

ORTHOTOPIC ILEAL NEOBLADDER RECONSTRUCTION USING A MODIFIED GOODWIN METHOD: FUNCTIONAL OUTCOME IN 37 PATIENTS

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Since 1996, we have been using a modified Goodwin technique for orthotopic ileal neobladder replacement. We report on the surgical technique and the voiding function of ileal neobladder in 37 patients. A small bowel segment, 50 cm in length, was resected 20 cm proximal to the ileocecal valve. The small bowel loops were then arranged in a U shape. Voiding function was evaluated in terms of voiding pattern, continence and urodynamic study. The mean follow-up period was 18 months (range 3 to 64). The mean maximum neobladder pressure in the storage phase was 15 cm water at 6 months, 12 at 12 months, and 7 at 24 months. The mean maximal urethral closed pressure was 52 cm water at 6 months, 51.7 at 12 months, and 66 at 24 months. The mean maximal urinary flow rate was 16.2 ml per second at 6 months, 17.6 at 12 months, and 20.8 at 24 months. The mean maximal neobladder capacity was 300 ml at 6 months, 302 ml at 12 months, 382 ml at 24 months. Among the 37 patients, 30 remained completely dry day and night. Three patients were incontinent only during the nighttime, and required only one pad. Four patients were wet day and night, and required 2 pads daily. Our results indicate that the modified Goodwin method appears to be an excellent technique for ileal neobladder replacement following cystectomy and seems successful in producing balanced voiding dynamics.

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Key words: Ileal neobladder, Urinary reconstruction, Modified Goodwin method

INTRODUCTION

Bladder replacement has become a standard method of urinary diversion. Orthotopic bladder replacement following radical cystectomy for bladder cancer has gained popularity among urologists. It has been reported that these patients retain a satisfactory quality of life, including micturition status and continence^{1–3)}. In general, the orthotopic ileal neobladder replacement, which was originally described by Hautmann et al.⁴⁾ and Studer et al.⁵⁾, has been adopted as a standard surgical technique. We previously used the orthotopic ileal neobladder reconstruction, a modification of the procedure described by Giertz, but residual urine showed a large volume because of voiding by bowel peristalsis. Since 1996, we have used a modified Goodwin technique for orthotopic ileal neobladder replacement. We here describe a modified Goodwin technique for total bladder replacement and evaluate the clinical results.

MATERIALS AND METHODS

Patient population

From 1996 to 2001, 37 consecutive patients (33 men and 4 women), 36 to 77 years old (median age 63), underwent lower urinary tract reconstruction with an ileal neobladder after radical cystectomy in Hirosaki

University Hospital. The mean follow-up period of this retrospective study was 18 months (range 3 to 64). Thirty-five patients had transitional cell carcinoma and tumor stage ranged from T1 to T4a (T1 28.6%, T2a 28.6%, T2b 14.3%, T3a 2.8%, T3b 20.0%, T4a 5.7%), one patient had a contracted urinary bladder and one patient had a pyllodes tumor of the prostate (Table 1).

Patients with biopsy evidence of carcinoma in situ on preoperative evaluation were excluded. Orthotopic neobladder reconstruction has been contraindicated if the urethral margin has any evidence of malignancy on frozen section at the time of surgery, because of the high risk of urethral recurrence.

Table 1. Patient characteristics

Sex	Follow-up	Diagnosis	
Male	33	3–48 months	TCC* ¹ 35
Female	4	(Median 17)	Stage: T1 10
			T2a 10
			T2b 5
			T3a 1
			T3b 7
			T4a 2
			Contracted bladder 1
			Pyllodes tumor 1

*1: transitional cell carcinoma.

Negative urine cytology of the upper urinary tract is confirmed prior to surgery. Impaired renal function (creatinine greater than 2.0 mg/dl, upper limit of normal less than 1.1 mg/dl) that is unlikely to improve after cystectomy is a contraindication to neobladder reconstruction.

All patients gave their full consent after being informed about other operations for urinary reconstruction. If the urethral and ureteral margin had any evidence of transitional cell carcinoma on frozen section at the time of surgery, construction of the neobladder would not be performed, and diversion such as ileal conduit would be done according to the patient's preference, as discussed preoperatively.

Lower Urinary Tract Reconstruction (Fig. 1)

A small bowel segment, 50 cm in length, is resected 20 cm proximal to the ileocecal valve. The ileal segment is then split open along the anti-mesenteric border so that it will be detubularised. The small bowel loops are then arranged in a U shape, and the inner opposite borders are oversewn with a single-layer seromuscular running suture by means of 3-0 braided polyglactin. Uretero-ileal anastomosis is carried out bilaterally by the Le Duc technique⁴⁾. The surgeon's finger is introduced through the remaining opening to determine the most caudal part of the reservoir. Then a hole, 8 to 10 mm in diameter, is cut out of the pouch wall. We place mucosal eversion sutures before applying the anastomosis. After closure of the anterior wall employing a 3-0 braided polyglactin running suture, we confirm the urethral stump by means of urethral sound. Four 3-0 braided polyglactin for seromuscular sutures are placed between the hole in the reservoir wall and the membranous urethra. A 22-fr. urethral catheter with a 50 cc balloon is inserted before tying the four sutures. After all sutures are tied, traction is applied to the urethral catheter for one week to prevent leakage from the ileourethral anastomosis.

Follow-Up

Each patient was evaluated at regular intervals every 3 to 6 months. Gravity cystogram and excretory urogram or renal examination by ultrasonography, as well as serum electrolytes, blood urea nitrogen, creatinine measurements, and liver profile were performed at 1, 3, 6, 9 and 12 months, and then annually. Computed tomography was reserved for patients every 6 months only when there was the risk of distant metastasis such as pathological lymph nodes metastasis after bilateral pelvic lymphadenectomy. Urethral washing for cytology and urethoscopic examination were performed at 3-month intervals during years 1 and 2, at 4-month intervals during years 3 and 4, and 6 month intervals thereafter. Examination by transrectal ultrasonography was performed at each follow-up visit

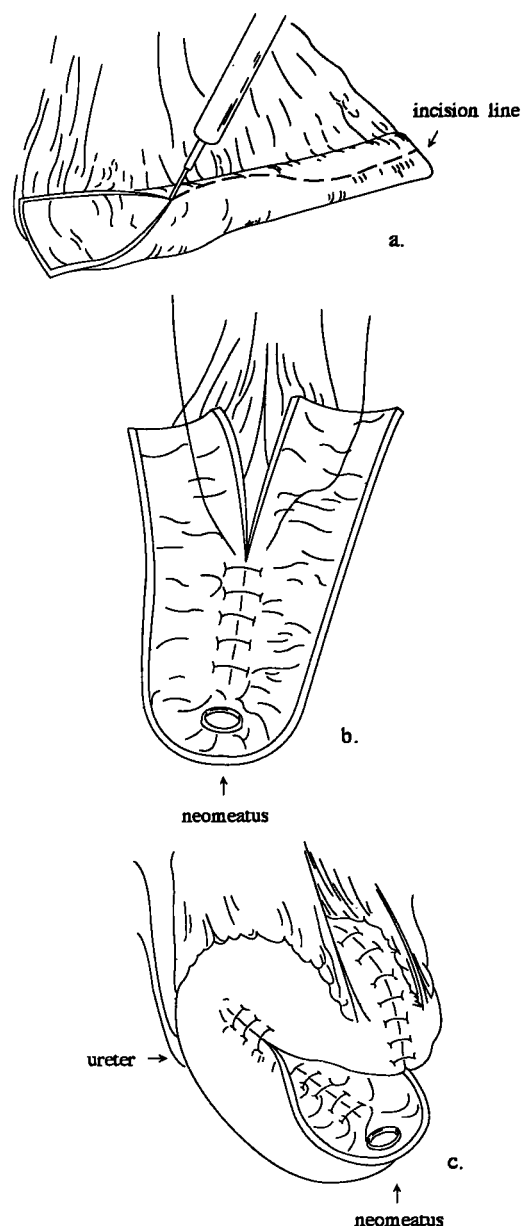


Fig. 1. Modified Goodwin method for orthotopic ileal neobladder reconstruction: a: A small bowel segment is resected 50 cm in length. The ileal segment is split open along the anti-mesenteric border so that it will be detubularised. b: The small bowel loops are arranged in a U shape, and inner opposite borders are oversewn with a single layer seromuscular running suture. The hole is cut out of the pouch wall. We place a mucosal eversion suture. c: Uretero-ileal anastomosis is carried out by the Le Duc technique. The anterior wall is closed with a single layer running suture.

with careful attention to the ileourethral anastomosis in an effort to detect local recurrence early.

Voiding Function

We asked the patients about voiding behavior, presence or absence of incontinence, and the need for

pads to manage incontinence. Pressure flow study, including urethral pressure profilometry were performed with uroflowmetry after 3, 6, 9 and 12 months, and then 6 months thereafter. Patients were requested to void completely and then were catheterized for residual urine volume determination. Results are expressed as the median. Comparisons among variable parameters were tested with Mann-Whitney U tests. Differences with *P* values less than 0.05 were considered statistically significant.

RESULTS

Radical cystectomy and bilateral pelvic lymphadenectomy were performed; operation time ranged from 270 to 544 minutes (mean 415 minutes) and blood loss ranged from 500 to 2,830 ml (mean 1,598 ml). Orthotopic urinary neobladder reconstruction was also performed; the operative time ranged from 110 to 285 minutes (mean 178 minutes) after the isolation of the ileal segment.

Among 37 patients, 5 patients died of cancer recurrence at 7, 8, 17, 21 and 29 months after the surgery, and they had metastatic pelvic lymph nodes on pathological diagnosis. No cancer recurrence in the urethra or ileal neobladder was found by cystourethroscopic examination in 37 patients.

The most frequent early complication related to the neobladder was leakage from the ileourethral anastomosis in 4 patients, but all patients were treated by conservative therapy with an indwelling urethral balloon catheter. Five patients had suffered from paralytic ileus and 4 patients had acute pyelonephritis. Four patients underwent endoscopic incision of the ileourethral anastomotic stricture, which having occurred more than 3 months after the surgery was seen as a late complication related to neobladder reconstruction. The late complications were hyperchloremic acidosis in 1 patient. No hydronephrosis or stone formation in the upper and/or lower urinary tract, cystoureteral reflux or deterioration of renal function was seen in any patient.

Voiding function was evaluated in all patients using cystometry, urethral pressure profilometry and uroflowmetry at 3, 6, 9 and 12 months, and then 6 months. Table 2 shows the chronological changes in various parameters including neobladder capacity, residual urine, neobladder pressure, urethral pressure and urinary flow rate. The maximum neobladder pressure with a follow-up longer than 6 months showed statistically significant improvement compared with 3 months ($p < 0.01$). Cystometry indicated that all orthotopic neobladders exhibited good compliance without involuntary pressure spikes during filling (Fig. 2). The maximal urethral closed pressure as a measure of urethral sphincteric activity showed a median pressure of 40 cm at 3 months, 52 cm at 6 months and 51.7 cm at 12 months after the surgery. The maximal urethral closed pressure with a follow-up longer than 6 months showed statistically significant improvement compared with that at 3 months ($p < 0.05$).

The maximal urinary flow rate remained unchanged throughout the entire evaluation time. The capacity of the ileal neobladder increased gradually, and the neobladder capacity with a follow-up longer than 6 months showed statistically significant improvement compared with those at 3 months ($p < 0.01$). The residual urine volume was small throughout the entire evaluation time. One patient required dilation for the ileourethral anastomotic stenosis regularly because of incomplete emptying of the neobladder. Two patients required clean intermittent catheterization because of residual urine over 150 ml.

Evacuation of the neobladder was prompted as scheduled in all cases. Among the 37 patients, 30 remained completely dry day and night, with voiding once or twice during the night. Three patients were incontinent only during the nighttime, and required only one pad. Four patients were wet day and night, and required 2 pads daily (Table 3).

Table 2. Chronological changes in variable parameters

After surgery (months)	Neobladder pressure (cmH ₂ O)	MUCP (cmH ₂ O)	Qmax (ml/sec)	Neobladder capacity (ml)	Residual urine (ml)
3	12-66 (mean 33)	18 - 70 (mean 40.5)	3.3-50.7 (mean 21.3)	143-410 (mean 235)	0-130 (mean 15)
6	7-42* (mean 19)	20 - 76* (mean 50.2)	5.9-53.7 (mean 20.3)	178-460* (mean 311)	0-100 (mean 12)
9	7-74* (mean 19)	28 - 72** (mean 52.2)	4.7-51.8 (mean 20.6)	185-482* (mean 330)	0-100 (mean 8)
12	6-33* (mean 15)	22 - 84** (mean 53.7)	6.3-52.2 (mean 20.7)	256-500* (mean 327)	0-210 (mean 16)
18	7-37* (mean 12)	36.8- 98** (mean 57.4)	4.4-39.8 (mean 21.2)	200-421* (mean 326)	0-180 (mean 21)
24	7-12* (mean 8)	23 -112** (mean 65)	6.2-49.4 (mean 20.2)	256-400* (mean 354)	0-150 (mean 29)

MUCP: maximal urethral closed pressure. Qmax: maximal urinary flow rate. Mann-Whitney U tests. *: $p < 0.01$. **: $p < 0.05$.

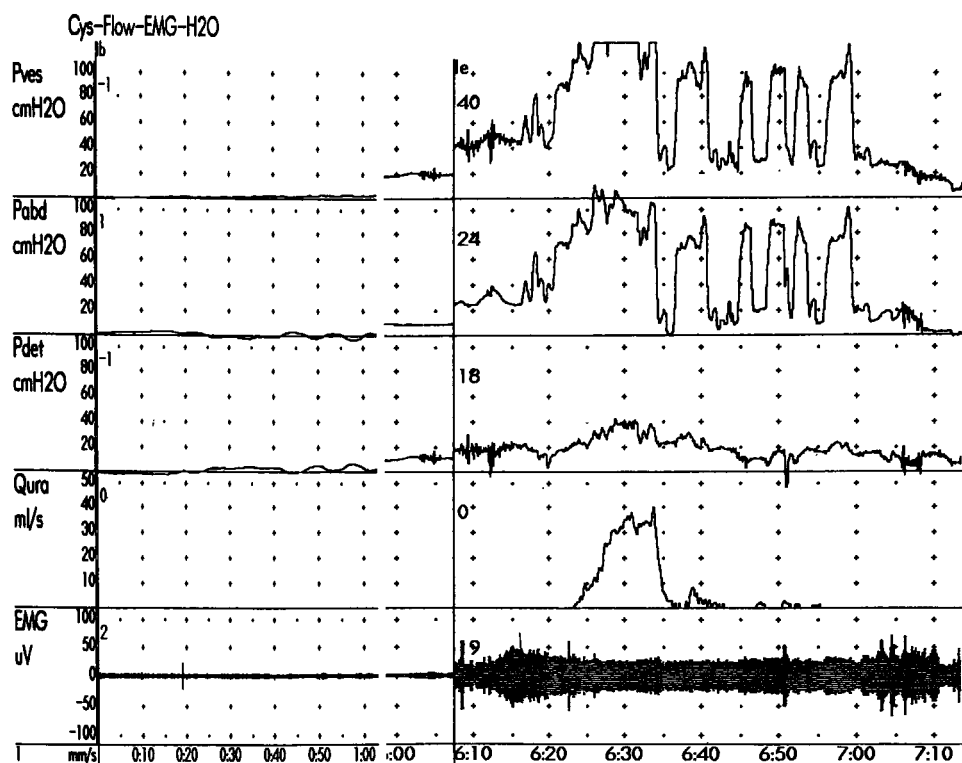


Fig. 2. Typical pressure flow study. The neobladder demonstrates good compliance without involuntary pressure spikes during filling. In the voiding phase, there are no high frequency and high amplitude spikes evident on the urethral sphincteric electromyogram. *Pves*, vesical pressure. *Pabd*, abdominal pressure, *Pdet*, detrusor pressure. *Qura*, urine flow. *EMG*, urethral sphincteric electromyogram.

Table 3. Incontinence data

Daytime	Nighttime
Completely dry	33
No more than 1 pad/day, damp	4
Completely dry without need for protection	8
Completely dry with 1 void/night	8
Completely dry with 2 void/night	14
No more than 1 pad/night, damp	7

DISCUSSION

Construction of an orthotopic bladder substitute has become a standard procedure in patients after radical cystectomy for invasive bladder cancer. The orthotopic ileal neobladder replacement has been performed by using various surgical techniques^{4,5}, and the patients have been reported to retain a satisfactory quality of life, including micturition status and continence. The main goal is to obtain a low-pressure, high-capacity and non-refluxing continent reservoir that is capable of voluntary complete emptying.

We previously used a modified Giertz technique for orthotopic ileal neobladder reconstruction, but residual urine showed a large volume by bowel peristalsis. The Goodwin technique is an augmenta-

tion method for the urinary bladder such as a contracted bladder. This procedure is very simple and is detubularised to inhibit bowel peristalsis. We considered that the Goodwin technique might be applicable to the orthotopic ileal neobladder by means of closing the anterior wall and forming it into a sphere, and used this method for orthotopic ileal neobladder replacement since 1996. The operation time for orthotopic urinary neobladder reconstruction was 180 minutes and blood loss was 1,471 ml. The surgical time was shorter than that of a standard technique such as Hautmann's⁴. The Le Duc technique was simplified by the ileoureteral implantation procedure⁶, but this system is very fragile. It is imperative that the reconstructed ileal neobladder has a low-pressure and high-capacity to provide an effective anti-reflux mechanism⁷. In our cases, the pressure-volume curve obtained by cystometry was very flat, similar to that obtained by normal cystometry, and the maximal neobladder pressure in the storage phase revealed a low-pressure, with a median of 15 cm water at 6 months, 12 cm water at 12 months, 7 cm water at 24 months after the surgery. The capacity of the ileal neobladder increased gradually, and the maximal neobladder capacity showed a sufficient median of 300 ml at 6 months, 302 ml at 12 months, and 382 ml at 24

months after the surgery.

Prolonged ileus is the most common early complication of the neobladder procedure. In our series, this problem was cured in all patients by conservative therapy within one week. We avoid resecting the peritoneum whenever possible at the time of radical cystectomy, because when the orthotopic ileal neobladder replacement can be confined to the extraperitoneal space by closing the peritoneum, small intestine adhesion to the neobladder or the pelvic wall can be avoided.

Daytime and nighttime continence was achieved in 89.2 and 81.1% of our patients at 12 months after the surgery, respectively, which is comparable to 88 and 88%¹⁾, and 95 and 56%⁸⁾ in other reports. Among the 37 patients, however, 33 were completely dry during the day and 30 were dry during the night 6 months after the surgery. The maximal urethral pressure revealed a median of 52 cm water at 6 months and median of 51.7 cm water at 12 months after the surgery, and these data seemed sufficient for preserving urinary continence.

In our series, 89.2% of the patients did not require intermittent self-catheterization. Only one patient had to regularly perform dilation for ileourethral anastomotic stricture, and it seemed sufficient enough when compared with the results reported by other investigators⁸⁻¹⁰⁾. Furukawa et al.⁹⁾ assessed the quality of life of 37 patients, including 2 women, with an orthotopic ileal neobladder and found that 58% of the cases voided in a sitting position. As reported by Mikuma et al.¹¹⁾, neobladder patients void by abdominal straining and relaxation of the pelvic floor musculature. We educated the patients to void in a sitting position initially, but it became gradually possible for them to completely empty the ileal neobladder in a standing position (Fig. 3). Twenty-eight male patients could evacuate and achieve complete emptying or only had a small volume of residual urine in the neobladder in a standing position at 6 months after the surgery.

The clinical and functional success of any bladder replacement procedure is intrinsically associated with the surgical method. The different reservoirs in use largely offer the same quality of life as far as daytime continence and metabolic safety are concerned. The lower pressure in the larger reservoir allows patients to remain dry by achieving a better degree of micturition control across the continence zone, particularly during the nighttime. Our data confirm these considerations with excellent functional results.

In conclusion, the results showed that the orthotopic ileal neobladder reconstruction procedure using the modified Goodwin method as a surgical technique is easy to perform. It does not significantly affect the operating time or the postoperative complication rate. This procedure is sufficiently effective to obtain a low-



Fig. 3. Typical voiding cystogram. He could evacuate and achieve complete emptying of the neobladder in a standing position.

pressure, high-capacity, non-refluxing reservoir that enables daytime and nighttime urinary continence by preserving the distal urethral sphincter adequately.

Our results indicate that the modified Goodwin method appears to be an excellent technique for ileal neobladder replacement following cystectomy which seems successful in producing balanced voiding dynamics.

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和文抄録

Goodwin 変法を応用した回腸代用膀胱再建術：37例の機能的評価

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1996年から，われわれは回腸新膀胱造設術に対し Goodwin 法を応用した方法を用いている．われわれは，手術方法および37例の回腸新膀胱の排尿機能について報告する．小腸を 50 cm，回盲弁より 20 cm の部位で切離する．小腸ループをU字に置く．排尿機能は，排尿パターン，尿禁制およびウロダイナミックスタディにて評価した．平均 follow-up 期間の中央値は 17カ月（3～64カ月）であった．安静時最大新膀胱内圧は 6 カ月で 15 cm 水柱，12カ月で 12 cm 水柱，24 カ月で 7 cm 水柱であった．最大尿道閉鎖内圧は 6 カ月で 52 cm 水柱，12カ月で 51.7 cm 水柱，24 カ月で 66 cm 水柱であった．最大尿流量率は 6 カ月で 16.2

ml/秒，12カ月で 17.6 ml/秒，24カ月で 20.8 ml/秒であった．新膀胱の最大容量は 6 カ月で 300 ml，12 カ月で 302 ml，24カ月で 382 ml であった．30例の昼夜問わず尿禁制が保たれていた．3 例は夜間のみ尿失禁がみられたが，使用パッド数は 1 枚であった．4 例が日中も尿失禁が認められ，使用パッド数は，1 日 2 枚であった．われわれの結果は，Goodwin 法を応用した方法が膀胱全摘術後の回腸新膀胱造設術において，素晴らしい方法であることを示しており，バランスのとれた排尿が行われているものと思われた．

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