Acta Medica et Biologica
Vol. 39, No. 1, 45-49, 1991

Studies on Bacteria Isolated from Catheter Edges and Urine in Double-J Catheterization

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Received December 7, 1990

Summary. **A double-J (D-J) catheter is a kind of artificial ureter which has the character of not contacting with skin. Among 21 cases with indwelling all-silicone D-J catheters, the catheter was inserted during operation in 20 cases, and indwelt transurethrally for treatment of hydronephrosis in the remaining one case. At the time of removal of the D-J catheter, bacteria were found in all 18 cases on the bilateral edges (renal pelvis and urinary bladder) of the catheter. The bacteria isolated from the bilateral edges were the same in 15 cases, but different in 2 cases. Bacteria were found only on the bladder edge in one case. Two or more species of bacteria were found in 7 cases, and 18 of 26 isolates were of cocci. Bacteria were isolated from cultivated urine samples only in 4 (20%) of 20 cases: all of the 4 isolates consisted of single species, 3 of which were of a yeast-like fungi, and the remaining isolate was a coccus. This suggests that bacteria, even though not found in urine, may be present in the catheter and can cause urinary tract infection at any time.**

The white blood cell count in the urine was 10 or less in a 400X visual field in 16 out of the 21 cases: no case with a count of 30 or more was found. The antibacterial treatment mainly employed was drip infusion of cephem drugs, usually until 7 days after the operation, followed by oral administration mainly of new quinolones.

INTRODUCTION

In cases of complicated urinary tract infection (UTI), particularly with indwelling catheters, the effect of drugs is less marked than in cases of simple infection. For this reason, indwelling catheter cases have at times been excluded from studies for drug evaluation.[1] In addition, it is well known that superinfection with *Serratia marcescens* or *Pseudomonas aeruginosa* will occur in cases with indwelling catheters.[2] Catheters indwelling for more than several days are said to inevitably cause infections which can be only partially prevented even by the use of closed bags and antibacterial catheters. These procedures are said to be inferior to non-sterile intermittent self-catheterization.[3,4] However, it may be possible to dramatically decrease the incidence of urinary tract infection in cases of indwelling catheters by a strict study of the relationship between indwelling catheters and bacterial contamination. In the present study, we examined the bacterial colonization in the edges of indwelling double-J (D-J) catheters. This catheter is a kind of artificial ureter between the renal pelvis and urinary bladder, and has come to be widely used for drainage and splintage in the field of urology[5,6] (Fig. 1). It does not contact with skin and rarely causes severe UTI, and precise studies for bacteria is thought to be lacking.

PATIENTS AND METHODS

The subjects were 21 cases of indwelling all-silicone D-J catheters treated in the Department of Urology, Nagaoka Red Cross Hospital, between August 1987 and January 1988. Intravesical urine samples at admission, and the bilateral edges (renal pelvis and urinary bladder) of the catheters and intravesical urine at the time of removal of the catheter were examined for the presence of bacteria. The D-J catheter was removed by a protractor following sterilization of the external urethral orifice. The bacteria on the edges of the catheter were cultured by direct plating on heart infusion agar (HIA) and in

Table 1. Cases of indwelling double-J catheter

No.	Age Sex	Disease	Operation	Days (Indwelt)	Bacteria in Urine Time at admission	Bacteria in Urine Time of removal	Bacteria on Catheter Renal side	Bacteria on Catheter U. bladder side	WBC in Urine (HPF)	Drugs
1	66M	Ureteral tumor	Partial resection Uretero-ureterostomy	22	(−)	*C. albicans*	*S. epidermidis*	*S. epidermidis*	5～6	CMX→ ENX
2	45F	Renal stone	Coagulum pyelolithotomy	14	(−)	(−)	*E. faecium*	*E. faecium*	1～3	CZX→ CINX
3	19M	Ureteral stone	Uretero-lithotomy	12	(−)	(−)	*S. epidermidis*	*S. epidermidis*	3～5	CZX→ OFLX
4	59M	Ureteral tumor	Partial resection Uretero-ureterostomy	12	(−)	(−)	*S. epidermidis* *S. aureus*	*S. epidermidis* *S. aureus*	5～10	CMZ→ OFLX
5	48F	Uretero-vaginal fistula	Uretero-vesico neostomy	13		Y-L fungi	*S. aureus* *E. faecium*	*S. aureus* *E. faecium*	10～12	CZX→ OFLX
6	66M	Renal stone	Extended pyelolithotomy	26	(−)	(−)	*S. epidermidis*	*S. epidermidis*	15～20	PIPC
7	22F	Vesico-ureteral reflux	Uretero-vesico neostomy	9	(−)	(−)			1～2	LMOX→ OFLX
8	65F	Ureteral injury	Repair	24			*A. anitratus* *E. faecalis*	*A. anitratus* *E. faecalis*	15～20	CMX→ CFIX
9	75F	Renal stone	Coagulum pyelolithotomy	18	(−)	*C. tropicalis*	*S. epidermidis* *E. faecium* *C. tropicalis*	*S. epidermidis* *E. faecium* *C. tropicalis*	3～5	CZX→ OFLX
10	44M	Ureteral stone	Uretero-lithotomy	14	E. faecalis	(−)	*Gram positive rod* *C. tropicalis*	*Gram positive rod* *C. tropicalis*	5～7	CMX→ OFLX
11	67M	Ureteral tumor	Partial resection Uretero-ureterostomy	19	(−)	(−)	*S. epidermidis*	*S. epidermidis*	0～1	PIPC→ OFLX
12	37M	Ureteral stone	Uretero-lithotomy	14	(−)	(−)	*E. faecalis*	*E. faecalis*	10～15	CMZ→ ENX
13	57M	Renal stone	Coagulum pyelolithotomy	44	(−)	(−)			0～1	LMOX→ OFLX
14	16F	Hydro-nephrosis	Pyeloplasty	49	Gram positive rod	(−)	Gram positive rod	Gram positive rod	0～1	CMZ→ CINX
15	23F	Ureteral injury	Repair Uretero-ureterostomy	33		(−)			0～1	LMOX→ (−)
16	30M	Ureteral stone	Uretero-lithotomy	16	*S. epidermidis*	(−)	(−)	*S. epidermidis*	3～5	CMX→ OFLX
17	51M	Ureteral stone	Uretero-lithotomy	8	(−)	(−)	*S. epidermidis*	*S. epidermidis*	0～1	FOM→ CINX
18	45F	Ureteral injury	Repair	14		(−)	*P. cepacia*	*P. cepacia*	3～5	PIPC→ MINO
19	48F	Retro-peritoneal invasion	Transurethral insertion	96	(−)	(−)	*S. morbillonum*	*K. pneumoniae*	4～6	(−)
20	30F	Ureteral stone	Uretero-lithotomy	12	(−)	(−)	*E. faecium* *C. parapsilosis*	*E. faecium* *C. parapsilosis*	4～6	LMOX→ OFLX
21	77F	Ureteral tumor	Partial resection Uretero-ureterostomy	16	*S. viridans*	*S. epidermidis*	*E. faecium*	*S. epidermidis* *E. faeclum*	10～15	CMX→ CFIX

Fig. 1. X-ray film of an indwelling double-J catheter for urinary drainage and splintage to ureter between renal pelvis and urinary bladder.

heart infusion broth (HIB). All the isolates were identified by standard bacteriological methods. The white blood cell count of the urine samples was also determined in 400X visual field.

RESULTS

A D-J catheter was inserted during operation in 20 out of the 21 cases (Table 1). Of the 3 cases with ureteral trauma, 2 were for repair of the damage caused during the operation, and the other was a complete breakage made by a weapon. Catheters were indwelt in 2 cases with vesico-uretero neostomy, 4 cases with partial resection of the ureter and uretero-uretero neostomy for treatment of a ureteral tumor, 1 case with pyeloplasty for hydronephrosis, 4 cases with pyelolithotomy, and 6 cases with ureterolithotomy. In our institution, catheters are not indwelt in cases with transurethral ureterolithotomy (TUL) or percutaneous nephrolithotomy (PNL). In the remaining one case, the D-J catheter was inserted transurethrally for treatment of hydronephrosis due to retroperitoneal invasion after an operation for gastric cancer. The catheter indwelt for 8 to 49 days in the post-operation cases, the median being 14 and 16 days, and the mean being 19 days. The case with transurethral indwelling showed flank pain with no regression of hydronephrosis, and therefore the catheter was removed after 96 days of indwelling.

Table 2. Bacteria isolated from urine

Species	No. of isolates
Candida albicans	1
Candida tropicalis	1
Yeast-like fungi	1
Staphylococcus epidermidis	1
Total	4

Table 3. Bacteria isolated from bilateral edges of D-J catheter

Species	No. of isolates
Staphylococcus epidermidis	9
Enterococcus faecium	5
Staphylococcus aureus	2
Streptococcus morbillorum	1
Enterococcus faecalis	1
Pseudomonas cepacia	1
Klebsiella pneumoniae	1
Acinetobacter anitratus	1
Gram positive rod	2
Candida tropicalis	2
Candida parapsilosis	1
Total	26

Cultivation of preoperative urine samples was performed in 17 of the 21 cases, and bacteria were isolated and identified in 4 out of the 17 isolates; *Enterococcus faecalis, Staphylococcus epidermidis,* viridans-group Streptococci and gram positive rod were found in 1 isolate each. From cultivation of urine samples collected at the time of removal of the catheter, bacteria were found only in 4 (20%) out of 20 cases, all of the isolates being of single species (Table 2). Three of the 4 isolates were *Candida albicans, Candida* tropicalis and a yeast-like fungi. The remaining isolate was *S. epidermidis.* Bilateral edges of the catheter were examined by cultivation in 18 cases, and bacteria were detected in all cases. The bacterial species on the pelvis and bladder edge were the same in 15 cases but different in 2 cases, and bacteria were found only on the bladder edge in 1 case. Two or

more species were found in 7 cases, and single species was found in 11 cases (Table 3). In 18 (69%) out of the 26 isolates cocci were found; *S. epidermidis* in 9, *Enterococcus faecium* in 5, *Staphylococcus aureus* in 2, *Streptococcus morbillorum* in 1, *E. faecalis* in 1, *Pseudomonas cepacia* in 1, *Klebsiella pneumoniae* in 1, *Acinetobacter anitratus* in 1, *C. tropicalis* in 2, *Candida parapsilosis* in 1 and an unidentifiable gram positive rod in 2 isolates. We found no relation between the duration of catheterization and the incidence of bacterial appearance in either urine or catheter edge.

The white blood cell count in the urine was 10 or less in a 400X visual field, in 16 (76%) out of the 21 cases. In the other 5 cases with a cell count of 10 to 20, bacteria were found in 2 cases (40%) from cultivation of urine samples. No case with a count of 30 or more was encountered. None of the cases revealed side effects, particularly pyelonephritis or sepsis. The treatment with drugs employed was drip infusion, mainly of cephem antibiotics, usually until 7 days after operation, followed by oral administration mainly of new quinolone, so as not to form stones and cause infection. The injections used include cefmenoxime (CMX) in 5, ceftizoxime (CZX) in 4, latamoxef (LMOX) in 4, piperacillin (PIPC) in 3, cefmetazole (CMZ) in 3 and fosfomycin (FOM) in 1 case. The oral drugs used include ofloxacin (OFLX) in 10, cinoxacin (CINX) in 3, cefixime (CFIX) in 2 and enoxacin (ENX) in 2 cases.

DISCUSSION

In the field of urological treatment, various kinds of catheterization are widely used. It is well known that the indwelling of a catheter can easily cause urinary tract infection. With respect to infections due to indwelling catheters, Nishiura[7] reported the following: 1) closed catheterization could prevent infection, at least for a short period (1 to 2 weeks); 2) prevention and control of infection was impossible when the catheter indwelt for a long period, and therefore intermittent catheterization should be employed as early as possible; 3) how the catheter was managed was closely related to the incidence of infection, and therefore instructions to the patients were very important; and 4) antibacterial treatment during the indwelling of catheter should be limited to the necessary minimum. While these conclusions were very informative, in practice many problems remained in the management and treatment of patients.

In our recent study,[8] the usefulness of a combination therapy with astromicin (ASTM) and a β-lactam drug was evaluated for complicated urinary tract infection, based on the fractional inhibitory concentration index (FIC index) and further factors. This combination therapy was revealed to be clinically useful even in the catheter-indwelling patients, since effects of drugs were observed in 16 (88.9%) out of 18 cases of simple infection with an indwelt catheter, and in 5 (62.5%) out of 8 cases of complicated infection with a catheter. However, this therapy was not perfectly succesful because of abnormalities often found in the data of myelopoietic functions.

The relationship between indwelling D-J catheters and infection has been investigated by Smedley et al.[9] in 168 cases of ureteric D-J catheterization. In that study, bacteria were found in 46 urine specimens (31%) out of 147 cases of catheterization with a soft catheter such as silicone, a multi-length catheter, and in 13 (61%) out of 21 cases of catheterization with a hard polyurethane catheter. However, bacterial species isolated from the D-J catheter were not mentioned in the study.

In the present study, a D-J catheter was inserted during an operation in 20 out of 21 cases, and the operation cases were given cephem antibiotics followed by oral drugs, while the non-operation case was given no antibiotic. Though the number of cases treated with each drug was small, and though there was no significant difference in the effect among the drugs, no severe urinary tract infection occurred throughout the study period, even in the case without medication.

Bacteria in the urine were isolated only in 4 (20%) of 20 cases; 3 of the 4 isolates were of a yeast-like fungi; no gram negative rods were found. In contrast, from the bilateral edges of D-J catheters, bacteria were found in all 18 cases. The isolates from the edge of the renal pelvis and the urinary bladder were the same in most cases, but more isolates from edge of urinary bladder were found in one case, and isolates were found only from the bladder edge in one case. This suggests that bacteria may first contaminate the bladder edge and then move backward to the pelvis, though this possibility cannot be ascertained in this study because of the limited number of cases; it will be studied further in the future. A new finding of the present study is that the baceteria contaminating the D-J catheter are rarely the same as the bacteria in the urinary tract. From the analogy of the flow of a river in hydromechanics, it may be assumed that the drug can hardly exert its effect on the wall of the catheter. This has a significant meaning that bacteria, even though not found in urine, may be present in the

catheter and can cause urinary tract infection at any time. This is similar to the phenomenon that, even when no bacteria were found in the intravesical urine, some bacteria may be kept hidden in the mucosa of the proximal urethra to cause recurrence of infection. Such a relationship between bacteria in urine and the D-J catheter may be found also with other types of catheters. From now on, cases with indwelt ureterocutaneostomy catheters, nephrostomy catheters, temporal or permanent urethral catheters will be studied from the bacteriological viewpoint, for elucidation of the intractability of complicated urinary tract infections.

REFERENCES

1) Morishita H, Torii T, Watanabe T, Yoshimizu A, Takeda M, Sato S, Nakamura S, Osawa T, Nishiyama T, Takano M, Sakata Y, Komatsubara S, Kitamura Y, Watanabe M, Anezaki M, Yamamoto T, Chiba E, Takashima A, Hiraiwa M, Shiga K, Ando T: Clinical study of Norfloxacin for complicated urinary tract infections. *Nishinihon J Urol* **50**: 1385-1398, 1988. (in Japanese)
2) Morishita H: Study of serotyping, phagetyping, and drug resistance of *Serratia marcescens* isolated from clinical specimens. *Jap J Urol* **71**: 1313-1327, 1980. (in Japanese)
3) Lapides J, Diakno AC, Silber SJ, Lowe BS: Clean intermittent self catheterization in the treatment of urinary tract disease. *J Urol* **107**: 458-461, 1972.
4) Origasa S, Koyanagi T, Motomura M, Kudo T, Togashi M: Experiences of non sterile, intermittent self-catheterization. *Jap J Urol* **67**: 7-13, 1976. (in Japanese)
5) Gibbons RP, Correa Jr RJ, Cummings K, Mason T: Experience with indwelling ureteral stent catheters. *J Urol* **115**: 22-26, 1976.
6) Pocock RD, Stower MJ, Ferro MA, Smith PJB, Gingell JC: Double J stents. A review of 100 patients. *Brit J Urol* **58**: 629-633, 1986.
7) Nishiura T: Urinary tract infections by indwelling catheter. *Jap J Urol* **70**: 990-995, 1979. (in Japanese)
8) Morishita H, Nakajima Y, Saito R, Torii T, Katayama Y, Tanigawa T, Tomita Y, Takeda M, Takano M, Tamaki M, Hatano A, Nakamura S, Osawa T, Nishiyama T, Kawakami Y, Takashima A, Komatsubara S, Kitamura Y, Watanabe M, Sakata Y, Anezaki M, Yamamoto T, Sekine S, Sakurai S, Mineyama H, Gou H, Ando T, Watanabe T, Tajiri M: Clinical evaluation of combination therapy with Astromicin and other drugs for complicated urinary tract infections. *Nishinihon J Urol* **51**: 731-742, 1989. (in Japanese)
9) Smedley FH, Rimmer J, Taube M, Edwards L: 168 double J (pigtail) ureteric catheter insertions. A retrospective review. *Ann Roy Coll Surg Eng* **70**: 377-379, 1988.