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Research Article

Role of serum procalcitonin level in early diagnosis of bacterial pneumonia in children, a hospital based study

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ABSTRACT

Background: Procalcitonin (PCT) is a precursor of hormone calcitonin. It is composed of 116 amino acids and is produced by para follicular C cells of the thyroid and by neuroendocrine cells of lungs and intestine. The level of Procalcitonin in healthy individuals is below the limit of detection (0.01µg/L).These levels may rise from extra thyroid tissues especially in response to inflammatory stimulus of bacterial origin. PCT has the greatest sensitivity and Specificity for differentiating patients with sepsis from those with systemic inflammatory response syndrome. And the objective of the study is to discuss the method for early diagnosis and use of antibiotic therapy in patients of bacterial pneumonia.
Methods: A hospital based study was conducted in our hospital from January 2015 to June 2015. Eighty six children with severe pneumonia were enrolled from Department of Paediatrics and were divided into two groups according to bacteriological detection; bacterial pneumonia group consisting of 44 children patients and non-bacterial pneumonia group of 42 children patients. Meanwhile, 45 healthy children were also enrolled and grouped into normal control group. Chest X-ray and Peripheral venous blood of all children was collected to detect complete blood count, CRP and procalcitonin (PCT).
Results: Serum PCT level of patients with bacterial pneumonia was significantly higher than that in the non-bacterial pneumonia patients and normal controls ; serum PCT level of patients with bacterial pneumonia, before and after treatment had statistical significance ; Serum PCT level of patients with non-bacterial pneumonia had no statistical significance before and after treatment .
Conclusions: Serum PCT is an important biomarker for prompt diagnosis of bacterial infection and a sensitive indicator to distinguish bacterial from non-bacterial pneumonia. Evaluating serum PCT levels helps in early use of antibiotic therapy and prognosis of underlying disease.

Keywords: Pneumonia, Serum procalcitonin, Infection

INTRODUCTION

The single leading cause of deaths in children aged less than 5 years is community acquired pneumonia (CAP), and 156 million cases occur in this age group each year, worldwide.[1] The main aetiology behind Community acquired pneumonia are Viral and bacterial pathogens.[2] In a country like India, the empirical use of antibiotics is routine because of the association between bacterial infection and childhood deaths attributable to CAP, there is a need to formulate various strategies to determine the underlying pathogen causing the disease and tests for early diagnosis and differentiation between viral and bacterial causes of CAP.[3,4] All over the world, it has been seen the viral infections among children with CAP are more frequent than bacterial infections.[5] Most frequently the viral co-infections are common, present as more severe cases and requires hospitalization most of the

times.[6] Viral and bacterial Infections causing CAP in children are difficult to differentiate on clinical and radiological characteristics and the commonly used methods like sputum culture, blood culture etc. have limitations.[7] So, it is of vital significance to choose a quickest, highly sensitive and specific laboratory index for early diagnosis of children with severe pneumonia for early application of treatment methods corresponding to different pathogen infections.[8-11]

Table 1: comparison between neonates with sepsis and control neonates with regards to laboratory findings.

Characters		Cases	control	T- test	P- value
Total leucocyte count	Range	9.7 – 19. 5	6-10	13.8	0.001
	Mean±SD	16.30±1.9	8.2±0.5		
CRP	Range	25.4-101.7	5.6-11.6	10.22	0.0001
	Mean±SD	65.6±14.4	8.09±1.1		
Procalcitonin level	Range	42.5-556.3	5.6-110.6	5.51	0.0001
	Mean±SD	185.6±144.4	44.09±29.1		

In recent years, PCT has been regarded as a very important biomarker for the diagnosis of systemic bacterial infection. Procalcitonin is a pro-hormone, and studies show that their serum levels can be used to distinguish sepsis from systemic inflammatory response.[12] PCT is the precursor of calcitonin, contains 116 amino acid peptide with a molecular weight of 14.5k Da and does not demonstrate any hormonal activity.[13] PCT has demonstrated the highest reliability in the early diagnosis of severe sepsis, sepsis, or septic shock compared to other available biomarkers.[14] In the year 1993, Assicot M et al. Stated that there is significant increase in serum PCT production following bacterial and fungal infections.[14] The role of PCT in rapid diagnosis of neonatal sepsis was assessed by Chiesa C et al in the year 1998. In an healthy individual PCT is synthesized in the C cells of thyroid gland and its level is undetectably low. However a significant rise in PCT levels in blood from extrathyroid tissue are seen following bacterial, fungal and parasitic infections.[16-17] In this paper, we aim to discuss the role of serum PCT in early diagnosis of severe bacterial pneumonia and differentiating bacterial and non-bacterial pneumonia through monitoring the serum PCT concentration on children diagnosed with severe pneumonia.

METHODS

It was a hospital based analytical study which was conducted from January 2015 to June 2015. Eighty six children with severe pneumonia were enrolled from Department of Paediatrics all of which conformed to the diagnostic criteria formulated by Infectious Diseases Society of America (IDSA).[15] The patients were divided into two groups according to bacteriological detection: bacterial pneumonia group consisting of 44 children patients, consisting of 21 cases of male and 23 cases of female, being aged between 9 months and 10 years old and non-bacterial pneumonia group consisting of 42 children patients, consisting of 20 cases of male and 22 cases of female, being aged between 11 months and 9 years old. Meanwhile, 45 healthy Children were enrolled in the study that were physically fit and without any clinical sign and symptoms and were grouped into normal control group, consisting of 21 cases of male and 24 cases of female being aged between 10 months and 8 years old.

Method used for the study includes collection of peripheral venous blood of all children using all aseptic precautions and proper consent was taken from their parents/ Guardians. Blood was analysed in the clinical laboratory of the hospitals to detect their PCT, CPR (C-reactive protein), and WBC counts.

Statistical analysis

Statistical analysis was done using SSPS 20.0 software, measurement data was presented by mean± standard deviation (±S), group comparison was done by t test, chi-square test was adopted to test enumeration data. $p<0.05$ was considered statistically significance.

RESULTS

Serum PCT levels in patients of bacterial pneumonia group was significantly higher than that of patients in the non-bacterial pneumonia group and control group respectively, and difference had statistical significance ($p<0.01$).

Table 2: PCT detection results of the three groups before and after treatment.

Group	Cases	Pre treatment	Post treatment
Bacterial pneumonial group	44	12.0±6.7	2.1±0.8
Non bacterial pneumonia group	42	2.8±1.2	2.4±0.7
Controls	45		1.1±0.2

Serum PCT level in patients of bacterial pneumonia group had statistical significance ($p<0.01$) before and after treatment; serum PCT level in patients of non-bacterial pneumonia group before and after treatment had no statistical significance ($p>0.05$) (Table 2).

DISCUSSION

The severity of pneumonia can be reduced by early diagnosis and application of appropriate antibiotic therapy, thus improving the overall status of the patient and reducing the morbidity and mortality especially in children. Previously it has been reported that clinical features, X-ray examination, laboratory test results, CRP and WBC counts are not specific enough for the diagnosis of bacterial pneumonia.[18-20] Various methods and indicators are employed to diagnose severe pneumonia but most of them are time consuming and lack specificity. An Increase in WBC count could hint towards severe bacterial infection but it lacks specificity. C-Reactive protein (CRP), an inflammatory marker usually appears in blood, 12 hours after the onset of inflammation and may rise in both infectious and non-infectious pathologies, thus making it less sensitive and nonspecific to diagnose bacterial pneumonia in children.[21] Most of the times blood cultures in patients of bacterial pneumonia are negative, and only a small amount of blood sample are withdrawn from children, therefore we must use other diagnostic procedures to diagnose the disease in question.

In a healthy individual, PCT a precursor substance is synthesized in the C cells of thyroid gland and its level is undetectably low. However a significant rise in PCT levels from extra thyroid tissue are seen following bacterial, fungal and parasitic infections.[16-17]

The rapid identification of bacterial pneumonia in children admitted in emergency rooms by use of rapid diagnostic markers are particularly useful. In our study, we found that PCT is probably the most predictive marker for identifying bacterial pneumonia in children.

CONCLUSION

In our study, PCT levels of patients in bacterial pneumonia group were significantly higher than that in the non-bacterial group and control group. Serum PCT levels in patients in bacterial pneumonia group before and after treatment has statistical significance and PCT levels in patients of non-bacterial group before and after treatment had no statistical significance. This all indicates that a rise of PCT levels can be used as serological marker in early diagnosis of bacterial pneumonia in children and can also help to determine the disease severity and early use of antibiotics where ever necessary.

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REFERENCES

1. Rudan I, Boschi-Pinto C, Biloglav Z, Mulholland K, Campbell H. Epidemiology and etiology of childhood pneumonia. Bull World Health Organ. 2008;86:408-16.
2. Nascimento-Carvalho CM. Etiology of childhood community acquired pneumonia and its implications for vaccination. Braz J Infect Dis. 2001;5:87-97.
3. World Health Organization. Integrated management of childhood illness. Chart booklet WC 503.2. Geneva: WHO; 2008. Available at: http://whqlibdoc.who.int/publication/2008/9789241597289_eng.pdf (accessed January 15, 2009).
4. Shann F. Etiology of severe pneumonia in children in developing countries. Pediatr Infect Dis J. 1986;5:247-52.
5. Peltola V, Ruuskanen O. Respiratory viral infections in developing countries: common, severe, and unrecognized. Clin Infect Dis. 2008;46:58-60.
6. Cilla G, Onate E, Perez-Yarza EG, Montes M, Vicente D, Perez-Trallero E. Viruses in community-acquired pneumonia in children aged less than 3 years old: high rate of viral coinfection. J Med Virol. 2008;80:1843-9.
7. Korppi M, Don M, Valent F, Canciani M. The value of clinical features in differentiating between viral, pneumococcal and atypical bacterial pneumonia in children. Acta Paediatr. 2008;97:943-7.
8. Bin Gadeem H, Barna M, Tóth A, Janakó M. Cryptosporidium as a co-pathogen in infantile diarrhea and pneumonia. Orv Hetil. 1990;131:1423-5.
9. Hyvarinen M, Piippo-Savolainen E, Korhonen K, Korppi M. Teenage asthma after severe infantile bronchiolitis or pneumonia. Acta Paediatr 2005; 94: 1378-83.
10. Schaad UB, Rossi E. Infantile chlamydial pneumonia-a review based on 115 cases. Eur J Pediatr. 1982;138:105-9.
11. Ono M, Takeda K, Okuda Y, Nakamura K, Yamaguchi N. Chest X-ray findings in infantile Chlamydia trachomatis pneumonia; report of two cases. Rinsho Hoshasen. 1989;34:173-6.
12. Reinhart K, Bauer M, Riedemann NC, Hartog CS. New approaches to sepsis: molecular diagnostics and biomarkers. Clin Microbiol Rev. 2012;25(4):609-34.
13. Whicher J, Bienvenu J, Monneret G. Procalcitonin as an acute phase marker. Ann Clin Biochem 2001. 38:483-93.
14. Assicot M, Gendrel D, Carsin H, Raymond J, Guilbaud J, Bohuon C. High serum procalcitonin concentrations in patients with sepsis and infection. The Lancet. 1993;341(8844):515-8.
15. Chiesa C, Panero A, Rossi A, Buffone E, Tramontezzi P, Osborn JF, et al; Reliability of

procalcitonin concentrations for the diagnosis of sepsis in critically ill neonates. CID 1998;26:664 -72.
16. Snider RH, Nylen ES, Becker KL. Procalcitonin and its component peptides in systemic inflammation immunochemical characterization. J invest med. 1997;45:552-60.
17. Bohuon C, Gendrel D. Procalcitonin. A new indicator for bacterial infection. Interest and perspectives. Arch Pediatr. 1999;6:141-4.
18. Peltola H, Jaakkola M. C-reactive protein in early detection of bacteremic versus viral infections in immunocompetent and immunocompromised children.J Pediatr. 1988;113:641-6.
19. Nohynek H, Eskola J, Laine E, Halonen P, Ruutu, Saikku P et al. Bacterial antibody assays in the diagnosis of acute lower respiratory tract infection in children.Pediatr Infect Dis J. 1995;14:478-84.
20. Toikka P, Virkki R, Mertsola J, Ashorn P, Eskola J, Ruuskanen O. Bacteremic pneumococcal pneumonia in children. Clin Infect Dis1999;29:568-72.
21. Brunkhorst FM, Eberhard OK, Brunkhorst R. Discrimination of infectious and non-infectious causes of early acute respiratory distress syndrome by procalcitonin. Crit Care Med.1999;27:2172-6.
22. Zhijingl, Yajingz, Xinw. Measurement of children with severe pneumonia PCT resulted from different infectious agents and the change of Creactive protein and white blood cell count and its clinical significance. Chin J Heal Bir Child Care. 2009;15:19-21.

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