Journal of the Egyptian National Cancer Institute (2011) **23**, 133–140

Cairo University

Journal of the Egyptian National Cancer Institute

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ORIGINAL ARTICLE

Orthotopic neobladder reconstruction after radical cystectomy in patients with a solitary functioning kidney: Clinical outcome and evaluation

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Received 13 May 2011; accepted 4 September 2011
Available online 23 November 2011

KEYWORDS

Orthotopic neobladder;
Solitary kidney;
Renal function;
Outcome

Abstract *Objective:* To evaluate, in a prospective study, the clinical outcome of orthotopic neobladder reconstruction after radical cystectomy in patients with a solitary functioning kidney at the time of surgery.

Patients and methods: This study included a total of 28 patients (25 males and three females) with muscle invasive bladder cancer and a solitary functioning kidney at the time of surgery who underwent radical cystectomy (anterior pelvic excentration for females) and urinary reconstruction using orthotopic neobladder at The National Cancer Institute, Cairo University between February 2004 and April 2009. The surgical procedures included ileocaecal neobladder in 19 patients, ileal neobladder (Studer) in five and sigmoid neobladder in four. All perioperative and long-term complications were recorded. The renal functions were evaluated using mainly serum creatinine level, abdominal ultrasonography and intravenous urography (IVU).

Results: The mean age of patients was 51.4 years (range of 38–62 years) while the mean follow-up period was 41.4 months (range 18–62 months). Early complications included wound infections in five patients, urine leakage in six, abdominal dehiscence with deep venous thrombosis in two, intestinal obstruction and prolonged ileus in three. During the follow-up period, 21 renal units (75%) remained stable with normal serum creatinine level and normal radiological configuration of the kidney. The remaining seven patients (25%) developed varying degrees of renal deterioration either

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Peer review under responsibility of Cairo University.
doi:10.1016/j.jnci.2011.10.005

due to uretero-intestinal stricture in three patients (10.7%), who were all treated by open surgical revision of the anastomotic sites or due to stricture at the vesico-urethral anastomosis in four patients (14.3%) that had been successfully managed by endoscopic dilatation and internal urethrotomy with stabilization of renal function. Severe metabolic acidosis occurred in one patient while mild forms occurred in three. These four patients required sodium bicarbonate therapy and their metabolic status was normalized thereafter.

Conclusion: Selecting the type of urinary diversion is important in patients with a solitary functioning kidney after radical cystectomy. Orthotopic neobladder reconstruction is a good choice in properly selected patients and could provide comparatively satisfactory results. Accordingly, a solitary functioning kidney should not be regarded as a contraindication for neobladder reconstruction after radical cystectomy.

Introduction

For patients who undergo radical cystectomy for muscle invasive bladder cancer, a major advantage of orthotopic bladder substitution over urinary diversion with an ileal conduit or with a continent diversion is the ability to void per urethra, hence avoiding the need for an external appliance or catheterization of a reservoir [1,2]. There has been a long search for the ideal bladder substitute after radical cystoprostatectomy, providing an acceptable quality of life without compromising radical cystectomy. The Fourth International Consensus Conference on bladder cancer endorsed orthotopic bladder reconstruction as the procedure of choice in properly selected patients [3].

The concept of a neobladder provides both functional and psychological advantages to patients who have undergone cystectomy. Studies now show that the mortality and morbidity rates between continent and standard urinary diversion (e.g. ileal conduit) are not significantly different [4,5]. So, orthotopic bladder replacement using an intestinal segment has become a standard method of urinary diversion after radical cystectomy, because the risk of surgical complications associated with this procedure has decreased with improvement in surgical techniques and the postoperative quality of life after neobladder creation has been shown to be improved compared with that after other types of urinary diversions [6].

Many different forms of continent urinary diversions are used in conjunction with radical cystectomy for bladder cancer. One of the central issues for the ideal bladder substitution is preserving the kidney function. A critical evaluation of the kidney function is mandatory in all patients when continent diversion is considered [7,8]. However, there are several problems that are characteristic of patients with a neobladder, among these, metabolic changes, including hyperchloremic metabolic acidosis, electrolyte disturbances, osteomalacia and skeletal growth retardation, have been reported as relatively frequent complications following neobladder creation [9]. So, hyperchloremic metabolic acidosis is a common complication after incorporating an intestinal segment into urinary tract and renal impairment may enhance these changes [10]. Miyake et al. [11] showed a close association between the serum creatinine level and the degree of metabolic acidosis in both ileal and colon neobladder groups. A serum creatinine of up to 2.5 mg/dL was accepted by Elmajjan et al. [12] in patients scheduled for continent reconstruction while Mansson [13] indicated that levels of only 1.5 mg/dL might indicate an appreciably decreased glomerular filtration rate with distinct implication for acid–base balance and eventually bone demineralization. A creatinine clearance of <60 ml/min was considered by Stein and Skinner [14] to be a contraindication to continent urinary diversion in patients with borderline renal function, but Shaaban et al. [15] stated that some of these patients may have reversible renal impairment secondary to obstruction and drainage before surgery should better indicate true renal function.

Objective

In this study, and considering these findings, we evaluated orthotopic neobladder replacement after radical cystectomy in patients with a solitary functioning kidney at the time of surgery assessing the possible complications of surgery and clinical outcome and evaluating whether patients with a solitary functioning kidney could be possible candidates for orthotopic neobladder reconstruction.

Patients and methods

This study included a total of 28 patients with invasive bladder cancer and a solitary functioning kidney (25 males and three females), mean age 51.4 years (range 38–62 years) and for whom standard radical cystoprostatectomy (for males) and anterior pelvic excentration (APE) for females had been performed followed by an orthotopic bladder reconstruction at NCI, Cairo University between February 2004 and April 2009. The cause of solitary kidney in these patients were as follows:

- The contralateral kidney was previously removed for benign lesions in 13 patients.
- A radiologically nonfunctioning kidney at the time of surgery in 12 patients.
- A simultaneous nephroureterectomy for upper urinary tract cancer in three patients.

A standard radical cystectomy (or APE) was performed in all patients followed by an orthotopic neobladder replacement. The types of neobladder used in this study were as follows:

- Ileocaecal neobladder in 19 patients (Figs. 1a–1c).
- Ileal neobladder (Studer type) in five patients (Figs. 2a, 2b).
- And sigmoid neobladder in four patients (Table 1).

The surgical procedure of each type of orthotopic neobladder replacement was previously described [1,2,4]. A direct

Figure 1a IVU of 56 years old patient with bladder cancer and right sided functioning kidney.

Figure 1b Same patient, 2.5 years after radical cystectomy and ileocaecal neobladder reconstruction showing good function and two neobladder calculi.

uretero-intestinal anastomosis was used in all patients and no anti-reflux procedure was applied. All of our patients had a

Figure 1c Ascending cystogram of the patient showing good neobladder capacity with no reflux after calculi removal.

Figure 2a IVU showing bladder cancer with left sided functioning kidney.

normal serum creatinine level (0.5–1.5 mg/dL) and a normal radiological configuration of the kidney. Patients who had a serum creatinine level >1.5 mg% or creatinine clearance <60 ml/min as well as patients who were lost to follow-up were excluded from the study. Patients were instructed to have sodium bicarbonate oral supplementation regularly after surgery in addition to strict instruction to high oral fluid intake.

In this study, early (within 30 days after surgery) as well as late postoperative complications (>30 days after surgery) were

Figure 2b Same patient, 2 years after radical cystectomy and Studer ileal neobladder reconstruction.

Table 1 Patient's characteristics.

No. of patients	28
Gender	
Male	25
Female	3
Age (years)	
Mean ± SD	51.4 ± 7.3
Range	38–62
Follow-up (months)	
Mean ± SD	41.4 ± 16.4
Range	18–62
Cause of solitary kidney	
Previous nephrectomy for benign lesions	13
Radiologically nonfunctioning kidney	12
Simultaneous nephrectomy for upper urinary tract cancer	3
Type of neobladder	
Ileocaecal bladder	19
Ileal neobladder (Studer)	5
Sigmoid neobladder	4

SD, standard deviation.

recorded. All factors were documented either for cancer-free patients or at last observation before developing treatment failure (local pelvic recurrence or distant metastases). Patients were followed-up regularly at 3-month intervals with history, clinical examination, measurements of serum creatinine level, blood urea nitrogen, creatinine clearance and serum electrolytes (sodium, potassium, and chloride) as well as blood gas analysis in patients suspected of having metabolic acidosis. Renal ultrasound, IVU and other radiological investigations (e.g. C.T. or renal isotope scanning) were used when clinically indicated as well as measures to detect local pelvic recurrence or distant metastases.

Results

In our study, no surgery-related or postoperative mortalities were recorded. The mean follow-up period was 41.4 months (range 18–62 months). The early complications are listed in Table 2. Two patients had abdominal dehiscence requiring reoperation, one patient had intestinal obstruction on the 9th postoperative day at the site of ileo-transverse anastomosis following ileocaecal neobladder reconstruction which necessitated reoperation and revision of the anastomosis and passed a smooth postoperative course. Patients with wound infection, DVT and prolonged ileus were all successfully managed conservatively. Also, six patients (21.4%) had urine leakage which ceased spontaneously after prolonged catheter drainage except for one patient who had a major leakage and required temporary urinary diversion with a percutaneous nephrostomy until the leak stopped. As regards the late complications (Table 2) and during the follow-up period, three patients had an incisional hernia which required mesh repair while four patients (14.3%) developed vesico-urethral stricture, of whom three were treated with cystoscopic urethral dilatation while the fourth was treated by a cystoscopic internal urethrotomy. Three patients (10.7%) developed uretero-enteric strictures and were managed by reoperation and revision of the anastomoses (Figs. 3a–3c). Four patients developed metabolic acidosis during the follow-up period (14.3%), of whom three had a mild form (base-excess > -5 Umol/L). These three patients neglected the oral sodium bicarbonate therapy following surgery and were reverted back to normal metabolic state following its regular oral intake. The fourth patient developed severe metabolic acidosis (base-excess < -5 Umol/L) and required hospitalization, urinary catheterization and wash together with intravenous sodium bicarbonate therapy until normalization of his metabolic state. Also, two patients had neobladder calculi and were managed endoscopically through cystoscopic removal. Twenty one renal units (75%) remained stable during the follow-up period i.e. having normal serum creatinine levels and normal radiological configurations of the kidneys (Figs. 1b and 2b) while the remaining seven patients (25%) developed deterioration of renal function due to various causes; three patients had obstruction due to uretero-intestinal stricture and were managed surgically by revision of the anastomoses and their renal units were stabilized while four patients had various degrees of strictures at the vesico-urethral anastomosis leading to obstruction, reflux and repeated renal infection and were managed successfully endoscopically by repeated dilatation and internal urethrotomy to prevent further deterioration of renal function.

Discussion

So far, there is no perfect substitute for the urinary bladder. Nearly a century and a half after the first reported urinary diversion, many ingenious procedures have been devised to channel urine temporarily before expelling it. We have learned that avoidance of long-term complications requires that the upper urinary tracts must be maintained free of reflux or

Table 2 Early and late postoperative complications.

Variable	Ileocaecal bladder	Ileal bladder	Sigmoid bladder	Total
No. of patients	19	5	4	28
Early complications (within 30 days)				
Wound infection	3	1	1	5
Abdominal dehiscence	2	–	–	2
DVT	–	1	–	1
Prolonged ileus	1	–	1	2
Urine leakage from neobladder	4	1	1	6
Intestinal obstruction	1	–	–	1
Late complications (> 30 days)				
Incisional hernia	2	–	1	3
Uretero-intestinal anastomotic stricture	2	1	–	3
Vesico-urethral anastomotic stricture	3	–	1	4
Metabolic acidosis	2	2	–	4
Neobladder calculi	2	–	–	2
Changes in the mean serum creatinine level (mg/dL%)				
Before surgery	1.3 ± .27	1.4 ± .34	1.3 ± .22	
After surgery	1.6 ± .19	1.6 ± .26	1.5 ± .13	

SD, standard deviation.

Figure 3a IVU showing stricture at the site of the ureterointestinal anastomosis 9 months after ileocaecal neobladder reconstruction.

obstruction, renal function must be preserved and metabolic abnormalities, infection, calculi and malignant transformation be avoided [16].

When deciding how to create a urinary reservoir, one must choose a design that provides characteristics similar to those found in the normal bladder; including a low pressure pouch with adequate compliance and capacity, preservation of the upper tracts by avoiding reflux and obstruction of the ureters, the ability to empty and daytime and nighttime continence. Clearly, no single technique is ideal for all patients and clinical situations [17].

Since the introduction of orthotopic neobladder, the technique has been regarded as the standard for urinary diversion after radical cystectomy because the desire for an intact body image and maintenance of voiding through the urethra can be achieved with favorable long-term functional outcomes. As a rule, if urethrectomy is not required after considering the cancer distribution, patients who are optimal candidates for radical cystectomy can also be potential candidates for orthotopic neobladder reconstruction [6]. But the question will be: should a solitary functioning kidney should be regarded as a contraindication for orthotopic neobladder replacement after radical cystectomy? [29]. To find an answer to this question, we prospectively evaluated 28 patients with invasive bladder cancer and a solitary functioning kidney at the time of surgery for whom urinary tract reconstruction was achieved using orthotopic neobladders focusing on postoperative complications with special regard to the functional outcomes of the upper urinary tract.

Most of the early complications (Table 2) like wound infections, DVT and prolonged ileus were not directly related to the neobladder and all were managed conservatively while the two patients with abdominal dehiscence and the one with intestinal obstruction at the site of ileo-transverse anastomosis required reoperation with wound closure and revision of the anastomosis, respectively. Six patients (21.4%) developed varying degrees of postoperative urinary leakage, all were successfully managed conservatively by prolonged catheter drainage but one patient with a major leak required temporary urine diversion by percutaneous nephrostomy until the leak stopped. The rate of acute complications (within 30 days after surgery) in this study is similar to that in other large series [18]. As regards late complications (Table 2) and during follow-up, three patients had incisional hernia and underwent reoperation and

Figure 3b Ascending cystogram of the same patient showing the site of stricture with reflux.

Figure 3c Same patient, 6 months after revision of the ureterointestinal anastomosis showing good function.

mesh repair while three patients (10.7%) developed uretero-enteric strictures causing gradual deterioration of renal function and necessitating open revision of the anastomoses with consequent stabilization of renal function. The incidence of ureterointestinal stricture is comparable with that reported by others [19,20] in spite of the fact that the number of patients in our study is comparatively small. We used a direct uretero-enteric anastomosis in all our patients. None of the different antireflux techniques had been used in this study. This might cause reflux and possible deterioration of renal function but this is usually serious in rectal diversion rather than orthotopic neobladder [15]. In general, the long-term uretero-intestinal stricture rate is 3–7% if a simple direct anastomosis is used and 7–15% if there is an antireflux anastomosis, irrespective of the type of the anastomosis or the segment of the bowel used [21–24]. Proponents of using an antireflux system argue that detubularized pouches are not necessarily low-pressure reservoir and are usually colonized by bacteria [19,20,25]. However, the potential benefits from an antireflux procedure may be outweighed if the technique has a high risk of stricture formation [26,27]. In our work, there was a stricture at the vesico-urethral anastomosis in four patients (14.4%) and were treated successfully with endoscopic dilatation and division of the stricture through internal urethrotomy. This is in contrast to ureteroileal strictures where endoscopic treatment is generally less successful than open surgery as reported by others [28]. Additionally, during the follow-up period, two patients developed neobladder calculi and were successfully managed endoscopically (Fig. 1b) while four patients (14.4%) developed varying degrees of metabolic acidosis (through assessing the base-excess: $<$ or >-5 Umol/L) and all were managed conservatively with success. The rate is much lower than that reported by Furukawa et al. [29] who reported a 33% rate of metabolic acidosis among their patients with a solitary functioning kidney who underwent neobladder reconstruction, and all were with severe degree (base-excess <-5 Umol/L). In our study, only one patient developed severe metabolic acidosis and responded well to hospital treatment with IV sodium bicarbonate therapy and later regular oral supplementation and his metabolic state was stabilized through follow-up. We think this high rate of metabolic acidosis in the reported study (33.3%) compared

to the rate in our study (14.4%) may be attributed to the strict routine use of sodium bicarbonate therapy after surgery in our patients in addition to high oral fluid intake. Furthermore, most of the patients in the reported study had ileal neobladder reconstruction after radical cystectomy (61%), they reported that severe metabolic acidosis developed mainly in patients with neobladder using an ileal segment while there was no severe metabolic acidosis in patients with sigmoid colon neobladder. This is consistent with their previously reported outcome in patients with bilateral normal kidneys, that is patients with ileal neobladders more easily develop metabolic acidosis than those with a colon neobladder (38.9% vs 26.7%) [11]. Most of our patients had ileocaecal and sigmoid neobladder reconstruction (23 of 28 patients) while ileal neobladder reconstruction was only used in five patients (17.8%), but this small number of patients does not support a rigid conclusion, although it might be safer to use the colon (preferably the sigmoid) for neobladder reconstruction in patients with a solitary functioning kidney to prevent metabolic acidosis as preoperative prediction of the risk of metabolic acidosis is difficult in such patients [29]. In our study, the functional outcomes of the upper urinary tract after orthotopic urinary diversion were assessed using serum creatinine level, renal ultrasonography and IVU. An increase in serum creatinine level in patients with a solitary functioning kidney is a suitable tool to determine renal function [15] while others [29] reported that evaluation of postoperative renal function by serum creatinine and radiological examination are not always adequate for proper assessment. Twenty five percent of patients in the present study had some degree of deterioration in renal function which had been attributed mainly to stricture formation either at the urertero-intestinal or the vesico-urethral anastomoses leading mainly to obstruction, back pressure and ascending infection.

Conclusion

Selecting the type of urinary diversion is important in patients with a solitary functioning kidney after radical cystectomy. Orthotopic neobladder reconstruction is a good choice in properly selected patients and provides comparatively satisfactory results. Accordingly, a solitary functioning kidney should not be regarded as a contraindication for neobladder reconstruction after radical cystectomy.

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