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C-REACTIVE PROTEIN, LEUKOCYTES AND ERYTHROCYTE SEDIMENTATION RATE AS IDENTIFICATORS OF INVASIVE BACTERIAL INFECTIONS

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Abstract: *The **aim of the study** is to evaluate the usefulness of leukocytes, CRP and ESR as identificators of invasive bacterial infections at children. We have prospectively evaluated 705 patients divided into two groups:1) group A with 110 patients having invasive bacterial infections and 2) group B with localised bacterial infections comprised of 595 patients. Mean values for leukocytes was 12536/mm3 ± 6642 for invasive bacterial infections versus 11263/mm3 ± 5285 for localized bacterial infections ($p < 0.0336$). Mean ESR for invasive infections was 31.13 mm/hr ± 29.11 versus 25.94 mm/hr ± 22.93 for localized infections ($p < 0.08$). Mean CRP for invasive infections was 25.45 mg/dl ± 42.57 versus 13.58 mg/dl ± 24.10 ($p < 0.04$) for localized bacterial one. This study suggest that CRP, ESR and leukocytes are good indicators in diagnose of invasive bacterial infections.*

Key words: *C-reactive protein, leukocytes, ESR, invasive bacterial infections, localized bacterial infections.*

1. Introduction

Several recent studies have discussed the usefulness of white blood cell count, C-reactive protein (CRP), ESR (erythrocyte sedimentation rate) as a screen for bacterial infection and to compare it to other laboratory markers [10], [11], [18], [19]. These were all prospective observational studies of infants and children who presented to the emergency department for evaluation of fever. The ability to distinguish bacteremia and other serious invasive bacterial infections from noninvasive or benign infections based on white blood cell count, ESR and C-reactive was evaluated [1], [2], [17]. The direct application of these results to the evaluation and treatment of occult bacteremia has some limitations [3–6].

2. Materials and Methods

We obtained white blood cell, ESR (erythrocyte sedimentation rate) and C-reactive protein along with culture data

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from infants and children presented to the Emergency Department of Children's Hospital Brasov, Romania, between 2006 and 2007. These data were obtained from our hospital patient database that prospectively capture information. Information was collected regarding patient history, laboratory results, culture results, medications, diagnoses and other aspects of clinical care.

3. Statistical Analysis

Continous variable are presented as mean ± standard deviation and categorial variables as absolute and relative frequencies. The statistical significance of the comparison of proportions was determined using chi square test. We conducted the analysis with Statistical StatSoft.inc.program.

4. Results

We identified 705 patients with bacterial infections, 110 patients having invasive bacterial infections and 595 patients with localised bacterial infections. 3,71% of invasive infections were pyelonephritis (55 cases); 2,36% were bronchopneumonia (35 cases) and 1,34% were sepsis (20 cases). We identified 25 positive urine culture. Of these, 20 were >100.000 *E. Coli* and 5 were >100.000 *Proteus.*

The following cultures were excluded from the analysis as their organisms were considered to be contaminants: unspecified streptococci, Gram-positive rods.

Of the 21 positive blood cultures, 6 were positive with MRSA, 5 were positive with *Klebsiella*, 4 were positive with *Streptococcus Pneumoniae*, 4 were positive with *Streptococcus beta hemolitic group B*, 2 were positive with *Pseudomonas Aeroginosa* and 1 of these was positive with *E.Coli.*

Mean values for leukocytes was 12536 /mm^3 ± 6642 for invasive bacterial infections versus 11263/mm^3 ± 5285 for localised bacterial infections (p< 0.0336).

Mean value for granulocytes was 6842.52/mm^3 ± 5309.15 for invasive bacterial infections versus 6253.51/mm^3 ± 4396.46 for localised bacterial infections (p=ns).

Mean values for lymphocytes was 4954.76/mm^3 ± 3243.47 for invasive bacterial infections versus 4135.73/mm^3 ± 2575.32 for localised bacterial infections (p < 0.011).

Mean CRP for invasive infections was 25.45 mg/dl ± 42.57 versus 13.58 mg/dl ± 24.10 for localized bacterial one (p < 0.04).

Mean ESR for invasive infections was 31.13 mm/hr ± 29.11 versus 25.94 ± 22.93 for localised infections (p < 0.08).

The mean age for invasive infections was significantly lower (2,79 years) than localized bacterial infections (3,76 years) **(**p<0.043).

We repeated the acute inflammatory markers after 24 hours. Mean values for leukocytes, after 3 days was 10101.63/mm^3 ± 4542.11 for invasive bacterial infections versus 1096.24/mm^3 ± 9511.40 for localized bacterial infections (p < 0.59).

Mean values for granulocytes, after 3 days was 4765.67/mm^3 ± 3009.86 for invasive bacterial infections versus 4790.47/mm^3 ± 2569.71 for localised bacterial infections (p=ns).

Mean values for lymphocytes, after 3 days was 5243.70/mm^3 ± 3338.44 for invasive bacterial infections versus 4718.23/mm^3 ± 2366.99 for localised bacterial infections (p < 0.34).

Mean CRP after 24 hours, for invasive infections was 4.29 mg/dl ± 2.67 versus 4.40 mg/dl ± 5.83 for localized bacterial one (p =ns).

Mean ESR after 2 weeks, for invasive infections was 21.42 mm/hr ± 14.02 versus 31.24 mm/hr ± 14.02 for localised infections (p < 0.07).

Table 1

Means for leukocytes, granulocytes, lymphocytes, ESR and CRP in localized and invasive bacterial infections

	Localized bacterial Infection			**Invasive bacterial Infection**			
	Mean	**Std.Dev.**	**Cases**	**Mean**	**Std. Dev.**	**Cases**	**P**
Age [days]	1373.45	1698.40	595	1019.74	1630.03	110	0.0440
Leukocytes [#/mm^3]	11263.83	5285.01	545	12536.53	6642.51	101	0.0336
Granulocytes [#/mm^3]	6253.61	4396.46	494	6842.52	5309.15	88	0.2632
Lymphocytes [#/mm^3]	4135.73	2575.32	462	4954.76	3243.47	82	0.0112
ESR [mm/hr]	25.94	22.93	407	31.13	29.11	76	0.0839
CRP [mg/dL]	13.58	24.10	144	25.45	42.57	28	0.0405

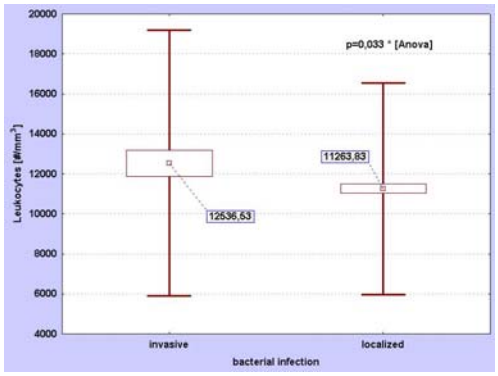

Fig.1. *Mean values for leukocytes in localized and invasive bacterial infections*

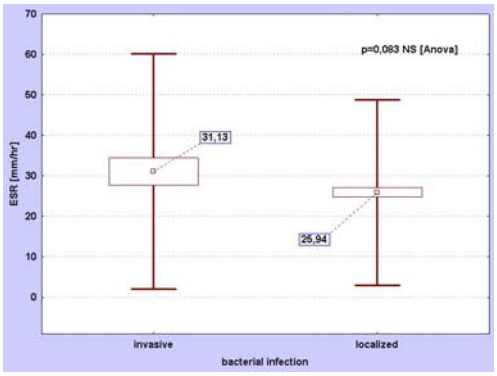

Fig. 3. *Mean values for ESR in localized and invasive bacterial infections*

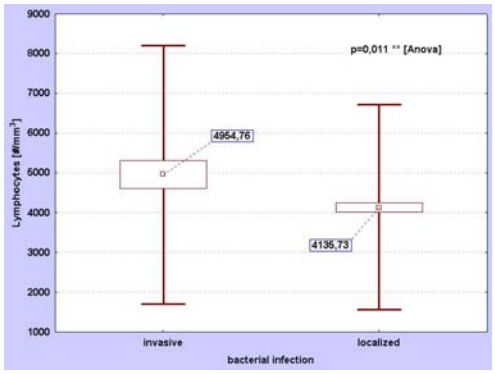

Fig. 2. *Mean values for lymphocytes in localized and invasive bacterial infections*

5. Discussion

Acute infections are very common during infancy and childhood. Although the majority of these are caused by viral agents, many infants and children receive unnecessarily antibiotic treatment. It is important for the pediatrician to be able to differentiate viral from bacterial infection, localized from invasive infection, not only using clinical signs, but also using low cost and easily performed laboratory tests [7], [12–15].

The goal of screening criteria and lab tests in evaluation of infants and young

children with fever has been to determine which patients are at a low risk (which patients can be safely managed as outpatients without antibiotic treatment) for infection compared to the ones that are at high risk.

The use of acute inflammatory markers to distinguish localized from invasive infections has been applied in children by using C - reactive protein and procalcitonin both being considered as the most useful tools [3], [8], [10], [11]. White blood cell count and granulocytes count are inferior indices in differentiating localized from invasive infections [3], [20], [21].

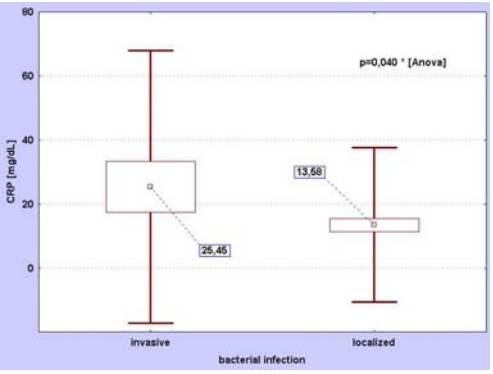

Fig. 4. *Mean values for CRP in localized and invasive bacterial infections*

The present study is aiming to establish a possible relationship between infectious indices (C- reactive protein, ESR, white blood cell count) and the likelihood that these correlations could be used to differentiate localized from invasive infections.

A missed diagnosis of invasive bacterial infection can be catastrophic because of its high morbidity and mortality associated of the disease [7]. Empirical antibiotics are frequently administered to infants and children with suspected bacterial invasive infections [5], [9], [16].

However, the majority (89,90 %) of the children of our study have negative blood cultures. There is a widespread and often unnecessary exposure to antimicrobials, intravenous access and frequent admission to intensive care nurseries of infants and children that have viral infections as far as their lab examination reveals.

We found white blood cell count, ESR, C- reactive protein to be helpful in distinguishing invasive or serious bacterial infections from localized infections.

Our study is limited by the lack information on previous antibiotic exposure. It is important to highlight that our study was not designed to address the issue of using white blood cell count, ESR, C- reactive protein indices to determine duration of antimicrobial therapy after its initiation. We did not differentiate a negative culture obtained on antibiotic therapy from one obtained when the infants or children were not on antibiotics. We therefore were unable to address the question of whether certain white blood cell count, ESR and C- reactive protein obtained after initiation of antimicrobial can be used to predict the need for continuation of treatment.

6. Conclusion

We consider that CRP, ESR and leukocytes are good indicators in diagnose of invasive bacterial infections.

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