 months. Most of these cases (83.3%) were reported between October and January. Rest of the cases were scattered throughout the year.

Among the study population 79(36.7%) children required less than two days of hospitalization, 88(40.9%) stayed in the hospital for 2 to 5 days while 44(20.5%) stayed for 5 to 10 days and only 4(1.9%) required more than 10 days of hospitalization. The mean duration of hospital stay is 3.52 days. While looking into the socioeconomic profile, 172 (80%) children in this study belong to middle (both upper middle and lower middle) socioeconomic status according to modified kuppusamy's scale, whereas 28(13%) belong to lower (both upper lower and lower) socioeconomic status and only 15(7.0%) of them belong to upper socioeconomic status.

All children in our study had upper respiratory illness in the form of cough, running nose or sneezing, of whom 185 (86.0%) children had upper respiratory symptoms for less than two days duration prior to hospitalization, whereas 29 (13.5%) children had these symptoms between 2 to 5 days duration and only one child (0.5%) had symptoms for more than five days duration. Among these 215 children, fever was documented in 150(69.8%) children. Among those 150 febrile children 131(87.3%) of them had low grade fever (temperature recorded less than 101 degree F) and 19(12.7%) children had fever of high grade (more than or equal to 101 degree F) in nature. All 215(100%) children had history of difficulty in breathing. Out of them, 184(85.6%) of children had these symptoms for less than two days duration and 31(14.4%) children were symptomatic for 2 to 5 days duration. But none of these children had these symptoms for more than 5 days duration.

Among these 215 children, 10(4.7%) children had various forms of congenital cardiac lesions. 4 children were already diagnosed prior to this hospital admission but in other 6 children, the diagnosis was established during this present hospitalization. Among these 10 children, 6 children had ventricular septal defect, two children had atrial septal defect and another two of them had patent ductus arteriosus. Congenital airway anomalies were present in 10(4.7%) children. Among these, eight children had laryngomalacia (5- already diagnosed, 3- diagnosed at this time) and two children had tracheomalacia (both of them were diagnosed at this time). Among those with congenital cardiac lesions and congenital airway anomalies, the clinical course went longer and severer ($p < 0.05$).

While analyzing the family history of these 215 children, family history of upper respiratory illness was present in 26 (12.1%) cases. This is most commonly seen among those children, who had severe clinical course ($p < .0.05$). Family history of smoking was present in 23(10.7%) cases. Family history of allergy or atopy was present in 20(9.3%) cases. But this history was most commonly seen in those who had milder clinical course. Indoor air pollution was present in 21(9.8%) cases. While probing into the birth and neonatal history, 137(63.70%) children were delivered by caesarean section and 78(36.30%) of children were delivered by normal vaginal delivery. Among them 189(87.90%) of children were delivered after 34 completed weeks and 26(12.10%) of them were delivered before 34 completed weeks.

While looking into the birth weight of these children, 180(83.70%) of children had birth weight of 2.0 to 4.0 kgs. 33(15.40%) children had birth weight of less than 2.0 kgs and 2(0.9%) children had birth weight of more than 4.0 kgs. Out of these 215 children, 21(9.8%) had history of admission in the neonatal nursery. These babies were admitted in the neonatal nursery for various reasons like low birth weight, respiratory distress, preterm care, sepsis and etc. Among these 21 children, 9(4.2%) were ventilated in the newborn period. Among these 215 children, 148(68.80%) children were fed exclusively with breast feeds for more than 3 months, but 67(31.20%) children were given breast feeds for less than 3 months period and given other type of feeds like cow's milk, artificial feeds during the first six months period. On examination, among these 215 children, 205(95.30%) had chest in drawing. Nasal flaring was present in 51(23.70%) children. 40(18.6%) children had grunting and cyanosis was present in 10(4.70%) children.

While analyzing the anthropometric measurements of these 215 children, 192(89.30%) children had age appropriate (between -2 z score to +2 z score) weight for length according to WHO growth standards, whereas 15(7.0%) children had their weight for length between +2 z score to +3 z score and 8(3.7%) children had their weight for length less than -2 z score. While analyzing the length for age, 212(98.6%) children had normal values (between -2 z score to +2 z score), whereas in 3(1.4%) children the length falls below -2 z score. Clinical pallor was noticed in 20(9.3%) children.In our study, only 3(1.40%) children had recurrent. Refusal of feeds and vomiting were seen in 48(22.30%) and 33(15.30%) children respectively. Among these 215 children, 39(18.1%) children presented in shock which required fluids and inotropic support. Oxygen saturation was maintained more than 92% without oxygen in 136(63.3%) children, whereas 40(18.6%) children required oxygen up to 10 liters/min to maintain saturation more than 92% and 39(18.10%) children failed to maintain the saturation even with oxygen supplementation. Wheeze and crepitations were present in 207 (96.3%) and 196 (91.2%) children respectively. Hepatomegaly and splenomegaly were noted in 37(17.2%) and 7(3.3%) children respectively. Chest x ray showed bilateral hyperinflation in 182(84.65%) children and it was normal in 33(15.35%) children. In our study population, 97(45.10%) children required intravenous hydration. Treatment with adrenaline aerosol therapy was given in 123 children (57.20%), followed by salbutamol and hypertonic saline aerosol therapy in 84(39.10%) and 8(3.70%) children respectively.The mean hospital stay in children treated with adrenaline, hypertonic saline and salbutamol nebulization were 3.2 days, 3.55 days and 4.02 days respectively. Out of these 215 children, 21(9.8%) children needed assisted ventilation and 4 of them expired with a mortality rate of 1.86%.

Univariate analysis

Demographic, environmental and clinical characteristics of the participants were analyzed for associations across disease severity groups using Pearson Chi-square test. The result of this analysis is given in the table (1).

Multivariate analysis:

All the significant Univariate variables were applied into the binary logistic regression model. Multivariate binary logistic regression models were constructed to identify associations between the environmental, demographic and clinical covariates and outcome measures (disease severity). The results are given in table 2.

Multivariate binary logistic regression analysis after adjustment for confounding factors shows that infants with fever, Cesarean delivery, mechanical ventilation in the newborn period, upper respiratory illness in the family were independently associated with increased risk of developing severe disease ($p < 0.05$).

Table 1: Comparison of demographic, environmental, perinatal and clinical factors among severe and non severe bronchiolitis groups – Univariate analysis

S.no	*Variable*	*Severe disease n (%)*	*Non severe disease n (%)*	*OR (95% CI)*	*P value*
1.	Age < 3 months	21(9.8)	12(5.6)	_	0.000 (<0.05)
	3 – 6 months	22(10.2)	70(32.6)		
	6 – 12 months	5(2.3)	78(36.3)		
	> 12 months	0(0.0)	7(3.3)		
2.	Sex Male	34(15.8)	103(47.9)	1.59(0.75 – 3.02)	0.245 (<0.05)
	Female	14(6.5)	65(29.8)		
3.	SE status Upper	1(0.5)	14(6.5)	-	0.130
	Upper middle	32(14.9)	68(31.6)		
	Lower middle	11(5.1)	61(28.4)		
	Upper lower	4(1.9)	22(10.2)		
	Lower	0	2(0.9)		
4.	F/H Atopy	2(0.9)	18(8.4)	0.35(0.08 – 1.60)	0.165
5.	Indoor air pollution	8(3.7)	13(6.0)	2.36(0.91 – 6.10)	0.068
6.	URI in the family	16(7.4)	10(4.7)	7.85(3.26 – 18.86)	0.000
7.	Passive smoking	15(7.0)	8(3.7)	9.03(3.54 – 23.04)	0.000
8.	Delivery LSCS	38(17.7)	99(46.0)	2.61(1.21 – 5.59)	0.012
	NVD	10(4.7)	68(31.6)		
9.	Gestational age >34 wks	30(14.0)	159(74.0)	11.92(4.75 – 29.91)	0.000
	<34 wks	18(8.4)	8(3.7)		
10.	Birth weight <2 kg	10(4.7)	23(10.7)		0.000

	2-4 kg > 4 kg	25(11.6) 0	155(72.1) 2(0.9)	_	
11.	H/O Neonatal admission	12(5.6)	9(4.2)	5.85(2.29 – 14.93)	0.000
12.	Neonatal mechanical ventilation	7(3.3)	2(0.9)	14.08(2.82 – 70.34)	0.000
13.	Breast feeding >3 month < 3 month	22(10.2) 26(12.1)	126(58.6) 41(19.1)	3.63(1.86 – 7.08)	0.000
14.	Fever	43(20.0)	107(49.8)	4.82(1.81 – 12.83)	0.001
15.	Underlying congenital cardiac lesions	6(2.8)	4(1.9)	5.82(1.57 – 21.57)	0.003
16.	Underlying airway anomalies	8(3.7)	2(0.9)	16.5(3.37 – 80.71)	0.000
17.	Weight for < -2 z score Length -2 to +2z score > +2 z score	3(1.4) 34(15.8) 11(5.1)	5(2.3) 158(73.5) 4(1.4)	_	0.000
18.	Pallor	12(5.6)	8(3.7)	6.62(2.52 – 17.38)	0.000

Table 2: Comparison of risk factors among severe and non-severe bronchiolitis groups Multivariate analysis

S.No	Variable	OR(95%CI)	Significance
1.	Fever	4.52 (1.05 – 19.32)	Significant
2.	Cessarian delivery	16.61(3.30 – 83.67)	Significant
3.	Neonatal mechanical ventilation	18.24(1.14 – 52.52)	Significant
4.	Upper respiratory illness in the family	15.26 (2.99 – 77.88)	Significant

4. Discussion

Bronchiolitis is an acute, infectious, inflammatory disease of the upper and lower respiratory tract resulting in obstruction of the small airways. Although it may occur in all age groups, the larger airways of older children and adults better accommodate mucosal edema and severe symptoms are usually only evident in young infants. It usually occurs in children less than two years of age and presents with coughing, wheezing, and shortness of breath. In this study, we have included 215 children who were diagnosed as bronchiolitis. Out of them, 167(77.67%) children had mild and moderate disease, whereas 48(22.33%) children had severe disease which similar to other literatures El-Radhi [6]. Out of these 48 severe cases 4 of them had died with a mortality rate of 1.86% similar to Thorburn K et al [7]., study which shows mortality rate of 1.7% whereas other studies showing mortality rate ranging from 0.5 to 7% [7].

In our study, 125(58.10%) of children were belongs to less than 6 months of age group which is comparable to Shay DK et al [8]., study. The mean age group in our study is 4.6 months which is comparable with El-Radhi A et al., study [6]. Out of 215 children, 63.7% children were males and 36.3% children were females in our study as similar to Al-Muhsen SZ et al., study [9]. Most of these cases (83.3%) were reported between the months of October to January. This seasonal pattern is similar to Al-Muhsen SZ et al., study [9].

While analyzing the risk factors using binary logistic regression model, fever, Cesarean delivery, neonatal mechanical ventilation and upper respiratory illness in the family became more significant ($p < 0.05$). So these factors are independently predicts the severity of bronchiolitis. Infants with RSV-associated bronchiolitis are often febrile at the time of presentation for medical care; in patients with adenovirus or influenza-associated bronchiolitis, however, fever is often higher than 39°8C. A rise in body temperature of 1°C results in an increase in energy expenditure of about 10%. These changes are accompanied by an increase in oxygen consumption of 10–12% for every 1°C rise in temperature. This may explain why a high proportion of the febrile children had a severe clinical course of bronchiolitis requiring oxygen supplementation [6].

Bronchiolitis is transmitted through droplets that contain viral particles. These are exhaled into the air by breathing, coughing, or sneezing. These droplets can be carried on the hands, where they survive and can spread infection for several hours. Marguet C et al, study states that viral co-infections in acute bronchiolitis raises cumulative pathogenic effect and consequently a more severe disease [10]. So when there is an upper respiratory illness in the family, it will predispose to co-infection or successive infection and consequently severe disease.

In our study, Cesarean delivery is independently associated with increased severity of bronchiolitis. This is similar to studies done by Moore HC et al, Hitt E et al [11, 12]. Act of labour promotes the production of various cytokines and stimulates the immune system in both the mother and the child. "Therefore the cytokine environment differs in a newborn delivered by elective caesarean delivery, as shown by the lower levels of interleukin (IL) 6 and IL-10 in their cord blood than in those who had a normal vaginal delivery [11]. Differing cytokine environment with elective caesarean delivery may lead to increased susceptibility to bronchiolitis in infancy

Neonatal mechanical ventilation is independently associated with severity of bronchiolitis. This is similar to observation of Perales AB et al [13]. Neonatal mechanical ventilation and oxygen therapy causes injury to airway of newborn babies and the airway undergoes some degree of bronchopulmonary dysplasia. This predisposes these babies to develop severe disease [14].

5. Conclusion

If a child with acute bronchiolitis has risk factors like fever, caesarean delivery, mechanical ventilation in the newborn period or upper respiratory illness in the family, severity should be anticipated and the child should be monitored closely for signs of clinical deterioration. Proper antenatal and neonatal care and creating awareness to the public regarding the separation of family members having upper respiratory illness from young infants will reduce severity of bronchiolitis.

6. Limitation

Present study had certain limitations. It did not confirm the laboratory diagnosis of bronchiolitis due to non-availability of diagnostic facilities but had relied on the case definition.

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8. Declarations

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Ethical approval

Not required

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