Predictors of Admission of Patients with Bronchiolitis to the Intensive Care Unit (ICU)

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ABSTRACT

Background

Bronchiolitis is a lower respiratory tract infection that occurs in children younger than two years old. It is usually caused by a virus; Bronchiolitis is a common cause of illness and is the leading cause of hospitalization in infants and young children. Bronchiolitis diagnosed clinically and can be treated by adequate fluids and oxygen therapy, but it can cause serious illness in some children and need Intensive Care Units management.

Objectives

To know the predictors of admission of the patient with bronchiolitis to the Intensive Care Unit..

Methods

A prospective, cohort study was conducted during the period from November 2011 to March of 2012 in Babylon Gynecology and Children Teaching Hospital. All our patients (251) aged less than 2 years and diagnosed as bronchiolitis according to the American Academy Of Pediatrics definition were enrolled in the study. Regular ward admission and ICU admission were compared.

Results

Two hundred fifty one patients were studied, 215 (85.7%) were admitted in regular ward and 36 (14.3%)patients were admitted in Intensive Care Unit(ICU) .Emergency department predictors of ICU admission were age less than 3 months(mean 3.15±2.5 VS 4.8±4.5: P value 0.002), formula feeding(36% VS 13% :P value 0.005), low oxygen saturation SPO2 (83.2%±7.3 VS 92.1%±4.5 :p value 0.000), rapid respiratory rate(64.3±7 VS 55.07±8.1 breaths/min :P value 0.000), and inadequate oral intake(97% VS 59% P value 0.000). Other factors like family history of asthma, eczema, sex, breast feeding, birth weight, heart rate and chest x rays finding were not associated with ICU admission.

Conclusion

Age of less than 3 months, formula feeding, low oxygen saturation SPO2 (83%), rapid respiratory rate, and inadequate oral intake are all predictors of ICU admission in children with bronchiolitis.

Key words*: Bronchiolitis, Intensive care unit, Emergency Department(ED). Asthma, SPO2, RR (Respiratory rate), HR (Heart Rate).*

INTRODUCTION

Bronchiolitis is the most common lower respiratory tract infection in children younger than 2 years [Subcommittee on diagnosis and management of bronchiolitis: (2006)], and present with wide a spectrum of clinical illness, from mild to severe symptoms of life-threatening respiratory distress. Bronchiolitis is diagnosed clinically , and usually start with two or three days prodromal phase of coryzal symptoms, cough , tachypnea, dyspnea, wheeze, crackles, and low grade fever, In the 1st 72 hours of illness infant may get worse before starting to improve [Scottish Intercollegiate Guidelines Network. (2006)]. and generally occurs in seasonal pattern, with the highest incidence in winter months [Bush A, Thomason AH. Acute bronchiolitis .BMJ.2007)].The American Academy of Pediatrics (AAP) position paper in 2006, described the child with bronchiolitis as being below 2 years of age and having: rhinitis, tachypnea, wheezing, cough, crackles, uses accessory muscles, and/or nasal flaring [Subcommittee on diagnosis and management of bronchiolitis: (2006)]. A variety of causative agents have been identified, with respiratory syncytial virus (RSV) is the most common (50%)to (80%)[Joseph J. Zarc and Caraline Breese Hall. (2010)]. Most children are infected with RSV by the age of 2 years[Glaen WP, Taber LH, Frank AL, Kasel JA, (1986)]. Other viruses have been linked to the bronchiolitis including Adenovirus[Rachall C, Gerben K, Daly J. (2004)],Parainfuenza virus, influenza virus AB [Iwane MK, Edwards's km, Szilagyi PG. (2004)], and Human metapneumovirus and Rhinovirus [Van den Haogen BG, et al. (2001)].Corona virus also has been linked to lower respiratory tract diseases in children[Lan SK, Waa PC, Yip CC. (2006)].The decision whether bronchiolitis should be treated in hospital or in the community is a difficult one .A significant proportion of children with bronchiolitis are admitted in the hospital and the cause of admission varies across individual clinician and institution [Chamberlain JM, Patel KM, Pollack MM, (2006)]. Increased rate of bronchiolitis and increased hospitalization have been associated with house crowding[Fiqueras-Aloy J, Carbonell-Estrony X, Q Uero J. (2004)], child care attendance [Simoes EA. (2003)], maternal smoking during pregnancy[Carroll K, et al., (2007)], passive smoking exposure[Stensballe LG, et al. (2006)], family asthma and child asthma and atopy [Carroll K, et al., (2007)] , [Stensballe LG, et al. (2006)], in addition to chronic medical condition including chronic lung disease [Glezen WP, et al: (2000)], congenital heart disease[Review **of** epidemiology and clinical risk factors for severe respiratory syncytial **virus (RSV) infection.**(2003)], immune compromised child[Meissen HC. (2003)], low birth weight and prematurity have been associated with severe bronchiolitis[Holman RC, Shay DK, Curns AT, Lingappa JR, Anderson LJ. (2003)]. An understanding of the possible etiology and risk factors for severe disease is likely to be important to the pediatrician who tries to make a decision about hospital admission and the level of care required for children who are admitted [Nielsen HE, etal. (2003)]. Despite the increase in frequency of bronchiolitis, there is considerable variation in the usual care given these patients in the hospital [DorothyDamoreMD,et al(2008)].Differences in patient severity undoubtedly contribute to this variability , but the primary cause may be simple ;practice preference ; that are pediatrician or institutionally determined and reflect the lack of consensus regarding optimal care[Everrad ML: (1995)].Treatment when needed, is supportive in order to maintain adequate hydration and oxygenation[Lazano JM, Wang E. (2002)]. Patients in whom need for admission to intensive care

unit(ICU) may be considered including those who progress to severe respiratory difficulty , those at risk group, patient with apneic episode and evidence of respiratory failure despite 40% to 50% inspired oxygen[Kini MM, et al. (2001)] .

AIM OF STUDY

To know the predictors of Intensive Care Unit(ICU) admission in children with bronchiolitis in Babylon Gynecology and Children Teaching hospital.

PATIENT AND METHODS

A. Study design

A prospective cohort study was conducted during the period from November 2011 to March of 2012 in Babylon Gynecology and Children Teaching Hospital .The number of patient enrolled in this study was 251 .Patient that were diagnosed as bronchiolitis according to the AAP definition were enrolled in the study.

The standard questioner consisted of emergency department(ED) interview and ED chart review .The ED interview assessed patient's demographics, characteristic medical and environmental history and details of their acute illness as follow:

Age in months, sex, any concomitant medical illnesses(congenital heart disease CHD, Cleft palate), birth weight (<3,3-5,>5KG) , type of feeding , history of passive smoking , history of wheeze (family), history of eczema(personal and family), day care center attendance, presence of cough, medications used in past week(inhaled β_2 agonist, antibiotic, systemic steroid), duration of illness, number of inhaled β_2 agonist in 1st hour, epinephrine , whether giving steroid , antibiotic in ED or not, RR, HR, signs of respiratory distress(retraction), oxygen saturation(Spo2) at room air ,wheeze, , any lab test(WBC), chest x-rays (CXR) was taken for every patient and read by a radiologist, idea about oral intake whether adequate or not, and finally whether admitted in regular usual ward or ICU .

Children admitted to ICU from ED (ICU admission group) were compared to children admitted to regular usual word (ward admission group).

STATISTICAL ANALYSIS

Computerized analysis of the data was carried out using SSPS program version 14.0, Chi-Square and Fisher Exact test were used to determine the statistical   significance of level of differences between ICU admission group and ward admission group, P value<0.05 was considered to be significant .

RESULTS

Two hundred fifty one patients with clinical diagnosis of bronchiolitis were studied during their admission to the ED. From all these patient 215 (85.7%) were admitted in regular ward and 36 (14.3%) patients were admitted in Intensive Care Unit (ICU). The following parameters is compared between ICU and ward admission were statistically significant(as in table 1) , like the age in which Patients whose admitted in ICU are younger than patient who those admitted in regular ward (mean age 3.1 VS mean age 4.8 respectively with P value 0.002), formula feeding with the percentage of formula feeding in ICU admission group was much higher (36%) than in ward admission group(13%) with significant p value (0.005) , while the percentage of breast feeding was 60% VS 47% respectively and inadequate oral intake in ICU group was 97% vs 59% in ward admission group with p value 0.042. Other parameters were not statistically significant (as in table 1) like, The concomitant medical illness, history of passive smoking,   positive family   history of asthma, positive history of eczema, day care center attendance female sex, birth weight, and attending medical advice in past week with taking medication like inhaledβ2 agonist, antibiotic and steroid.

Clinical presentation and progress of the disease in the ICU and wards were compared as in table (2),

The duration of symptoms , cough, wheeze, retraction, heart rate(HR), medications received in ED(inhaled β2 agonist , antibiotics and steroid), and abnormal chest x-rays (CXR) finding were not statistically significant(P value >0.05) as shown in table (2), while other predictors had statistical significant P value like, ICU admission patients had more respiratory rate(RR) than ward admission patients (mean 64 vs 55 /min) respectively with p value 0.000, and initial oxygen saturation (Spo2) in ICU admission patients was (mean 83% vs 92% in ward admission group with p value 0.000.

Table (1) Demographic characteristics and medical history of children presenting to the ED with bronchiolitis, according to word admission vs ICU admission

Demographic characteristics	Word admission(n=215)	ICU admission (n=36)	P value	Odd ratio(OR)	Confidence interval(CI)
Age in months(mean ±SD)	4.8± 4.5	3.15±2.5	0.002		
Sex, female (%)	1o4(48%)	21(58%)	0.269	1.4	0.7313-3.051
Concomitant med. illness	2.3%	2.7%	1.00		
hx of passive smoking	110(51%)	24(66%)	0.08	1.909	0.908-4.0125
Family hx of wheeze (%)	121(56%)	23(63%)	0.39	1.374	0.661-2.85
hx of eczema	19(8.8%)	6(16%)	0.147	2.66	o.762-5.58
Day care-center attendance	23(10%)	6(16%)	0.3	1.66	0.62-4.4
Medication in past week(inhaledβ2 agonist)	69(32%)	12(33%)	0.8	1.05	0.49-2.2
Antibiotic	159(73%)	25(69%)	0.5	0.8	0.37-1.73
Steroid	117(54%)	21(58%)	0.6	1.17	0.57-2.39
formula feeding	30(13%)	13(36%)	0.005		
Breast feeding	130(60%)	17(47%)			
Inadequate oral intake	128(59)	35(97%)	0.000		
Birth weight in Kg(mean ±SD)	3.17±0.6	3.06±0.82	0.36		

Table (2) ED presentation and clinical course among children with bronchiolitis, according to word admission VS ICU admission

	Word admission(n=215)	ICU admission (n=36)	P value	Odd ratio(OR)	Confidence interval(CI)
Duration of symptoms in days(mean ±SD)	4.38± 2	6.2±2	0.398		
Cough	213(99%)	36(100%)	1.00		
wheeze	212(98%)	36(100%)	1.00		
retraction	196(91%)	36(100%)	0.64		
RR (mean ± SD)	55.07±8.19	64.30± 7	0.000		
HR(mean ±SD)	133.5± 16.3	139.9±17.8	0. 33		
O2 saturation(Spo2)(mean ±SD)	92.13±4.5	83.2±7.3	0.000		
Steroid given in ED	171(79%)	25(69%)	1.00	0.58	0.26-1.27
inhaledβ2 agonist	173(80%	36(1000	1.00		
Antibiotic	214(99%)	36(100%0	1.00		
Abnormal CXR finding	142(66%)	25(69%)	0.68	0.85	0.399-1.83

DISCUSSION

Indications of admission to the ICU or pediatric wards differ among pediatrician. Two hundred fifty one patients were studied in the ED to delineate the parameters which direct their way and care. In this study, we found the admission rate to ICU is 14.3% while in other study[(DorothyDamoreMD,et al(2008)]was 9%, and this is variation possibly due to absence of exact guide lines and protocol for ICU admission in our hospital.

In this study, we found five predictors for ICU admission in patients with bronchiolitis, age less than 3 month, formula feeding, and low oxygen saturation at room air (Spo2) in ED, rapid respiratory rate (RR) and inadequate oral intake. Regarding the age we found young agechild (mean 3.15±2.5) is predictor of ICU admission (p value 0.002) while in other study [(Glezen WP, Greenberg SB, Atmar RL, Piedra PA, Couch RB: (2000, DorothyDamoreMD,et al(2008)]the age less than 6 week and 2moths respectively , A retrospective study of 62 children requiring mechanical ventilation for bronchiolitis found that the mean age was 73 days [(Nielsen HE, etal. (2003)]Regarding the respiratory rate(RR), rapid(mean 64.30± 7 breaths/min) is also predictor of ICU admission with p value 0.000 and similar to finding

obtained from other study[Glezen WP, et al: (2000)],while in other study [DorothyDamoreMD,et al(2008)], (RR) was not included as predictor of ICU admission. Children on formula feeding are more prone to get severe bronchiolitis with increase rate of ICU admission than breast-fed infants with bronchiolitis (p value 0.005) and this observation similar to the results obtained from a study of[oddywh et al. 2003].

In the present study, we found low oxygen saturation at room air(Spo2) in ED also is a predictive factor for ICU admission (mean 83.2%±7.3%) with p value 0.000 while in the other study [Walsh P, et al . (2004)] the cutoff point of Spo2 is less than 90%, and this variation possibly due to our hospital is tertiary hospital and receive the more critical cases from other hospital. Inadequate oral intake in children with bronchiolitis favors their admission to the ICU (97%) in comparison with those admitted in the usual wards(59%) with p value of 0.000 while in another study[Mai TV, et al . (1995, Walsh P, et al . (2004)] the decrease in oral intake was associated with an increase rate of hospital admission but not necessarily ICU admission.

CONCLUSION AND RECOMMENDATIONS

In our study , we found five independent predictor factors for admission of patients with bronchiolitis to ICU and these are, age less than 3 month, formula feeding, low SPO2 (mean 83%), rapid RR (mean 64breath/min) and inadequate oral intake . we suggest to do a guide lines and protocol for ICU admission in ED of our hospital, and also we suggest to do pulmonary function test(end-tidal rapid thoracoabdominal compression) (ETRTC) in the ED in high risk patient, Pulmonary function test is a valuable way for surveillance of the course and prognosis of bronchiolitis.

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