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## Original article

# Comparison between the use of percutaneous nephrostomy and internal ureteral stenting in the management of long-term ureteral obstructions

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## ABSTRACT

**Objectives:** In this study, we compared between the efficacy and complications of percutaneous nephrostomy (PCN) tubes and those of internal ureteral stents (e.g., double-J stents) used for relieving ureteral obstructions.

**Materials and methods:** A retrospective chart review was performed. Between 2003 and 2009, 110 patients (63 females and 47 males, with a mean age of 63.6 years, range 19–89 years) who had an extrinsic ureteral obstruction, and subsequently underwent either PCN tube placement ( $n = 44$ ) or internal ureteral stent placement ( $n = 66$ ), were enrolled. Clinical data on patients with duration of diversion/drainage for more than 6 months were collected. Statistical analyses were performed with respect to a patient's age, etiology of the obstruction, outcome of residual hydronephrosis, and renal function tests.

**Results:** Patient ages and procedure-related complications were comparable between these two groups. The mean duration of diversion was  $16.8 \pm 8.6$  months in the stent group versus  $14.1 \pm 6.7$  months in the PCN group ( $p = 0.067$ ). A smaller elevation in serum creatinine was noted in the PCN group (0.21 vs. 0.78 mg/dL,  $p = 0.03$ ). Nine of 86 (10.4%) double-J stents were converted to PCN tubes during the study period. Residual hydronephrosis after decompression was more common in the stent group than in the PCN group (65.2% vs. 27.2%,  $p = 0.01$ ). These findings suggest better preservation of renal function by a PCN tube.

**Conclusions:** Results of this study suggest that, to better preserve renal function, PCN is the choice of treatment, irrespective of the etiology. While patients who have a PCN tube may have to carry an additional external drainage device, the complications did not seem to differ significantly from those who used internal drainage with a ureteral stent. Because young cancer patients may especially need aggressive chemotherapy to prolong their survival, PCN urinary drainage may become a better choice from the standpoint of cancer control.

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## 1. Introduction

Urinary diversion is one of the ways to manage ureteral obstructions and is commonly performed in our daily practice when the underlying condition of ureteral obstruction cannot be eliminated in a short period. Ureteral obstructions can be a consequence of malignancies or benign diseases. Once a metastatic lesion affects a ureter, the resultant obstruction is very difficult to cure and should therefore be drained. The approach of draining urine, the

so-called urinary diversion, can be either the use of an internal ureteral stent (e.g., a double-J stent) or a percutaneous nephrostomy (PCN). Although both the approaches preserve renal function, they differ in many aspects.

Clear guidelines regarding optimal urinary diversions have not been established. Most authors agreed that decisions should be individualized.<sup>1</sup> Retrograde implantation of ureteral stents is associated with a high failure rate in patients with an obstruction secondary to a malignancy.<sup>2,3</sup> Such patients ultimately require PCN procedures to drain the affected kidney. However, it is reasonable that a large portion of patients will initially refuse the PCN procedure, because of the need to carry an external urine-collecting bag.<sup>4</sup>

It is pivotal to preserve the long-term renal function in young patients with ureteral obstruction, since they have a long life

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expectancy. Furthermore, when a ureteral obstruction is caused by a malignancy, optimal renal function is a prerequisite for aggressive treatments such as chemotherapy.

The true efficacies of PCN tubes and double-J stents were not clearly compared in the previous studies. We believe that obtaining these data will help establish a good rationale to approach these cases.

## 2. Materials and methods

A retrospective chart review was performed. Between 2003 and 2009, 110 patients (47 males and 63 females; 86 stents and 60 PCN tubes) were enrolled in a single institute. Enrollment criteria consisted of the need for unilateral or bilateral upper urinary tract diversion for at least 6 months. Either a PCN tube or an internal ureteral stent (e.g., double-J stent) was used for ureteral obstructions of various etiologies. Cases of stone-related hydronephrosis were excluded from this study.

In the stent group, the obstructed ureters were stented with 7-Fr catheters (InLay<sup>®</sup> ureteral stent; Bard, Covington, GA, USA) under cystoscopy. In the PCN group, radiologists performed the procedures under ultrasonographic guidance. In all cases, 8-Fr nephrostomy catheters were put in place. In our practice, either PCN tubes or double-J stents were kept for a maximal period of 3 months, and then replacement was required. The tubes were also replaced when obstructions or infections were observed clinically.

We measured hydronephrosis according to sonographic findings using the SFU grading system.<sup>5</sup> In our study, any hydronephrosis of no less than grade 1 (i.e., dilated renal pelvis) was recorded as residual hydronephrosis. The criteria for acute pyelonephritis were met when fever, backache, and a positive urine culture presented together.

Data on serial serum creatinine levels and adverse events after both procedures were collected. We also reviewed interval changes in the severity of hydronephrosis in the study cohort.

Statistical analysis was performed with commercial computer software (SPSS version 15; SPSS Inc., Chicago, IL, USA). Statistical significance was set at  $p < 0.05$ .

## 3. Results

Patients who received upper urinary tract diversions were aged 19–89 (mean, 63.6) years. We identified 66 patients (60%) with ureteral stents and 44 (40%) with PCN tubes. In total, 86 renal units receiving ureteral stents and 60 renal units receiving PCN tubes were included in the analysis. The mean duration of diversion was  $16.8 \pm 8.6$  months in the stent group versus  $14.1 \pm 6.7$  months in the PCN group ( $p = 0.067$ ).

Gender, laterality, and location of the obstruction/stricture did not differ in the two groups. The overall age of the two groups differed significantly (60.8 vs. 67.8 years,  $p = 0.004$ ); younger patients tended to receive ureteral stenting as the treatment. This was more obviously noted for patients under 65 years old (Table 1).

Regarding the etiology, 56 cases were of benign causes and 54 were due to a malignancy. Extensive ureteral injury was the most common cause requiring urinary diversion among the benign etiologies; cervical cancer was the most common malignancy associated with ureteral obstructions in the study cohort (Table 2).

Maintaining a stable serum creatinine level and relieving hydronephrosis were the primary goals of upper urinary tract diversion. The baseline mean serum creatinine level was higher in the PCN group than in the stent group (2.96 vs. 1.48 mg/dL,  $p = 0.014$ ). We also noted that nine of 86 double-J stents (10.4%) were converted to PCN tubes because of failure to maintain patency or of an associated refractory infection. Cases of conversions were

**Table 1**  
Patient characteristics.

Variable	Ureteral stent	Percutaneous nephrostomy	<i>p</i>
Total ( <i>n</i> )	66	44	
Mean age (y)	60.8	67.8	0.043
Age $\geq 65$ y ( <i>n</i> , %)	24 (36.4)	26 (59.1)	
Age $< 65$ y ( <i>n</i> , %)	42 (63.6)	18 (40.9)	
Gender ( <i>n</i> , %)			
Male	25 (37.9)	22 (50)	
Female	41 (62.1)	22 (50)	
Laterality ( <i>n</i> , %)			0.22
Left	23 (34.8)	14 (31.8)	
Right	23 (34.8)	14 (31.8)	
Both	20 (30.4)	16 (36.4)	
Duration of diversion (mean $\pm$ SD mo)	$16.8 \pm 8.6$	$14.1 \pm 6.7$	0.067
Stricture level ( <i>n</i> )			
Upper	17	13	
Middle	5	13	
Lower	44	18	

SD = standard deviation.

noted in four of 17 (23.5%) strictures in the upper, zero of five (0%) in the middle, and five of 44 (11.3%) in the lower ureter.

Regarding the efficacy of urinary diversion, a smaller elevation in the serum creatinine level was observed in the PCN group than in the stent group (0.78 vs. 0.21 mg/dL,  $p = 0.003$ ) (Table 3). Residual hydronephrosis in renal units after the diversion was more common in the stent group than in the PCN group (65.2% vs. 27.2%,  $p = 0.01$ ). The stent group was observed to have more frequent urinary tract infections, including urosepsis and pyelonephritis, than the PCN group, but the difference was not statistically significant.

## 4. Discussion

Ureteral obstruction was highly amenable to endoscopic ureteral stents in cases of benign intrinsic obstruction, but the incidence of stent failure was significantly higher in cases of extrinsic compression, as was seen with most malignant diseases. Retrograde insertion of ureteral stents ultimately failed in 16–58% of patients whose ureteral obstructions were due to a malignancy.<sup>6</sup> Despite previous enthusiasm, metallic stents were also reported to have considerable failure rates of 38–48%.<sup>7</sup> These patients then required a PCN or ureterostomy to achieve adequate diversion.

Although the severity of hydronephrosis itself is not directly related to residual renal function, more severe hydronephrosis still implies higher intrarenal pressure that can hamper renal function.

**Table 2**  
Primary cause of ureteral obstruction.

	Ureteral stent	Percutaneous nephrostomy
Benign causes	40	16
Malignancy	26	28
Cervical cancer	19	9
Prostate cancer	4	5
Colon cancer	1	7
Bladder cancer	2	1
Stomach cancer	0	1
Ovarian cancer	0	1
Lung cancer	0	1
Endometrial cancer	0	1
Lymphoma	0	1
Breast cancer	0	1

**Table 3**  
Efficacy of urinary diversion/drainage.

	Ureteral stent	Percutaneous nephrostomy	<i>p</i>
Mean initial creatinine (mg/dL)	1.48	2.96	0.014
Creatinine change (mg/dL)	0.78 (–1.8 to 1.2)	0.21 (–2.4 to 1.9)	0.03
Residual hydronephrosis	43/66 (65.2%)	12/44 (27.2%)	0.01

In our series, percentage of residual hydronephrosis after ureteral decompression was higher in patients who had undergone ureteral stenting (65.2% vs. 27.2%). A small percentage of patients in the PCN group had undergone ureteral stenting initially, but eventually switched to PCN after learning that their renal function had deteriorated.

Progressive loss of patency after various methods of urinary diversion was reported by Ku et al,<sup>1</sup> who also reported that morbidities after internal or external diversion were minimal in cases of malignant obstruction. However, patients scheduled to receive an internal ureteral stent should be more carefully monitored for ongoing obstruction than those scheduled for PCN tube placement.<sup>1</sup> A greater chance of ongoing obstruction of a ureteral stent than a PCN tube may explain why the latter was associated with a less elevated creatinine level. The treatment consensus in our institute recommends placing bilateral double-J stents or PCN tubes when bilateral obstructions are diagnosed. Although serum creatinine may return to normal with unilateral diversion, our goal is to preserve every kidney whenever possible.

Mechanisms of stent occlusion are not fully delineated, but it is suspected that impairment of ureteral smooth muscles by extrinsic ureteral compression and encrustation of the lumen play important roles.<sup>8</sup> Previous studies showed that repeated stent replacement for a malfunction did occur, on average, 2.8 times in a 90-day period. Other studies showed similar results for stent failure rates, including 11% of patients at 2 months and 56% at 3 months due to obstruction.<sup>9</sup> Chung et al<sup>10</sup> reported that 44% of patients with malignant ureteral obstruction had stent failure in their 15-year experience with management. Despite improvements in techniques and biomaterials, optimal management of malignant ureteral obstruction remains unclear.<sup>11</sup> Progressive urinary obstruction can lead to renal failure, electrolyte imbalances, and urinary tract infections. These complications were more commonly observed in the double-J stent group.

Modern ureteral stents were modified to improve resistance to extrinsic compression, cause less bladder irritation and infection, and offer prolonged effective indwelling periods.<sup>4</sup> Long-term follow-up data on these new stents are still lacking.

McCullough et al reported that the serum creatinine at the diagnosis of obstructive hydronephrosis could be used to predict which patients will have retrograde stent placement failure. A serum creatinine level before retrograde ureteral stent placement of  $\geq 1.2$  mg/dL is known to be an unfavorable prognostic factor of overall survival in malignant ureteral obstruction.<sup>12</sup> It is therefore important to prevent, as much as possible, serum creatinine levels from rising in all patients. Although increases in body muscles, heart failure, and profound shock may also contribute to elevated serum creatinine, these factors were not seen in our study population.

Our current study showed that patients were older in the PCN group. Elderly patients have long been considered to be at high risk and to be poor candidates for surgery or chemotherapy.

However, since younger cancer patients may need more aggressive chemotherapy to prolong their survival, better preservation of renal function with PCN may be indicated. On the contrary, most young patients were put on internal ureteral stents due to concerns about their quality of life; gradual loss of renal function of the affected side may become irreversible after long-term stents in these patients. At that point of time, there would be no choice but to modify the dose or formula of the chemotherapy.

A major limitation of our study is the sample size. Secondly, the ages and baseline creatinine levels were not completely matched in these two groups, thereby making comparisons difficult. A randomized, double-blind study should be performed in the future to make clear suggestions regarding choices between an internal stent and a PCN tube.

## 5. Conclusions

Urinary diversion or decompression using PCN produced better preservation of renal function and lower incidences of complications in our study. For younger cancer patients who may need aggressive chemotherapy to prolong their survival, even with normal baseline serum creatinine levels, turning away from long-term double-J stents and choosing a PCN tube may become more acceptable.

## Conflicts of interest statement

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

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