# Biochemical Correlations in Peritoneal Sepsis in Children

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*The biochemical analysis in acute peritonitis follows the assessment of the objective severity degree sustained by endotoxicosis, homeostasis disorders and acid-base balance. We had monitored the biochemical peculiarities and correlations in acute peritonitis in children during a retrospective study statistically analyzed on a group of 127 patients in the period 2009-2014. The obtained results were consistent with the form and late phase of peritonitis.*

*Keywords: peritonitis, biochemistry, alterations*

Despite the scientific progress in the last decades, the degree of systemic endothelial damage in acute peritonitis in children remains a topical issue in scientific research due to the complications they cause, with a frequency ranging from 10% to 35.5% [1 - 3].

According to literature data, it is known that an extracellular dehydration characterized by osmotic pressure depletion occurs in most patients with purulent peritonitis, in the conditions of negligible deviation of electrolytes as compared to the normal limits [4-6]. But in the case of severe peritonitis [13], the osmotic pressure increases (intracellular dehydration), which does not depend on electrolyte disturbances, but is conditioned by the formation of biologically active substances, which determines the degree of intoxication [4, 5].

The academic studies are poor in results on the particularities of the biochemical examination and on the assessment of the severity degree of acute peritonitis in children, which justifies the actuality of this study.

## Experimental part

*Material and method*

We performed a retrospective study on a number of 127 patients admitted and treated in the Pediatric Clinic Section of Sf. Ioan Emergency Clinical Hospital for Children, Galati and in Surgery Clinic II of Sf. Ap. Andrei Emergency Clinical Hospital, Galati, during 2009-2014.

The inclusion criteria were age between 0 months and 18 years old and the presence of signs of peritonitis and endotoxicosis.

The statistical analysis was carried out with the XLSTAT 2017, program using descriptive analytical methods, univarious and multivarious statistical analytical methods: average / median, standard deviation, box-plot diagrams, media comparison tests, Student, ANOVA, Pearson correlation coefficient, main component analysis (correlation circle and biplot diagrams).

The degree of statistical significance has been set according to the values of the *parameter p*:

-p <0.05, the difference between the two averages is significant;

-p <0.01, the difference between the two averages is highly significant;

-p <0.001, the difference between the two averages is very highly significant;

-p> 0.05, the difference between the two averages is insignificant;

**Table 1**

ANALYZED STATISTICAL PARAMETERS

| Analyzed parameter | Number of patients (%) |
|---|---|
| Median age (years old) (interval) | 13 (0.01-18) |
| **Age groups (years old)** | |
| 0-6 | 23 (18.11) |
| 7-12 | 37 (29.13) |
| 13-18 | 67 (52.76) |
| **Sex** | |
| Male | 74 (58.26) |
| Female | 53 (41.73) |
| **Origin environment** | |
| Urban | 41 (32.28) |
| Rural | 86 (67.72) |
| **Peritonitis etiology** | |
| • acute appendicitis | 56 (44.09) |
| • diverticulitis | 12 (9.45) |
| • invagination | 6 (4.72) |
| • other causes | 53 (41.73) |

## Results and discussions

The incidence of cases according to the age group revealed the frequency of the interval 13-18 years old in 52.76% cases, corresponding to the period of maximal development of the lymphatic system and to the prevalence of appendicular etiology of peritonitis. The greatest difference between the average and the median was observed at the *age* parameter, which varied within wide limits: the average age = 11.658 years old and the median = 13 years old.

The male sex was affected in 58.25% cases, as compared to the female sex, which was affected in 41.73% cases out of the analyzed cases.

In the 127 cases of peritonitis in children, a significantly higher incidence had been observed in the rural patients, 67.72%, as compared to ones from the urban environment, 32.28%, which can be explained by the poor quality of healthcare in the territory and by the delay in diagnosis, their coming to the hospital being already late, in the complication stage.

The appendicular peritonitis had prevailed in 44.09% cases, where the following were considered as contributing factors: late addressability, diagnostic errors

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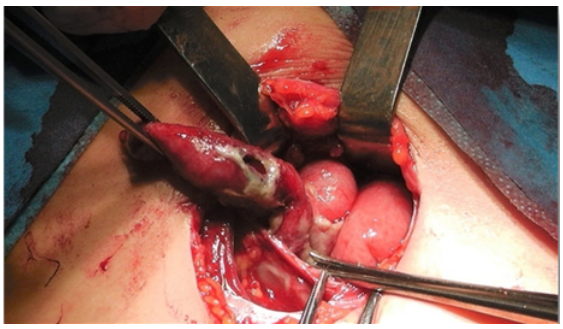

Fig. 1. Perforated gangrenous appendicitis with localized peritonitis, intra-surgical aspect Pediatric Surgery Department, Sf.Ioan Children's Hospital

due to the atypical manifestations of the acute appendicitis and the low age of children.

The time interval between symptomatology's onset and admission to hospital was the most frequent for 24-48 h in 40.16% cases, followed by those for 48-72 hin 25.2% cases and those for over 72 h in 22.05% cases.

**Table 2**

THE RESULTS OF LABORATORY EXPLORATIONS

| Hematological/biochemical constants | Values |
|---|---|
| Hb values at admission into hospital (g/dl)<br>Median, (interval, min-max)<br>Average (±DS) | 11.9 (8.2-15.8)<br>11.99 (±1.54) |
| Ht values at admission into hospital (%)<br>Median, (interval, min-max)<br>Average (±DS) | 33.7 (22.5-46.3)<br>33.83 (±4.18) |
| Electrolyte values<br>Low<br>Normal values | 23 (18.11)<br>104 (81.89) |
| Alkaline reserve<br>Low<br>Normal values | 23 (18.11)<br>104 (81.89) |

The hydro-electrolyte imbalances induced in the set-up and evolution of peritonitis were monitored through electrolyte values and alkaline reserve. Changes were noted in 18.11% of cases, present particularly in the case of severe *neglected* peritonitis.

Negative correlations between onset - admission to hospital and Hb, Ht and electrolyte values were identified, in the sense that, with the increase of the time interval between the onset of the symptoms and the time of admission to hospital, the values of the above mentioned hematological constants showed lower values.

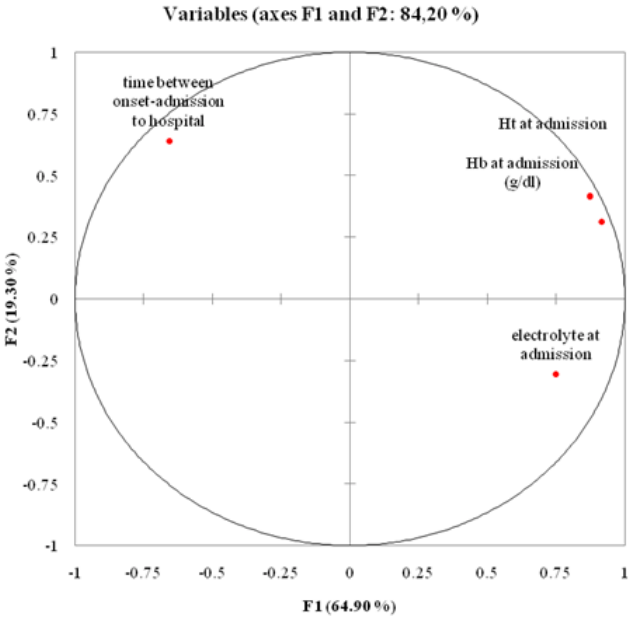


Fig. 2. The circle of correlations on the time between onset and admission to hospital with: Hb, Ht, electrolyte at admission

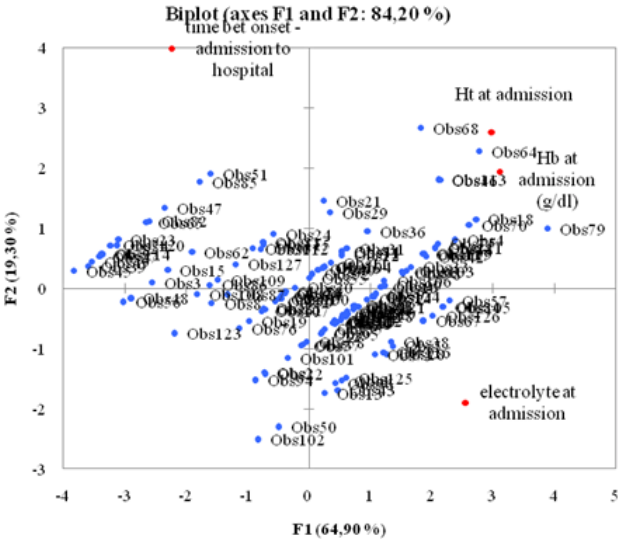


Fig. 3. Biplot chart for the time between onset and admission to hospital and admission with: Hb, Ht, electrolyte at admission

**Table 3**

CORRELATION MATRIX BETWEEN ONSET – ADMISSION TO HOSPITAL WITH: Hb AT ADMISSION TO HOSPITAL, Ht AT ADMISSION TO HOSPITAL, LOW ELECTROLYTE

| Correlation matrix. Pearson Coefficients | | | | |
|---|---|---|---|---|
| **Variables** | Time between onset – admission to hospital | Hb at admission to hospital (g/dl) | Ht at admission to hospital | Electrolyte at admission to hospital |
| **Time between onset – admission to hospital** | 1 | -0.432 | -0.359 | -0.455 |
| **Hb at admission to hospital (g/dl)** | -0.432 | 1 | 0.886 | 0.537 |
| **Ht at admission to hospital** | -0.359 | 0.886 | 1 | 0.463 |
| **Electrolyte at admission to hospital** | -0.455 | 0.537 | 0.463 | 1 |

**Table 4**

CORRELATION MATRIX BETWEEN THE OCCLUSIVE STAGE AND Hb, Ht, ELECTROLYTE VALUES

| Variables | Occlusive stage of peritonitis | Hb at admission to hospital (g/dl) | Ht at admission to hospital | Electrolyte values at admission to hospital | Age (years old) |
|---|---|---|---|---|---|
| Occlusive stage of peritonitis | 1 | -0,416 | -0,340 | -0,500 | 0,014 |
| Hb at admission to hospital (g/dl) | -0,416 | 1 | **0,886** | **0,537** | 0,434 |
| Ht at admission to hospital | -0,340 | 0,886 | 1 | 0,463 | 0,467 |
| Electrolyte values at admission to hospital | -0,500 | **0,537** | **0,463** | 1 | 0,128 |
| Age (years old) | 0,014 | 0,434 | 0,467 | 0,128 | 1 |

The occlusive stage of peritonitis had correlated negatively and strongly with Hb and, respectively, with electrolyte values at admission, CP = - 0.416 respectively, CP = 0.5. A negative but weak correlation occurred between occlusive status and Ht values at admission, CP = - 0.340. The patients with occlusive peritonitis presented lower Hb, Ht and electrolyte values at admission to hospital.

Also, strong and positive correlations were recorded between Hb values and Ht values (CP = 0.886) and electrolyte values at admission to hospital (CP = 0.537).

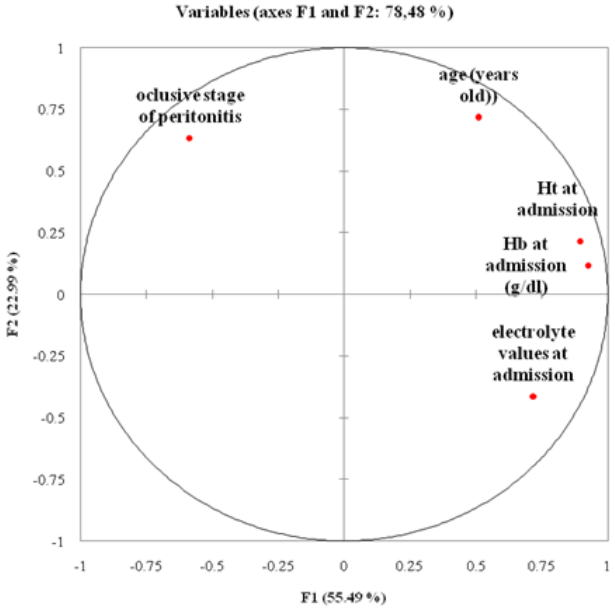


Fig. 4. Circle of correlations between the occlusive stage and Hb, Ht, electrolyte values

The data from the literature suggest that acid-base balance plays a decisive role in the regulation of hydro-saline metabolism through mutual interaction [7, 8]. Acidic products constantly penetrate the body as a result of cellular anaerobic metabolism. In the case of hepato-renal damage, these products cannot be metabolized. Under the conditions of acute peritonitis, intensification of metabolism occurs with increasing the energy use. The low energy input and the increased excretion of metabolites, electrolytes and water, lead to the depletion of carbohydrate reserves and the use of lipid and protein reserves as an energy substrate. As a result of the breakdown of these substances, lactic products, acids - ketone compounds, oxybutyric acid, lactic acid, pyruvic acid are formed, which further aggravates acidosis. In addition, oligoanuria, the decrease of the circulating blood volume, alkaline loss simultaneously with vomiting, diarrheal stools, lead to tissue hypoxia, lactic acid accumulation and other acidic compounds [9-11].

Dyspnea occurs in children with peritonitis, which in connection with algic syndrome and the limitation of diaphragm movements, a rapid pulmonary de-compensation for eliminating these products occurs, and simultaneously with the diminishing of the renal flow, the renal excretion decreases and subcompensated metabolic acidosis passes into the decompensated phase [12, 14].

## Conclusions

Concepts on the diagnosis of acute peritonitis are based on clinical signs, supplemented with laboratory and imaging data.

Depending on the acute peritonitis form and phase and the correlation with the biochemical data, it is possible to adopt an appropriate therapeutic attitude, differentiated by the endotoxicosis severity degree.

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