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Assessment of Urinary Tract Infection and Estimation of Procalcitonin Serum Level Among Iraqi Children

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Abstract

Urinary tract infections (UTIs) considered as a serious public health issue, especially in children, which can be caused by a variety of organisms, especially gram-negative bacteria. Procalcitonin (PCT) is a precursor of the calcitonin hormone, which normally released in the thyroid gland, and this biomarker has become more effective in diagnosing bacterial infections in the last decade. Moreover, to establish the utility of procalcitonin for predicting urinary tract infections in children. The current study included two groups of patients of approximately sixty cases from patients with urinary tract infection (UTI), besides, sixty cases from healthy individuals. Samples were collected from Al Imamain Al-Kadhimain Medical City in Baghdad. The result showed a highly significant difference in procalcitonin levels in UTI patients compared to the control group. The results of this investigation support the use of PCT as an indicator for the diagnosis of UTI children.

Keywords: Procalcitonin, PCT, Urinary tract infection, UTI among children.

1. Introduction

Urinary tract infection is one of the most common bacterial illnesses, affecting approximately 150 million people worldwide [1-2]. In microbiology, UTIs are defined as the inflammatory response of the urothelium to microbial invaders [1,2]. In children, UTI may affect either the upper urinary tract causing pyelonephritis or the lower urinary tract causing to as cystitis [3]. The severity of urinary tract infection depends on the virulence of the bacteria and the susceptibility of the host [4]. There are many pathogens responsible for UTI, the

most prevalent bacterium is Escherichia coli (E.coli) between 60 % and 70 % of cases [5]. Other species of bacteria that involved are Staphylococcus, Proteus spp., Enterococcus spp, K. pneumoniae and P. aeruginosa [6]. Procalcitonin (PCT), a precursor of the calcitonin hormone, which thought to be a marker of bacterial infection; studies have shown that procalcitonin levels rise after bacterial infection [7]. PCT is normally generated by the thyroid, but in cases of bacterial infections, it is released as an acute-phase reactant by the neuroendocrine cells of the gut and lung [8]. Procalcitonin (PCT) is an important biomarker that aids in the diagnosis of bacterial infections, determining the severity of the disease, estimating the patient's response to specific treatment, and preventing antibiotic overuse [9, 10]. Furthermore, the current study aimed to establish the utility of procalcitonin for predicting urinary tract infections in children.

2. Materials and methods

2.1 Sample and study design

The ethical-review committee has approved the research inside the Medical College of Al-Iraqia University. Two different types of specimens collected include 120 blood, and 120 urine samples. Samples were collected from children from various age groups between three to twelve years old at Al Imamain Al-Kadhimain Medical City in Baghdad. These samples were divided into two groups. The first group is the control group consisting of sixty healthy individuals, while the second group is the study group which also consists of sixty individuals who suffer from UTI.

2.2 Sample processing

2.2.1 Urine sample processing

A total of 120 midstream urine samples were collected using a variety of techniques, such as urine cups, bag urine, and clean-catch urine. Then, collected 120 urine samples were investigate the presence of urinary tract infections by two different techniques, includes dipstick screening technique where urine samples were tested by using the multi-sticks technique to indicate pH, sugar, protein, leukocyte esterase, nitrite levels. The results were read after one minute. The second technique involved microscopic examination of urine specimen. Urine samples were centrifuged for five minutes at 3000 to 4000 rpm. After that, the sediments were directly examined under high power microscopically (× 40) lens to determine the R.B.C.s, pus cells, epithelial cells, crystals, casts, monilia, mucus, and

bacteria. Furthermore, positive tests samples were cultured on appropriate media to identify the type of bacterial infections. Also, culture media include blood agar, macconkey agar, mannitol salt agar and eosin methylene blue agar, where each one of them was prepared according to the manufacturer instructions of the company.

2.2.2 Blood sample processing

One hundred and twenty blood samples were collected, transferred inside gel tubes, and centrifuged to obtain serum. Then, the serum was moved into a plain tube and kept in a refrigerator to measure the immunological tests that include Procalcitonin.

2.3 Measurements of human procalcitonin by ELASA

Following the protocol of the manufactured company, an indirect ELISA (enzyme linked immune-sorbent assay) test was run to determine serum levels of Human PCT ELISA kit (catalog number YLA0401HU ,96T) with a (Biomedical/ UK ELISA system) microtiter plate reader to calculate the results. Additionally, the sandwich, Human PCT ELISA kit, six standards were made according to the instructions of the manufacturing company to be used for quantification and analysis of Human serum PCT (pg/ml). In relation to the extinction ratio of the tested pattern or monitored pattern to the extinction of the calibrator, the quantitative results have been studied. Furthermore, resulting data for both groups (control and infected) were counted and analyzed using statistical analysis system (SAS).

3. Results

3.1 Samples collection

One hundred and twenty specimens of blood, besides one hundred and twenty specimens of urine were obtained at a ratio of 1:1 from both the patient and control groups. These samples were analyzed following the inclusion and exclusion criteria. The age of study samples was normally distributed and ranged from three to twelve years old.

3.2 Urinalysis

3.2.1 Dipstick results

The urine dipstick is made of chemically treated paper that, when immersed in a urine sample, changes color to indicate the presence of blood, leukocyte esterase, nitrites, and protein. These results of the dipstick are displayed in (table 1).

Table 1: Dipstick test results.

Test	Dipstick test	Male	Female	Total	%
PH	Acidic (4.5-6.9)	44	67	111	92.5 %
	Alkaline (7.1-9.0)	3	6	9	7.5 %
Leukocytes esterase	Positive	21	32	53	44.2 %
	Negative	26	41	67	55.8 %
Nitrite	Positive	12	33	45	37.5 %
	Negative	35	40	75	62.5 %

3.2.2 Microscopic examination of urine

The general urine examination test to diagnose a urinary tract infection, revealed the following results in the microscopical examination and dipstick test, as listed in (table 2). Then, the urine culture test was applied to positive samples.

Table 2: Finding of microscopical.

Microscopic Examination	cell /H.P.F	Male	Female	Total	%	P
Pus	<10	29	33	62	51.6 %	<0.0001
	>10	18	40	58	48.3 %	
R.B.C	>10	4	9	13	10.8 %	0.18
	<10	43	64	107	89.1 %	
Calcium Oxalate	Presence	19	31	50	41.6 %	<0.0001
	Absent	28	42	70	58.3 %	

3.3 Estimation of procalcitonin serum level

The resulted data of procalcitonin was highly significant with P value P≤0.01, in UTI patients than the control group as showing in the (table 3).

Table 3: Distribution of procalcitonin.

Group	Procalcitonin frequency				P-value
	Positive (>0.25 ng/ml)		Negative (0-0. 25 ng/ml)		
	No.	%	No.	%	
Controls	3	4.98 %	57	94.62 %	0.0001 **
Patients	53	87.98 %	7	11.62 %	0.0001 **
P-value	---	0.0001 **	---	0.0001 **	---
** (P≤0.01).					

The serum level of procalcitonin elevated significantly (P≤0.01), with mean 0.735 ±0.032 (ng/ml) in UTI children, compared to the healthy group 0.170 ±0.011 (ng/ml) as listed in (table 4).

Table 4: Comparison between control and infected in procalcitonin serum level.

Group	Mean ± SE of Procalcitonin level (ng/ml)
Control	0.170 ± 0.011
Infected	0.735 ± 0.032
T-test	0.0694 **
P-value	0.0001
** (P≤0.01).	

4. Discussion

The procalcitonin serum level data from our present study indicated that the mean was 0.735 ±0.032 ng/ml in the patient group and 0.170 ±0.011 ng/ml in the control group. This indicates that there was a significant rise in procalcitonin in the infected individuals. The current research supports the findings of Suhaila N. Darogha [11], who found that PCT levels in UTI patients (104.6 ± 6.07) and control groups (54 ± 2.24) differed significantly ($p<0.0001$) and that an increase in PCT caused by a bacterial infection in the urinary tract. Moreover, our findings agree with the findings of Levine [12], with PCT was a strong predictor of a positive UTI. Besides, the findings of Justin Choi [13] showed that procalcitonin serum level offer a novel diagnostic strategy for urinary tract infections, which is consistent with the current results. In bacterial infections, procalcitonin that activated by the bacterial endotoxin, or lipopolysaccharides, as well as other inflammatory cytokines including IL-6 and IL-1 in infections. The procedure applied to help the marker for the quick detection of urinary tract infections (UTIs), to enhance the care of UTI patients and lowers the need for medications.

5. Conclusion

Urinary tract infection is common in children, and although asymptomatic UTI has a prevalence of 25.9 %. Most urinary tract infections in children are due to gram-negative bacteria. The predominant bacteria among gram-negative bacteria were E.coli with (51.66 %), while S. aureus were the most common isolates among gram-positive bacteria with (18.33 %). This study found that serum levels of procalcitonin were much higher in UTI patients when it compared to the control group, which may play a role in the development of UTI in children. Moreover, the current study concludes that procalcitonin serum level offers a good diagnostic strategy for urinary tract infections among children.

6. References

1. Sihra N., Goodman A., Zakri R., Sahai A., and Malde S., (2018). Nonantibiotic prevention and management of recurrent urinary tract infection. Nature reviews. Urology. 15, 12, 750-776.
2. Briel M., Schuetz P., Mueller B., Young J., Schild U., Nusbaumer C., Périat P., Bucher H. C., and Christ-Crain M., (2008). Procalcitonin-guided antibiotic use vs a standard approach for acute respiratory tract infections in primary care. Archives of internal medicine. 168, 18, 2000-2008.
3. Leung A. K. C., Wong A. H. C., Leung A. A. M., and Hon K. L., (2019). Urinary Tract Infection in Children. Recent patents on inflammation and allergy drug discovery. 13, 1, 2-18.
4. Säemann M., and Hörl W. H., (2008). Urinary tract infection in renal transplant recipients. European journal of clinical investigation. 38 Suppl 2, 58-65.
5. Foxman B., (2002). Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. The American journal of medicine. 113 Suppl 1A, 5S-13S.
6. Nicolle L. E., (2000). Urinary tract infection in long-term-care facility residents. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America, 31, 3, 757-761.
7. Lee H., (2013). Procalcitonin as a biomarker of infectious diseases. The Korean journal of internal medicine. 28, 3, 285-291.
8. Samsudin I., and Vasikaran S. D., (2017). Clinical Utility and Measurement of Procalcitonin. The Clinical biochemist. Reviews. 38, 2, 59-68.
9. Davis G. S., Waits K., Nordstrom L., Weaver B., Aziz M., Gauld L., Grande H., Bigler R., Horwinski J., Porter S., Stegger M., Johnson J. R., Liu C. M., and Price L. B., (2015). Intermingled Klebsiella pneumoniae Populations Between Retail Meats and Human Urinary Tract Infections. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America. 61, 6, 892-899.
10. Bharath M. S., Ramesh S. Hiremath, and Arini Basu. (2017). Role of procalcitonin and C-reactive protein in urinary tract infection diagnosis in adults. International Journal of Advances in Medicine. 4, 2, 417-419.

11. Darogha S. N., Azeez S. H., and Abdullah Z. G., (2022). Evaluation of Procalcitonin and Interleukin-6 as a Marker of Bacterial Urinary Tract Infection. Cellular and molecular biology (Noisy-le-Grand, France). 67, 4, 203–213.
12. Levine A., Tran M., and Naut Edgar. (2018). The Diagnostic Value of Recalcitration In Urinary Tract Infections. Critical Care Medicine. 46, 1, 306.
13. Choi J. J., McCarthy M. W., Meltzer K. K., Cornelius-Schecter A., Jabri A., Reshetnyak E., Banerjee S., Westblade L. F., Mehta S., Simon M. S., Zhao Z., and Glesby M. J., (2022). The Diagnostic Accuracy of Procalcitonin for Urinary Tract Infection in Hospitalized Older Adults: a Prospective Study. Journal of general internal medicine. 37, 14, 3663-3669.