Original Research Article

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20181520

Platelet indices in children with urinary tract infection

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Received: 05 February 2018 **Accepted:** 07 March 2018

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ABSTRACT

Background: Urinary tract infection is one of the most common infection in children and may lead to serious morbidity like chronic pyelonephritis and renal scarring. Our hypothesis is that alteration of the platelet morphology can be a reliable index for early diagnosis and management of UTI without waiting for urine 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 antibiotic regimen.

Methods: It is a retrospective case control study where 35 urine culture proven cases and 35 cases of non UTI cases was taken as control. Children with haematological diseases affecting platelet were excluded. Platelet indices were taken including for MPV, PDW and platelet count and statistically analysed.

Results: MPV and PDW were higher in patient with culture proven especially with gram positive organism.

Conclusions: Although urine culture is considered as golden standard for diagnosis of urinary culture, it is time consuming. But early diagnosis can prevent renal parenchymal complications. Hence, we tried to find out other early, easy and sensitive method for detection of urinary tract infections in children. Platelet parameters (thrombocytosis, mean platelet volume, platelet distribution width) is available in analyser report of any complete blood count with no added value. It was also found that gram positive organism has higher mean platelet volume and platelet distribution width as compared to gram negative organism.

Keywords: Culture positive growth, Mean platelet volume, Platelet distribution width, Urinary tract infection

INTRODUCTION

Urinary tract infection is one of the most common infections in children and may lead to serious morbidity and mortality in children. UTI associated with high grade vesicoureteral reflux (VUR) can lead chronic pyelonephritis and eventual renal scarring which are components of reflux nephropathy. Larly diagnosis and prompt antimicrobial treatment are required to minimize renal scarring and progressive kidney damage. Larly

In children most often, urinary tract infection (UTI) manifests as fever of unknown origin. The clinical

presentation of UTI in infants and young children can vary from occult and undiagnosed fever to gastrointestinal manifestations as well as upper and lower urinary tract symptoms whereas, in older children symptoms referring to the urinary tract may be observed6. In 1st year of life, urinary tract infection is more common in boys than girls. After 1 year, this ratio reverses and girls show more predominance of urinary tract infection than boys. Certain anatomic and physiologic factors are responsible for this variation in ratio. 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. Suprapubic aspiration has been regarded as the reference standard collection method which is an invasive procedure. Although urine culture is regarded as the gold standard of diagnosis, it takes at least 48 h to obtain confirmative results. Antibiotic treatment should be initiated as soon as possible to eradicate infection, prevent bacteraemia, improve outcome, and reduce the likelihood of renal involvement leading to excessive use of antibiotics with a risk of adverse reactions and bacterial resistance.

Laboratory findings of UTI usually show leukocytosis, neutrophilia, and increased erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP) levels. Complete blood count is routinely ordered in most of these patients, and information regarding the patient's platelet indices is made available without added cost. Thrombocytosis in cases of upper UTI though often unexpected and most of the time ignored is present in most of cases. It is a response of the bone marrow to the infection and is therefore classified as secondary thrombocytosis.

Mean platelet volume (MPV), a parameter routinely determined by complete blood count analyzer's, indicates the average size of platelets and reflects the platelet production rate and stimulation. A higher MPV value is indicative of increased platelet activity reflecting more intense inflammation 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%. Platelet indices had been studied as an inflammatory marker in various diseases but there are no sufficient data about its role in the diagnosis of UTI in children.

The hypothesis is that alteration of the platelet morphology can be a reliable index for early diagnosis and management of UTI without waiting for urine 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 antibiotic regimen.

METHODS

This prospective case—control study was conducted in paediatric ward of Kempegowda Institute of Medical Science, Bengaluru, India. The study included 35 children with culture proved UTI as cases and 35 non UTI cases as control. Informed consent was obtained from the participating children parents.

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 IAP

growth charts. Systolic and diastolic blood pressure was assessed in all studied children. 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.

Blood samples

Five ml of venous blood sample was drawn under complete aseptic conditions (alcohol swab 70%). CBC parameters including mean platelet volume (MPV) and platelet distribution width (PDW). Blood film was done. CRP was assayed (reference range <0.5mg/L).

Inclusion criteria

- Age from 1 month up to 17 years,
- Positive urine culture
- Urine culture revealing more than 105 colonies/ml of a single pathogen in a midstream urine sample

Exclusion criteria

- 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 diseases)
- Those who received antibiotic therapy or other medications affecting the platelet count as antihypertensive drugs or anticoagulants.

Data entry and analysis

The data was entered in Microsft Excel and analyzed in Epidata analysis V2.2.2.184 and SPSS 20.0 software. The continuous variables age, haemoglobin values, total count, ESR, MPV, Platelet count, PDW and CRP were reported as Mean (SD). The categorical variables such as group (urinary tract infection present and absent), gender, urine albumin, pus cells, red blood cells, urine culture and gram staining were reported as proportions.

The association between continuous variables and the groups (urinary tract infection present and absent) were assessed using independent t test or Mann Whitney U test and the association between categorical variable and groups were assessed using Chi Square test or Fishers exact test. The correlation between platelet parameters and haematological parameters were reported using Pearson correlation test. The area under the curve, sensitivity and specificity of various haematological parameters in identifying urinary tract infection was found using receiver operating curves. The p value of <0.05 was considered for statistical significance.

RESULTS

Total no of cases and control were 35 each of which 37 were female (17 cases and 20 control) and 33 male (18 cases and 15 controls).

Increase in total leukocyte count, C reactive protein, mean platelet volume (MPV), Platelet distribution width (PDW) and platelet count were statically significant in patients with urinary tract infection. Author found that, though urinary albumin level were more in case group as compared to control group, but it was not significant.

Table 1: Demographic characteristics of children with and without UTI.

	Urinary tract infection absent (n=35)		Urinary tract infection present (n=35)		Total no. of participants	P value
	Median(N)	Inter quartile range(%)	Median(N)	Inter quartile range(%)	participants	
Age in years	8	3-11	4	1-11	70	0.146*
Gender						
Male	18	51.4	15	42.9	33	0.473#
Female	17	48.6	20	57.1	37	0.473"

^{*}Mann Whitney U test # chi square test

Table 2: Hematologic parameters of children with and without UTI.

	Urinary tract infection absent (N=35)		Urinary tract infection present (N=35)		Total no. of	Dareles
	Mean/ Median	SD/ inter quartile range	Mean/ Median	SD/ inter quartile range	participants	P value
Hemoglobin	12.1	1.8	11.1	1.4	70	0.010†
Total leukocyte count	7644	3764.4	15912	5805.5	70	<0.001†
ESR median (IQR)	18	13-22	15	10-22	70	0.693*
Mean platelet volume	10.2	0.8	12.4	1.0	70	<0.001†
Platelet count (in lakhs) median (IQR)	1.9	1.1-2.9	3.7	3.0-4.6	70	<0.001*
PDW	10.8	1.0	13.6	1.9	70	<0.001†
C Reactive protein	0.5	0.3-0.8	2.1	1.3-4.0	70	<0.001*

^{*}Mann Whitney U test †unpaired t test

Table 3: Urinary parameters of children with and without UTI.

	Urinary tract infection absent (N=35)		Urinary trac (N=35)	ct infection present	Total no. of	P value
	Number	Percentage	Number	Percentage	participants	
Urine albumin						
Nil	32	91.4	30	85.7	62	
Traces	1	2.9	3	8.6	4	0.404#
1+	1	2.9	2	5.7	3	0.494#
2+	1	2.9	0	0.0	1	
Pus cells						
< 5	35	100.0	1	2.9	36	
5-10	0	0.0	13	37.1	13	<0.001#
>10	0	0.0	21	60.0	21	
Red blood cells						
Nil	35	100.0	34	97.1	69	1.000§
5-6 cell	0	0.0	1	2.9	1	1.000°
Urine culture						
No growth	35	100.0	0	0.0	35	
E. coli	0	0.0	25	71.4	25	
S. aures	0	0.0	3	8.6	3	<0.001#
Klebseilla	0	0.0	3	8.6	3	<0.001#
Strepococci	0	0.0	1	2.9	1	
Proteus	0	0.0	3	8.6	3	

[#] chi square test §Fisher exact test

Pus cells in urine were divided in 3 categories <5/HPF, 5-10/HPF and >10/HPF. Pus cells were found significantly high in group with urinary tract infection than control group. This result was found significant by using statically methodology.

Urinary red blood cells though were increased in cases, was not statically proven to be significant enough.

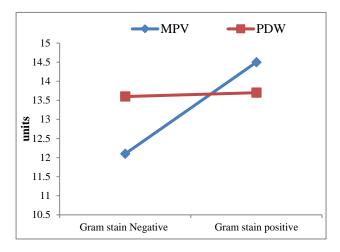


Figure 1: Hematologic parameters of children with and without UTI (N=35).

Both mean platelet volume (MPV) and PDW (platelet distribution width) increases with gram positive infections as compared to gram negative cultures. The p value being <0.05.

Table 4: Sensitivity and specificity pattern of various parameters.

Parameter	AUC	P value	Sensitivity	Specificity
Hemoglobin	0.665	0.017	60.0%	63.0%
Total count	0.90	< 0.001	91.4%	71.4%
ESR	0.53	0.694	62.9%	34.3%
CRP	0.91	< 0.001	88.6%	83.9%
PDW	0.91	< 0.001	82.9%	83.9%
Platelet count	0.85	< 0.001	82.9%	77.1%
MPV	0.99	< 0.001	97.1%	97.1%

DISCUSSION

The early diagnosis of UTI may be difficult especially during infancy but is important for early management and prevention of renal parenchymal damage which leads to renal scarring, renal hypertension and ultimately renal failure.

Platelets, as a part of the natural immune system, can be elevated as a part of acute phase reaction during the inflammatory process. Activation of the platelets causes some morphological alterations: the activated platelets seem larger by becoming spherical in shape and forming

pseudopodia. Platelet activation leads to changes in platelet shape with an increase in platelet swelling leading to an increase in MPV and PDW. Role of MPV as acute phase reactant has been studied by many.^{7,8}

Present study demonstrated that children with UTI had a significantly higher platelet index (MPV and PDW) than children with non UTI causes with significant increase in platelet indices (MPV and PDW) in children with gram positive UTI in comparison to those with gram negative infection.

Tekin et al had reported thrombocytosis and elevated MPV and PDW in patients with UTI in comparison to healthy controls.⁹

This is in accordance with Catal et al. who demonstrated that the platelet counts were higher in patients with upper UTI and MPV values were higher in Gram-positive infections compared with Gram-negative infections. ¹⁰ He speculated that the rise in MPV in UTI can be caused by increased production of larger and /or younger platelets as a reaction to infection related platelet destruction, and increased level of beta- thromboglobulin in bacterial infection might activate and release platelet.

Another mechanism by Senaran et al reported that, there was positive co-relation between thrombopoietin (TPO) levels and MPV values in patients with coronary artery disease. 11

On the other hand, many studies revealed that platelet count is greatly decreased in severe sepsis (thrombocytopenia) but this occurred mainly in late stages of sepsis or severe septicemia as in septic shock due to severe exhaustion of bone marrow (bone marrow failure).

CONCLUSION

Although urine culture is considered as golden standard for diagnosis of urinary culture, it is time consuming. But early diagnosis can prevent renal parenchymal complications. Hence, author tried to find out other early, easy and sensitive method for detection of urinary tract infections in children.

Platelet parameters (thrombocytosis, mean platelet volume, platelet distribution width) is available in analyser report of any complete blood count with no added value. It was also found that gram positive organism has higher mean platelet volume and platelet distribution width as compared to gram negative organism.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

 $Institutional\ Ethics\ Committee$

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Cite this article as: Srinivasa S, Dhingra P. Platelet indices in children with urinary tract infection. Int J Contemp Pediatr 2018;5:953-7.