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Research Article

Analysis of C-reactive protein in pyelonephritis

Piyelonefritte C-reaktif protein analizi

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Abstract
Urinary tract infection especially pyelonephritis is a common condition worldwide caused by different uropathogens. The host-response parameters like C-reactive protein (CRP) are important inflammatory markers and diagnostic tests. The aim of this study was to assess the usefulness of CRP in urinary tract infection- pyelonephritis caused by different bacteria for defining the urinary tract infection (UTI). A total of fifty patients with clinical symptoms of pyelonephritis referred to Al-Kindi Teaching Hospital (Baghdad, Iraq), were investigated from October 2009 to November 2009. Clean-catch midstream urine of the patients was collected. Urine specimens were cultured for isolation of the microbial agents of UTI. The isolated bacteria were identified using biochemical tests. CRP were assessed in relation to the inflammatory responses. The most common isolated bacteria were *Escherichia coli* (40%), Enterobacter (20%) and Klebsiella (12%). The least frequent bacteria were *Staphylococcus aureus* (4%), *Streptococcus pyogenes* (4%) and *Streptococcus fecalis* (4%). There was a significant difference (P<0.001) between systemic inflammatory responses (CRP) with urinary tract inflammatory response (pyuria). According to the findings of this study, CRP can be suggested as useful and valuable tests in pyelonephritis.
Keywords: Bacterial agents; C-reactive protein; infection; pyelonephritis; urinary

Özet
Üriner kanal enfeksiyonu özellikle piyelonefrit farklı üropatojenlerin neden olduğu yaygın bir durumdur. C-reaktif protein (CRP) gibi vücut yanıt parametreleri önemli inflamatuar belirteç ve diagnostik testidirler. Bu çalışmanın amacı, üriner kanal enfeksiyonunu tanımlamak için farklı bakterilerin neden olduğu üriner kanal enfeksiyonu piyelonefritte CRP'nin faydasını saptamaktı. Al-Kindi Eğitim Hastanesi'ne (Bağdat, Irak) başvuran piyelonefrit klinik semptomlu 50 hasta, Ekim 2009'dan Kasım 2009'a kadar araştırıldı. Hastaların idrarları temiz bir şekilde toplandı. Üriner kanal enfeksiyonu için mikrobiyal ajanların izolasyonu için idrar örneklerinin kültürü yapıldı. İzole edilen bakteriler biyokimyasal testler kullanılarak tanımlandı. İnflamatuar yanıta ilişkili olarak CRP ölçüldü. En yaygın izole edilen bakteriler, *Escherichia coli* (%40), Enterobacter (%20) ve Klebsiella (%12) idi. En az sıklıkta görülen bakteriler, *Staphylococcus aureus* (%4), *Streptococcus pyogenes* (%4) ve *Streptococcus fecalis* (%4) idi. Sistemik inflamatuar yanıt (CRP) ile üriner kanal inflamatuar yanıt (piyüri) arasında anlamlı fark (P<0.001) vardı. Bu çalışmanın bulgularına göre, CRP piyelonefritte faydalı ve değerli bir test olarak kabul edilebilir.
Anahtar kelimeler: Bakteriyel ajanlar; C-reaktif protein; enfeksiyon; piyelonefrit; üriner

Introduction

Urinary tract infection (UTI) accounts for more than 7 million cases to physicians' clinic and over one million hospital admissions in the United States annually (1). The incidence of UTI is higher among females with an anatomically normal urinary tract. Conversely, in males and children, UTI publicize a urinary tract lesion that must be treated to suppress the infection and prevent recurrence (2). UTI involves upper urinary tract (pyelonephritis). This could result in renal injury with subsequent renal scarring. The most common pathogens responsible for pyelonephritis are Enterobacteriaceae with a high predominance of *Escherichia coli* (cystitis and pyelonephritis). Other strains are less common, including *Proteus mirabilis*, Klebsiella and Enterobacter. Other gram-positive microbe is *Staphylococcus saprophyticus* that is responsible for 5% to 15% of such primary infections (3).

Recognizing the level of infection is important primarily in patients older than two years in order to determine low-risk patients. Many tests help in defining the level of UTI like determination of antibodies against the infecting bacteria, detection of antibody-coated bacteria in urine, urography, ultrasonography and renal scintigraphy (4-6).

Serum C-reactive protein (CRP) level and erythrocyte sedimentation rate (ESR) have been found to be of worth in UTI (7). For ESR, moderate elevations are common in active inflammatory diseases and infections, but normal ESR cannot be used to exclude infections (8). Progressive neutrophilic leukocytosis is common in UTI (9). Measurement of CRP level has been advised for monitoring of disease processes and for diagnosis of pyelonephritis (10). Studies on the usefulness of CRP for the diagnosis of UTI have so far been confined to the study of school girls and determination the site of urinary tract infection (10,11).

This study was undertaken to determine the type of bacteria that was isolated from pyelonephritis, total count of pus cells in general urine examination, and value of CRP as analytic guides in UTI.

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Patients and methods

A total of fifty patients with clinical symptoms of pyelonephritis (lumber pain, fever and hematuria) referred to Al-Kindi Teaching Hospital (Baghdad, Iraq), were investigated from October 2009 to November 2009. Clean-catch midstream urine of the patients was collected in a sterile tube (4-5 ml) and immediately transported to the laboratory. Guidelines for proper specimen collection were given to all patients on a printed card (12).

The study was approved by the Ethical Committee of the Al-Kindi Teaching Hospital, and all samples were obtained with informed consent in accordance with the Al-Kindi Teaching Hospital Declaration.

Bacterial colony count of bacteria was done by a measured amount of urine, using calibrated loop method was inoculated to nutrient agar medium (MAST Lab., England) for colony count. One or more than one urine cultures of midstream samples with only single potential pathogen or two potential pathogens and a colony count of 105 or more colony-forming units per milliliter were considered positive for pyelonephritis (13).

Urine cultures were performed according to standard technique. All the bacteria isolated from urine in this study were identified using conventional biochemical tests (14). Pyuria was defined as five or more leukocytes in a high-power field in the urine sediment by general urine examination (15). Serum level of CRP was evaluated in all of the patients by qualitative method of latex-CRP (Spinreact, Spain). Results of latex-CRP tests were reported according to the presence or absence of agglutination and size of agglutinated droplets on microscopic examination: no agglutination was considered to be negative and small-sized agglutinated droplets was considered to be positive. The patients were divided into two groups according to CRP results: CRP positives or CRP negatives.

Statistical analysis

Non-parametric chi-square test and Fisher's exact test was used to compare results, and a P value less than 0.05 was considered significant.

Results

Totally, 50 patients were included in this study, 32 of which (64%) were females and 18 (36%) were males. The age of patients ranged from 6 to 70 years (mean 17.5± SD 20.7). The most common isolated bacteria were *Escherichia coli* (40%), Enterobacter (20%) and Klebsiella (12%). The least frequent bacteria were *Staphylococcus aureus* (4%), *Streptococcus pyogenes* (4%) and *Streptococcus fecalis* (4%) as shown in Table 1.

Patients with a positive CRP were not significantly more frequent than those with a negative CRP (P = 0.266) as demonstrated in Table 2. There was a significant difference (p<0.001) between systemic inflammatory responses (CRP) with urinary tract inflammatory response (pyuria) as demonstrated in Table 3. After treatment with proper antibiotics by their physicians the positive percentage of CRP patients was decreased to (5 out of 50 patients) 10%.

Table 1. Frequency of bacterial agents isolated from urine specimens of patients with urinary tract infection.

Positive cases		Isolated bacteria
%	No	
40	20	*Escherichia coli*
20	10	*Enterobacter*
12	6	*Klebsiella*
8	4	*Proteus*
8	4	*Pseudomonous aeruginosa*
4	2	*Staphylococcus aureus*
4	2	*Streptococcus pyogenes*
4	2	*Streptococcus fecalis*
100	50	Total

Table 2. Patients with urinary tract infection and positive CRP according to sex.

P value	CRP negative		CRP positive		Sex
	No.	%	No.	%	
0.266	12	24	20	40	Female
	4	8	14	28	Male

Table 3. Patients with pyuria and positive CRP.

Patients with pyuria	CRP positive		CRP negative		P value
	No.	%	No.	%	
<5 pus cells/ HPF	0	0	16	32	<0.001
>5 pus cells/ HPF	34	68	0	0	

HPF, High power field

Discussion

CRP is a simple noninvasive test that is used for diagnosis of invasive bacterial infections and determining the UTI level. In our study, we found a significant increase (P<0.001) in CRP with pyuria and urinary tract infection- pyelonephritis. This was in agreement with Peltola and Rasanen (16) who found that CRP was usually highest and reflected bacteramic disease reliably. Lin and associates (17) reported that the most sensitive indicator for UTI was pyuria, and its combination with CRP improved the specificity to 98%. In this study (17), they demonstrated that increased CRP values between 25 mg/l to 300 mg/l were found in all patients with pyelonephritis. In contrast, Hellerstein and coworkers (11) found that serum CRP concentrations were not accurate in localizing the site of UTI and dimercaptosuccinic acid (DMSA) renal scintigram is the test of choice to make diagnosis of pyelonephritis (18). Ayazi et al. (19) found no significant correlation between renal parenchymal involvement and serum level of CRP.

The most common isolated bacteria in this study was *Escherichia coli* (40%), Enterobacter (20%) and Klebsiella (12%). The uropathogens identified in our study are similar to those of many other studies conducted in different countries (3,20,21). There were some differences in the percentages of isolated bacteria with other studies. This may be due to site of infection, host factors, environmental conditions, socioeconomic and hygiene standards. The least frequent bacteria were *Staphylococcus aureus* (4%), *Streptococcus pyogenes* (4%) and *Streptococcus fecalis* (4%). The prevalence of Gram-positive cocci was not high in our study; this is similar to other studies (22).

According to the findings of this study, CRP can be suggested as useful and valuable tests in pyelonephritis.

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