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

**مؤشرات دخول التهاب القصيبات الى وحدة العناية المركزة**

**الخلاصة**

**المقدمة:** التهاب القصيبات هو التهاب يصيب الجهاز التنفسي السفلي ويحدث لدى الاطفال دون سن الثانيه من العمر, وعادة يكون بسبب(راشح). التهاب القصيبات هو من الامراض الشائعة وسبب يؤدي الى دخول المستشفى للرضع والاطفال الصغار العمر. التهاب القصيبات يشخص سريريا وممكن معالجته عن طريق اعطاء السوائل الكافيه و الاوكسجين, ولكن في بعض الحالات الشديده يتطلب ان يكون العلاج في وحدة العناية المركزة

**الهدف:** معرفة مؤشرات دخول مرضى التهاب القصيبان الى وحدة العناية المركزة.

**الطريقه:** دراسه مستقبليه اجريت في الفتره من شهر تشرين الثاني من عام 2011 ولغاية شهر اذار من عام 2012 في مستشفى بابل التعليمي للنسائيه والاطفال , تمت دراسة 251 طفلا مريضا دون سن الثانيه من العمر لاصابتهم بالتهاب القصيبات حسب تعريف الاكاديميه الامريكيه لطب الاطفال. تمت مقارنة المرضى الداخلين الى وحدة العنايه المركزه مع عينه ضابطه من المرضى الداخلين الى الوحدات الاعتياديه المصابين بنفس المرض.

**النتائج:** مئتان وواحد وخمسون مريض تم دراستهم, 215(85.7%) ادخلوا الى الردهات الاعتياديه و 36(14.3) تم دحولهم الى وحدة العنايه المركزه. مؤشرات قسم الطوارءى للدخول الى وحدة العنايه المركزه كانت , العمر دون 3 شهر(3.15±2.5 مقابل 4.8±4.5)و( بفارق احصائي 0.002),الرضاعه الاصطناعيه (36% مقابل 13%) و(الفارق الاحصائي هو 0.005), قلة نسبة الاكسجين في الشريان عند هواء الغرفه(83±7% مقابل 92.1±4.5%) و(بفارق احصائي 0.000),سرعة نباضات التنفس (64.3±7 مقابل 55.07 ±8 تنفس بالدقيقه) و(بفارق احصائي 0.000), و عدم كفاية التغذيه الفمويه(97% مقابل 59%) و(بفارق احصائي 0.000). اما العوامل الاخرى مثا التاريخ العائلي للربو,الاكزيما, الجنس, الرضاعه الطبعيه, عدد دقات القلب, مؤشرات اشعة اكس للصدر ,فلم يسجل اي فارق احصائي مهم.

**الاستنتاج:** العمر دون 3 شهر, الرضاعه الاصطناعيه, قلة نسبة الاوكسجين في الشريان(83%), سرعة التنفس, و عدم كفاية التغذيه الفمويه كانت مؤشرات لدخول الاطفال المصابين بالتهاب القصيبات الى وحدة العنايه المركزه.

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**Introduction**

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ronchiolitis is the most common lower respiratory tract infection in children younger than 2 years[1], 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 day 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.[2], and generally occurs in seasonal pattern, with the highest incidence in Winter months[3].The American Academy of Pediatric (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 [1]. A variety of causative agents have been identified , with respiratory syncytial virus (RSV) is the most common (50%)to( 80%) [4].Most children are infected with RSV by the age of 2 years [5]. Other viruses have been linked to the bronchiolitis including Adenovirus[6], Parainfuenza virus, influenza virus AB[7], and Human metapneumovirus and Rhinovirus [8], Corona virus also have been linked to lower respiratory tract diseases in children [9]. 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 [10]. Increased rate of bronchiolitis and increased hospitalization have been associated with house crowding [11], child care attendance [12], maternal smoking during pregnancy [13], passive smoking exposure [14], family asthma and child asthma and atopy [13,14], in addition to chronic medical condition including chronic lung disease [15], congenital heart disease [16], immune compromised child[17], low birth weight and prematurity have been associated with severe bronchiolitis [18,19]. 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 [20]. Despite the increase in frequency of bronchiolitis, there is considerable variation in the usual care given these patient in the hospital [21,22]. 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[22].Treatment when needed, is supportive in order to maintain adequate hydration and oxygenation [23]. 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 apneaic episode and evidence of respiratory failure despite 40% to 50% inspired oxygen[24].

**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**

**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 .Patients that 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 β2 agonist, antibiotic, systemic steroid), duration of illness, number of inhaled β2 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 , Fisher Exact test and T 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

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

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

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

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

**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 [25] 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, low oxygen saturation at room air (Spo2) in ED, rapid respiratory rate (RR) and inadequate oral intake. Regarding the age we found young age child (mean 3.15±2.5) is predictor of ICU admission (p value 0.002) while in other study [15,25] 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 [27]. 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 15], while in other study [25] (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 oddy wh et al [26]. 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 [28] 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 [27,28] 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, but because of its unavailability in our country and large number in our study, its value was limited.

**References**

1-Subcommittee on diagnosis and management of bronchiolitis: Diagnosis and Management of bronchiolitis.Pediatrics; 2006, 118 (4): 1774-1793.

2-Scottish Intercollegiate Guidelines Network. Bronchiolitis In Children . SIGN Guideline 91.November ,2006.

3-Bush A, Thomason AH. Acute bronchiolitis .BMJ.2007;335:1037-41.

4-Joseph J. Zarc and Caraline Breese Hall. Bronchiolitis, Recent evidences on Diagnosis and Management, Pediatrics 2010;125: 342-349.

5-Glaen WP, Taber LH, Frank AL, Kasel JA, Risk of pulmonary infection and reinfection with Respiratory Syncytial virus , AmJ Dis Child, 1986;140(5):543-6.

6-Rachall C, Gerben K, Daly J .Adenovirus infection in children: The important of rapid diagnosis, Pediatrics.2004;113:e51-6.

7-Iwane MK, Edwards km, Szilagyi PG. Population –based surveillance for hospitalization associated with Respiratory Syncyntial virus, Infuenza, Parainfuenza viruses among young children. Pediatrics, 2004;113(6):1758-64.

8- Van den Haogen BG, De long JC, Groen J. A newly discovered Human mtapneumavirus isolated from young children with respiratory tract diseases. Nat Med, 2001;7(6):719-24.

9-Lan SK, Waa PC, Yip CC..Coronvirus Hkul and other corovirus infection in Hongkong. Jchim Microbial 2006;44(6):2063-71.

10-Chamberlain JM, Patel KM, Pollack MM, Association of emergency department care factors with admission and discharge decision for pediatric patient J Pediatr 2006;149:644-9.

11-Fiqueras-Aloy J, Carbonell-Estrony X, Q Uero J. Case – control study of risk factors linked to Respiratory Syncyntial virus infection requiring hospitalization in premature infant borne at a getational age of 33-35 weeks in Spain. Pediatric infectious Dis J.2004;23:815-20.

12-Simoes EA. Environmental and demographic risk factors for Respiratory Syncyntial virus lower respiratory tract disease. J Pediatr.2003;143(5 suppl)5118-26.

13- Carroll K, Gebretsadik T, Griffin MR, et al., Maternal asthma and maternal smoking are associated with increased  risk of bronchiolitis during infancy, Pediatrics, 2007;119(6):1104.

14- Stensballe LG, Kristensen K, Simoes EA, . Atopic disposition, wheezing, and subsequent respiratory syncytial virus hospitalization in Danish children younger than 18 months: a nested case-control study. *Pediatrics.* 2006; **118**:e1360–8.

15- Glezen WP, Greenberg SB, Atmar RL, Piedra PA, Couch RB: **Impact of respiratory virus infections on persons with chronic underlying conditions.** JAMA  2000, **283:**499-505.

16-  **Review of epidemiology and clinical risk factors for severe respiratory syncytial virus (RSV) infection.** J Pediatr 2003, **143:**S112-S117.

17- Meissner HC. Selected populations at increased risk from respiratory syncytial virus infection. *Pediatr Infect Dis J.* 2003; **22**(2 Suppl):S40–4.

18- Holman RC, Shay DK, Curns AT, Lingappa JR, Anderson LJ. Risk factors for bronchiolitis-associated deaths among infants in the United States. *Pediatr Infect Dis J.* 2003; **22**:483–90.

19- Holman RC, Shay DK, Curns AT, , Risk factors for bronchiolitis-associated deaths among infants in the US, Pediatr Infect Dis J, 2003; 22 (6): 483

20-Nielsen HE, Slersma V, Andeson S, te al. Respiratory Syncyntial virus –risk factors for hospital admission a case-control study. Acta. Pediatrics. 2003; 92(11):1314-21.

21-Willson DF , Jiaon JH, Dano witz L, et al: Invasive monitoring in infant with Respiratory Syncyntial virus infection.J Pediatrics 1996;128:357-362.

22-Everrad ML: Bronchiolitis . Origins and optimal management .Drug 1995;49:885-886.

23-Lazano JM, Wang E. Bronchiolitis. Clin Evid 2002;8:291-303.

24-Kini MM, Robbins JM, Kirschbaum MS, et al. Inpatient care for uncomplicated bronchiolitis . Arch Pediatr Adolse Med 2001;155:1323-1327.

## 25- Dorothy Damore MD, Jonathan M. Mansbach MD, Sunday Clark MPH, ScD, Maria Ramundo MD, Carlos A. Camargo Jr MD, DrPH. Academic Emergency Medicine 2008;15(10):887-894.

## 26-Oddy WH, Sly PD, de Klerk NH, Landu LI ,Kendall GE, Holt PG. Breast feeding and respiratory morbidity in infancy: abinth cohort study .Arch Dis Child 2003;88:224-8.

## 27- Mai TV, Selby AM, Simpson JM, Isacs D. Use of simple clinical parameters to assess severity of bronchiolitis. *J Paediatr Child Health.* 1995; 31:465–8.

## 28- Walsh P, Rothenberg SJ, O’Doherty S, Hoey H, Healy R. A validated clinical model to predict the need for admission and length of stay in children with acute bronchiolitis. *Eur J Emerg Med.*  2004; 11:265–72.