Turkish Journal of Medical Sciences

Volume 29 | Number 1 Article 11

1-1-1999

Nosocomial Urinary Tract Infections in Children

Ayse BALAT

L. Leighton HILL

Tr. J. of Medical Sciences
29 (1999) 51–57

Ayse BALAT
L. Leighton HILL

Nosocomial Urinary Tract Infections in Children

Received: February 05, 1998

Department of Pediatric Nephrology, Baylor College of Medicine, Texas Children's Hospital, Houston, TX.

Abstract: Nosocomial infections are a major cause of morbidity and mortality in hospitalized children, and the urinary tract is one of the most common sites of these infections. We retrospectively reviewed the charts of 1,221 children discharged with a diagnosis of urinary tract infection (UTI) from July 1, 1991 to June 30, 1994. Of the 1,221 UTIs, there were 137 (11.2%) cases of nosocomial UTI (NUTI) in 136 patients. NUTI accounted for 0.28% of all discharges (48, 382 patients) at a single institution over the 3-year period studied. There were 75 girls and 61 boys. The mean age was 4.4 years old. The peak occurrence of NUTI was in patients younger than 1 year old and in girls more than 3 years to 11 years old and more than 11 years to 18 years ($P<0.05$). Fever was the most common symptom (82.5%). Ninety-three (67.9%) of the 137 NUTIs identified occurred in catheterized patients. Fifty (30.3%) of the 165 causative organisms isolated were *Escherichia coli*. Of the patients with NUTI, 22.6% had cardiologic diseases, 19.7% had neurological diseases, and 13.9% had malignant diseases. The rate of bacteremia was 8.8%.

NUTI appeared to be associated with some predisposing factors such as younger age, urinary tract catheterization, and the severity of disease.

Key Words: Nosocomial, urinary tract infection.

Introduction

Nosocomial infections are a major cause of morbidity and mortality in hospitalized children (1–3). Data from the National Nosocomial Infections Surveillance of 79 hospitals indicated a 9.2% rate of infection from October 1986 to December 1990 (4). The overall mortality rate attributable to nosocomial infections is approximately 11% for pediatric and neonatal nosocomial infections (5–7). The urinary tract is one of the most common sites of nosocomial infections. In children, nosocomial urinary tract infections (NUTIs) account for between 6 and 18% of nosocomial infections on pediatric services in small and large teaching hospitals (8, 9). Although the epidemiology of nosocomial urinary tract infection is well described in adults, more information is needed about NUTIs in children. We retrospectively reviewed the charts of 1221 children with the discharge diagnosis of urinary tract infections and from this group selected the patients with NUTI to evaluate age, sex, presenting signs and symptoms, underlying diagnoses, probable risk factors, microorganism profile, and complications of NUTI in children.

Patients and Methods

Patients: All patients discharged with the diagnosis of UTI from Texas Children's Hospital between July, 1, 1991, and June 30, 1994, were included in the study. All charts were analyzed for information regarding age, sex, race, presenting symptoms and signs, routine urinalysis, all cultures taken during hospitalization, exposure to urinary–tract catheterization during hospitalization, other discharge diagnoses, and secondary bacteremia.

Urinalysis: The diagnosis of UTI was based on: 1) a colony count of least 10^5 organisms/ml in a midstream, clean–voided specimen, 2) a colony count of $\geq 10^3$ organisms/ml in a catheter specimen, and 3) any growth of bacteria on suprapubic aspiration in symptomatic children (10). Asymptomatic infections were detected by urine cultures ordered by the patients' physicians. In some cases, these cultures were ordered because of the presence of a urinary catheter; the reasons for the other

cultures were ordered could not be determined. UTIs were considered nosocomial if symptoms occurred and the documenting urine culture was obtained at least 48 hours after hospital admission or previously collected urine specimens revealed no evidence of infection (11). Hospitalized patients who were known to have persistent bacteriuria were not entered into the study. Secondary bacteremia was defined as a blood stream infection with the same organism that was isolated from the urinary tract (8).

Statistical analysis: Chi–Square and Fisher's exact tests were used to compare the groups. A p value of<0.05 was considered significant.

Results

Patients: A total of 1,221 discharges with the diagnosis of UTI were found. These records were retrospectively reviewed. There were 137 cases of NUTI in 136 patients (75 girls, 61 boys) comprising 11.2% of the total study population. The boy to girl ratio was 0.8. The mean age was 4.4 years old (range; 14 days to 18 years). The age and sex distribution of children with NUTI is shown in Table 1. Peak occurrences of NUTI were seen in patients age 0 to 1 year old for both sexes and >3 years to 11 years and >11 years to 18 years old for girls (P<0.05). Fifty–three of the patients were white, 31 were black, 51 were Hispanic, and one was Asian.

Catheter use and duration of hospitalization: It was not possible in our retrospective chart review to verify complete details concerning the duration and type of catheter used. But none of the patients were catheterized at the time of admission. Forty–four (32.1%) of the 137 infections occured without catheter exposure, whereas 93 (67.8%) occurred in catheterized patients. Catheter use and duration of hospitalization in different age groups are shown in Table 2. There were no differences in catheter use and duration of hospitalization among age groups or between sexes (P>0.05).

Table 1. Age and sex distribution in patients with NUTI.

Age groups (year)	Female	Male	Total
0–1	28	34	62*
> 1–3	11	14	25
> 3–11	21*	8	29
> 11–18	16*	5	21
Total	76	61	137

* P < 0.05

Patient signs and symptoms: One hundred and thirty (94.9%) of the 137 NUTIs were symptomatic. Of the 93 catheter–related infections, 87 (93.5%) were symptomatic. Of the 44 infections that were not catheter–related, 43 (97.7%) were symptomatic. Fever was the most common symptom for all age groups and the only symptom in 45 (32.8%) patients. The other signs and symptoms were nausea/vomiting (13.9%), irritability (9.5%), decreased appetite (8.8%), lethargy (6.6%), diarrhea (4.4%), and abdominal pain (2.2%) (Table 3). There were no differences in the signs and symptoms found in catheterized patients and noncatheterized patients (P>0.05).

Urinalysis: All patients had urinalysis performed on the same day of infection documentation. At least one of these tests (positivity for the presence of nitrite, leukocyte esterase, more than 5 white blood cells

Table 2. Catheter use and duration of hospitalization in patients with NUTI.

	Age groups (year)							
	> 0–1		> 1–3		> 3–11		> 11–18	
Sex ⇒	F	M	F	M	F	M	F	M
⇓ Duration of hospitalization (day)								
≤ 30	15	13	5	12	15	6	10	3
> 30	13	21	6	2	6	2	6	2
Total	28	34	11	14	21	8	16	5
Catheterization+	19	24	8	11	14	5	11	1
Catheterization–	9	10	3	3	7	3	5	4
Total	28	34	11	14	21	8	16	5

* P > 0.05 (There were no differences in catheter use and duration of hospitalization among age groups or between sexes), F: Female, M: Male.

microscopically and microscopic bacteriuria) was positive in 124 (90.5%) of the 137 urinalyses performed. More than 5 white blood cells per high power field were positive in only 48.2% of the urinalysis.

Table 3. Signs and symptoms in patients with NUTIs.

Signs and symptoms	n= 137	%
Fever	113	82.5
Nausea/Vomiting	19	13.9
Irritability	13	9.5
Decreased appetite	12	8.8
Lethargy	9	6.6
Diarrhea	6	4.4
Abdominal pain	3	2.2
Dysuria	2	1.5
Costo–vertebral tendemess	1	0.7
Abdominal distention	1	0.7
Asymptomatic	7	5.1

Microbiology (Table 4): Of 137 urine cultures, 97 were catheter specimens, 32 were mid–stream, clean–voided specimens, 6 were suprapubic aspirate, and 2 were nephrostomy specimens. A total of 165 organisms wer isolated. Fifty (30.3%) of the 165 causative organisms were *Escherichia coli,* 17 (10.3%) were *Enterococcus*, 16 (9.7%) were *Klebsiella*, 16 (9.7%) were *Pseudomonas*, 16 (9.7%) were *Staphylococcus* (2 *S. aureus*, 14 *S. epidermidis*), 14 (8.5%) were *Enterobacter*, and 13 (7.8%) were *Candida*. Thirty–seven (74%) of the *E. coli* infections, 15 (88.2%) of *Enterococcus* infections, 11 (84.6%) of the *Candida* infections, 10 (62.5%) of the *Enterobacter* infections, 5 (68.8%) of the *Staphylococcus* infections, 10 (62.5%) of the *Pseudomonas* infections, 5 (62.5%) of the *Proteus* infections, and all of the *Serratia, Morganella morganii, Acinetobacter,* and *Providencia rettgeri* infections occurred in patients subjected to urinary tract catheterization.

E. coli was the most common pathogen for all age groups except newborns. The second and third common pathogens differed by age group (Table 4). *Staphylococcus* was seen in equal percentage with *E. coli* in the newborns (18.2%).

Principal diagnoses: The principal discharge diagnoses of patients are shown in Table 5. Cardiologic diseases accounted for 22.6% of the diagnoses. Thirty of them had congenital heart diseases. One had cardiomyopathy. Of these 31 patients, 15 (48.3%) had developed UTI

Table 4. Microorganisms in patients with NUTIs.

	Agegroups (year)												Catheter use			
	0–1 month		1 month–1		> 1–3		> 3–11		> 11–18		0–18		cath+		cath–	
Microorganism	*n=18	%	n=44	%	n=25	%	n=29	%	n=21	%	n=137	%	n=93	!%	n=44	!%
Ecoli	4	182	12	21.4	11	34.4	16	53.3	7	28	50	30.3	37	74	13	26
Enterococcus	2	9.1	9	16.1	3	9.4	2	6.6	1	4	17	10.3	15	88.2	2	11.7
Klebsiela	3	13.6	8	14.3	2	6.3	–	–	3	12	16	9.7	7	43.8	9	56.3
Pseudomonas	2	9.1	4	7.1	2	6.3	5	16.6	3	12	16	9.7	10	62.5	6	37.5
Saphylococcus	4	18.2	6	10.7	3	9.4	2	6.6	1	4	16	9.7	11	68.8	5	31.3
Enterobacter	1	4.5	7	12.5	2	6.3	3	10	1	4	14	8.5	11	68.8	3	21.4
Candida	3	13.6	3	5.4	2	6.3	–	–	5	20	13	7.8	11	68.8	2	15.4
Proteus	1	4.5	2	3.6	2	6.3	1	3.3	2	8	8	48	5	62.5	3	37.5
Streptococcus	1	4.5	2	3.6	1	3.1	–	–	–	–	4	2.4	2	50	2	50
Citrobacter	–	–	1	1.8	3	9.4	–	–	–	–	4	2.4	2	50	2	50
Serretia	1	4.5	1	1.8	1	3.1	–	–	–	–	3	1.8	3	100	–	–
Salmonella	–	–	–	–	–	–	1	3.3	–	–	1	0.6	–	–	1	100
M. morganii	–	–	–	–	–	–	–	–	1	4	1	0.6	1	100	–	–
Acinetobacter	–	–	–	–	–	–	–	–	1	4	1	0.6	1	100	–	–
P. rettgeri	–	–	1	1.8	–	–	–	–	–	–	1	0.6	1	100	–	–
** Total	22	100	56	100	32	100	30	100	25	100	165	100	117		48	

* Number of the patients, ** Number of times microorganism isolated, ! Percentage for each microorganism.

Table 5. Principal diagnosis in patients with NUTIs.

	Agegroups (year)									
	0–1		> 1–3		> 3–11		> 11–18		Total (0–18)	
⇓ Principal diagnosis	No	%	No	%	No	%	No	%	No	%
Cardiologic	16	25.8	6	24	5	17.2	4	19.04	31	22.6
Neurologic	6	9.7	2	8	8	27.5	11	52.4	27	19.7
Oncologic	1	1.6	6	24	8	27.5	4	19.04	19	13.9
Urologic	11	17.7	3	12	3	10.3	–	–	17	12.4
Gastrointestinal	4	6.4	2	8	2	6.9	1	4.8	9	6.6
Prematurity	8	12.5	–	–	–	–	–	–	8	5.8
Pulmonary	7	11.2	1	4	–	–	–	–	8	5.8
Immunologic	1	1.6	2	8	–	–	1	4.8	4	2.9
Endocrinologic	1	1.6	1	4	–	–	–	–	2	1.5
Hematologic	1	1.6	1	4	–	–	–	–	2	1.5
Orthopedic	–	–	1	4	–	–	–	–	1	0.7
Multiple major diagnosis	2	3.2	–	–	3	10.3	–	–	5	3.6
Other	4	6.4	–	–	–	–	–	–	4	2.9
Total	62	100	25	100	29	100	21	100	137	100

following corrective cardiac surgery, one (3.2%) had after heart transplantation. Neurologic disorders accounted for 19.7% of the diagnoses. Seven (25.8%) of them had central nervous system trauma, seven (25.8) with myelomeningoceles and 13 (48.1%) with cerebral palsies. Nineteen (13.9%) of 137 had malignancy: 4 (21.1%) with brain tumors, three (15.8%) with rhabdomyosarcoma, four (21.1%) with leukemia, three (15.8%) with neuroblastoma, two (10.5%) with Hodgkin's lymphoma, one (5.3%) with hepatoblastoma, one (5.3%) with stomach adenocarcinoma, and one (5.3%) with Wilm's tumor. Seven patients had developed UTI after chemotherapy and one after bone marrow transplantation.

Seventeen (12.4%) of 137 children had urinary tract abnormalities. Of these 17 patients, 7 (41.2%) had uretero–pelvic junction obstruction, five (29.4%) had vesico–ureteral reflux, two (11.8%) had calculi, two (11.8%) had kidney transplantation, one (5.9%) had uretero–vesical junction obsturction.

Eight (5.2%) patients were premature but also had another major diagnosis thought to be more directly related to the subsequent development of UTI. Three (16.6%) of the 18 newborn patients had uretero–pelvic junction obstruction diagnosed by prenatal ultrasonography and confirmed after birth.

Cardiologic and urologic diagnoses were common in patients 0 to 1 years old. Cardiologic and oncologic diagnoses were common in patients >1 year to 3 years old. The percentage of neurologic diseases was higher in >3 years to 11 years old and >11 years to 18 years old age groups than the other age groups (9.7%, and 8% in 0–1 and >1–3 age groups, 27.5%, and 52.4% in >3–11, and >11–18 age groups, respectively). The percentage of oncologic diseases was high in patients older than 1 year–old (1.6% in 0–1 age group, 24% in >1–3, 27.5% in >3–11, 19.04% in >11.18 age groups). Of 16 patients with neurologic or oncologic diseases in age group >3 years to 11 years old, 10 (62.5%) were girls, and 6 (37.5%) were boys ($P<0.05$). Of 15 patients in age group >11 years to 18 years old with the same diagnosis, 9 (60%) were girls, and 6 (40%) were boys ($P<0.05$).

Complications: One girl (0.7%) had a recurrence with a different organism occurred within the first week of the discontinuation of antibiotic therapy. Urine and blood cultures obtained on the same day were positive with the same organisms in 12 (8.8%) of the 137 infections. There were four isolates of *S. epidermidis*, three isolates of *E. coli*, one isolate of *Klebsiella,* one *S. aureus,* one *Enterobacter,* one *Candida*, and one *Enterococcus.* Seven patients died of causes unrelated to their UTI.

Discussion

NUTI accounted for 0.28% infections per 100 discharges and 11.2% of UTI cases in our institution

during the study period. This rate is less than figures equated in a previous study of NUTI in children, which reported 1.4 infections per 100 admissions and 0.8 infection/100 admissions (12, 13), but it is similar to the results of the Ford–Jones study (8) that they found the ratio of NUTI 0.56% in children ages ≤23 months old, 0.20 in ages 2 to 4 years, 0.28 in ≥5 years of age.

Pediatric nosocomial infection rates are inversely proportional to age and much higher in children younger than 1 year of age than in those aged 10 years old or more (2, 9, 14–17, 18). Our results were similar, except the peak at the >3 to 11 and the >11–18 age group of girls. The reasons for the higher incidence in children up to 1 year of age included their immunologic status, susceptibility to infections, and procedures required because of their underlying conditions. In our study, the distribution of girls showed an increase in the >3 to 11–year and the >11 to 18–year age groups, which was different from the boys. The duration of hospitalization and catheterization ratio was similar for both sexes and all age groups (P>0.05). The percentage of girls with neurologic or oncologic diseases was higher than boys in these age groups (P<0.05); so, severity of disease may be a predisposing factor for these patients. The second peak at these age groups may also parallel the age distribution of asymptomatic and symptomatic bacteriuria in girls (10, 19, 20).

Fever was the most common symptom and was documented in 94.8% of our patients. It was the only symptom in 45 (32.8%) of the patients. For this reason, UTI should always be considered in children who complain of fever. Urinary tract catheterization is a risk factor for NUTI. Wenzel et al (21) defined a 9% risk for UTI among pediatric patients who were catheterized. Our overall percentage of patients with NUTI–associated with catheter usage was 68.9% (48% in Davies study (12), 92% in the Lohr study (9). In the Lohr study (9), between 10% to 30% of short term (<30 days) catheterized patients in acute–care hospitals developed bacteriuria. As we do not have enough information about the duration of catheterization in our study, we can not compare our results with theirs.

As shown by the Lohr study (9), more than five white blood cells per high–power field were identified in only 48.2% of the urinalysis in our study. So, lack of pyuria do not rule out the presence of a NUTI.

The frequency of isolation of more common organisms seen in our study was similar to the previously published pediatric data, with *E. coli, Enterococcus, Pseudomonas, Klebsiella, Staphylococcus, Enterobacter,* and *Candida* accounting for the 85.9% of all isolates in our study compared with 78% of all isolates in the Lohr study (9), 81% in the Davies study (12), 95% in the Maguire study (3), and 74% in the Welliver study (16). Similar bacteriologic results between different centers, especially *E. coli* as a most common causative organism, may support the hypothesis that NUTIs also arise from endogenous flora as well as the patient's environment. *E. coli* was the most common pathogen for all age groups. The second and third most common pathogens were different in different age groups. *Staphylococcus* was the other important pathogen seen with *E. coli* in patients younger than 1 year of age. The importance of coagulase negative *Staphylococcus* and *Candida*, as a casue of NUTI in the newborn period is not surprising given the skin colonization of critically ill neonates, the multiple interventions they undergo, the increasing use of steroids and the relative immaturity of their immune system (22, 23).

Thirty–one (22.6%) of our patients with NUTI had cardiologic diseases, and most of them had developed UTI after cardiac surgery. Congenital heart disease which indirectly modifies host resistance by requiring prolonged invasive devices results in increased manipulation, colonization and in some cases infection (1, 24). The risk of infection in patients undergoing cardiac surgery is high due to a number of factors, including the long operation time, the presence of indwelling catheters and cannulae, the deleterious effect of extracorporeal circulation on the host immune system, poor tissue perfusion, and the insertion of foreign materials. The incidence of NUTI after cardiac surgery was 1.2% in Orita's study (25) as a third common nosocomial infection.

The second most affected group was neurologic patients (19.7%). Seven of them had head injury. Severe head injury is more closely associated with nosocomial infection than other nonpenetrating trauma. UTI is one of the most common nosocomial infections in association with trauma (26). Reid et al (27) has shown the high incidence of urodynamic abnormalities and UTI (48.14%) in children with cerebral palsy.

Nineteen of our patients (13.9%) had oncologic diseases. Patients who are immunosuppressed because of malignancy or treatment for malignancy are frequently neutropenic, or severely deppressed bone marrow and are at risk for nosocomial infection (18, 28). In our study, of 19 patients with malignancies, seven had developed UTI after chemotherapy, one had after bone marrow transplantation.

Patients born with underlying urogenital abnormality are under increased risk of developing UTI (10,29). The incidence of UTI in patients with UPJ obstruction is 61.5% for l month–2 years of age (29). In our series, 17 (12.4%) of 137 patients had urinary tract abnormalities, and 7 (41.2%) of 17 had UPJ obstruction.

Hospital–and community acquired Gram–negative bacteremia is a significant cause of mortality and morbidity in pediatric medical centers (11, 30). The rate of bacteremia in our study was 8.8%. But it was not possible to determine the site of primary infection in these patients that the same organisms was isolated on the same day from the blood and urinary tract.

Seven patients died. They had an already resolved UTI at death, and other disorders were considered as a cause of death. There was no mortality that was attributable to the NUTIs during the study period in contrast to the high mortality noted in adults (31).

In conclusion, NUTI appeared to be associated with some predisposing factors such as younger age, urinary tract catheterization, and the severity of disease (such as patients with cardiologic, neurologic, oncologic, and urologic abnormalities). Complications are infrequent and not life threatining.

Correspondence author:

Ayse BALAT, M.D

P.K: 12, 44020 Karakas,

Malatya/TURKEY

References

1. Goldmann DA., Durbin WA., Freeman J.: Nosocomial infections in a neonatal intensive care unit. J Infect Dis 144: 449–59, 1981.
2. Jarvis WR.: Epidemiology of nosocomial infections in pediatric patients. Pediatr Infect Dis 6: 344–51, 1987.
3. Maguire GC., Nordin J., Myers MG., et al: Infections acquired by young infants. Am J Dis Child 134: 693–8, 1981.
4. Jarwis WR., Edwards JR., Culver DH., et al: Nosocomial infection rates in adult and pediatric intensive care units in the United States. Am J Med 91 (suppl 3B): S185–S191, 1991.
5. Donowitz LG.: High risk of nosocomial infection in the pediatric critical care. Crit Care Med14 26–28, 1986.
6. Milliken J., Tait GA., Ford–Jones EL., et al: Nosocomial infections in a pediatric intensive care unit. Crit Care Med 16: 233–237, 1988.
7. Horan T., White J., Larvis W., et al: Nosocomial infection surveillance. MMWR; 35: 17ss–288ss, 1984.
8. Ford–Jones E., Mindorff C., Langley J., et al: Epidemiologic study of 4684 hospital–acquired infections in pediatric patients. Pediatr Infect Dis J 8: 668–75, 1989.
9. Lohr JA., Donowitz LG., Sadler JE.: Hospital–acquired urinary tract infection. Pediatrics 83: 193–9, 1989.
10. Jodal U., Hansson S., Urinary tract infection. In: Pediatric Nephrology. Edited by Holliday MA., Barratt TM., Anver ED. Baltimore: Williams & Wilkins, 1994, pp: 950–62.
11. Garner JS., Emorl TG., Horan TC., Hughes JM.: CDC definitions for nosocomial infections 1988. Am J Infect Control 16: 128–40, 1988.
12. Davies DH., Ford Jones EL., Sheng RY., et al: Nosocomial urinary tract infections at a pediatric hospital. Pediatr Infect Dis J 11: 349–54, 1992.
13. Lohr JA., Downs SM., Dudley S., et al: Hospital–acquired urinary tract infections in the pediatric patient: A prospective study. Pediatr Infect Dis J 13: 8–12, 1994.
14. Allen U., Ford–Jones EL.: Nosocomial infections in the pediatric patient: An update. Am J Infect Control 18: 176–93, 1990.
15. Singh–Naz N., Sprague BM., Patel KM., Pollack MM. Risk factors for nosocomial infection in critically ill children: a prospective cohort study. Crit Care Med 24: 875–8, 1996.
16. Welliver RC., McLaughlin S.: Unique epidemiology of nosocomial infection in a children's hospital. Am J Dis Child 138: 131–5, 1984.
17. Polz M, Jablonski L: Nosocomial infection in a children's hospital: A retrospective study. J Hyg Epidemiol Microbiol Immunol 30: 149–53, 1986.
18. Chiu NC., Ching YF., Huang FY. Pediatric nosocomial fungal infections. Southeast Asian J Trop Med Public Health 28: 191–5, 1997.
19. Kunin C.: A ten–year study of bacteriuria in schoolgirls: Final report of bacterio–logic, urologic, and epidemiologic findings. J Infect Dis 122: 382–93, 1970.
20. Winberg J., Anderson HJ., Bergstrom T., et al: Epidemiology of symptomatic urinary tract infection in childhood. Acta Paediatr Scand (suppl 252) 63: 1–20, 1974.
21. Wenzel RP., Osterman CA., Hunting KJ., et al: Hospital–acquired infections: II. Infection rates by site, service and common procedures in a university hospital. Am J Epidemiol 104: 645–51, 1976.

22. Bailey JE., Kleigman RM., Boxerbaum B., et al: Fungal colonization in the very low birth weight infant. Pediatrics 78: 225–32, 1986.

23. Turner RB., Donowitz LG., Hendley JO.: Consequences of candidemia for pediatric patients. Am J Dis Child 139: 178–80, 1985.

24. Kollef MH., Sharpless L., Vlasnik J., Pasque C., Murphy D., Fraser VJ. The impact of nosocomial infections on patient outcomes following cardiac surgery. Chest 112: 666–75, 1997.

25. Orita H., Shimanuki T., Fukasawa M., et al: A clinical study of postoperative infections following open–heart surgery: Occurence and microbiological findings in 782 cases. Japanese J Surg 22: 207–12, 1992.

26. Stillwell M., Caplan ES.: The septic multiple trauma patient. Infect Dis Clin North Am 3: 155–83, 1989.

27. Reid CJD., Barzyskowski M.: Lower urinary tract dysfunction in cerebral palsy. Arch Dis Child 68: 739–42, 1993.

28. Marina NM., Flynn PM., Rivera GK., et al: Fungemia in children with leukemia. Cancer 68: 594–9, 1991.

29. White JM: UPJ obstruction in children. AFP 29: 3: 212–6, 1984.

30. Levy I., Leibovici L., Drucker M., Samra Z., Konisberger H., Ashkenazi S. A prospective study of Gram–negative bacteremia in children. Pediatr Infect Dis J 15: 117–22, 1996.

31. Bryan C., Reynolds K.: Hospital–acquired bacteremic urinary tract infection: Epidemiology and outcome. J Urol 132: 494–8, 1984.