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Ureteral stent placement and percutaneous nephrostomy in the management of hydronephrosis secondary to cervical cancer

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ABSTRACT

Objective: This study aimed to evaluate the efficacy of ureteral stent placement for the treatment of hydronephrosis secondary to cervical cancer and analyze factors that may predict failure of ureteral stent placement and the differences between ureteral stent placement and percutaneous nephrostomy.

Study design: Clinical data of patients with cervical cancer complicated with hydronephrosis admitted to our hospital from July 2008 to August 2018 were retrospectively analyzed. To evaluate the efficacy of ureteral stent placement and percutaneous nephrostomy in the management of hydronephrosis secondary to cervical cancer.

Results: A total of 89 patients were analyzed. A ureteral stent was successfully placed in 60 patients. Indwelling stent failed in 29 patients, and then percutaneous nephrostomy was performed. Both surgical procedures were safe and effective. There was a significant correlation between the success rate of ureteral stent placement and the degree of hydronephrosis and the length of the ureteral obstruction. There was no significant difference in the incidence of complications following ureteral stent placement and percutaneous nephrostomy, while there were significant differences between the two treatment modalities in terms of surgical time, hospitalization time, and surgical cost.

Conclusion: Ureteral stent placement is the preferred method for the treatment of hydronephrosis secondary to cervical cancer. However, in patients with more severe hydronephrosis and ureteral obstruction >3 cm in length, percutaneous nephrostomy may be more appropriate.

Introduction

Cervical cancer is a common malignancy among women. Due to the anatomical proximity of the ureter and the cervix, tissue from malignant cervical tumors can directly invade the ureter or result in ureteral scarring or stricture due to radiotherapy or surgery. Thus, hydronephrosis is not uncommon among patients with cervical cancer, particularly those with advanced cervical cancer. Moreover, it is a poor prognostic in patients with advanced cervical cancer [1]. Effective treatment should be performed immediately as long-term obstruction may result in pain, infection, and ultimately kidney damage or failure. Active management of cervical cancer complicated with hydronephrosis can improve the patient's quality of life and prognosis [1].

The median survival time of patients with cervical cancer complicated with hydronephrosis is 3 to 12 months [2]. This shorter life expectancy discourages most urologists from reconstructive surgery. Thus, many such patients are given palliative care. In these patients, ureteral stent placement and percutaneous nephrostomy can be selected for urine drainage. This can alleviate the suffering of patients and protect the renal function of patients, which is conducive to the follow-up treatment of cervical cancer if necessary. Currently, ureteral stent placement is generally considered the preferred method for relieving ureteral obstruction, but in the presence of cervical cancer, manipulation may be difficult. Some researchers have shown a significant increase in the failure rate of ureteral stent placement when pelvic tumors cause

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exogenous compression [3]. Meanwhile, percutaneous nephrostomy can also cause many problems, such as the displacement of the external urine collection bag and the drainage tube, which reduces the quality of life of the patient. Therefore, the best treatment for hydronephrosis secondary to cervical cancer is still unclear.

This study aimed to evaluate the efficacy of ureteral stent placement for the treatment of hydronephrosis secondary to cervical cancer and analyze factors that may predict failure of ureteral stent placement and the differences between ureteral stent placement and percutaneous nephrostomy.

Materials and methods

Patients

Patients with cervical cancer complicated with hydronephrosis who were admitted to the Shengjing Hospital of China Medical University from July 2008 to August 2018 were selected for the study. Patients with ureteral obstruction with hydronephrosis were diagnosed via ultrasound, computed tomography (CT), or magnetic resonance imaging (MRI). The patients were divided into two groups according to the treatment they received as follows: the ureteral stent group and the percutaneous nephrostomy group. The age, International Federation of Gynecology and Obstetrics (FIGO) stage, degree of hydronephrosis, sites of hydronephrosis, length of ureteral obstruction, previous history of radiotherapy or surgery, and serum creatinine level before treatment were recorded. The complications, surgical time, cost, and hospitalization time were compared between the two groups. The study was approved by the ethics review board; and Informed consent was obtained.

Ureteral stent placement

For all patients, a urological surgeon first attempted cystoscopic ureteral stent placement. The clinical indications for ureteral stent placement included imaging evidence of ureteral obstruction, impaired renal function, and severe urinary tract infection. The ureteral stent can be placed in the surgical clinic or in the hospital using lidocaine gel as a local anesthetic. Flexible cystoscopy was used in all procedures, and if unsuccessful, percutaneous nephrostomy was performed. Indwelling stent failure was defined as the inability to place the ureteral stent under the cystoscope or continuous progression of hydronephrosis after placement, accompanied by low back pain, fever, and elevated serum creatinine. Percutaneous nephrostomy was performed by an interventional physician under ultrasound or radiography guidance, and coagulation dysfunctions were corrected before surgery. In both procedures, the final position was confirmed via radiography. Surgical complications were defined as urinary tract infections, back pain, and stent/catheter displacement. Informed consent was obtained from each patient prior to the procedure. Prophylactic antibiotics were administered before surgery. Patients were re-examined in the clinic every 3 months. The stent or drainage tube was replaced every 3–6 months. Patients were treated as needed if the stent or drainage tube dislocated or became blocked.

Statistical analysis

All statistical analyses were performed using SPSS 19.0 (IBM Corp, Armonk, NY). The Student's *t*-test and the $\chi 2$ test were used to determine any significant difference in the outcomes between the 2 groups. Differences with $p < 0.05$ were considered statistically significant.

Results

Patients

A total of 89 patients were included in the analysis. The average patient age was 50.3 years (range, 25–78 years). The general characteristics of the patients are shown in Table 1. All 89 patients were treated with ureteral stent placement as the preferred treatment. Of these, 69 (77.5%) successfully underwent cystoscopic stent placement, and the remaining 20 (22.5%) failed stent placement because the ureteral orifice could not be identified, the stent could not be passed, or the patient could not physically tolerate the procedure. These 20 patients underwent nephrostomy after stent placement failure. Of the 69 patients in which stent placement was initially successful, 9 experienced late failure, which presented as lack of remission of hydronephrosis. Stent placement was also converted to nephrostomy in these 9 patients. In the end, 60 of the 89 patients (67.4%) were treated with ureteral stent placement. Nephrostomy was used to salvage all cases of failed stent placement with a success rate of 100%.

Comparison of outcomes

Cystoscopic ureteral stent placement was significantly correlated with the degree of hydronephrosis ($p < 0.05$) and ureteral obstruction $\leq$ 3 cm in length ($p < 0.01$), while it was not significantly correlated with age ($p = 0.235$), FIGO stage ($p = 0.096$), single/bilateral hydronephrosis ($p = 0.316$), history of pelvic radiotherapy ($p = 0.753$), history of pelvic surgery ($p = 0.846$), or preoperative creatinine levels ($p = 0.632$) (Table 2).

In this study, the incidence of complications in the ureteral stent group was not significantly different from that in the percutaneous nephrostomy group (Table 3). There were 4 cases of retraction of the stent into the ureter requiring ureteroscopic removal in the ureteral stent group. In addition, there were 2 cases of the ureteral stent falling into the bladder requiring re-placement via cystoscopy. In the percutaneous nephrostomy group, 3 patients developed catheter dislocation, which required emergency

Table 1
General characteristics of the patients.

Characteristic	N (%)
Age (years)	
≤ 50	48.3)
>50	46 (51.7)
FIGO stage	
I	17 (19.1)
II	53 (59.6)
III	14 (15.7)
IV	5 (5.6)
Degree of hydronephrosis	
Mild	23 (25.8)
Moderate	37 (41.6)
Severe	29 (32.6)
Site of hydronephrosis	
Unilateral	67 (75.3)
Bilateral	22
Length of ureteral obstruction (cm)	
≤ 3	62 (69.7)
> 3	27 (30.3)
Radiotherapy	
Yes	68 (76.4)
No	21 (23.6)
History of pelvic surgery	
Yes	55 (61.8)
No	34 (38.2)
Pre-treatment creatinine level	
≤ 200 μmol/L	49 (55.1)
> 200 μmol/L	40 (44.9)

Table 2
Correlation between clinical factors and the two type of surgeries.

Index	Indwelling ureteral stent (n = 60), n (%)	Percutaneous nephrostomy (n = 29), n (%)	Success rate of indwelling ureteral stent (%)	*p*
Age (years)				0.235
≤ 50	25 (41.7)	18 (62.1)	58.1	
> 50	35 (58.3)	11 (37.9)	76.1	
FIGO stage, n (%)				0.096
I-II	49 (81.7)	21 (72.4)	70.0	
III-IV	11 (18.3)	8 (27.6)	57.9	
Degree of hydronephrosis				0.032
Mild	19 (31.7)	4 (13.8)	82.6	
Moderate	29 (48.3)	8 (27.6)	78.4	
Severe	12 (20.0)	17 (58.6)	41.4	
Site of hydronephrosis				0.316
Unilateral	47 (78.3)	20 (69.0)	70.1	
Bilateral	13 (21.7)	9 (31.0)	59.1	
Length of ureteral obstruction (cm)				0.001
≤ 3	50 (83.3)	12 (41.4)	80.6	
> 3	10 (19.7)	17 (58.6)	37.0	
Radiotherapy				0.753
Yes	46 (76.7)	22 (75.9)	67.6	
No	14 (23.3)	7 (24.1)	66.7	
History of pelvic surgery				0.846
Yes	37 (61.7)	18 (62.1)	67.3	
No	23 (38.3)	11 (37.9)	67.6	
Pre-treatment creatinine level				
≤ 200 μmol/L	35 (58.3)	14 (48.3)	71.4	0.632
> 200 μmol/L	25 (41.7)	15(51.7)	62.5	

Table 3
Comparison of outcomes between groups.

	Indwelling ureteral stent	Percutaneous nephrostomy	*p*
Complications, n (%)	25 (41.7%)	9 (31.0%)	0.136
Stent/catheter dislocation, n (%)	6 (10.0%)	3 (10.3%)	0.628
Surgical time (min), average	30.6 ± 10.1	51.0 ± 8.7	0.000
Surgical cost (RMB*), average	1155.7 ± 27.4	3967.6 ± 35.6	0.000
Hospitalization time (days), average	1.7 ± 0.3	3.2 ± 0.5	0.000

* 1 RMB≈ 0.15 US dollar.

re-inflation or re-ostomy. There were no serious long-term complications in the two groups. And only a small number of patients had mild hematuria or waist discomfort. There were significant statistical differences between the two groups in average surgical time and hospitalization time. Percutaneous nephrostomy also cost significantly higher than ureteral stent (Table 3).

Discussion

Cervical cancer complicated with hydronephrosis is not uncommon in clinical practice. The incidence of hydronephrosis is particularly higher in patients with advanced cervical cancer [4], and it is a significant indicator of poor prognosis in these patients [5,6]. The cervix and the ureters have a close anatomical relationship, and the tumor itself as well as associated enlarged lymph nodes can affect the ureters, leading to hydronephrosis. Other factors such as surgery and radiotherapy are also important causes of hydronephrosis. If the ureters are injured or excessively isolated during surgery, blood supply to the ureter is affected, which can lead to postoperative ureteral stricture and secondary hydronephrosis. Even if there is no intraoperative ureteral injury, the incidence of hydronephrosis 3 months after surgery can be as high as 15% [7]. Some researchers have found that patients with stage IB1-IIA cervical cancer with no intraoperative ureteral injury have a significantly higher incidence of hydronephrosis after postoperative radiotherapy than those who did not undergo radiotherapy [8]. Cervical cancer complicated with hydronephrosis can lead to many urinary tract complications, such as intractable back pain, urinary tract infection, nausea, vomiting, bleeding, and even kidney failure. Therefore, follow-up on the urinary system of patients with cervical cancer is highly necessary. Currently, studies have found that active treatment of hydronephrosis can prolong the survival period of patients and improve their quality of life [9,10].

Ureteral stent placement and percutaneous nephrostomy are established alternatives to open surgery in the palliative treatment of malignant urinary tract obstruction [11–14], and they are currently the mainstream surgical procedures. Park et al. [15] believed that percutaneous nephrostomy should be the primary method for drainage in critically ill patients with exogenous ureteral obstruction. However, Rosenberg et al. [16] recommended ureteral stent placement as the first choice of treatment for exogenous ureteral obstruction secondary to malignancy because of the low risk of stent failure and the short life expectancy of these patients. In the present study, ureteral stent placement was usually successful in cases of hydronephrosis secondary to gynecological malignant tumors. However, some economically underdeveloped regions have limited medical standards, and percutaneous nephrostomy is technically difficult.

Cystoscopic ureteral stent placement is minimally traumatic and has a high success rate. In addition, it does not require an

external tube and management is simple, resulting in a relatively small impact on quality of life and in high patient compliance. However, the success rate is affected by many factors. The results of the present study showed that patients with mild hydronephrosis and ureteral obstruction ≤ 3 cm in length had a high success rate of ureteral stent placement. The first choice for these patients can be cystoscopic ureteral stent placement. Meanwhile, more severe hydronephrosis and longer length of ureteral obstruction indicate greater severity of obstruction, and ureteral stent placement becomes correspondingly more difficult. The results of the study by Song et al. [17] are similar to our results, that is, ureteral obstruction > 3 cm in length results in a significant decrease in the success rate of indwelling ureteral tube placement. Direct nephrostomy may be more appropriate in these patients. Percutaneous nephrostomy is a minimally invasive, effective, and safe surgical procedure that can directly drain urine and improve renal function regardless of the condition of the ureter. Some researchers even believe that nephrostomy is the last and only way to improve the survival period of patients [18]. The success rate of nephrostomy in the present study was 100%. However, although percutaneous nephrostomy method has a high success rate, the patient needs a long-term external drainage bag, quality of life is poorer, management is less convenient compared to ureteral stent placement, and patient compliance is low.

None of the patients in the present study had life-threatening complications. The primary complications included urinary tract infection and lower back discomfort. There was no significant difference in the incidence of complications between the two groups. Both the ureteral stent and the nephrostomy drainage tube can be displaced. The two ends of the ureteral stent are not firmly fixed in the body; thus, they can be displaced upward or downward. In the present study, 4 patients with ureteral stent placement were found to have retraction of the stent into the ureter; they were re-set via ureteroscopy. In the other 2 cases, the stent fell into the bladder; after they were discovered, the were re-set via cystoscopy. Because patients who have underwent percutaneous nephrostomy need an external drainage bag, there is a possibility that the drainage tube will be accidentally removed. The amount of hydronephrosis is reduced after placement of the drainage tube. The kidney moves with breathing, thus increasing the probability of nephrostomy displacement.

When replacing the ureteral stent, there is a high rate of stent replacement failure if the stent is directly removed during replacement because the tumor or other cause of ureteral obstruction has not been eliminated. The reported failure rate on 1-year follow-up is 55.7% [19]. Therefore, during each replacement, the stent is first moved to the urethral orifice, a guide wire is placed in the ureter through the stent opening, and then the stent tube is replaced with the guidance of the guide wire. Although such an operation increases the probability of infection to some extent, the success rate can reach 100%. The ureteral stent is generally replaced within 3–6 months; any longer greatly increases the risk of urinary tract infection and the rate of calculus formation in the stent lumen. Consequently, this will it difficult for the guide wire to pass through the stent opening, leading to an increased risk of stent replacement failure. Meanwhile, the best time to replace the nephrostomy is 3–6 months; any longer considerably increases the risk of obstruction and infection of the drainage tube. Replacement is best performed under the guidance of a guide wire. The sinus can be easily lost when the nephrostomy is replaced without the guide wire; if this happens, the nephrostomy should be re-performed.

In addition, health resources and the economic situation of patients should also be considered. As shown in Table 3, the two methods have different average surgical costs, surgical times, and hospitalization times. Compared with percutaneous nephrostomy, ureteral stent placement has a significantly lower cost and shorter surgical and hospitalization time, which has prompted some patients to select this method. However, CT or MRI findings of ureteral obstruction >3 cm in length is an important risk factor for ureteral stent placement failure and conversion to percutaneous nephrostomy. Thus, ureteral stent placement may not be suitable for such patients.

This research has some limitations including a small sample size, its retrospective design, and the use of data from a single center. In the future, a multi-center prospective study should be conducted to recruit more patients and conduct more in-depth analysis.

In summary, both ureteral stent placement and percutaneous nephrostomy are effective methods for the treatment of hydronephrosis in cervical cancer, with low incidence of complications. Patients with more severe hydronephrosis, ureteral obstruction >3 cm in length, or bladder infiltration have a lower success rate for cystoscopic ureteral stent placement, and percutaneous nephrostomy can be the first choice for these patients. The success rate of nephrostomy is higher, but patient compliance is lower due to the presence of external tubing. Therefore, when selecting a surgical procedure, the physician must comprehensively consider the condition of the patient's hydronephrosis, ureters, and bladder and fully communicate with the patient to make the choice that best meets the actual needs of the patient.

Declaration of Competing Interest

None.

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