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The Influence of the Procalcitonin Method in Detecting Paediatrics Infections

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Abstract

BACKGROUND: In daily pediatric clinical practice, in addition to the standard markers such as PCR.

AIM: We aimed to demonstrate the role of Procalcitonin in early detection of bacterial infections of the respiratory tract at pediatric age and to determine the sensitivity, specificity, VPP, PCT VNP (quantitative method VIDAS-B-R-A-H-M-S-PCT) in bacterial respiratory infections.

METHODS: The prospective, randomized study, conducted at the Clinical Tetovo Hospital (Neonatology Department - Pediatric, Clinical and Biochemical Laboratory), in the period November 2011-December 2012. It includes 99 children. The study group includes 76 children. With upper respiratory tract infections (tonsil pharyngeal) 35 cases. With respiratory tract infections (bronchopneumonia) 41 cases, control group 23 cases.

RESULTS: With tonsil pharyngeal infections, out of 35 cases (28.57% were bacterial by criterion). With respiratory tract infections (bronchopneumonia), from 41s (39.02% were bacterial by criterion). In all 35 studies with bacterial tonsil pharyngeal disease, specificity, sensitivity, PPV, NPV of Procalcitonin, which resulted in the following (88%, 90%, 75%, 95.65%), and P = 0.12. All 41 patients with bacterial bronchopneumonitis were calculated as: Specificity, Sensitivity, PPV, and NPV of Procalcitonin, which resulted in the following (72.73%, 100%, 76%, and 100%). and P = 0.12.

CONCLUSION: Procalcitonin may serve as an early marker of upper and lower respiratory infections.

Introduction

With the term infectious bacterial disease, we mean pathological conditions directly caused by a certain number of microorganisms responsible for causing the disease.

Infectious respiratory diseases in childhood are frequent occurrences and account for about 70% of the general morbidity in childhood [1]. Pneumonia is a common disease affecting about 450 million people a year in all parts of the world [2], [3].

Acute tonsil pharyngeal - Commonly the inflammatory process affects tonsils and pharynx together, t tonsils and pharynx are commonly associated with tonsil pharyngeal diseases.

Many authorities recommend the use of 4 criteria for the diagnosis of pharyngeal tonsil, as follows: Fever, Tonsils with Exudates, Cough, and Cervical Anterior Lymphadenopathy. Patients who meet the 2 criteria can be tested [4] for Epidemiological survey; - Laboratory research; and Other research [5].

Blood analysis: Leukocyte differential leukocyte formula is very important for some diseases, especially for those with infectious origin. [6] Neutrophils- Neutrophilia indicates left-leukocyte leukocyte. Most often occurring in bacterial infections, tissue necrosis, we normally have also increased number of leukocytes [7], [8].

The role of procalcitonin in respiratory infections

Procalcitonin is a precursor of the calcitonin hormone, which is part of calcium homeostasis. It is composed of 116 amino acids, Fig. 1, and is produced by the thyroid (C-parafollicular) cells and the neuroendocrine cells of the lungs and intestines. Under

inflammatory systemic conditions, inflammatory mediators cause procalcitonin production in many places, from neuroendocrine cells throughout the body.

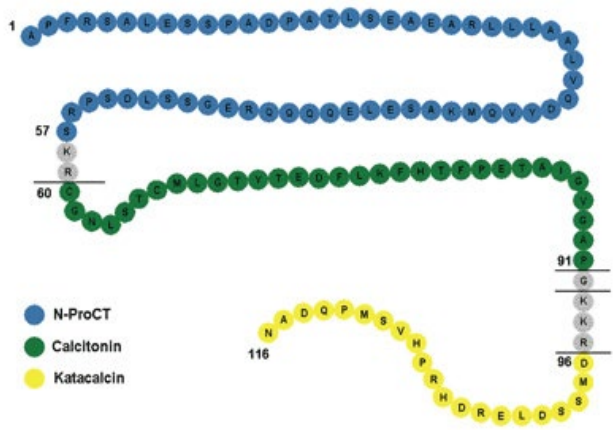

Figure 1: Primary Structure 116-kD Precursor Polypeptide of Calcitonin. The PCT composition of 116 amino acids produced by cells (C-parafollicular cells) of the thyroid and from the neuroendocrine cells of the lungs and intestines. Procalcitonin is composed of three sections: the amino terminus (N-ProCT), immature calcitonin, and katacalcin

Calcitonin discontinued procalcitonin was discovered in 1980. Ten years later, researchers found that procalcitonin levels increase in the presence of pneumonia, sepsis, or other bacterial systemic infection. Procalcitonin serum has a half-life of 25-30 hours [9]. The elevated levels of PCT show bacterial infection accompanied by systemic first published study that suggested that procalcitonin levels were increased in the presence of bacterial infection occurred in France in the early 1990s. A major advantage of PCT compared to other parameters is its very early growth and quite specific in response to severe systemic bacteria [10], [11], [12], [13], [14].

Trials from 2008 and 2009 have shown that procalcitonin may help guide therapy and reduce the use of antibiotics, which can help maintain the cost of using antibiotics and bacterial resistance [15], [16]

The purpose of this study is: 1. To reflect the role of Procalcitonin in early detection of respiratory infections at pediatric age; and 2. Recommend the role of Procalcitonin as an early biomarker in differentiating infections, in order to reduce daytime hospital stay.

Material and Methods

The study is prospective and randomized; 99 children were included in the study. The study lasted two years from November 2011 to December 2012 year. The clinical part of this study was carried out in Neonatology Departments and Children's Department at IPSH - Clinical Hospital Tetovo, Faculty of Medicine - USHT. The laboratory part was performed in the Clinical Biochemistry laboratory near the Tetovo Clinical Hospital. The men resulted 56 or 56.56%, females 43 or 43.43%. Average age 2.47 years ± 3.5 months, average length 81.42 ± 12.4 cm, mean hospital stay was 4.1 ± 1.3 days, mean weight 12.05 ± 2.8 kg, Diagnosis is based on data:

1. Clinical (auscultatory phenomena, local tonsil aspect, febrile condition, etc.)

2. Biochemical Examinations (Quantitative method of PCT (VIDAS-B.R.A.H.M. S PCT) cut-off > 0.25 ng/ml.

We divided the subjects into two groups as follows: 35 cases with acute tonsillopharyngitis, and 41 cases with bronchopneumonia. All 76 cases are diagnosed according to the criteria, with upper and lower respiratory tract infections (acute tonsillopharyngitis, bronchopneumonia), and 23 cases as a control group. Study group included 76 cases suspected of upper respiratory tract infections [ITSR] - acute tonsillopharyngitis and lower respiratory tract infections [ITPR], bronchopneumonia with clinical shyness in suspicion of respiratory infections in the presence or absence of infectious factors. The control group which consists of 23 cases that are occasionally selected without clinical signs and anamnestic for respiratory infection. All the examinations were performed as in the study group.

Results

The results are compared in the ratio between procalcitonin (PCT) and C reactive protein (CRP) and differentiated according to the etiology of infection. - In Upper respiratory tract infections [ITSR] - Acute tonsillopharyngitis.

The diagnosis is based on: presence of fever, changes in tonsils, lack of cough, cervical front lymphadenopathy. For the diagnosis of infections, we are based on findings such as: PCT, CRP, Le (neutrophil, lymphocytes), cramps.

According to etiology tonsillopharyngitis we have classified into:

- Bacterial: 10 or 28.57%, viral: 18 or 51.42%, unknown etiology 7 or 20% Out of a total of 35 cases, PCT increases to 12 or 34.3% of cases. CRP increased to 42.9%, in 77% increased number of leukocytes, increased lymphocytes at 68.6%, neutrophils in 31.42% of cases, the presence of local changes in tonsils at 88.57%, the cervical lymph glands in excess of 37.1%, coughing is not present at 45.7%, fetal condition in admission at 87.9%, positive strike in 17.14 cases.

- In respiratory tract infections [ITPR] – bronchopneumonia. The diagnosis of pneumonia was

based on findings: radiography and fever (> 37.5°C), respiratory phenomena, radiological diagnosis was done by independent radiologists and pediatricians, for the differentiation of infections we were based on findings such as PCT, CRP, Le (neutrophile, lymphocytes), aspirate tracheal. According to bronchopneumonia etiology we have classified: bacterial: 16 or 39.02%, viral: 9 or 21.95%, atypical 6 or 14.63%, unknown etiology10 or 24.39%.

Of the 41 cases, PCT increases to 26 or (63.4%), CRP to (34.1%), increased leucocytes at 75.6%, neutrophils increased to 46.34%, lymphocytes increase in 53.7%, out of 53.65% of patients with positive bronchopneumonia radiography, resulted in 63.63%, at 65.9% coughing present, febrile condition in admission in 75.6% of cases, and positive aspirations at 17.03%.

In the control group: Of the 23 cases, slight increase in Procalcitonin is found in 4 cases and in three cases in the newborn, which has not been significant for respiratory infections.

Children with tonsillopharyngitis

In patients with tonsillopharyngitis disease at 12 or 34.4% of patients showing increases in the value of the procalcitonin, 23 or 65.7% were with normal values of procalcitonin, the mean procalcitonin value was 1.73 ng/ml (Table 1).

Table 1: Percentage distribution by procalcitonin value in tonsillopharyngitis patients

Procalcitonin ng/ml	Number	Value in Percent
Patients with normal value (up to 0.25 ng/ml)	23	65.7%
Patients with values above normal (> 0.25 ng/ml)	12	34.3%
Total:	35	**100%**
The average value of procalcitonin in all patients	1.73 ng/ml	

In all 35 studies with bacterial tonsillopharyngitis disease, specificity, sensitivity, PPV, NPV of procalcitonin, which resulted in the following (88%, 90%, 75%, 95.65%), and P = 0.12.

Procalcitonin (PCT):
Sensitivity 90%
Specificity 88%
PPV 75%
NPV 95.65%
P = 0.12

Patients with bronchopneumonia

In patients with bronchopneumonia at 26 or 63.4% of patients showing PCT increase (cut-off > 0.25 ng/ml), 15 or 36.6% are of normal PCT values, the PCT average value were 6.61 ng / ml (Table 2).

Table 2: Percentage distribution of patients according to the value of procalcitonin, in patients with bronchopneumonia

Procalcitonin	Number	Value in Percent
Patients with normal value (up to 0.25 ng/ml)	15	36.6%
Patients with values above normal (> 0.25 ng/ml)	26	63.4%
Total	41	100%
Mean	6.61 ng/ml	

In all 41 patients with bacterial broncho-pneumonia, the following were calculated: Specificity, Sensitivity, PPV, NPV of procalcitonin, which resulted as follows (72.73%, 100%, 76%, 100%). and P = 0.12.

PCT:
Sensitivity: 100.00%
Specificity: 72.73%
PPV: 76.00%
NPV: 100.00%
P= 0.12

Statistical processing in the control group

In a studied control group of patients, leukocytes, lymphocytes, neutrophils, procalcitonin, CRP Tek 6 or 26.1% of patients showed a slight increase in the value of procalcitonin and in three cases in the newborn, 17 to 73.9% normal, the average PCT percentage in the patients studied as a control group was 0.28% (Table 3).

Table 3: Percentage distribution of patients as percentage of procalcitonin in patients as control group.

Procalcitonin	Number	Value in Percent
Patients with normal values(< 0.25 ng/ml)	17	73.9%
Patients with values above normal(> 0.25 ng/ml)	6	26.1%
Total	23	100%
Average value of lymfocits in all patients	0.28 ng/ml	

Discussion

Based on the results in both diagnoses of acute tonsillopharyngitis and bronchopneumonia PCT, CRP, Neutrophils have resulted in:

PCT:
Sensitivity: 95 %
Specifity: 80.36%
PPV: 75.5%,
NPV: 97.82%

CRP:
Sensitivity: 74.41%,
Specificity: 78.00%
PPV: 63.39%
NPV: 84.15%

Neutrophile sensitivity 90.57%, specificity 82.11%, PPV 77.92%, NPV 92.35%.

Which confirms the highest PCT values as compared to CRP and neutrophils in pediatric respiratory infections.

In all 35 studies with acute bacterial procalcitonin tonsillopharyngitis disease, the results were: Sensitivity, Specificity, PPV, NPVs below (90%, 88%, 75%, 95.65%) and P = 0.12. In all 41 patients with proximal bronchial bronchopneumonia disease resulted in: Sensitivity, Specificity, PPV, NPVs below (100%, 72.73%, 76%, 100%) and P = 0.12. According to the study our percentage of bacterial infections according to the criteria for diagnosis of bacteria based on the growth of PCT, CRP, leukocyte-neutrophils, lung radiography, acute stroke auscultative phenomena, febrile condition, is presented in these values:

- bacterial infections of the upper respiratory tract at 28.57%;
- bacterial infections of the respiratory tract at 39.02%.

As a result of the early detection of infections according to their etiology, it is possible to reduce antibiotic delivery, reduce day of stay or exclude the need for hospitalization.

Although this method has its own difficulties due to the high cost, it should be noted that from studies conducted by other authors, as it results from our study, the benefits are very large for patients as well as for health institutions having consider the rational use of antibiotics to be used in hospitals and shortening the days of attitudes in them.

Therefore, early and accurate diagnosis of bacterial infections is feasible at pediatric age using the procalcitonin method in order to prevent unnecessary administration of antibiotics or the same not to be initiated at all.

Conclusions

a) In our study PCT has resulted in 95% sensitivity, 80.36% specificity, PPV 75.5%, 97.82% NPV. Which confirms high PCT reliability compared to CRP and neutrophils in pediatric respiratory infections.

b) In all 35 patients with acute bacterial tonsillopharyngitis disease Procalcitonin resulted in: Sensitivity, Specificity, PPV, NPV (90%, 88%, 75%, 95.65%) and P = 0.12.

c) In all 41 patients with bacterial bronchopneumonia, procalcitonin resulted in: Sensitivity, Specificity, PPV, NPVs below (100%, 72.73%, 76%, 100%) and P = 0.12.

e) With high statistical value we can conclude that in our study PCT has resulted with 95% sensitivity, 80.36 specificity, 75.5% PPV, 97.82% NPV (p = 0.12) and difference between study group and the control group is of high statistical significance (p = 0.003). This correlation or statistical link is significant, i.e. important (p = 0.003).

Recommendations

1) Although this method has its own difficulties due to the high cost of procalcitonin reagents, the benefits are great:

- Reduce daytime hospitalization and rational use of antibiotics

2) Openness to further studies opens, as a new database of pediatric fields has been established, from clinically proven and diagnosed patients.

3) Establish the database of these data in the form of computer,

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