Analysis of chest x-ray and clinical finding in children with pneumonia

Received: 14/11/2011 Accepted: 13/11/2012

Salwa Ahmad Al-Najjar * Abbas Al-Rabaty ** Isam Al- Hatam ***

Abstract

Background and objective: The objectives of the study research were to determine the relationship between clinical and chest X-ray findings of pediatric patients.

Methods: A Prospective clinical study carried out at Raparin hospital in Erbil city, Iraq. A sample of 356 children admitted between Decembers 2004 and June 2005 from emergency ward and inwards in Raparin hospital were collected with age range from 2 months to 10 years with mean age of 19 months. All children had chest radiography on the bases of clinical decision by pediatricians. Descriptive and statistical procedures were used to analyze the data.

Results: All children had signs and symptoms of respiratory infections for instance, fever (87.4%), shortness of breath (99.5 %),cough (98%), tachypnea (73.5%), wheezes (93.3%), chest retraction (80%), crepitations (82%) and, 42.4% of chest X-rays showed focal infiltrations. Three clinical parameters related to pneumonia diagnosed by chest X-ray these were, chest retraction with sensitivity of 80%, and specificity of 88.29%), tachypnea with sensitivity of 73.5% and specificity of 56.59% fever with sensitivity of 87.42% and specificity of 60.98%.

Conclusion: Tachypnea, chest retraction and fever were found to be highly suggestive of pneumonia, chest x-rays was positive in about 425 of patients with pneumonia.

Keywords: pneumonia, chest-X-ray.

Introduction

Radiography has been an important tool in the investigation of chest infection since its invention in the late 19th century. Plain radiographs remain the most commonly used radiological tool [1]. Pediatric respiratory disease remains an important cause of morbidity in both developed and developing countries. Chest radiograph is frequently used in the management of acute lower respiratory infection in children [2] and still considered to be the gold standard for diagnosing respiratory infection and pneumonia [3]. Despite the great scientific advance during the last two decades, the diagnosis of pneumonia in children remains a challenge [4]. Physical examination findings can help the clinician in defining the need of chest x-ray in pediatric patients [5]. Although it is not clear which clinical sign should indicate the need for chest X-ray, different published studies which examine the relation between clinical signs and radiological changes gave contradictory results [6]. In a different study, Heulitt et al reported a sensitivity and specificity for detecting pneumonia of 45% and 92% respectively ,for the presence of fever and tachypnea in infants under 3 months .Only 6% of febrile infants had an abnormal chest radiograph in the absence of respiratory signs**.** The authors recommend that a chest radiograph should be obtained in febrile infants only when signs of respiratory distress are present .However, the radiological features of segmental consolidation are not always easy to distinguish from those of segmental collapse, apparent in about 25% of children with bronchiolitis [7].

*** Department of Surgery (Radiology), College of Medicine, Hawler Medical University, Erbil, Iraq.**
****Department of Pediatric Medicine, College of Medicine, Hawler Medical University, Erbil, Iraq.**
*****Department of Surgery (Radiology), College of Medicine, Duhok University, Duhok, Iraq.**

This study aimed to analyze CXR and clinical findings in children with pneumonia.

Methods

The sample of this study was collected in the period from December 2004 till June 2005 and the study was conducted at the Raparin Hospital (Hawler City). This hospital is with 105 beds and serves a large area of population concerning the Erbil governorate. A number of 356 infants and children age (2 months, to 10 years) were included and they were complaining of cough, shortness of breath, wheezes, chest retraction, and fever who had attended both emergency &inpatient department. Chest-X-ray was taken using X-ray equipment withr (Siemens, Multix 500 mA). All films were processed by the same automatic processor at temperature of 35^0C ±1 with chemical solution. Infants and children aged less than 4 year were examined in supine position. Children who were old enough to stand straight for the examination without turning to the side or twisting their bodies and to take a deep breath when requested are best examined in PA position with their arms held over their heads. Evaluation of chest X-rays , all reported by same radiologist then were rechecked by consultant radiologist.

Statistical Analysis:

In this study data were analyzed by statistical package for the social sciences (SPSS) software package using chi-square tests and fisher's exact test. The established method for evaluating the efficacy (accuracy) of an assessment test is to determine its sensitivity and specificity compared to an adequate reference standard. P value of ≤ 0.05 was considered statistically significant .

Results

The study were included 356 patients, 221 (62%) were males and 135 (38%) were females; male to female ratio was 1.6:1. seventy patients (19.7%) had pneumonic consolidation, 11 patients (3.1%) had bronchopneumonia and 70 patients (19.7%) had interstitial pneumonia in chest radiogram. Total pneumonic chest X-ray was 151 and 205 cases (57.6%) were normal chest X-ray as shown in Table 1. Table 2 summarized the clinical findings of all patients, Fever found in 132 patients (87.4%) the sensitivity and specificity were 87.42% and 60.98% respectively and P value of =0.0000.The proportion of tachypnea (73.5%) among patient proved to have pneumonia by chest X-ray findings was significantly higher than the proportion of tachypnea (43.4%) among those who did not have pneumonia. Wheezes were found in 141 patients (93.4%) and P=0.096 which is not significant .Ninety eight percent of patients has cough although sensitivity was 98.1% but it was not significant statistically (P=1). The relationship between chest retraction and pneumonia was found in 121 patients (80.1%) with sensitivity of (80.13%) and specificity of 88.29%. P value = 0.0000 it was statistically significant also ,while the relationship between crepitations and pneumonia found in 123 patients (81.5 %) with sensitivity 81.46% and specificity of 16.1%. and the P value was equal to 0.545 which is not significant.

Table1: Distribution of Pneumonia according to chest X-ray findings.

	No.	%
No pneumonia	205	57.6
Pneumonic Consolidation	70	19.7
Broncho pneumonia	11	3.1
Interstitial pneumonia	70	19.7
Overall total	356	100.0

Table 2: Relation between clinical finding and diagnosis of pneumonia

Findings	pneumonia	No Pneumonia	Total	Sensitivity %	Specificity %	PPV %	NPV%	P value
Fever	132 87%	80 39.0%	212 59.6%	86.8	61	62.3	86.2	0.000
No fever	19 12.6%	125 61.0%	144 40.4%					
Tachypnea	111 73.5%	89 43.4%	200 56.2%	73.5	56.6	55.5	74.3	0.001
No Tachypnea	40 26.5%	116 56.6%	156 43.8%					
Wheezes present	141 93.4%	199 97.1%	340 95.5%	93.4	2.9	41.5	37.5	0.096
Wheezes absent	10 6.6%	6 2.9%	16 4.5%					
cough present	148 98%	201 98%	349 98%	98	1.9	42.5	57.1	1
cough absent	3 2%	4 2%	7 2%					
Retraction present	121 80.1%	24 11.7%	145 40.7%	80.1	88.3	83.4	85.8	0.001
Retraction Absent	30 19.9%	181 88.3%	211 59.3%					
crepitation	123 81.5%	172 83.9%|	295 82.9%	87.2	15.6	41.5	64	
No crepitation	28 18.5%	33 16.1%	61 17.1%					

Discussion

The accurate diagnosis of pneumonia in children remains an important yet difficult clinical problem .The chest radiography remains the diagnostic test of choice in tertiary care center. Given that the decision to pursue diagnostic chest radiograph in the context of suspected pneumonia is largely influenced by clinical predictors of pediatric pneumonia, it is therefore, important to have these determined accurately. But the benefit of chest radiograph in such cases of pneumonia is not known and very limited number of studies have been done on the impact of chest radiograph on clinical outcome in acute lower respiratory tract infection [^]. In our study, 205 (57.6%) out of 356 cases suspected pneumonia chest X-rays were negative, and 151 cases (42.4%) had radiological findings as shown In Table1 this results are similar to the finding of Nizami's et al(2005) where 50% of chest X-rays were negative [1], and agrees with Wilkins's study where chest X-rays was frequently negative in patients suspected of having pneumonia [9]. and also agree with Lynch study in which 36% showed evidence of pneumonia [8]. Different studies provide statistically significant clinical factors that are predictive of childhood pneumonia and the use of these clinical factors may help to guide the physicians to more selective ordering of diagnostic chest radiography. Regarding fever it was found in 132 patients (87.4%) and 80 patients (39%) had no fever with sensitivity of 87.42 % and specificity of 60.9 % positive predictive value was 62.2 % and P = 0.0000. There was a significant relationship between fever & pneumonia this finding in agreement with the finding

of Zukin et al(1986), where the best screen for pneumonia is the presence of fever with sensitivity of 94% and NPV =97 % [5]. Also in agreement with Shamo'ons study which showed a sensitivity of 78% and specificity of 42 % [10], and agree with Juven T. et al [11]. In this study, the mean respiratory rate was 44.75 breath/min with a range of 29-68 breath/min, and it was shown that (73.5%) of pneumonic patients have tachypnea ,sensitivity of it was 73.5% , specificity of 56.59% , positive predictive value of 55.5% and diagnostic accuracy of 3.76% with X^2 =31.99, P<0.001. A statistically significant relationship was found between tachypnea and pneumonia. this is comparable to result reported by Palafox M et al (1995), who found that tachypnea has highest sensitivity (74%) and specificity of 67% and he concluded that tachypnea, used as the only clinical sign useful for identifying pneumonia in children, independent of the child's age or nutritional status [12] .The result is also consistent with the finding of Taylor et al (1995) who found that tachypnea is an important predictive sign of pneumonia in febrile children younger than 2 years of age with 73.8% sensitivity , 76% specificity , and the PPV and NPV were 20.1% 97.4% respectively [14]. A study done in China showed that tachypnea more reliable than auscultation in predicting pneumonia [(15)], Anadol et al found that tachypnea had a specificity of 99% and a sensitivity of 61% and was the most important sign in diagnosing pneumonia [16]. In our study wheezes was present in 93% in patient with pneumonia with sensitivity, specificity, PPV, and NPV were 93.3%,2.9% , 41%, and 37.5% respectively and P value of 1.9, no significant statistical relation between wheezes and pneumonia was found. Our findings are in agreement with the results reported by Lynch et al (2004), which was found wheezes only in 7% and it was not significant [9]. Shamo'on et al(2004), study like our results, found wheezes in 33% of the children with sensitivity of 22% and specificity of 49% and it was not a useful sign to determine pneumonia in children .This is in agreement with a study done by Mahabee-Gitten et al [17]. In the present study cough was present in 98 % with sensitivity of 98 % and specificity of 1.95 %, PPV of 42.4% and NPV of 57 % and there was no significant relationship between cough and pneumonia. These results are consistent with the findings of lynch et al who found cough in 88 of patients of positive chest X-rays and 84 in patients with negative chest X-ray and they found cough to be not significant [8]. Chest retraction was found in 80 % of pneumonic patients with sensitivity of 80% specificity of 88.2 %, PPV of 83.45% and NPV of 85.7 % and X^2 =168.6, P value =0.0000 and it found that there was a significant relationship between pneumonia and chest retraction. These findings similar to result of study done by Shamo'on's ,who where found chest in drawing in 79 % of patient with sensitivity of 88 % and specificity of 77 % and also they found that tachypnea and chest wall in drawing in the presence of cough help the clinician to determine the need for chest radiograph in the pediatric emergency clinic These results justified the premise that pneumonia case detection does not require auscultation, chest X-ray, or laboratory testing and that observation of the respiratory rate and lower chest wall in drawing are the key elements of assessment in young children [17] Crepitation was found in 81.5 % with sensitivity of 81.4% and specificity of 16 % and there was no significant relation between pneumonia and crepitations. No statistically significant difference occurred in the presence of crackles between viral and bacterial pneumonia [9]. Also in Shamo'on's study crepitation was found in 35 % with sensitivity 30 % and specificity of 56 % and it was not significant [11]. Our findings are in agreement with Lynch et al study where crackles were found in 43% with sensitivity of 43 % and specificity of 73 % and NPV of 70 % and PPV of 47 % which was not significant alone but when combined with other signs like fever or tachypnea the sensitivity was increased [8].

Conclusion

1. A considerable proportion (42.4%) of patients who have symptoms suggestive of acute lower respiratory infections, found to have a positive chest X-ray finding.
2. Tachypnea, fever and chest retraction were found to be highly suggestive of pneumonia.

References

1. Sheikh Q., Zulfiqar B. ,Role of chest X-ray in diagnosis of lower respiratory tract infections in children less than 5 years of age in community .Pak .J Med Sc: October-December 2005 Vol. 21 No. 4: 417 -421
2. Swingler G.H. observer variation in chest radiography of acute lower respiratory infections in children: a systematic review .BMC medical Imaging 2001 ;1(1): 1.
3. Monica L, Maria A. Community acquired pneumonia in children: A clinical update .Arch Dis Child Adu pract Ed, 2001, 89:29-34.
4. Jayme Murahovschi, Chest X-ray in pediatric emergency department. J pediatr. 2004 , 80 :2, 312-315.
5. Zukin DD, Hoffman JR, Cleveland RH, Kushner DC, Herman TE. correlation of pulmonary signs and symptoms with chest radiography in pediatric age group. Ann Emerg Med, 1986 Jul: 15 (7)792-796Available
6. British guidelines for the management of community acquired pneumonia in childhood .Thorax 2002; 57: i1-i24.
7. Heulitt MJ, Abelow RC, santos cc. Febrile infants less than 3 months old: value of chest radiography .Radiology 1988; 67:135-7.
8. Lynch T, Platt R,. Can we predict which children with clinically suspected pneumonia will have the presence of focal infiltrated on chest radiographs Pediatrics, Mar. 2004; 113 (3pt 1):186-9.
9. Wilkins TR, Wilkins RL, Clinical and radiographic evidence of pneumonia .Radio Technol .2005 , 77(2):106-10.
10. Shamo'on H, Hawamdah R,. Detection of pneumonia among children under six years by clinical evaluation .Eastern Mediterranean Health Journal, 2004 10:415, 482-487.
11. Juven T,Runskanen O. symptoms and signs of community –acquired pneumonia in children. Scand J prim Health Care 2003;21:52-56.
12. Palafox M, Guiscafre H. Diagnostic value of tachypnea in pneumonia defined radiologically .Ach Dis child 2000; 82:41-45.
13. Taylor JA, Del Beccaro M. Establishing clinically relevant standard for tachypnea in febrile children younger than 2 years.Arch Pediatr Adolese Med, 1995; 149(3) 283-7.
14. Dayi Y, Foy HM. Respiratory rate and signs in roentgengraphically confirmed pneumonia among children in china.Pediatr infect Dis J.1995 May ;14(5):405-6.
15. Anadol D, Aydin YZ, Over-diagnosis of pneumonia in children .Turkish journal of pediatrics, 2001; 43(3):205-9
16. Mahabee Gittens. Clinical Factors associated with focal infiltrates in wheezing infants and toddlers .clinical Pediatrics, 2000, 39(7):387-93.
17. Bachur R,Perry H,Harper Mb. Occult pneumonias : empiric chest radiographs in febrile children with leukocytosis.Ann Emerg Med.1999 ; 33 (2): 166-73.