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The Studer Orthotopic Neobladder: Long-Term (More Than 10 Years) Functional Outcomes, Urodynamic Features, and Complications

Jong Kil Nam, Tae Nam Kim, Sung Woo Park, Sang Don Lee, and Moon Kee Chung

Department of Urology, Research Institute for Convergence of Biochemical Science and Technology, Pusan National University Yangsan Hospital, Pusan National University School of Medicine, Yangsan, Korea.

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Corresponding author: Dr. Moon Kee Chung, Department of Urology, Pusan National University School of Medicine, Pusan National University Yangsan Hospital, 20 Geumo-ro, Mulgeum-eup, Yangsan 626-770, Korea.
Tel: 82-55-360-2134, Fax: 82-55-360-2931
E-mail: toughkil76@naver.com

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Purpose: Radical cystectomy and urinary diversion are the standard treatment for invasive bladder cancer. We analyzed the long-term (>10 years postoperatively) functional outcomes, complications, and urodynamic findings in a single center series of patients who underwent cystectomy and a Studer ileal neobladder substitution. **Materials and Methods:** A retrospective chart review of 108 Studer pouches constructed during 1990 and 2011 was performed. Data were analyzed in terms of long-term (>10 years) outcomes. Complications, incontinence, voiding difficulties, upper urinary tract changes, overall satisfaction, and urodynamic findings of the reservoir were obtained. **Results:** We evaluated 19 out of 50 patients who had lived for over 10 years postoperatively. Another 31 patients were not traced: 7 patients died following recurrence, 15 died due to exacerbation of a comorbidity, and 9 patients were lost to follow-up. Concerning complications, 6 patients had an atrophied kidney, 5 patients had moderate hydronephrosis, 5 patients had chronic recurrence of pylelonephritis, and 2 patients had voiding difficulty because of bladder neck stricture due to clean intermittent catheterization. One patient underwent an operation due to intestinal obstruction. Seven patients had incontinence; all 7 patients showed intermittently at night and 2 patients even in waking hours. Maximum bladder capacity was 484.1±119.2 mL, maximum flow rate was 13.6±9.7 mL/sec, and post-void residual urine volume was 146.8±82.7 mL. **Conclusion:** Long-term outcomes with the Studer orthotopic ileal neobladder have an acceptable complication rate and good functional results. However, potential adverse outcomes such as renal deterioration, dysfunctional voiding should also be considered.

Key Words: Urinary diversion, cystectomy, urinary bladder neoplasms

INTRODUCTION

Since 1980s, orthotopic bladder substitution using an ileal neobladder has been the treatment of choice for patients of both sexes undergoing cystectomy.[1] A radical cystectomy is accepted by many surgeons as a proper treatment for patients with muscle invasive bladder cancer. It is also a suitable option for select patients with high-

risk of non-muscle-invasive bladder cancer, and is used as a effective treatment modality for recurrent or refractory tumors after bladder preservation therapies.[2] The final decision of urinary diversion in the individual patient is made after many considerations: it should be considered the comorbidities, possibility of complete recovery, technical feasibility, expected functional outcomes, and comply with the patient's choice if possible.

The neobladder as an orthotopic bladder substitute approaches the ideal urinary diversion by providing a low-pressure, easily emptied continent reservoir. Continent urinary diversions may be of great psychological benefit to select patients.[3,4] In fact, the desire to provide patients with a near-normal state of voiding by preserving the natural continence mechanism led to the development of orthotopic urinary diversion.

However, they may be associated with different complications. Multiple large published series and reviews have reported the surgical complications and long-term outcomes of orthotopic neobladders.[5-7] Typical early postoperative complications include persistent urine leak, pyelonephritis, and bowel complications such as ileus and small bowel obstruction.[6] Late complications include ureteroenteric and neovesical-urethral anastomotic stricture, urinary fistula, urolithiasis and voiding dysfunction, and incontinence.[6] However, improvements in surgical technique and modern perioperative care have substantially diminished the perioperative complication rate.

We analyzed the functional outcomes, complications and urodynamic findings after long-term follow-up (>10 years postoperatively) in a single center series of patients who underwent radical cystectomy with Studer ileal neobladder substitution.

MATERIALS AND METHODS

A retrospective chart review was made of 108 consecutive Studer pouches performed from 1990 to 2011 at our institution. All patients underwent a radical cystectomy for bladder cancer with Studer orthotopic bladder substitute, survived 5 years or longer, and were evaluated regularly with a standard protocol.

A pelvic lymphadenectomy and cystectomy were performed according to standard procedure with a slight modification.[8] Briefly, the technique for bladder substitute construction was as follows. To construct the reservoir, a 45-50 cm ileal segment was isolated about 20-25 cm proximal to the ileocecal valve. About 30-35 cm of the distal ileal segment is then detubularized on the amtimesenteric border, leaving the proximal 15 cm intact for later implantation of the ureters. To construct the reservoir, the adjacent detubulized limbs are folded into a U shape, and the back wall were oversewn. The bottom of the U was folded over between the two ends of the U, resulting in a roughly spherical shape reservoir consisting of four cross-folded ileal segments.[9] The ureters were next anastomosed to the afferent tubular segment in end-to-side refluxing fashion. Eventually, then it resulted in a spherical reservoir with an initial capacity of about 100 cc.

For the first week of the postoperative period, the reservoir was irrigated with 50 cc saline solution every 6 hours through a rubber catheter. The purpose of this procedure was to try to dissolve mucous inside the reservoir to prevent formation of a mucous plug, which could obstruct the reservoir. The ureteral stents were left inside for 2 weeks and were irrigated as needed. Two weeks postoperatively, a contrast study of the reservoir and intravenous pyelogram were done to evaluate for leakage, reflux, and anastomotic site stricture. If the radiographs were normal, the patient was discharged on antibacterial medications.

All patients were regularly educated on how to reduce post-void residual urine and how to increase voiding volume and intervals. Initially, they were taught to empty the pouch less than 4 hours in a sitting position by relaxing the pelvic floor and increasing intra-abdominal pressure. Our patients were followed regularly every 3 months for 5 years and then at yearly intervals thereafter.

We evaluated those patients who survived more than 10 years after radical cystectomy and orthotopic bladder susbstitution. Institutional review board approval was obtained for the study. Oncological and functional follow-up included clinical, laboratory and metabolic assessments, and imaging procedures. The urinary tract was assessed by ultrasound and computed tomography scans, while functional reservoir capacity, continence status, and voiding difficulties were assessed by voiding diaries and urodynamic study. In addition, postvoid residual measurements were evaluated by clean intermittent catheterization or ultrasound. Indications for regular clean intermittent catheterization were symptomatic postvoid residual urine exceeding 150 cc or an asymptomatic postvoid residual above 250 cc. Complete continence was defined as no involuntarily loss of urine and no pad use. Complications, incontinence, voiding difficul-

ties, upper urinary tract changes, and urodynamic findings of the reservoir were obtained.

RESULTS

We evaluated 19 of 50 patients who had undergone surgery more than 10 years previously. Another 31 patients were not followed; seven patients had died following a recurrence, 15 patients died from exacerbation of comorbidity, and 9 patients were lost to follow-up. The mean age of the 19 patients (18 males and one female) was 70.4±9.3 years (range 44-84). The mean follow-up duration was 179.2±37.9 months (range 120.4-264.5). The pathologic T stages were T1 (7 patients), T2 (9 patients) and T3 (3 patients). All patients displayed no lymph node involvement, no distant metastasis, and no recurrence (Table 1).

Complications were assessed according to the final follow-up state. In addition, if there were complications, the onset time was investigated. The delayed complications comprised atrophied kidney in 6 patients (one patient had a nonfunctional kidney), moderate-to-severe hydronephrosis in 5 patients (one patient experienced in both kidneys), development of recurrent pyelonephritis in 5 patients exceeding 10 year after surgery, voiding difficulty in 3 patients who were using clean intermittent catheterization, small bowel obstruction in one patient, and urinary stones in one patient. Two patients who complained of voiding difficulty were bladder neck contracture. One patient underwent an operation due to intestinal obstruction (Table 2). Incontinence status included no incontinence (12 patients), night-time incontinence only (5 patients) and day- and night-time incontinence (2 patients). For the incontinent group of patients, 5 patients were previously complete continent and 2 patients were only night-time incontinent. Average voided volume of the neobladder was 344.1±100.2 mL with a post-void residual urine volume of 146.8±82.7 mL. Urodynamic evaluation was performed in 13 patients. Six patients refused urodynamic testing. Urodynamic analysis of patients revealed maximum bladder capacities of 484.1±119.2 mL, maximum filling pressure of 24.4±10.8 cmH_2O, maximum flow rate of 13.6±9.7 mL/sec, and maximum urethral closure pressure of 55.6±14.2 cmH_2O (Table 3). The flow curves were divided according to a previously described classification.[10] Uroflowmetry pattern of patients were bell shaped (5 patients), fractionated shape (6 patients), and plateau (2 patients). We did not assess routine urodynamics of these patients.

Table 1. Clinicopathologic Characteristics of Patinents with Bladder Cancer

Characteristics	n
Male : Female	18 : 1
Mean age (yrs)	70.4±9.3
Mean f/u duration (months)	179.2±37.9
Pathologic T staging	
pT1	7
pT2	9
pT3	3
Pathologic N stage	
pN0	19
pN1	0
Comobidity	
DM	3
HT	4
Others	2 (hepatitis, esophageal ca.)

DM, diabete mellitus; HT, hypertension.

DISCUSSION

Historically, conduit diversion has been the mainstay of urinary tract reconstruction. Initial interest in conduit diver-

Table 2. Long-Term Complications and Its Detection Times

Complications	n		Mean detection time (months)	Delayed detection (10 yrs later) (n)
Atrophied kidney	6	2 bilateral cases (8 renal units) Non-functional kidney (1 renal unit)	91.3±49.7	5
Hydronephrosis (moderate to severe)	5	1 bilateral case (6 renal units)	56.5±46.6	2
Chronic recurrence of pyelonephritis	5		13.8±6.6	0
Voiding difficulty (using CIC, intermittently)	3	Bladder neck contracture (2 patients)	9.0±5.2	0
Small bowel obstruction	1		180	1
Urinary stones	1	Renal stone (1 renal unit)	120	1

CIC, clean intermittent catheterization.

sion, however, gradually decreased because of the desire to provide an optimal quality of life with an orthotopic bladder substitute. The use of the ileum for orthotopic bladder substitution has gained general acceptance within the past decade, and orthotopic continent diversions have become the "gold standard" reconstructive procedure after radical cystectomy.[11] Nowadays, all cystectomy patients are potential candidates for a neobladder.[2,3,5] Also, contraindications for orthtopic neobladder are fewer than in the past. Orthotopic neobladder substitution is contraindicated in patients with permanently compromised renal function or severe hepatic dysfunction, inadequate intellectual problem, and positive margin status of the urethra.[2] In addition, orthotopic neobladder is relatively contraindicated in patients with compromised intestinal function, in particular inflammatory bowel disease, or recurrent urethral stricture.[2]

A Studer ileal bladder substitute initially described by Studer and colleagues uses a long, afferent, isoperistaltic, tubular ileal segment.[3,4] The technique was established in 1984 and has been used worldwide.[12] The advantages of this bladder substitute include the simplicity of the construction and the ability to accommodate short ureters. One hundred eight patients underwent surgery at our institution between 1990 and 2011, and showed good results from this technique.

Following an othotopic bladder substitution, the greatest issues of concern include upper urinary tract changes and voiding dysfunctions. The absence of coordinated contractions during the filling phase of bladder substitution is a low pressure reservoir. During voiding, the use of Valsalva maneuver results in complete emptying without reflux because the pressure increases in the bladder, the abdomen and the renal pelvis simultaneously.[13,14] Furthermore, the unidirectional peristaltic movements of the ureters and proximal ileal segment serves as a dynamic antireflux system during the filling phase.

In the present study, long-term outcomes were assessed in 19 men who lived a minimum of 10 years with their bladder substitute. The average voided volume of the neobladder was 344.1±100.2 mL with a post-void residual urine volume of 146.8±82.7 mL. The maximum bladder capacity was 484.1±119.2 mL and maximum flow rate was 13.6±9.7 mL/sec in a urodynamic study (Table 3). Day-time incontinence may range from mild stress incontinence to severe incontinence in a small percentage of patients, but complete day-time continence is achieved in close to 90% of patients with neobladder.[6] As many as 50% of patients experience some degree of night-time incontinence.[6] The day-time continence rates in our study were 89.5%. Night-time incontinence rate (36.8%) was considerably higher than the day-time incontinence rate (10.5%) in this long-term (>10 years postoperatively) study. Of the incontinent patients, five patients had not had prior incontinence and two patients had night-time incontinence only. The gradual decrease of continence rates could possibly be due to a declining external sphincter function with age. The importance of age is underlined by the fact, that in those exceeding 10 years after surgery, the median ages were 70.4±9.3 years. A prior longitudinal study reported a 17% prevalence of urinary incontinence among men 70 years of age,[15] and another study conducted with this age group reported an approximately 15% rate of urinary incontinence in healthy men.[16]

Table 3. Urodynamic Parameters for Patients with Orthotopic Neobladder Substitution

Urodynamic parameters (n=13)	
Maximum reservior capacity (mL)	484.1±119.2
Maximum filling pressure (cmH_2O)	24.4±10.8
Maximum flow rate (mL/sec)	13.6±9.7
Maximum urethral closure pressure (cmH_2O)	55.6±14.2
Post-void residual volume (mL)	146.8±82.7
Uroflowmetry pattern (n=13)[27]	
Bell type (%)	5 (38.5)
Fractionated type (%)	6 (46.2)
Plateau type (%)	2 (15.4)

Our long-term experience demonstrated a sustained favorable voiding outcome with slightly increasing incontinence rates as patients aged. Nocturnal incontinence following orthotopic bladder substitution results from the absence of a neuro-feedback to the brain, of sphincter-detrusor reflex, as well as decreased sphincter tone at night.[8,17] Apart from the same mechanisms responsible for the gradual decline in day-time continence with age, increased night-time diuresis and a shift of free water into the concentrated urine are additional factors.[18] The decrease in nocturnal continence over time might also reflect a gradual decline in patient compliance.[19] However, the low proportion of men frequently or regularly using pads shows that leakage is likely not a frequent impairment to the quality of life.[19]

Radical cystectomy with orthotopic neobladder is still associated with significant complications. Reported rates and types of complications vary widely.[7,20-22] Most early complications including bleeding, neurologic, thromboembolic, cardiac and pulmonary complications, wound-related, gastrointestinal, genitourinary problems and infection are related to urinary diversion. However, late complications are often in-

fluenced by the type of urinary diversion.[6,11] The primary late complications of orthotopic diversion that may be related to the diversion itself include atrophied kidney, chronic pyelonephritis, decreased renal function, ureteroileal or urethral anastomotic site stricture, urinary tract stones, and incontinence.

Bacterial colonization of the neobladder diversion occurs in 40-80% of patients.[23,24] Colonization is strongly associated with residual urine,[25] and approximately 6% of patients with neobladders progress to overt pyelonephritis at some point following urinary diversion.[15] In the absence of obstruction, upper urinary tract infections can be managed with an administration of culture-specific antibiotics. In our cases, 5 patients had recurrent pyelonephritis (Table 2).

One of the most difficult complications of urinary diversion is breakdown or stricture of the ureterointestinal anastomosis. In some cases where upper urinary tract changes were noted postoperatively, these were invariably associated with preexisting pathologies or a new obstruction. The reported incidence of this complication is approximately 2.4-9%.[6,26,27] In our institution, imaging studies were performed more than 10 years after surgery and moderate-to-severe hydronephrosis were evident in five patients (Table 2).

Failure to empty after orthotopic urinary diversion necessitates cystoscopic and radiographic examination to differentiate between dysfunctional voiding and neobladder-urethral obstruction. A report of a large series of neobladder emptying failures in men demonstrated an 8% incidence of mechanical dysfunction and a 3.5% incidence of dysfunctional voiding.[26] Dysfunctional voiding commonly results from an unsuitable size or shape of the neobladder, from the position, length, or angulation of the neobladder neck, or from a denervated proximal urethra.[28] Presently, two patients who complained of voiding difficulty were bladder neck contracture (Table 2).

Orthotopic bladder substitution is technically difficult procedure and time-consuming. Postoperatively, patients leave the hospital with indwelling catheters for a long time. Following catheter withdrawal, patients are carefully instructed on how to void. Additionally, patients are also at a higher risk of metabolic problem, voiding difficulty.[22,29] However, Continent urinary diversion remains the best option for patients requiring radical cystectomy.

Our study had several limitations. The number of patients in this study was small, which imposed limitations on statistical power. This was a retrospective analysis, which created the potential for selection bias. Further large, prospective investigations and long-term follow-up are required to evaluate the definite conclusions.

The present results indicate that the long-term outcomes with the Studer orthotopic ileal neobladder are an acceptable complication rate, oncologically safe, and technically feasible, and produce good functional results. In conclusion, the impact of urinary diversion on the quality of life still remains controversial, although promising long-term functional data argue in favor of orthotopic bladder substitution as the preferred method for lower urinary tract reconstruction. In our experience, however, long-term outcomes of the Studer orthotopic ileal neobladder may be performed with an acceptable complication rate and good functional results. A high rate of continence is achieved, however, it decreased slightly more than 10 years after cystectomy. Also, renal deterioration and dysfunctional voiding were observed. Thus, the possibility of long-term adverse outcomes should also be considered when deciding orthotopic neobladder operation.

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