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Diagnostic value of platelet parameters versus interleukin-6 in children with urinary tract infection

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KEYWORDS

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Abstract *Background:* Urinary tract infection (UTI) is a common problem that is frequently encountered by pediatric healthcare providers. Diagnosis of UTI is often difficult, particularly in critically ill patient and in patients with nonspecific and mild symptoms. Testing for platelet parameters is inexpensive, easily accessible and routinely performed that had been recognized as a hallmark in the diagnosis of platelet activation during infection and inflammatory disorders.

Aim: To evaluate the value of platelet parameters in the diagnosis of UTI in children in comparison to interleukin-6.

Method: This case–control study included 88 children; 44 of them had culture proved UTI. In addition 44 age and sex matched healthy children served as a control group. Complete blood picture with emphasis on platelet parameters (mean platelet volume (MPV), platelet distribution width (PDW) and platelet count), C-reactive protein, erythrocyte sedimentation rate and interleukin-6 serum levels were done for both groups. We investigated the correlation between platelet parameters, inflammatory biomarkers and the type of organism in children with UTI.

Results: Platelet parameters were significantly higher in children with UTI in comparison to those of the control group. There was a significant positive correlation between platelet parameters, ESR, CRP and interleukin-6 in children with UTI. MPV & PDW have 90.1% & 88.6% sensitivity and 86.3% & 84.1% specificity respectively for diagnosis of UTI. Platelet parameters are significantly higher in children with gram positive infection.

Conclusion: Platelet indices could be used as an indicator of UTI in children. It could predict the type of causative organism. Further researches are needed to evaluate its role for detection of recurrence of UTI in high risk children.

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Introduction

Urinary tract infections (UTI) are a common and a serious clinical problem in children. About 8% of girls and 2% of boys develop at least one episode of acute UTI during childhood. UTI has been increasingly recognized as an occult cause of febrile illness in infants and young children.[1] Upper urinary tract infections (i.e., pyelonephritis) may lead to renal scarring, hypertension, and end-stage renal disease.[2]

The diagnosis of febrile urinary tract infection (UTI) is often difficult in young children who are not capable of accurately describing their physical problems.[3] In young children; UTI presented with nonspecific symptoms include discomfort, fever, poor oral intake, malaise and vomiting.[4] Early diagnosis and prompt antimicrobial treatment are required to minimize renal scarring and progressive kidney damage.[5]

The issue of appropriate urine sampling techniques is of particular concern in young children, where the collection of a sterile, midstream sample can be problematic. Different methods of urine sampling may be differently susceptible to contamination and hence to false positive results.[6,7] Suprapubic aspiration has been regarded as the reference standard collection method which is an invasive procedure that may require the use of ultrasound guidance. The reference standard for diagnosis of UTI in children is any bacterial growth of a urine culture that had been obtained by suprapubic aspiration. Although urine culture is regarded as the gold standard of diagnosis, it takes at least 48 h to obtain confirmative results.[8]

When used alone, urinalysis or blood tests such as C-reactive protein (CRP) may be inadequate due to their nonspecific nature.[9] In children with UTI, antibiotic treatment should be initiated as soon as possible to eradicate infection, prevent bacteremia, improve outcome, and reduce the likelihood of renal involvement.[10] This leads to excessive use of antibiotics with a risk of adverse reactions and bacterial resistance. To improve diagnosis, alternative more rapid, more reliable, cost effective diagnostic methods are required.[11]

Complete blood count is routinely ordered in most patients with UTI, and information regarding the patient's platelet indices is available, easily accessible, without added cost. A well-prepared peripheral blood film can be used for evaluation of platelet number, size, distribution, and structure under light microscope. However, with availability of automated cell counters more precise information can be gathered.[12]

Platelets are highly complex anucleated cells. They are the derivatives of bone marrow megakaryocytes. Platelets are believed to be active participants in the host defense through phagocytosis and generation of cytotoxic free radicals and oxidative molecules when activated. Platelets can potentiate inflammatory process by enhancing recruitment of leukocytes and inhibiting the apoptosis of neutrophils, monocytes, and eosinophils.[13,14]

Mean platelet volume (MPV), a parameter routinely determined by complete blood count analyzers, indicates the average size of platelets and reflects the platelet production rate and stimulation.[15] Platelet distribution width (PDW) is an indicator of variation in platelet size which reflects platelet activation. Normal values of PDW are between 10% and 17.9%. PDW more than 20% is considered high.[16]

Although MPV & PDW are not generally taken into consideration by clinicians; they are valuable markers of platelet activation.[17] A higher MPV value is indicative of increased platelet activity reflecting more intense inflammation.[18] Platelet indices had been studied as an inflammatory marker in various diseases[19,20] but there are no sufficient data about its role in the diagnosis of UTI in children.

IL-6 is a multifunctional cytokine with proinflammatory and immunoregulatory functions. It is a key activator of the acute-phase response and acts on the hypothalamic temperature regulatory center.[21] IL-6 concentrations are considered as useful diagnostic tools increase early in children with different forms of UTI and are higher in patients with acute pyelonephritis than in those with asymptomatic bacteriuria.[22]

On the basis of these previous data, we conducted the present study to assess whether platelet indices are useful markers for diagnosis of UTI in children in comparison to acute phase reactant (ESR & CRP) and IL-6 serum levels. Our hypothesis is that alteration of the platelet morphology can be a reliable index for early diagnosis and management of UTI without waiting for blood culture results. We try to demonstrate a link between the platelet indices and the type of organism, whether gram positive or gram negative to allow proper selection of the empiric antibiotic regimen.

Patients and methods

This prospective case–control study was conducted in pediatric inpatients and outpatient clinics of Al Hussein, Bab El Sharia and AL Zahraa university hospitals, Al-Azhar University, Cairo, Egypt during the period from January 2015 to July 2015. The study included 44 children with culture proved UTI and 44 age and sex matched healthy children as a control group. Informed consent was obtained from the participating children's parents in adherence to the guidelines of the ethics committee of AL-Azhar University, Cairo, Egypt.

All children were subjected to the following: Detailed history and thorough clinical examination. The relevant clinical history includes demographic data, presenting symptoms, any previous surgery, and current medications. The findings of systemic and abdominal examinations were recorded in detail. The assessment of growth by anthropometric measurements was represented by weight and length/height, which were plotted on Egyptian growth Charts 2002[23] to detect weight for age and height/length for age percentiles. Systolic and diastolic blood pressure was assessed in all studied children and plotted on blood pressure chart for age to detect any deviation from normal expected values for age.[24]

UTI was diagnosed according to clinical symptoms (fever, vomiting, anorexia, dysuria, frequency of micturition, abdominal or flank pain) and confirmed by abnormal urine analysis and positive urine culture.

The following criteria were included in our study: age from 2 years up to 6 years, positive urine culture (urine culture reviled more than 10^5 colonies/ml of a single pathogen in a midstream urine sample). On the other hand we excluded children with any hematological disorders affecting the platelet (e.g. Hemolytic anemia, iron deficiency anemia, thrombocytopenia, and leukemia), those with any concomitant acute or chronic illness (e.g. diabetes, obesity, hypothyroidism, autoimmune diseases as ankylosing spondylitis, rheumatoid arthritis, inflammatory diseases as acute appendicitis, ulcerative colitis, chronic infectious diseases, chronic renal, cardiac, hepatic