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Validity of bag urine culture for predicting urinary tract infections in febrile infants: a paired comparison of urine collection methods

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Purpose: Catheter urine (CATH-U) and suprapubic aspiration (SPA) are reliable urine collection methods for confirming urinary tract infections (UTI) in infants. However, noninvasive and easily accessible collecting bag urine (CBU) is widely used, despite its high contamination rate. This study investigated the validity of CBU cultures for diagnosing UTIs, using CATH-U culture results as the gold standard.

Methods: We retrospectively analyzed 210 infants, 2- to 24-month-old, who presented to a tertiary care hospital's pediatrics department between September 2008 and August 2013. We reviewed the results of CBU and CATH-U cultures from the same infants.

Results: CBU results, relative to CATH-U culture results ($\geq 10^4$ colony-forming units [CFU]/mL) were widely variable, ranging from no growth to $\geq 10^5$ CFU/mL. A CBU cutoff value of $\geq 10^5$ CFU/mL resulted in false-positive and false-negative rates of 18% and 24%, respectively. The probability of a UTI increased when the CBU bacterial count was ≥105/mL for all infants, both uncircumcised male infants and female infants (likelihood ratios [LRs], 4.16, 4.11, and 4.11, respectively). UTIs could not be excluded for female infants with a CBU bacterial density of 10^4–10^5 (LR, 1.40). The LRs for predicting UTIs based on a positive dipstick test and a positive urinalysis were 4.19 and 3.11, respectively.

Conclusion: The validity of obtaining urine sample from a sterile bag remains questionable. Inconclusive culture results from CBU should be confirmed with a more reliable method.

Key words: Catheter urine culture, Collecting bag urine culture, Febrile infants, Paired comparison, Urinary tract infection

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Introduction

Urinary tract infections (UTIs) are common causes of generalized pyrexia in infants, occurring in approximately 5% of 2- to 24-month-old febrile children[1,2]. Fevers associated with UTIs are usually caused by pyelonephritis[3,4], the early diagnosis and treatment of which are important for the prevention of complications, including renal scarring which are associated with later renal dysfunction and progressive septicemia[5,6]. The diagnosis of a UTI is most commonly accomplished using a urine culture, but the collection of urine samples from infants is difficult. Regardless, choosing an appropriate urine collection method for young children is important to avoid misdiagnosing a UTI. Over-diagnosis of UTIs can lead to unnecessary radiological evaluations and antibiotic treatment[7], and the consequences of under-diagnosis were previously stated.

Suprapubic aspiration (SPA) is regarded as the gold standard method for collecting urine samples with minimal false-positive results[2,8]. However, this method is more invasive and painful than the others[9]. Transurethral catheterization is a less painful method that

has comparable sensitivity and specificity as SPA, making it more routinely used[2,6]. The noninvasive and easily accessible collection and culturing of collecting bag urine (CBU) is widely used in outpatient clinics and emergency units, despite its high contamination rate[2,10].

A few authors have performed paired examinations of the different urine culture methods used for diagnosing UTIs in children of various ages (9 days to 9 years)[11] and in asymptomatic infants during voiding cystourethrograms[7], and with prior selection (by urinalysis) for febrile infants[12]. In this study, we compared the results of CBU cultures and catheter urine (CATH-U) cultures, following the recovery of both sample types from the same patients. The culture results were used to estimate the ability of CBU cultures to diagnose UTIs, when CATH-U samples were considered the "gold standard" for diagnosing UTIs in infants.

Materials and methods

The study population consisted of infants examined in the pediatrics department of Inje University Sanggye Paik Hospital (Seoul, Korea), between September 2008 and August 2013. We retrospectively analyzed patient records to determine if the patients had a potential risk of UTI, based on the following inclusion criteria: (1) a tympanic fever >38°C of unknown origin, (2) patient age of 2–24 months, (3) non–toilet-trained patients, and (4) all female infants and uncircumcised male infants.

Demographic and clinical profiles, laboratory findings, urinalyses, and urine culture results were reviewed for each patient. Only infants with collecting bag and CATH-U cultures, obtained on the same day, were included. Patients already receiving antibiotics or having incomplete data for evaluation were excluded from the study, as were patients with contaminated CATH-U or CBU cultures.

Urine specimens were collected using an aseptic technique, according to our departmental guidelines. After cleansing the perineum with antibacterial cotton (povidone iodine), a urine collection bag was attached to the patient's perineum by trained pediatric nurses. The urine bag was left in place for up to 1 hour, without changing the bag, unless there was evidence of leakage, stool contamination, or the bag separated from the skin. The perineum was also cleaned with povidone iodine before catheterization, which involved inserting an uncontaminated, lubricated, 5-Fr feeding tube into the urethra. Whether the urine was collected via a urine bag or catheterization, the first few drops were routinely discarded because of potential bacterial contamination from the distal urethra[2,13]. Within 30 minutes of collection, the urine specimens were sent to the laboratory for prompt urinalysis and culture. This study received ethical approval from the institution`s research board.

1. Definitions

The following definitions were based on published descriptions [2,5,14–19]. Dipstick tests were defined as positive if either nitrite or leukocyte esterase (LE) was positive. Microscopy was positive if either the white blood cell (WBC) counts were $\geq 10/mm^3$ or bacteria were present. Positive urinalysis was defined when the dipstick and/or microscopy evaluations were positive. A CATH-U culture was considered indicative of a UTI if the culture grew only a single species of bacteria at a density of $\geq 10^4$ colony-forming units (CFU)/mL. CBU cultures were stratified, based on the presence of a single uropathogen species at densities of $\geq 10^3$, $\geq 10^4$, and $\geq 10^5$ CFU/mL, and were compared to the positive/negative CATH-U results. The definition of CBU contaminants was similar to that of CATH-U, except for the bacterial colony count. Contaminants of CATH-U results were defined as: (1) bacteria present at densities of $<10^4$ CFU/mL, (2) the presence of mixed pathogens, (3) recovery of organisms such as *Lactobacillus* spp., coagulase-negative staphylococci (CNS), and *Corynebacterium* spp., or (4) different pathogens were isolated from the two urine samples from the same patient. Urine cultures were considered to be negative if bacteria were not recovered.

The patients were categorized into three groups according to the number of bacteria recovered from their urine cultures. The UTI group was subdivided into patients with high CBU colony counts (CBU $\geq 10^5$ CFU/mL and CATH-U $\geq 10^4$ CFU/mL, group A) and those with low CBU colony counts (CBU $<10^5$ CFU/mL and CATH-U $\geq 10^4$ CFU/mL, group B). If bacteria were not cultured from the CATH-U samples, the patients were classified into the non-UTI group (group C).

2. Statistical analysis

The data were analyzed using IBM SPSS Statistics ver. 21.0 (IBM, Armonk, NY, USA). The chi-square test or Fisher exact test for small numbers was used to compare the percentages of infants with positive CBU and CATH-U cultures. One-way analysis of variance was used to compare the differences between the groups (A vs. B vs. C); a P value <0.05 was considered significant. We calculated the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for the prediction of UTIs using the CBU culture method; the results were based on a UTI defined by the CATH-U culture results; likelihood ratios (LRs) were also calculated with a 95% confidence interval (CI).

Results

A total of 246 infants were potential participants in this study. We excluded 36 patients; 15 infants had contaminated CATH-U cultures (CFU $<10^4$/mL, 1 patient; growth of CNS, 2 patients; growth of different microorganisms in the 2 cultures, 12 patients),

13 received antibacterial agents before urine collection, 6 were circumcised male infants, and 2 patients had CBU cultures positive for CNS. Of the remaining 210 patients, there were 86 female infants and 124 uncircumcised male infants. The median age of the included children was 6.0 months (range, 1–23 months).

The CBU and CATH-U culture results are shown in Table 1. The UTI group (those with CATH-U cultures ≥10^4 CFU/mL) comprised 53% (111/210) of the infants. Of these, the high CBU colony count UTI group accounted for 84 children (76%) and the low CBU colony count UTI group accounted for 25 (21.6%). The non-UTI group, with negative CATH-U culture results, comprised the remaining 99 infants (47%). The CBU results for patients diagnosed as having a UTI, based on the CATH-U culture results, showed varying densities of bacteria. If a positive CBU culture was indicated by a bacterial density ≥10^5 CFU/mL, the false-positive and false-negative rates were 18% and 24%, respectively. However, if the cutoff value for the CBU cultures was changed to ≥10^3 CFU/mL, the false-positive and false-negatives rates were 38% and 3%, respectively. False-positive UTI results were associated with CBU CFU counts of 10^3–10^4 CFU/mL in 64% (7/11) of the cases and with CFU counts of 10^4–10^5 CFU/mL in 44% (16/36) of the cases.

Table 2 shows the sensitivity and specificity of the different CBU cut-off values among female infants and uncircumcised male infants. For male infants, a cutoff value of ≥10^5 CFU/mL resulted in a missed diagnosis in 24% of those with UTIs and falsely diagnosed a UTI infection in 18% of those without a UTI. The PPVs for the uncircumcised male infants and female infants were 91% and 69%, respectively. Using a CBU cutoff value of ≥10^3 CFU/mL, the sensitivity approached 97%, but misdiagnosed a UTI in 41% of patients without a UTI.

Table 3 shows that the probability of UTI increased when the CBU bacterial count was ≥10^5/mL for all infants, uncircumcised male infants, and female infants, with LRs of 4.16, 4.11, and 4.11, respectively. Overall, a CBU cutoff value of 10^4–10^5 CFU/mL had a borderline probability (LR 1.11) of correctly diagnosing a UTI; a cutoff value of 10^3–10^4 CFU/mL had a low probability (LR, 0.51) of correctly diagnosing a UTI. Although UTIs could not be excluded in male infants when the CBU bacterial density was 10^3–10^4 CFU/mL (LR, 1.06), the probability of a UTI was lower when the CBU bacterial density was 10^4–10^5 CFU/mL (LR, 0.93). For female infants, a bacterial count of 10^4–10^5 CFU/mL showed a borderline UTI probability (LR, 1.40), but a UTI was unlikely for female infants, if the bacterial density was 10^3–10^4 CFU/mL.

A comparison of clinical and laboratory findings between the UTI and non-UTI groups is shown in Table 4. Group A

Table 1. Result of collecting bag urine and catheter urine cultures

Collecting bag urine culture (CFU/mL)	Catheter urine culture (CFU/mL)		
	≥10^4	No growth	Total
≥10^5	84 (75.7)	18 (18.2)	102 (48.6)
10^4–10^5	20 (18.0)	16 (16.2)	36 (17.1)
10^3–10^4	4 (3.6)	7 (7.1)	11 (5.2)
No growth	3 (2.7)	58 (58.6)	61 (29.0)
Total	111 (100)	99 (100)	210 (100)

Values are presented as number (%).
CFU, colony-forming units.

Table 2. Sensitivity, specificity, positive predictive value, and negative predictive value for urinary tract infection diagnoses using different colony count ranges from bag urine

Colony count unit (CFU/mL)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Male infants				
≥10^5	76	86	91	66
≥10^4	93	70	85	85
≥10^3	98	65	84	97
Female infants				
≥10^5	73	83	69	86
≥10^4	93	69	61	95
≥10^3	93	60	55	95
Total infants				
≥10^5	76	82	82	75
≥10^4	94	66	75	90
≥10^3	97	59	73	95

CFU, colony-forming units; NPV, negative predictive value; PPV, positive predictive value

Table 3. Likelihood ratios of collecting bag urine culture accurately predicting a urinary tract infection according to different colony count ranges

Colony count unit (CFU/mL)	UTI (n)	Non-UTI (n)	LR (95% CI)	Probability
Total (n= 210)				
≥10^5	84	18	4.16 (2.70–6.40)	Intermediate
10^4–10^5	20	16	1.11 (0.61–2.03)	Borderline
10^3–10^4	4	7	0.51 (0.15–1.69)	Low
No growth	3	58	0.05 (0.01–0.14)	
Male infants (n=124)				
≥10^5	62	8	4.11 (2.18–7.78)	Intermediate
10^4–10^5	14	8	0.93 (0.42–2.04)	Low
10^3–10^4	4	2	1.06 (0.20–5.57)	Borderline
No growth	1	25	0.02 (0.00–0.15)	
Female infants (n=86)				
≥10^5	22	10	4.11 (2.25–7.50)	Intermediate
10^4–10^5	6	8	1.40 (0.54–3.66)	Borderline
10^3–10^4	0	5	0	
No growth	2	33	0.11 (0.03–0.44)	

CFU, colony-forming units; UTI, urinary tract infection; LR, likelihood ratio; CI, confidence interval.

Table 4. Comparison of demographics, clinical and laboratory data between each group*

Variable	Group A (n=84)	Group B (n=24)	Group C (n=99)	*P* value†
Age (mo)	5.3±3.0	6.3±4.0	10.1±5.2	<0.01
Uncircumcised male infants	62 (73.8)	18 (75.0)	43 (43.4)	<0.001
Fever duration (day)	2.6±1.4	2.6±1.3	3.0±1.4	NS‡
Initial WBC (cells/μL)	15,296±6,464	17,684±7,180	10,369±5,189	<0.001
Initial CRP >2 (mg/dL)	54 (64.3)	20 (83.3)	25 (25.3)	<0.001
LE (+)§	70 (86.4)	19 (79.2)	20 (20.2)	<0.001
Nitrite (+)	34 (40.5)	4 (16.7)	1 (1.0)	<0.001
Pyuria (+)	70 (83.3)	17 (70.8)	15 (15.2)	<0.001
Bacteriuria (+)	67 (79.8)	14 (58.3)	11 (11.1)	<0.001

Values are presented as mean±standard deviation or number (%).
WBC, white blood cell; CRP, C-reactive protein; LE, leukocyte esterase; NS, no significance; CFU, colony-forming units.
*The patients were categorized into three groups according to the number of bacteria recovered from their urine cultures. The urinary tract infection group was subdivided into patients with high collecting bag urine (CBU) colony counts (CBU $\geq 10^5$ CFU/mL and urinary catheter [CATH-U] $\geq 10^4$ CFU/mL, group A) and those with low colony counts (CBU $<10^5$ CFU/mL and CATH-U $\geq 10^4$ CFU/mL, group B). If bacteria were not cultured from the CATH-U, the patients were classified into the group C. Sample statistics presented in this table are mean±standard deviation and frequency (percentage) for categorical variables. †The listed *P* values of statistical tests were calculated using the one-way analysis for continuous variables and chi-square test or Fisher's exact test for categorical variables between groups A and C, and between groups B and C. There was no statistically difference between group A and B, $P>0.05$. ‡*P* value >0.05 between groups A and C, and between groups B and C. §(+) means positive result; urine dipstick and microscopic analysis were defined as positive if either nitrite or LE was positive or if either the WBC counts were ≥10/mm^3 or bacteria were present.

Table 5. Comparison of imaging study data between groups A and B*

Variable	Group A (n=84)	Group B (n=24)	*P* value†
USG			
Normal	76 (90.5)	21 (87.5)	
Abnormal‡	6 (7.1)	3 (12.5)	0.65
Not done	2 (2.4)	0 (0)	
DMSA			
Normal	52 (61.9)	15 (62.5)	
Photon defect	23 (27.4)	7 (29.2)	0.939
Not done	9 (10.7)	2 (8.3)	
VCUG			
Normal	67 (79.8)	16 (66.7)	
VUR	10 (11.9)	3 (12.5)	0.219
Not done	7 (8.3)	5 (20.8)	

Values are presented as number (%).
USG, ultrasonogram; DMSA, technetium^{99m} dimercaptosuccinic acid scintigraphy; VCUG, voiding cystourethrography; VUR, vesicoureteral reflux; CFU, colony-forming units.
*The urinary tract infection group was subdivided into patients with high collecting bag urine (CBU) colony counts (CBU $\geq 10^5$ CFU/mL and urinary catheter [CATH-U] $\geq 10^4$ CFU/mL, group A) and those with low colony counts (CBU $<10^5$ CFU/mL and CATH-U $\geq 10^4$ CFU/mL, group B). Sample statistics presented in this table are shown as frequencies (percentages). †The statistical test *P* values were calculated using a chi-square test or Fisher exact test for categorical variables. ‡USG findings of focal or diffuse parenchymal hyperechogenicity, irregular kidney outlines, reduced parenchymal thickness, and renomegaly are considered to be evidence of pyelonephritis.

UTIs were more common among younger ($P<0.01$) patients and uncircumcised male infants ($P<0.001$) than were non-UTIs. However, the fever duration among the 3 groups was not different. The initial WBC counts and C-reactive protein (CRP) levels were higher in the UTI groups than in the non-UTI group. Similarly the UTI groups had higher rates of positive LE, nitrite levels, pyuria, and bacteriuria than did the non-UTI group (all, $P<0.001$). The clinical and laboratory findings of group B were similar to those in group A.

The imaging study results of UTI groups are described in Table 5. There were no statistically significant differences between groups A and B relative to the number of abnormal ultrasonography, technetium^{99m} dimercaptosuccinic acid scintigraphy (DMSA), or voiding cystourethrography findings.

In Table 6, the LRs for predicting a UTI with either a positive dipstick test or a positive urinalysis were 4.24 and 3.11, respectively. The probability of the determination of an elevated nitrite level was very high (LR, 35.68), but their sensitivity and NPV were low (36% and 58%, respectively.)

Discussion

In a febrile infant with suspected UTI, prompt antibiotic administration is important for the eradication of the infection, after obtaining a confirmatory urine culture. According to the American Academy of Pediatrics guideline, urine cultures by CATH-U or SPA are necessary to accurately diagnose UTIs in infants[2]. Although SPA is regarded as the "gold standard" for collecting urine specimens, its success rate in correctly diagnosing a UTI has been reported to range from 23% to 90%. Because of the variable success rates, ultrasonographic guidance and greater technical experience are required for the conduct of this sample collection technique[2,8,20-22]. Moreover, obtaining parental consent

Table 6. Predictive values for urinalysis accurately diagnosing urinary tract infections

Variable	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR (95% CI)
Dipstick					
LE	85	80	82	82	4.19 (2.81–6.25)
Nitrite	36	99	98	58	35.68 (5.00–254.74)†
LE or nitrite	86	80	83	83	4.24 (2.84–6.31)
Microscopy					
Pyuria	81	85	86	80	5.35 (3.33–8.60)
Bacteriuria	75	89	88	76	6.73 (3.82–11.87)
Pyuria or bacteriuria	87	78	81	84	3.89 (2.67–5.67)
Positive urinalysis*	91	71	78	88	3.11 (2.27–4.24)

PPV, positive predictive value; NPV, negative predictive value; LR, likelihood ratio; CI, confidence interval; LE, leukocyte esterase.
*Positive urinalysis was defined when LE and/or nitrite, or pyuria and/or bacteriuria were positive. †High probability, the others are categorized as intermediate probability.

is more difficult because SPA is a more invasive and painful urine collection method than CATH-U[9]. CATH-U has a sensitivity of 95% and a specificity of 99% for detecting UTIs, compared with urine collection via SPA[2,20,23]; the extent of contamination is less than for CBU[7]. Hence, CATH-U is considered an alternative method to SPA. In this study, we used CATH-U as the "gold standard" for diagnosing UTI in the infants.

This study was performed retrospectively and in a non-selective fashion for collecting and evaluating the urine culture samples. McGillivray et al.[16] suggested that "selective catheterization" is a more reasonable strategy than catheterization of all infants for avoiding unnecessary, invasive examinations of febrile infants. However, a negative urinalysis result does not guarantee the absence of a UTI in a febrile infant[2]. The collection of urine samples for urinalysis is still a time-consuming procedure for non–toilet-trained children and their parents. Moreover, obtaining the urinalysis results and the subsequent decision to require CATH-U collection indicates that physicians, patients, and parents have to wait for a longer period without treatment. A prior urinalysis could also lead to a selection bias in the evaluation. Therefore, a policy recommending catheterization of all febrile infants, suspected of having a UTI, may be more convenient for the patients and their parents. In this study, the infants had a very high prevalence of UTIs (52.5%) compared with previous studies [1,16]. The main reason for this high prevalence may be related to a selection bias in the sample population (all uncircumcised male infants) or the small sample sizes. Other factors, possibly contributing to the high prevalence of UTIs, include the physicians being aware of which infants were at high risk of having a UTI, the catheterizations being performed by the treating physician, and a CATH-U-based definition of UTI.

Our study indicated that CBU colony counts do not always match those of CATH-U samples. A CBU cutoff value $\geq 10^5$ CFU/mL would miss approximately one-fourth of the UTIs. This was suggested by the fact that 24 patients had low CBU bacterial counts ($<10^5$ CFU/mL), despite clinical and laboratory findings comparable to those for group A. Low-colony-count UTIs predominate in infants and young children[24], and there is an increasing rate of gram-negative bacteria, other than *Escherichia coli*, involved in these infections[25]. However, our study showed that *E. coli* was the principal microorganism in this group (88%), as it was in the patients with high-colony-count UTI. Factors causing low bacterial colony counts include urine concentration defects, urine samples obtained following hydration, and reduced bladder incubation times[5,24,25]. The collection of CBU after CATH-U, or vice versa, may also affect the results of bacterial colony counts because of the reduced urine dwell time[16]. However, the sequence of each urine sample collection was not determined, nor was the interval between each procedure estimated in this study. Additionally, the specific gravities of the urine samples from the individuals in the three groups A, B, and C were (1.012, 1.010, and 1.013) respectively, were similar ($P>0.05$). Thus, the involvement of the previously enumerated factors in causing low bacterial colony counts in our patients is uncertain. Febrile infants with low bacterial colony count UTIs should not be overlooked, as the prevalence of pyelonephritis and vesicoureteral reflux (VUR) is similar to that in patients with high-colony-count UTIs[24].

Three infants with CATH-U-positive and CBU-negative culture results were included in the group having true UTI. Our review of their medical records showed that they experienced leukocytosis, elevated CRP levels, and pyuria. The cleansing materials, containing antimicrobials, used prior to sample collection may have impacted the urine culture results, with false-negative cultures ensuing[12,26]. A previous report mentioned that high number of false-negative CATH-U cultures resulted from povidone-iodine cleansing[27]. Therefore, false-negative CBU cultures could be caused by repeated application of disinfectants such as povidone iodine, before collecting urine samples. However, the influence of the disinfectant was uncertain, since this study was not designed to compare the effects of cleansing

materials. None of the 3 patients demonstrated abnormal DMSA findings, but 1 patient showed VUR. In febrile children with an initial UTI, only 57% showed abnormal DMSA results[28], and the absence of DMSA abnormalities could not guarantee the absence of high grade VUR[29]. Normal DMSA findings cannot exclude the possibility of UTI or the presence of VUR; therefore, clinicobiological features suggestive of UTI require administration of appropriate antibiotics.

In this study, conflicting results were found when comparing the colony counts of CBU specimens with those collected by CATH-U. Since the CBU results from patients with CATH-U bacterial counts $\geq 10^4$ CFU/mL demonstrated a wide range of colony counts, from no growth to $\geq 10^5$ CFU/mL, the interpretation of the CBU results was difficult. A CBU colony count $\geq 10^5$/mL had an intermediate probability of correctly diagnosing UTI, whereas counts of 10^4–10^5 CFU/mL and 10^3–10^4 CFU/mL showed borderline and low UTI probabilities, respectively. The gender difference in the UTI probability associated with counts of 10^4–10^5 CFU/mL and 10^3–10^4 CFU/mL may be related to the small number of patients with urine samples having each bacterial density; more patients in these groups would allow better determination of the reasons for these results. Therefore, the establishment of a valid cutoff level at which UTI could be excluded, based on the CBU culture results, was somewhat vague and confusing.

Urinalysis cannot replace urine culture for diagnosing UTI, but it may predict urine culture and may discriminate true UTI from bacteriuria resulting from contamination or colonization. This would facilitate the initiation of prompt treatment[2,18]. Our results suggest that urinalyses (LE or nitrite, pyuria or bacteriuria) have high probabilities of predicting true UTIs in febrile infants. The sensitivity and PPV of a positive dipstick test (83% and 82%, respectively) and of a positive urinalysis (90% and 78%, respectively) were comparable to those associated with CBU bacterial densities $\geq 10^5$/mL (76% and 82%, respectively). However, 10 patients (9%, 10/111) in the UTI group showed negative dipstick and urinalysis results. The prevalence of VUR in infants with positive urinalyses and those with negative urinalyses were 14% (13/90) and 10% (1/10), respectively (P=0.76). Therefore, a negative dipstick and/or microscopic urine examination cannot exclude the risk of UTI and the presence of VUR.

This study had a low CBU culture contamination rate compared with that in other studies (28% vs. 88%)[2]. Although the reasons were uncertain, numerous UTIs with low bacterial counts were observed, raising questions about the validity of CBU cultures.

There is a risk of contamination when collecting CATH-U samples as the catheter passes through an area of urethral contamination; this has been shown to be more likely in uncircumcised male infants than in female infants[7]. In this study, the contamination rate of the CATH-U cultures was estimated to be approximately 12% (15 patients were excluded, including 10 male infants), despite the absence of mixed bacterial populations in the CATH-U cultures. Moreover, the CATH-U sample collection is more difficult in male infants with moderate or severe phimosis and in female infants with tight labial adhesion[2]. A meticulous approach is required to avoid contamination and the resulting possibility of unnecessary treatment[19].

Our study has several limitations. Data analyses were performed retrospectively using patient records, and involved a small sample size. Selection bias also existed, including the exclusion criteria for contaminated samples and the exclusion of circumcised males.

In conclusion, positive urinalyses help health care personnel to determine the necessity of further investigations because they have greater probabilities of predicting a UTI than does CBU culture, alone. The study also confirmed that physicians should not ignore UTIs associated with low CBU colony counts, especially if there are also indicative laboratory findings, such as leukocytosis or elevated CRP levels. Nevertheless, the validity of obtaining urine samples from sterile bags remains questionable. Inconclusive culture results from CBU samples should be confirmed using either retests or more reliable diagnostic methods, such as CATH-U or SPA[5,12,16,25].

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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