Pediatric Urology

Comparison of Surgical Outcomes between Dismembered Pyeloplasty with or without Ureteral Stenting in Children with Ureteropelvic Junction Obstruction

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Purpose: To evaluate the impact of temporary internal ureteral stents on the surgical outcomes of dismembered pyeloplasty in children.

Materials and Methods: The medical records of 70 children (76 renal units) who underwent dismembered pyeloplasty for ureteropelvic junction (UPJ) obstruction at at Asan Medical Center between January 2005 and December 2010 were retrospectively reviewed. We classified the renal units into the stented group (22 renal units) and the nonstented group (54 renal units). Fifty-four of 70 patients were male and their mean age was 2.2±3.8 years old. The mean follow-up period was 29.6±16.8 months.

Results: Sixty-four children had unilateral UPJ obstruction. The mean stent duration was 31.9 days. As shown by evaluation of radiologic images, there were no significant differences between the stented group and the nonstented group during the follow-up period (p>0.05). The mean preoperative and postoperative anteroposterior pelvic diameters (APPDs) of the nonstented group were 31.3 mm and 15.1 mm, respectively (p<0.001). The preoperative and postoperative grades of hydronephrosis were 3.9 and 2.9, respectively (p=0.037). The mean preoperative and postoperative APPDs of the stented group were 36.4 mm and 15.6 mm, respectively (p<0.001). The preoperative and postoperative grades of hydronephrosis were 4 and 3.1, respectively (p<0.001). Repeat obstruction was shown in 4 subjects as a postoperative complication (5.7%). Two children from each group had recurrent UPJ obstruction, with percentages of 3.7% and 9%, respectively (p=0.575).

Conclusions: In a comparison of nonstented and stented groups during pediatric dismembered pyeloplasty for UPJ obstruction, no significant differences were found in the resolution of hydronephrosis or overall postoperative complications.

Key Words: *Child; Hydronephrosis; Stents; Ureteral obstruction*

INTRODUCTION

Ureteropelvic junction (UPJ) obstruction is the most common congenital abnormality of the upper urinary tract. The surgical repair of UPJ obstruction was first recorded more than 100 years ago [1]. Since then, a number of modifications have been made regarding the surgical intervention, and Anderson-Hynes pyeloplasty is currently considered the gold standard for UPJ obstruction treatment, with proven efficacy and a high success rate following long-term follow-up assessment [2]. The success rates of this technique have been reported to exceed 95% in

long-term studies [3]. In addition, many minimally invasive options, such as Acucise catheter incision, balloon dilation, the endopyelotomy technique, and laparoscopic pyeloplasty (LP), have been developed to minimize the postoperative morbidity of open pyeloplasty. LP was initially reported in adults by Schuessler et al. [4] in 1993, and pediatric laparoscopic Anderson-Hynes pyeloplasty was introduced by Peters et al. in 1955 [5]. Currently, the selection of the pyeloplasty approach in children with UPJ obstruction is mostly based on the surgeon's preference and experience. Once an approach is chosen, the surgeon must then decide whether to place a ureteral stent for internal urinary drainage, to select an external stent such as a trans-nephrostomy tube or trans-pyelostomic stent, or to just simply leave a perinephric drain without urinary diversion. Nevertheless, whether a temporary urinary stent such as a nephrostomy tube or ureteric stent leads to better results than simple perinephric drainage during the hospital stay remains controversial [6-11]. Nowadays, many surgeons tend to prefer internal drainage to external drainage [12,13]. However, there is no reported evidence to date to support a clear advantage of either practice regarding relieving UPJ obstruction or reducing postoperative morbidities in terms of the modality of urinary diversion. We therefore investigated whether temporary internal ureteral stents improve the surgical outcomes of children who undergo dismembered pyeloplasty.

MATERIALS AND METHODS

1. Patient characteristics

The medical records of 70 children (76 renal units) who underwent dismembered pyeloplasty for UPJ obstruction at our institution between January 2005 and December 2010 were retrospectively reviewed. Fifty-four of the 70 children were male and their mean age was 2.2±3.8 years old at the time of operation (Table 1). Open Anderson-Hynes reduction pyeloplasty was performed for 68 renal units and LP was performed for 8 renal units. The transperitoneal approach was only used to perform LP. The authors classified the subjects into the stented group and the nonstented group. Perinephric drainage was performed for both groups. The mean follow-up period was 29.6±16.8 months.

2. Changes in hydronephrosis

The degree of hydronephrosis was graded according to the classification of the Society for Fetal Urology (SFU), with 0 indicating normal kidney with intact renal sinus, 1 indicating slightly dilated renal pelvis without caliectasis, 2 indicating moderately dilated renal pelvis with mild caliectasis, 3 indicating large renal pelvis and dilated calices, and 4 indicating large renal pelvis with large dilated calices [14]. "Improved hydronephrosis" was defined as a reduction in at least 1 SFU grade. We also measured the anteroposterior pelvic diameter (APPD) pre- and postoperatively. Renal APPD was defined as the maximum anteroposterior pelvic diameter for each kidney.

3. Changes in differential renal function and diuretic excretion

We also compared the differences in results of a postoperative diuretic ^{99m}Tc-mercaptoacetotriglycine (^{99m}Tc-MAG3) renal scan. A total of 66 of 70 patients were checked by diuretic ^{99m}Tc-MAG3 renal scanning preoperatively. A follow-up diuretic ^{99m}Tc-MAG3 renal scan was performed 1 year after surgery by using a standardized well-tempered renogram for both groups [15]. If ultrasonography or the follow-up diuretic renal scan did not show improvement, additional diuretic ^{99m}Tc-MAG3 renal scans were performed 2 years after the operation. Dynamic digital data were acquired for 20 minutes by using a gamma camera at 3 seconds per frame for the first 1 minute, followed by 30 seconds per frame (128×128 matrix format). Furosemide (1 mg/kg) was injected 20 minutes after injection of ^{99m}Tc-MAG3, and a diuretic renogram was obtained for an additional 20 minutes. In the diuretic renogram, $T_{1/2} > 20$ minutes was defined as being equal to "obstruction."

4. Statistical analysis

To evaluate the efficacies of ureteral stents, we investigated the preoperative characteristics of the patients and assessed the improvement in hydronephrosis and the complications between the groups and between the preoperative values and those at 1 year after surgery. Patient age, gender, obstruction side, nuclear renography findings, hydronephrosis grades on ultrasonography, etiology of UPJ obstruction, and symptoms of the patients were compared between the two groups. Postoperative factors

TABLE 1. Patient demographic characteristics

Characteristic	Stented group	Nonstented Group	p-value
No. of renal units	22	54	
Mean age (yr)	1.09	4.95	0.001
No. of male (%)	17 (77)	43 (79)	
Severity of hydronephrosis			
SFU grade	4	3.92	0.518
APPD (mm)	36.4	31.3	0.701
Relative renal function (%)	47	47.2	0.556
Operative methods			0.091
Open	16	52	
Laparoscopic	6	2	
Mean follow-up (mo)	23.9	31.9	0.055
Cause of UPJ obstruction			
Intrinsic	20	51	
Extrinsic	1	2	
Polyp	1	1	
Symptom			0.214
Urinary tract infection	1	2	
Pain	1	1	
Hematuria	0	0	
Prenatal sonography	20	51	

SFU, The Society for Fetal Urology; APPD, anteroposterior diameter; UPJ, ureteropelvic junction.

such as the duration of stent indwelling, recurrence as a postoperative complication, results of the ultrasonography, and results of the diuretic renal scan were evaluated.

Statistical analysis was performed by using SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA). The chi-square and Fisher exact tests were used to compare categorical variances, and the Mann-Whitney U test was used for nonparametric continuous variances. The paired t-test was also used to compare pre- and postoperative hydronephrosis status. Values of $p < 0.05$ were considered statistically significant in the current study.

RESULTS

Sixty-four children had unilateral UPJ obstruction. Internal ureteral stents were used in 16 of 68 renal units that underwent open dismembered pyeloplasty. The mean duration of stent indwelling was 31.9±8.4 days. The stents were removed under general anesthesia.

The postoperative status of the two groups was compared with their preoperative hydronephrosis by measuring APPD and the SFU grade of hydronephrosis (Table 2). In the nonstented group, the mean preoperative and postoperative APPD were 31.3 mm and 15.1 mm, respectively ($p < 0.001$). The preoperative and postoperative grades of hydronephrosis in the nonstented group were 3.9 and 2.9, respectively ($p < 0.001$). In the ureteral stented group, the mean preoperative and postoperative APPD were 36.4 mm and 15.6 mm, respectively ($p < 0.001$). Preoperative and postoperative grades of hydronephrosis in the stented group were 4 and 3.1, respectively ($p < 0.001$). There were no significant differences between the stented and the nonstented group in image follow-ups ($p > 0.05$).

In the nonstented group, the mean differential renal function changed from 47.2 to 48.8% after surgery, and improvement of diuretic obstruction was shown in 42 of 51 renal units (82.4%) when the results of the 1-year postoperative diuretic renal scan were evaluated. In the stented group, the mean differential renal function changed from 47 to 48% and improvement of diuretic obstruction was shown in 18 of 21 renal units (85.7%).

UPJ re-obstruction (Clavien system grade IIIb) occurred in 4 of the 70 children (5.7%) in the form of postoperative complications. There were no other complications such as urine leakage or febrile urinary tract infection. Both groups had two children with recurrent UPJ obstruction, 4% and 9%, respectively (p=0.575) (Table 3). Preoperatively, four patients with re-stricture had severe hydronephrosis that measured more than 40 mm APPD and SFU grade 4. Repeat pyeloplasty was performed in all four of these patients. Three of these four children with recurrence underwent repeat open dismembered pyeloplasty, and the other child underwent ureteroscopic holmium laser endopyelotomy.

Two of these four patients initially underwent open pyeloplasty, and the other two patients underwent LP. Despite the fact that LP had a higher recurrence rate of UPJ obstruction than did open pyeloplasty, it was judged that there was no significant difference in the recurrence rate between the operation methods (Table 3).

DISCUSSION

Although dismembered pyeloplasty has become a well-accepted gold standard treatment modality for UPJ obstruction, the question of whether postoperative urinary diversion after pyeloplasty is beneficial has been debated for decades, particularly in infants and smaller children who have narrow ureters. There are many ways to divert urine, and different types of drainage methods have been described in the literature, including nephrostomy tube drainage, internal ureteral stents such as the double 'J' stent, external stent anastomosis, and a combination of these modalities [16,17]. In the original report of Anderson and Hynes, they clearly supported nonstented repair for UPJ obstruction and claimed that a nephrostomy tube or internal stent caused urinary tract infection, fibrosis at the suture line, and recurrent UPJ obstruction and hindered healing of the anastomosis site [1]. However, as operative techniques have evolved and postoperative complications such as urine leakage have been reported, the standard operative technique has evolved to include a urinary diversion modality such as a nephrostomy tube or internal

TABLE 2. Comparison of hydronephrosis between the stented group and the nonstented group

	Stented group	Nonstented group	p-value
SFU grade of hydronephrosis			
Preoperative	4	3.92	0.518
Postoperative 1 year	3.14	2.91	0.139
p-value	< 0.001	< 0.001	
Anteroposterior pelvic diameter			
Preoperative (mm)	36.4	31.3	0.701
Postoperative 1 year (mm)	15.6	15.1	0.482
p-value	< 0.001	< 0.001	

SFU, The Society for Fetal Urology.

TABLE 3. Comparison of recurrence of complications according to the ureteral stent and operation method in pyeloplasty

	Recurrence (+)	Recurrence (-)	Total
Ureteral stent, n (%)			
(+)	2 (9)	20 (91)	22
(-)	2 (4)	52 (96)	54
p-value	0.575		
Operation method, n (%)			
Open	2 (3)	66 (97)	68
Laparoscopic	2 (25)	6 (75)	8
p-value	0.053		

ureteric stent to prevent urine leakage at the anastomosis site. Several favorable reports on the use of internal stents have been published in recent years showing their several advantages [6,18]. The advantages of a double 'J' stent compared with a nephrostomy tube include a shorter hospital stay and a lower morbidity rate [19,20]. Furthermore, double 'J' stents prevent adhesion to the suture site by splitting the suture line, help to maintain an appropriate diameter and alignment of the ureter, and limit ureter kinking [21]. Woo and Farnsworth [12] used only internal ureteral stents rather than both a stent and a nephrostomy tube because the former showed a low rate of postoperative complications and a decreased postoperative hospital stay. Ninan et al. [6] reported a review of the records of 60 patients who underwent pyeloplasty in 2008. They strongly recommended double 'J' stenting, claiming that it was the safest mode of drainage in pediatric pyeloplasty. None of their 58 stented patients developed stricture of the anastomosis site, whereas 1 of the 3 patients who did not receive a stent developed stricture of the anastomosis site requiring redo pyeloplasty. The other two patients who had a ureteric stricture responded to balloon dilatation. In addition, they also reported a mean hospital stay of 2.6 days in the stented patients and that the majority of the patients could be safely discharged on the second postoperative day. On the other hand, the mean hospital stay of the nonstented patients was 7 days. The disadvantages of the double 'J' stent include that it can cause stent-related complications such as urinary tract infection and provoke obstruction of the ureter by irritating the mucosa of the ureter or the renal pelvis. Furthermore, leaving a double 'J' stent in neonates or pediatric patients requires additional general anesthesia for removal. In recent years, there has been a favorable tendency toward nonstented pyeloplasty [9,11]. Braga et al. [11] evaluated influential factors associated with recurrent UPJ obstruction and concluded that stenting did not affect the long-term outcomes after pyeloplasty. This result was also found in the present study. We found no significant difference between the nonstented group and the stented group in terms of improvement of hydronephrosis (Table 2). The overall numbers of recurrent UPJ obstruction in each group (2 of 22 vs. 2 of 54) were the same in the current study, and the recurrence rate of UPJ obstruction in the stented group (9%) was slightly higher than in the nonstented group (4%). Despite this, there was no significant difference in the recurrence rate between the groups (p=0.575) (Table 3). Fortunately, no other complications associated with the operation, which may require additional procedures and a longer hospital stay, occurred in either group. Smith et al. [8] compared the differences in complications or intervention rates in the stented (n=52) and nonstented (n=65) groups and reported that urinary tract infection occurred in 3 of 52 stented cases (6%) versus 1 of 65 nonstented cases (2%). Prolonged drainage or urinoma occurred only in nonstented cases (3% or 5% each). However, the overall rate of urological complications in each group was similar: 12% in the stented and 15% in the

nonstented group. Therefore, the choice of postoperative urine drainage should be made by surgeon's preference rather than by the perceived complication rate or the duration of hospital stay. In Korea, Lee et al. [7] retrospectively analyzed 20 cases with UPJ obstruction who underwent pyeloplasty with or without diversion. The postoperative symptomatic and radiologic results were improved in 9 (75%) of 12 patients with nephrostomy tubes or internal ureteric stents and in 7 (87.5%) of 8 patients without any urinary diversion (p>0.05). In addition, there was no significant difference in complication rates between the groups.

We also performed LP in 8 cases (6 in the stented group vs. 2 in the non-stented). LP for UPJ obstruction was first described in 1993 by Schuessler et al. [4] and has become widely accepted as the first minimally invasive modality with success rates comparable to those of the open surgical approach [22]. Although the laparoscopic approach has been developed worldwide and has become a preferred method for UPJ obstruction repair [23], it has not yet reached the same degree of popularity among pediatric urologists. Currently, the selection of the pyeloplasty approach in children with UPJ obstruction mostly depends on the surgeon's preference and experience. Although several studies have been conducted in patients with UPJ obstruction, their sample sizes were small and the true effectiveness and advantages of LP over open pyeloplasty in children have not yet been clearly demonstrated [24,25]. Calvert et al. [25] reported that the success rate of primary LP was equivalent to that of open pyeloplasty (98% vs. 96%), but the success rate of secondary LP was inferior to that of secondary open pyeloplasty (57% vs. 67%) and that preoperative stent insertion did not seem to affect any objective measures of outcomes for LP. Although the success rate of LP was relatively lower than that of open pyeloplasty in our study, there was no significant difference owing to the small sample size of the subjects (p=0.057) (Table 3). The authors also performed secondary open pyeloplasty in three of four patients with recurrent UPJ obstruction.

The limitations of this study include that the subjects were retrospectively analyzed and the sample size was relatively small. Hence, a prospective study with a larger sample will be required to enhance the validity of this study in the future. Another drawback of this study is that the patients in the nonstented group were older than those in the stented group (Table 1). Nevertheless, the optimal age for pediatric pyeloplasty currently remains controversial. Although it was suggested that early repair of UPJ obstruction could prevent irreversible renal damage and improve renal function [26], other studies failed to demonstrate that pyelocaliectasis was easier to resolve postoperatively in the infant kidney [27,28]. It is more likely that patient ages at repair may have a minor role in the eventual resolution of hydronephrosis. However, the effect of patient ages at repair should be evaluated in further prospective studies with larger samples and long-term follow-up [29].

CONCLUSIONS

In the comparison of the nonstented group and the stented group during dismembered pyeloplasty in children with UPJ obstruction, we found no significant differences in the resolution of hydronephrosis or overall postoperative complications. Therefore, the insertion of an internal ureteral stent during pyeloplasty is not necessary and the choice of an internal ureteral stent for postoperative drainage should be made by surgeon's experience and preference.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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