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URINARY INFECTION

Original Article

For reliable urine cultures in the detection of complicated urinary tract infection, do we use urine specimens obtained with urethral catheter or a nephrostomy tube?

Komplike üriner sistem enfeksiyonunda perkutan nefrostomiden ve üretral kateterden alınan idrar kültürlerinden hangisi daha güvenilirdir?

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ABSTRACT

Objective: The aim of this study was to compare the results of urine cultures obtained either from urethral, and percutaneous nephrostomy (PCN) catheters.

Materials and methods: This study included 328 consecutive patients that underwent PCN at our institution with complicated urinary tract infections (UTIs) between July 2010 and April 2015. Results of urine cultures obtained from the urethral and nephrostomy catheters were compared.

Results: This study included 152 male and 176 female patients. Mean age of the patients was 46.2±24.3 years. The main indications were obstructive uropathy due to urolithiasis complicated with pyonephrosis 145 (44%), malignant disease (n=87; 26%), pregnancy (n=26; 8%), and anatomical abnormality (n=23; 7%). One hundred and twenty three patients had diabetes mellitus. The most common causative organisms were *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. Blood cultures showed the same results for the PCN and bladder urine cultures. The bladder urine culture was positive in 304 patients, while the PCN urine culture in 314 patients.

Conclusion: PCN is an important treatment for the management of pyonephrosis. Cultures from the PCN yield valuable information that is not available from urethral urine cultures, and is a guiding tool for antibiotic therapy selection.

Keywords: Complicated urinary tract infection; percutaneous nephrostomy culture; urethral culture.

ÖZ

Amaç: Çalışmanın amacı üretral ve perkutan nefrostomi (PN) kateterlerinden alınan idrar kültür sonuçlarını karşılaştırmaktır.

Gereç ve yöntemler: Bu çalışma komplike idrar yolu enfeksiyonu nedeniyle Temmuz 2010 ve Nisan 2015 yılları arasında PN takılan 328 hastayı kapsamaktadır. Hastalardan idrar kültürü aynı anda hem üretral hem de PN kateterinden alınmış ve sonuçlar değerlendirilmiştir.

Bulgular: Bu çalışma 152 erkek ve 176 kadın hastayı içermektedir. Hastaların ortalama yaşı 46,2±24,3 yıl olarak bulundu. Piyonefroza neden olan obstruktif patoloji sırasıyla ürolitiazis 145 (%44), malign hastalık 87 (%26), gebelik 26 (%8) ve anatomik anomali 23 (%7) olarak bulundu. Hastalardan 123'ü diyabet hastasıydı. En sık etken mikroorganizmalar sırasıyla *Escherichia coli*, *Klebsiella pneumoniae* ve *Pseudomonas aeruginosa* olarak bulundu. Kan kültürü sonuçları ile perkutan nefrostomiden alınan kültür sonuçları benzerdi. Üretral idrar kültürü 304 hastada, perkutan nefrostomi kültürü ise 314 hastada pozitif saptandı.

Sonuç: Perkutan nefrostomi pyonefrozlu hastaya yaklaşımda önemli bir tedavidir. Perkutan nefrostomiden alınan idrar kültüründe üretral idrar kültürüne göre daha fazla etken üretilmiştir bu nedenle antibiyotik seçiminde kılavuz olarak seçilmelidir.

Anahtar Kelimeler: Komplike üriner sistem enfeksiyonu; perkutan nefrostomi kültürü; üretral kültür.

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Introduction

Urinary tract infections (UTIs) are problematic conditions frequently encountered by primary care physicians, emergency care physicians, and urologists.[1] A complicated UTI (cUTI) can be associated with any condition that increases the probability of acquiring infection. These UTIs do not typically respond to standard treatment because of the presence of any anatomical abnormality or pathophysiology.[2] It is generally related to urinary stasis which provides the time and opportunity for bacteria to adhere to the urothelium, and infect the patients.[3] Percutaneous nephrostomy (PCN) is now a well-established technique for providing temporary or permanent drainage of an obstructed urinary system.[4] A contributing factor such as ureteral obstruction may cause renal dysfunction and render the kidneys less effective in concentrating antibiotics in the urine. Ureteral obstruction causes incomplete eradication of bacteria and increases bacterial resistance. The most important determinants of cUTI caused by resistant strains are previous use of antibiotics and the presence of underlying urological diseases.[5] The microbiological spectrum is wider, with a greater prevalence of mixed infections. *E. coli* remains as the most commonly isolated microorganism (40–70%).[6]

The correct and rapid recognition of complicated pyelonephritis is important. When complicating factors are present, antimicrobial resistance is more common and the response to therapy is often disappointing, even with agents active against the pathogen.[7]

The aim of this study was to evaluate UTI and compare urine culture results obtained from PCN tube and urethral catheter.

Material and methods

After obtaining institutional review board approval, and informed consent from each participant, 328 consecutive patients with cUTI who underwent PCN at our institution between July 2010 and April 2015 were reviewed. Results of urine cultures obtained from urethral and nephrostomy catheters were compared. Blood cultures were obtained from only 12 patients because of the presence of clinical symptoms of sepsis. We defined a positive culture as a clean- catch midstream urine specimen with a growth of 10^5 cfu/mL of a single microrganism or mixed flora with a predominant species. Negative urine culture was defined as no growth, insufficient growth, or a mixed microbial flora with no predominant organism. Patients with positive preoperative urine cultures were treated with suitable antibiotics based on the susceptibility test results. For patients with mixed flora but a predominant organism on urine culture a specific antibiotic effective on this organism was selected. If culture results contained mixed organisms contamination was established and these results were excluded from the analysis.

A drainage procedure under the guidance of computed tomography or ultrasound was considered when clinical improvement has not been noted within 48–72 h of adequate antimicrobial treatment. If concomitant obstructive uropathy still existed, the upper urinary tract was decompressed with PCN.

All cases of PCN were performed under ultrasonographic or fluoroscopic guidance with local anesthesia with the patient in a prone or prone-oblique position. Prophylactic antibiotics were routinely administered and routine coagulation profiles were obtained before the PCN.

All medical records were reviewed for etiology, clinical presentation, laboratory and microbiological culture reports, definitive treatment, complications, and patient outcomes.

Statistical analysis

For statistical analyses, the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) software package was used. $P<0.05$ was accepted as the cut-off value for the level of statistical significance. The Pearson chi-square method was used to compare parameters between the two groups.

Results

This study population consisted of 152 male, and 176 female patients. The mean age of the patients was 46.2±24.3 years. The main indications were obstructive uropathy due to pyonephrosis with urolithiasis 145 (44%), malignant disease 87 (26%), pregnancy 26 (8%), anatomical abnormalities 23 (7%), diabetes mellitus 123 (37%). PCN was performed on 183 right and 145 left kidneys. Two hundred- ninety procedures were performed under ultrasound guidance alone, while 33 procedures were performed using a combination of ultrasound and fluoroscopic guidance. Patient demographic data are shown in Table 1.

During 328 procedures, major complications were sepsis (n=8), and hemorrhage (n=4) requiring transfusion. In all these patients, the bleeding ceased after prolonged tube drainage within one week. Minor complications within 30 days of follow-up were recorded in 28 patients. Retroperitoneal urine extravasation was encountered in 8 of 328 patients and treated conservatively. Tube-related complications, such as catheter dislodgement and leakage from the catheter occurred in 20 patients.

Causative organisms were *Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Enterococcus spp, Candida albicans, Staphylococcus epidermidis, Acinetobacter spp, Stenotrophomonas,* and *Pantoea*. Blood and PCN culture results were not significantly different. One patient had different urethral urine and blood culture results. Culture results of urine specimens obtained from urethral catheter and PCN tubes dif-

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Table 1. Demographic data of the study population.

Mean age (years)	46.2±24.3
Gender	
Male	152 (46%)
Female	176 (54%)
Side	
Right	183 (56%)
Left	145 (44%)
Technique	
Ultrasound	295
Fluoroscopy	33
Comorbidities	
Urolithiasis	145 (44%)
Malignant disease	87 (26%)
Pregnancy	26 (8%)
Anatomical abnormalities	23 (7%)
Diabetes mellitus	123 (37%)

Table 2. Organisms grown culture positivity rates in urine samples obtained from percutaneous nephrostomy (PCN) tubes and urethral catheters

	PCN culture+(n=314)	Urethral urine culture+(n=304)	p 0.09
Escherichia coli	198 (63%)	192 (63%)	
Klebsiella spp.	48 (15%)	46 (15%)	
Pseudomonas spp.	32 (10%)	31 (10%)	
Enterococcus spp.	13 (4%)	13 (4%)	
Candida spp.	8 (3%)	7 (2%)	
Staphylococcus spp.	11 (4%)	11 (4%)	
Acinetobacter spp	1 (0.3%)	1 (0.3%)	
Stenotrophomonas	2 (0.6%)	2 (0.6%)	
Pantacea	1 (0.3%)	1 (0.3%)	

fered in 18 patients. Urethral urine culture was positive in 304 (92%) patients, while the PCN urine culture in 314 (95%) patients without any statistically significant intergroup differences (p=0.09). However, ten patients had positive PCN, but negative urethral urine culture results. Negative PCN (n=14), and urethral (n=24) urine culture results were detected in respective number of patients (Table 2).

E. coli and *Klebsiella spp*. were commonly sensitive to amikacin (89%-63%), ceftriaxone (24%-23%), ciprofloxacin (50%-50%), imipenem-silastatin (100%-100%), cotrimoxazole (67%-63%) and ampicillin (10%-13%) in urethral urine cultures, respectively. These microorganisms detected on PCN urine culture media were sensitive to amikacin (88%-63%), ceftriaxone (24%-25%), ciprofloxacin (49%-48%), imipenem-silastatin (100%-100%), cotrimoxazole (66%-60%) and ampicillin (12%-15%) (Table 3).

Discussion

The treatment of cUTIs in the presence of urinary tract obstruction requires effective antibiotic therapy as well as appropriate urological intervention to prevent septicemia and recurrent UTIs.[8] Patients who have cUTIs should be hospitalized, and empirical treatment may include intravenous ampicillin and gentamicin or alternatives such as ciprofloxacin, levofloxacin, ceftriaxone, aztreonam, and imipenem-cilastin. The choice of empirical antibiotic treatment should based on local antibiotherapy protocols. Empirical therapy of cUTIs should usually include an intravenous antipseudomonal agent. Targeted therapy should be initiated once susceptibility data are known. Agents commonly prescribed include aminoglycosides, betalactamase inhibitor combinations, imipenem, advanced generation cephalosporins, and fluoroquinolones. Indiscriminate use of quinolones and cephalosporins is strongly discouraged because of increasing bacterial resistance. Therapy is usually switched from parenteral to oral as soon as possible.[8]

The negative urethral urine susceptibility test results did not correlate well the upper urinary tract infection. It has been reported that urine culture and positive calculus culture were better predictors for potential urosepsis than urethral urine specimens.[9] Studies also have shown that the disparity between urethral urine and PCN tube urine cultures ranged from 37% to 52 percent.[10] The reason for the poor correlation between PCN and urethral urine culture results could be related to complete ureteral obstruction which often prevents microorganisms from travelling from upper urinary tract down to the bladder. In this study ten patients had positive PCN, but negative urethral urine cultures.

The discordance between the urine and blood culture results is usually seen in 2-3% of the cases with uncomplicated pyonephrosis.[11] On the other hand, discordance between urine and blood culture results in complicated pyonephrosis is not unusual. It is known that blood, and PCN urine culture results were more similar when compared with urethral urine culture results.

Table 3. Antibiotic suspectibility of isolated microorganisms from PCN and urethral urine cultures

Antibiotic		*Escherichia coli*	*Klebsiella* spp	*Pseudomonas* spp	*Enterococcus* spp	*Staphylococcus* spp
Amikacin	PCN	175 88%	30 63%	17 53%	5 38%	4 36%
	Urethral	170 89%	29 63%	16 52%	5 38%	4 36%
Ampicillin	PCN	23 12%	7 15%		6 46%	3 27%
	Urethral	19 10%	6 13%		6 46%	3 27%
Cefazolin	PCN	39 20%	6 13%			3 27%
	Urethral	38 20%	6 13%			3 27%
Ceftriaxone	PCN	48 24%	12 25%			
	Urethral	47 24%	11 23%			
Ceftazidim	PCN	46 23%	11 23%	17 53%		
	Urethral	45 23%	11 23%	17 55%		
Ciprofloxacin	PCN	98 49%	23 48%	16 50%	7 54%	4 36%
	Urethral	96 50%	23 50%	16 52%	7 54%	4 36%
Imipenem	PCN	198 100%	48 100%	22 69%		
	Urethral	192 100%	46 100%	22 71%		
Meropenem	PCN	198 100%	48 100%	21 66%		
	Urethral	192 100%	46 100%	21 68%		
Piperacillin-tazobactam	PCN	119 60%	25 52%	13 41%		
	Urethral	116 60%	25 54%	13 42%		
Cotrimoxazole	PCN	131 66%	29 60%	12 38%	6 46%	
	Urethral	129 67%	29 63%	11 35%	6 46%	
Vancomycin					13 100% 13 100%	11 100% 11 100%

PCN: percutaneous nephrostomy

[12] In our study, there were no differences between PCN urine and blood culture results. In our patients with positive urine cultures, *E. coli* was the most common organism, which accounted for 60.0% of the positive cultures. *Escherichia coli* is the most frequent etiological agent in any UTI, whereas other gram-negative bacteria such as *Klebsiella spp* or *Proteus ssp* should be considered as well. A recent study that included 800 patients with cUTI, most of which concerned with complicated pyonephrosis, found that *Escherichia coli*, and *Klebsiella spp* were responsible for 63.0%, and 7.0% of the infectious episodes, respectively.[12] In our study, ESBL- producing microorganisms were detected in 58-60% of our patients, which was consistent with previous reports.[13] This etiological spectrum and the ever increasing incidence of ESBL- producing multi-resistant microorganisms demand a special effort in the etiological diagnosis of complicated pyonephrosis.

Percutaneous nephrostomy and ureteral stenting for the treatment of pyonephrosis were compared and it was reported that both percutaneous and retrograde routes were effective. However, 62.0% of PCN urine cultures were positive compared with only 19.0% of retrograde catheter urine cultures.[14] This is because retrograde ureteral stenting has a number of disadvantages in the management of pyonephrosis compared with PCN. Ureteral stent has few disadvantages as it usually comes in smaller sizes, which provides less effective drainage and often needs to be performed in the operating room under general anesthesia. Furthermore, there is the risk of perforating the ureter during

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manipulation. In addition, bacteremia and septicemia may flare up under the pressure of the irrigation fluid.

In conclusion, PCN is an important treatment for the management of pyonephrosis. Although there was no statistically significant differences between groups, number of positive PCN urine cultures was higher when compared with urethral urine cultures. PCN cultures are associated with minor morbidity, provide therapeutic benefit, and its use is recommended as a guiding tool for the re-treatment of pyonephrosis after failed medical therapy.

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