Original Article

Results of Chimney Modification Technique in Ureterointestinal Anastomosis of Hautmann Ileal Neobladder in Bladder Cancer

Tawatchai Taweemonkongsap, Sunai Leewansangtong, Anupan Tantiwong and Suchai Soontrapa,
Division of Urology, Department of Surgery, Faculty of Medicine, Siriraj Hospital, Mahidol University,
Bangkok, Thailand.

BACKGROUND: To evaluate the surgical technique and functional outcome of a new application of the chimney modification to the popular Hautmann ileal neobladder. This modification used 3–5 cm chimney tubularized ileal segment for the bilateral ureterointestinal anastomosis.

METHODS: Between December 2000 and July 2004, 15 patients (14 men, 1 woman) with invasive bladder cancer underwent radical cystectomy and Hautmann neobladder with chimney modification at Siriraj Hospital, Bangkok. Mean age was 61.7 years (range, 43–72 years). Perioperative morbidity, early and late urinary diversion-related complications, other surgical complications, follow-up results of ureterointestinal anastomosis, renal function and metabolic disorders were evaluated. Patients were interviewed about their continence, voiding function and potency.

RESULTS: At a mean follow-up of 29.5 months, two patients had died of cancer progression. Of the 15 patients, nine (60%) had 10 early complications. Eight complications were related to the neobladder and two were not. Three (20%) patients had three late complications. Two complications were neobladder-related and one was not. There was no perioperative mortality. There was no ureteroileal anastomosis stricture in this series. Neobladder–ureteral reflux was demonstrated in eight of 22 ureteral units in 11 patients in whom cystography was performed. All patients had normal upper urinary tract without evidence of urinary obstruction. All 14 men (93% of study sample) had spontaneous urination, normal renal function and no metabolic acidosis. Good and satisfactory continence in the day and night were 93% and 73%, respectively. All male patients experienced impotence postoperatively. Only one sought treatment and was successfully treated with sildenafil. The one woman in this study required intermittent catheterization to empty the neobladder completely. She also had renal insufficiency with serum creatinine of 2.2 mg/dL and hyperchloremic metabolic acidosis.

CONCLUSION: New chimney modification in Hautmann ileal neobladder is simple and safe. Complications are acceptable. Follow-up results of renal and voiding functions are satisfactory. This operation can maintain good quality of life for patients with bladder cancer undergoing radical cystectomy. [Asian J Surg 2006;29(4):251–6]

Key Words: bladder cancer, chimney modification, neobladder

Address correspondence and reprint requests to Dr Tawatchai Taweemonkongsap, Division of Urology, Department of Surgery, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkoknoi, Bangkok 10700, Thailand. E-mail: sittm@mahidol.ac.th ● Date of acceptance: 20 December 2005

© 2006 Elsevier. All rights reserved.
Introduction

Urothelial bladder cancer is the second most common urological malignancy.\(^1\) Some tumours are relatively benign, but on the other hand, lots are highly aggressive. Since the early 1960s, radical cystectomy has become the standard treatment for high-grade invasive bladder cancer. To improve quality of life, orthotopic neobladder substitutes have been used after radical cystectomy in invasive disease.\(^2\) Various techniques are available for performing orthotopic neobladder. However, available experience indicates that none are able to address all expectations. The Hautmann ileal neobladder is a simple technical procedure. It has a high capacity and low-pressure urinary reservoir with more than 90% continence rate.\(^3\) However, the ureterointestinal anastomosis that is applied to the Hautmann ileal neobladder has several techniques. Although with acceptable results, the Le Duc ileoureterostomy is limited in application for short ureters and ureterointestinal anastomotic strictures.\(^4\) This remains the most common late complication.\(^3\) Furthermore, postoperative revision is difficult due to the anastomotic location being in the posterior aspect of the reservoir.

We describe our results with chimney modification of the Hautmann ileal neobladder, which was recently described by Hautmann.\(^5\) The ureterointestinal anastomosis uses chimneys of 3–5 cm afferent limb on each side of the ileal pouch, which enhances the flexibility of this procedure as shown in Figure 1. This provides many advantages. Firstly, the extra length of the neobladder makes it easy to reach the distal ureteral stumps because of an ileal chimney. Secondly, the simplified ureteroileal anastomosis decreases mobilization of the ureters and subsequently avoids anastomotic strictures. Finally, postoperative surgical revision of ureteral anastomosis would not be difficult due to the location of the chimney and ureter on the anterior surface. Only few data on the results of the new chimney modification in ileal neobladder have been reported in the literature. All data are from Western studies. To our knowledge, this is the first series to be reported in Asia. Surgical technique, complications and follow-up results of neobladder function in terms of voiding function, continence, renal function and metabolic disorders were evaluated.

Patients and methods

Between December 2000 and July 2004, 15 patients (14 males, 1 female) underwent radical cystectomy for invasive bladder cancer at Siriraj Hospital, Mahidol University, Bangkok. Mean age was 61.7 years (range, 43–72 years). For urinary diversion, the Hautmann ileal neobladder was performed. All patients were operated on by one surgeon (TT). Preoperative evaluation of urinalysis, serum determinations, chest radiography, excretory urography and abdominal computed tomography were performed to clinically stage as negative for distant metastasis. All patients had transitional cell carcinoma and tumour stage ranged from pT2 to pT3N2M0. Contraindications to orthotopic diversion were tumour involving urethral margins on intraoperative frozen section, serum creatinine > 2.0 mg/dL, significant comorbidities or advanced pathological findings at surgery.

Surgical technique

Staging pelvic lymphadenectomy and radical cystectomy were performed as standardization.\(^6\) For the Hautmann ileal neobladder, the 65 cm isolated small ileal segment was arranged into a W shape and the traction suture brought into the bottom position of the W pouch directed caudal towards the urethra. For chimney modification, both ends of the W shape were not detubulized and used as chimneys of 3–5 cm afferent limb on each side as shown in Figure 1. The remaining bowel was opened strictly along the antimesenteric border except for a 5 cm section around the traction suture. At that point, an incision was made at the anterior mesenteric border to create
a U-shaped flap to facilitate anastomosis of the neobladder to the urethra as shown in Figure 1A. The back wall of the W was sewn to create a pouch. The U-shaped flap served as a new bladder neck. A 1 cm incision was made in the centre of the U-shaped flap. A transurethral 20-Fr catheter was placed through and then the small bowel was anastomosed to the urethral remnant. Ureteroileal anastomosis was performed after the ileal neobladder was placed in the pelvis and anastomosed to the urethra. The distal segments of the ureter were mobilized with particular attention paid to preserving the vascular supply of the periureteral adventitia. Implantation of the 2 cm spatulated ureter into each side of the chimney was performed by using the refluxing technique of end-to-end anastomosis. The anastomosis was oversewn with running 4-0 absorbable sutures. The ureters were splinted with 6-Fr feeding tubes for 10 days. The splints were brought out through the skin separately. The anterior aspect of the W pouch was sutured to complete the pouch as shown in Figure 2. The indwelling catheter was maintained for 21 days and cystography was performed before removal. Early postoperative complication was defined as occurring within 30 days after surgery. Late complications of surgery were also evaluated.

Postoperatively, patients were evaluated at 3-month intervals in the 1st year, and at 6-month intervals in the 2nd and 3rd years. Follow-up evaluations were performed annually thereafter. Renal ultrasound, urine examination, serum electrolytes, blood urea nitrogen, creatinine and liver profile were used for monitoring. Chest X-ray and intravenous urography were done annually. Urethroscopy was performed in patients with microscopic haematuria, discharge of blood or abnormal voiding. If patients had metabolic acidosis, oral sodium bicarbonate was given.

At each visit, all patients were interviewed about their voiding symptoms, continence and potency. Continence was classified into three categories: good, satisfactory and unsatisfactory. Good continence was defined as being completely dry without the need for any devices. Satisfactory continence was defined as requiring one pad during the day or night. Unsatisfactory continence was defined as requiring more than one pad during the day or night.

Follow-up results of renal function in terms of anatomical and functional upper urinary tracts, metabolic conditions, voiding function, continence and potency were evaluated as described.

**Results**

Mean follow-up was 29.5 months (range, 11–54 months). Two patients died due to tumour metastasis: one had liver metastasis, and the other had lung metastasis. Of the 15 patients, nine (60%) had 10 early complications. Eight complications were related to the neobladder and two were not. Of the eight patients with early neobladder-related complications, seven had acute pyelonephritis and were treated with antibiotics. One patient had prolonged urinary leakage and was conservatively treated with urethra catheter indwelling. Of the two patients with other early complications, one patient had deep wound infection and the other had partial small bowel obstruction. They required rehospitalization for conservative treatment. No reoperation was required for early complications.

Three (20%) patients had three late complications. Two complications were neobladder-related and one was not. Of the two patients with late neobladder-related complications, one had neobladder urethral anastomotic stricture requiring direct vision urethrotomy, and the other had urinary tract infection due to mucous urinary retention and was treated conservatively. The one late complication not related to the neobladder was incisional hernia requiring surgical repair.

For evaluation of ureteroileal anastomosis, static cystography was performed in 11 patients before urethral catheter removal. Of 22 units of ureteroileal anastomosis, eight ureteral units had neoureteral reflux. Upper urinary tract anatomy was also evaluated with ultrasound and intravenous urography. Fourteen patients had normal
upper urinary tract without evidence of obstruction as shown in Figure 3. One patient had previous unilateral atrophic hydronephrosis. During follow-up, no progression of hydronephrosis was demonstrated in this patient. Thus, with a mean follow-up of 29.5 months, there was no ureteroileal anastomosis stricture in our chimney modification series. For evaluation of renal function, serum creatinine was analysed. Mean pre- and postoperative serum creatinine was 1.11 mg/dL (range, 0.7–1.5 mg/dL) and 1.31 mg/dL (range, 0.9–2.2 mg/dL), respectively. Mean postoperative serum creatinine was higher than preoperative serum creatinine. However, it was within the normal range. This suggested that there was no significant renal impairment after Hautmann ileal neobladder with chimney modification urinary diversion.

Importantly, renal function also depended on voiding function. Patients voided by relaxing the urethral sphincter mechanism and passively expressing the pouch by abdominal straining. Patients relied on a sensation of abdominal fullness and did not require a time clock for their voiding schedule. All of the 14 male patients voided completely without catheterization. They voided at 3–5 hour intervals during the day depending on fluid intake. The neobladder capacities were between 500 and 800 mL. Furthermore, all male patients maintained normal renal function as determined by serum creatinine. They also had no hyperchloraeic metabolic acidosis and did not need alkalinizing medication. On the other hand, the female patient in our series could not completely empty her bladder. She had high residual urine of more than 200 mL and sometimes had mucous urinary retention. Thus, clean intermittent catheterization was needed. She also had renal insufficiency (serum creatinine, 2.2 mg/dL) and metabolic acidosis, and needed oral alkalinizing medication.

For evaluation of continence, 14 (93%) patients had good or satisfactory continence during the day. For nighttime continence, 11 (73%) patients reported good or satisfactory continence. All patients who had good nighttime continence also had good daytime continence. This suggests that the Hautmann ileal neobladder with chimney modification urinary diversion results in acceptable continence. Unfortunately, all of the male patients suffered impotence postoperatively. However, one man sought treatment and was successfully treated with sildenafil.

Discussion

The ideal ureteroenteric anastomosis is easily constructed and has a low incidence of stricture or refluxing. Several antireflux techniques have been developed. Some data in the literature show that antireflux techniques seem to involve more complicated surgical techniques and higher risk of anastomotic stricture. We believe that the chimney modification offers several advantages compared to other ureterointestinal anastomotic methods. The chimney modification method is easily performed. The chimney allows less mobilization and more proximal resection of bilateral ureters, providing a tension-free anastomosis and minimizing ureteral ischaemia. Since the location of the chimney modification ureterointestinal anastomosis is on the anterosuperior surface of the neobladder, the risks of ureteral angularity and obstruction are low when the neobladder overdistends. In addition, if patients need reoperation, the ureterointestinal anastomosis can be easily accessed from a flank incision through the virginal retroperitoneum. Hollowell et al and Lippert and Theodorescu reported the same principle of uretero-intestinal anastomosis in single chimney bowel afferent loop. Recently, Hautmann et al reported overall results between the modified chimney technique and classic Le Duc anastomosis. To our knowledge, our study is the first to evaluate this approach in a clinical setting.
first to describe a 4-year experience with this technique in Asia.

Radical cystectomy with orthotopic bladder substitution is a major surgery with 1–3% mortality. However, there was no mortality among our outpatients, although there were several morbidities. For early complications, acute pyelonephritis was common. Its occurrence seemed to be higher than in other series because of refluxing from cystography. Since the modified chimney technique used is still in the early experience stage, cystography was performed to demonstrate neobladder–ureteral reflux for evaluation. This complication can be avoided if cystography does not need to be performed routinely. However, urinary tract infection could be treated conservatively. For other early complications, such as urinary leakage, wound infection and partial small bowel obstruction, the incidences were similar to those of previous reports. All early complications were treated conservatively. Regarding late complications, one patient had urethral–neobladder anastomotic stricture and was managed endoscopically. This late neobladder-related complication stemmed from a problem with the surgical technique due to the high degree of difficulty in establishing a urethra–neobladder anastomosis in the obese patient.

Regarding ureteroileal anastomosis, no stricture with this modified chimney technique was found in our series. These favourable results are consistent with those of other reports. Roth et al reported a 20% stricture rate compared to only 3.6% after direct anastomosis. Hollowell et al reported a 6% stricture rate in ureterointestinal anastomosis to single chimney modification. Importantly, Hautmann reported a 9.5% ureterointestinal anastomosis stricture rate for the Le Duc procedure compared to a 1% stricture rate for modified chimney ureteral direct anastomosis. Our results and those of other series indicate that chimney modification of ureterointestinal anastomosis has a very low stricture rate. Thus, the chimney modification technique is a good option for Hautmann ileal neobladder urinary diversion.

Neobladder–ureteral reflux was demonstrated in eight of 22 renal units in the early postoperative period. However, no progression of hydronephrosis was demonstrated.

Several studies show an impact of urinary tract infection on the development of reflux nephropathy scar. Free radical oxygen damage of infection has an important role in reflux nephropathy. Renal impairment would not occur unless infected urine is present. In addition, asymptomatic bacterial colonization is not sufficient to cause renal damage. Renal impairment is caused by recurrent urinary tract infection, especially in women with hypercontinence or in men with severe voiding dysfunction. It was reported that between 4% and 25% of male patients needed intermittent self-catheterization for incomplete neobladder emptying. The reported functional outcome in female patients differed among series, particularly with regard to voiding ability. The reported rate of clean intermittent catheterization was approximately 50%, .

In our series, we found good voiding function in all male patients, including in the two patients who died, but with good neobladder function. All male patients had completely emptied bladders and no recurrent urinary tract infection. They had no renal impairment (mean postoperative serum creatinine within normal range). Furthermore, no symptomatic metabolic acidosis was found in any of the male patients. This represented favourable voiding results with small residual urine. On the other hand, the one female patient experienced voiding dysfunction. She could not completely empty her bladder and sometimes had mucous urinary retention and recurrent urinary tract infection, causing renal impairment (abnormal serum creatinine). She also had metabolic acidosis. If the patient cannot empty the bladder, waste products will be reabsorbed into the blood circulation. Thus, our female patient required clean intermittent catheterization and oral alkalinizing medication.

In our series, there were some limitations since we used serum creatinine to determine overall renal function or renal impairment. Renal scintigraphy with 99mTc-DTPA should be used. Minervini et al examined the morphological and functional outcomes of the upper urinary tract using 99mTc-DTPA renal scintigraphy in orthotopic neobladder with no antireflux mechanism. Data showed that there was no effect on renal function with a mean follow-up of 50 months.

Regarding continence, our series showed acceptable outcomes. More than 90% and 70% of patients could control urination during the day and night, respectively. However, some of our patients had incontinence during the night. The two patients with follow-up time < 1 year continued to have nighttime incontinence. The ultimate level of day- and nighttime continence was achieved by 5 years postoperatively in other series. A longer period of follow-up is needed.
The effects of cystoprostatectomy on sexual function may be important in younger patients, as recently reported with the nerve-sparing technique.\textsuperscript{26,27} With the radical technique in our series, we found impotence in all the male patients postoperatively. However, one patient who sought treatment and received oral medication had a successful result.

In conclusion, new chimney modification in Hautmann ileal neobladder is simple and safe. Complications are acceptable. Follow-up results of renal and voiding function are satisfactory. This operation can maintain a good quality of life in patients undergoing radical cystectomy for bladder cancer.

References

1. Sangruchi S. \emph{Statistical Annual Report, 2004}. Tumor Registry, Siriraj Cancer Center, Faculty of Medicine, Siriraj Hospital, Bangkok, 2005:26–7.