Continent Catheterizable Pouches for Urinary Diversion

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Abstract

Context: Catheterizable pouches represent a good alternative in patients with continent urinary diversion (CUD) when neobladder reconstruction is contraindicated.

Objective: This review summarizes the different techniques, indications and contraindications, functional results, outcomes, and complications of continent catheterizable pouches.

Evidence acquisition: A PubMed Medline database research was performed, identifying publications of CUD using a catheterizable pouch after radical cystectomy for treatment of bladder cancer.

Evidence synthesis: In some patients with infiltrating bladder cancer, a continent cutaneous diversion is indicated when the urethra is involved. Some authors also recommend a catheterizable pouch in patients with carcinoma in situ and in female patients. Different bowel segments have been used to build the reservoir: ileocecum, colon, and ileum. Especially in patients with previous pelvic irradiation, the transverse colonic pouch represents a feasible urinary diversion. Reservoirs with high volume and low pressures can be fashioned by antimesenteric opening and spherical reconfiguration of the bowel. The need for antirefluxive ureteral implantation is questioned and there is a trend towards refluxive implantation. Simple and reproducible techniques (eg, appendix stoma, flap-valve T mechanism, serosalined extramural tunnel) have been developed for creation of a continence mechanism. Satisfactory continence rates >90% are reported for most techniques and quality of life is comparable with orthotopic continent diversion. The overall incidence of complications varies from 28–57%. However, most urinary tract complications (eg, pouch calculi, ureteroenteric anastomotic strictures, efferent limb strictures, mucous retention) are corrected by endoscopic means. Open surgery is mainly performed in strictures of the afferent limb.

Conclusions: Cutaneous catheterizable pouches represent an established and good opportunity for CUD after radical cystectomy for treatment of bladder cancer. Most of the problems that occurred during creation of continent cutaneous reservoirs in the past have been solved. Long-term data of different surgical techniques show excellent continence and acceptable complication rates.

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Introduction

Urothelial carcinoma of the bladder (UCB) is an important cause of morbidity and mortality [1], as well as the main indication for urinary diversion. Radical cystectomy is the gold-standard treatment for muscle-invasive and recurrent high-risk UCB [2]. Safe long-term oncologic outcome, reasonable functional results, as well as an easy adjustment to patients’ lifestyle and recovering the quality of life are the major goals of contemporary surgical approaches in patients receiving radical cystectomy for treatment of UCB. Orthotopic neobladder reconstruction currently represents the primary modality for continent urinary diversion (CUD) in patients with infiltrating UCB at most institutions [3]. However, when the urethra is involved, continent cutaneous diversion (CCD) is indicated. Some authors also recommend CCD in patients with carcinoma in situ [4] and in female patients, since long-term follow-up has shown that clean intermittent catheterization to empty the neobladder is required in a significant number of patients [5]. Furthermore, nononcologic indications for CCD are present in patients with irreversible lower urinary tract dysfunction.

The initial description of many CUD techniques dates back to the period between 1890 and 1920. Due to high complication and low success rates in these early years, the number of patients treated remained small. Several decades later, interest in CUD was renewed. Improvements in surgical techniques, new instruments, as well as suture materials and the availability of antibiotics and alkalinizing drugs succeeded in tremendously reducing intra- and postoperative complications.

For continent cutaneous urinary diversion (CCUD), creation of a reservoir, ureteral implantation, and a continent stoma are required. Different bowel segments have been used to build the reservoir: ileocecum, colon (ascending, transverse, and descending), and ileum. Techniques already established for ureteral implantation in ureterosigmoidostomy were simply transferred to CCUD. Creation of a safe continence mechanism was a main challenging intent.

This review article provides a literature overview of the history and types of CCUD, clinical implications, and results of the most important techniques used for CCD, including complications and outcome, with focus on standard techniques performed today in patients with infiltrating bladder cancer.

Evidence acquisition

Publications relating to CUD using a catheterizable pouch after radical cystectomy for treatment of bladder cancer were identified by searching the PubMed Medline database. Search terms were: bladder cancer, continent urinary diversion, pouch, continent cutaneous diversion, continence mechanism and complication. Language was not a specific search parameter; therefore, papers in English, French, and German were identified and selected for this review article. There was no time limit in the Medline search; however, publications presented in this review were selected because they were the most recent and contained the most relevant supportive and conclusive information regarding continent catheterizable pouches.

Evidence synthesis

3. History, types, and techniques

Over the last century, many different continent catheterizable reservoirs for urinary diversion were described. First reports by Verhoogen [6] and Makkas [7] were published 1908 and 1910, respectively. However, in these first reports on reconstructive urinary diversion using a reservoir, no real continence mechanism was created. Since the 1950s, due to surgical improvements, the “burden of care and discomfort because of incontinence,” as described by Hinman and Weyrauch [8], was solved when the first continent reservoirs were built. The different variants of continent catheterizable reservoirs can be divided by the bowel segment (ileocecum, colon, and ileum) that is used. Therefore, we used this structure to describe the different types and techniques.

3.1. Ileocecal reservoirs

In 1950, Gilchrist and colleagues [9] were the first to describe the successful use of the ileocecal segment for CUD with excellent results. Gilchrist rotated the segment by 90° and applied a submucosal Coffey II implantation of the ureters. The natural antireflux mechanism of the ileocecal valve and the peristalsis of the prevalvular ileal segment, which was used as the efferent segment, served as the continence mechanism. However, the excellent results were not reproducible by others and therefore other techniques were needed.

In 1977, the first descriptions of the Lundiana pouch (Fig. 1) were published [10] and Mansson et al reported clinical results after several modifications in 1990 [11].
original reservoir consisted of a detubularized segment of ascending colon with the ureters being implanted through submucosal tunnels. An ileal nipple fixed by staples and sutured to the rectus fascia served as the continence mechanism. At the same time, Benchekroun developed his inkwell valve and reported results on 33 patients in 1980 [12].

In 1983, the Mainz pouch was developed for orthotopic bladder substitution in benign diseases. In 1986, first clinical results with CCD using this technique in 12 patients were published [13]. The reservoir was created by antimesenteric opening and spherical reconfiguration of the ileocecal segment. Ureters were implanted using submucosal tunnels as an antireflux mechanism. The intussuscepted terminal ileum fixed by staples served as continence mechanism (Fig. 2). A modification was reported in 1992 by Riedmiller and colleagues [14], using the appendix as a stoma. In that report, the appendix vermiformis was in situ submucosally embedded into the caecal pole as a continence mechanism (Fig. 3). Other modifications of the efferent segment (eg, in situ tunneled bowel-flap tubes) were described over the years [15,16].

Rowland et al [17] described the Indiana pouch technique in 1985 and presented first clinical results of 29 patients in 1987 [18]. Compared to the Mainz pouch, this technique was a modification using the ileocecal segment with the ureters being implanted along the tenia libera. The tapered ileal segment, together with the natural antireflux mechanism of the ileocecal valve, served as a continence mechanism. Furthermore, continence was improved by plication sutures.

In 1987, the Florida pouch was introduced by Lockhart [19]. The reservoir consisted of cecum and ascending colon, including the right colonic flexure, with the ureters implanted using the Le Duc technique at first, and later
by direct refluxing anastomosis. Using the antireflux mechanism of the ileocecal valve and a double plication of the efferent segment, continence is accomplished with this technique.

The Miami pouch was introduced in 1988 [20]. The same segments for reservoir creation as the Florida pouch were used. They were opened antimesenterically and reconfigured in a U-shape. Ureters were implanted using a modified Le Duc technique. The terminal ileum, serving as efferent segment, was tapered and reinforced by three proximal sutures.

3.1.2. Colonic reservoirs
As previously mentioned, the Florida and the Miami pouches were constructed using the cecum and ascending colon including the right colonic flexure. Some authors also might classify these reservoirs as colonic.

Another colonic reservoir was first described by Leissner and colleagues [21] in 2000. The transverse pouch (Mainz Pouch III) consists of transverse and upper ascending or descending colon to create an upside-down U-shaped reservoir (Fig. 4). A tailored bowel segment incorporated into the anterior pouch wall serves as a continence mechanism. As the bowel segments in this reservoir type are outside the irradiation field in patients with previous pelvic irradiation, this cutaneous urinary diversion was developed for those patients [21–24].

3.1.3. Ileal reservoirs
The most common continent ileostomy for urinary diversion is the Kock pouch. Kock first reported this reservoir for urinary diversion in 1975 [25]. However, when using this reservoir for urinary diversion, Kock transferred his work on “ileal low pressure pouches” in patients with proctocolectomy, published in 1969 [26], to the urinary tract. The ureters were implanted using an intussuscepted ileal nipple as the antireflux mechanism (afferent segment). Another intussuscepted ileal nipple served as the efferent segment. Both were reinforced by Marlex tapes. Clinical results on this technique were published in 1982 [27].

Further work on continent ileal reservoirs was reported by Leisinger et al [28] and Madigan [29] in 1976. Over 20 yr after introduction of the Kock pouch, a new technique of an antirefluxive valve mechanism was described and named the T-pouch [30]. Due to significant improvements with fewer complications using the continent T-pouch compared to the Kock pouch, this new technique replaced the traditional one.

Another modification of the continent ileal reservoir was described by Abol-Enein [31] in 2004 (Fig. 5). He used a serosa-lined extramural valve as a continence mechanism. Ureters were implanted into a W-shaped ileal reservoir through serosa-lined extramural tunnels.

3.2. Indications for continent pouches in urinary diversion
In patients with infiltrating bladder cancer and in need of a radical cystectomy, one question is uppermost in patients’ minds: “Which type of urinary diversion can I receive?”

Over the last decades, a substantial change in the paradigm of urinary diversion has been reported. The number of patients receiving an orthotopic neobladder is

Fig. 4 – The Mainz pouch III is built from 30–40 cm of nonirradiated transverse colon and either ascending or descending colon. (a) A tailored bowel segment serves as continence mechanism in the U-shaped reservoir. (b) A refluxing anastomosis is used for ureterointestinal implantation [23].
steadily increasing [3,32] and today potentially all cystectomy patients are suggested to be candidates for a neobladder [32]. Nevertheless, there are still absolute and relative contraindications for orthotopic and continent urinary diversion. Therefore, it is important to identify patients who are candidates for CUD, but less ideal for orthotopic urinary diversion.

3.2.1. Patient selection
CCD is indicated when the urethra is involved and a simultaneous urethrectomy is indicated on the basis of the tumour. An orthotopic diversion in these candidates is absolutely contraindicated [33]. Some authors also recommend CCD in patients with carcinoma in situ (CIS), especially at the bladder neck or prostatic urethra [4], as it has been shown that patients with concomitant CIS are at increased risk of urethral transitional cell carcinoma involvement [34] and therefore a urethrectomy might be discussed.

Furthermore, some authors suggest performing CCD in female patients, since functional long-term results have shown that clean, intermittent, self-catheterization is needed in up to 40% of these patients to empty the neobladder [4,5]. Even with technical improvements in surgical strategies, rates of self-catheterization in female neobladder patients is still high (>30%) [35]. Catheterization through a continent abdominal stoma is easy to perform; specifically, it is easier than self-catheterization through the urethra, especially for obese patients.

Baseline external sphincter function is essential for continence mechanism after surgery. Therefore, patients with known external sphincter dysfunction might be compromised by orthotopic diversion and benefit from cutaneous diversions. Likewise, patients with recurrent urethral strictures benefit from this diversion type as complications and recurrent surgery are more frequent in these patients.

3.2.2. Absolute contraindications
If renal function is compromised (ie, serum creatinin level >150–200 μmol/l) due to chronic renal failure or urinary tract obstruction, continent diversion of any type is absolutely contraindicated. Similarly, in case of severe hepatic dysfunction, incontinent diversion is recommended [36].

3.2.3. Relative contraindications
Selection criteria for continent cutaneous reconstruction are age, and mental and health status. The upper age limit is usually 75–80 yr. The patient should be compliant and mentally capable of performing self-catheterization and correctly interpreting the symptoms of a full reservoir. Patients with an advanced disease will most likely not benefit from CUD with respect to quality of life (QoL). Even patients with compromised intestinal function, particularly inflammatory bowel disease, may benefit from an incontinent conduit.

3.3. Functional results and outcome analysis

3.3.1. Continence
Excellent continence rates are achieved with all CCD types. Data on continence rates are summarized in Table 1. Continence rates vary from 72% to 98%. Mansson et al reported continence rates of 94% for the Lundiana pouch [4]. Similar results were reported in studies by Abol-Enein [31] for the Mansoura ileal pouch (94.6%) and Webster et al [37] for the Florida pouch. Wiesner and colleagues reported an overall continence rate of 92.8% for the Mainz pouch I reservoir. However, in their large series of 977 patients, continence rates were dependent on the type of efferent limb: appendix stoma (96%) versus intussuscepted nipple (89.5%) [38]. Lower continence rates (83% and 72%) were reported by Stolzenburg et al and Holmes et al for the transverse (Mainz III) and Indiana pouches, respectively [24,39]. In general, continence rates of cutaneous catheterizable pouches are higher than those for orthotopic neobladders.

3.4. Quality of life
Easy adjustment of urinary diversion to patients’ lifestyle after radical cystectomy leads to a major improvement in recovering QoL. To evaluate QoL, well established, disease-specific, validated questionnaires are used (QLQ-C30, QLQ-BLM30, QLQ-BLS24). Different studies have analysed the QoL difference between CCD and orthotopic neobladder, conduit diversion, or both.

For comparison of QoL between CCD and orthotopic neobladder, only retrospective studies exist. In these, no differences were noted comparing both diversion types [35,40,41]. In the analysis of Pazooki et al, the majority of the patients were satisfied or very satisfied with their diversion, but more patients were troubled by leakage in the orthotopic bladder group [41]. In a recently published study, Large et al identified 92 women who either received an orthotopic neobladder (n = 47) or an Indiana pouch.
Serum creatinine levels were implantations in Mainz pouch I reservoirs, retrospectively.

and the serosa-lined extramural tunnel in uretero-intestinal units, Wiesner et al [45] compared the submucosal tunnel between these groups [44]. In a large cohort of 883 renal yr, no statistically significant GFR deterioration was found

nal anastomosis) and CCD. Within a mean follow-up of 10

colonic conduit (refluxing or antirefluxing uretero-intestinal by glomerular filtration rate (GFR) in patients with ileal or evidence: 2), Kristjansson et al compared the renal function in patients and renal function remained stable with both
catheterizable pouches are limited [44]. As previously described, baseline renal function remains an important factor for patients' QoL after urinary diversion [40,42].

3.6. Complications

Various complications in patients with catheterizable pouches for CUD have been reported [4,21,24,31,37,38,46–52]. Basically, cutaneous pouch-related complications may be divided into early and late complications according to the time of occurrence, and as general or specific. General complications are mainly based on the nature of the CUD using a bowel segment. It has been reported that general complications are comparable in patients with orthotopic neobladder and continent catheterizable pouch reconstructions [36]. Specific complications are mainly based on the nature of the catheterizable cutaneous reservoir (ie, the afferent or efferent segment). Meanwhile, long-term follow-up results are available for specific complications [37,38,46,48,51–53]. The number of complications arising with an increasing follow-up is significant: Overall complication rates range between 28% and 57% [53]. It appears that complication rates are comparable for different types of different cutaneous continent pouches. Excluding those with a transverse pouch [24], irradiated patients show a significantly higher number of complications [48,52]. An overview of common pouch-specific complications is displayed in Table 1. However, especially in comparison to orthotopic neobladder reconstruction, no differences have been observed in the number of complications between orthotopic and CCD in contemporary series [4,35].

3.6.1. General complications

Patients with CUD are at risk for metabolic complications, which may have serious consequences, especially if they are not recognized and corrected. Due to the use of ileal or colic segments for the reservoir construction, electrolyte shift

<table>
<thead>
<tr>
<th>Pouch technique [reference] (bowel segment)</th>
<th>Year of publication</th>
<th>Patients in follow-up, no.</th>
<th>Continen ce rates, %</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indiana pouch [39] (ileoacaecum)</td>
<td>2002</td>
<td>125</td>
<td>72.0</td>
<td>15.2</td>
</tr>
<tr>
<td>lundiana pouch [4] (ileoacaecum)</td>
<td>2003</td>
<td>77</td>
<td>93.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Florida pouch [37] (caecum plus colon ascendens)</td>
<td>2003</td>
<td>179</td>
<td>93.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Mansoura pouch [31] (ileum)</td>
<td>2004</td>
<td>93</td>
<td>94.6</td>
<td>5.4</td>
</tr>
<tr>
<td>Mainz pouch I [38] (ileoacaecum)</td>
<td>2006</td>
<td>839</td>
<td>92.8 (overall)</td>
<td>23.5</td>
</tr>
<tr>
<td>With appendix stoma</td>
<td></td>
<td></td>
<td>96.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Mainz pouch III [24]</td>
<td>2007</td>
<td>24</td>
<td>83.8</td>
<td>4.2</td>
</tr>
<tr>
<td>With intussuscepted nipple</td>
<td></td>
<td></td>
<td>89.5</td>
<td>15.3</td>
</tr>
<tr>
<td>Charleston pouch I [47] (ileoacaecum)</td>
<td>2007</td>
<td>194</td>
<td>98.0</td>
<td>8.2</td>
</tr>
</tbody>
</table>
and reabsorption are feasible; electrolyte abnormalities like hypokalemia, hyperchloremic acidosis, and absorption of ammonia have been reported [36]. According to the bowel segment used to build the reservoir, different electrolyte abnormalities may occur more frequently. For example, ileal segments absorb more potassium, whereas colic segments may absorb more sodium and chloride, with an increased possibility of hyperchloremic acidosis [36]. Furthermore, chronic acidosis may affect the skeleton in different ways. Therefore, long-term changes in acid–base balance may represent an important factor for bone demineralization after urinary intestinal diversion [54]. Acid–base abnormalities in patients presenting with osteomalacia should be corrected first, as this might lead to remineralisation. Further, treatment with activated vitamin D and calcium supplements are recommended.

The use of ileum and, less often, the ileocecal segment may also lead to chronic vitamin B12 deficiency in some patients as vitamin B12 absorption occurs primarily in the terminal ileum. Age, renal function, and baseline level may play an important role in vitamin B12 absorption and development of clinical symptoms. As depletion of body stores of vitamin B12 requires 3 to 5 yr, symptoms may be delayed. However, chronic deficiency may result in irreversible neurologic and hematologic sequelae [55,56]. Bowel mucosa secretes mucous and patients with CUDs produce about 35 g/d of mucus. Whether long-term adaptation of bowel mucosa incorporated into urinary diversion leads to decreased mucous production is still under debate. After exposure to urine, ileal mucosa appears to atrophy over the time. On the other hand, colonic mucosa seems to be preserved and retains its mucous and immunoglobulin secretory abilities [36]. Incomplete emptying of the pouch during catheterization may lead to mucous retention and may increase the hazard of acute urinary retention. To prevent initial mucous build-up within the pouch, careful irrigation through the indwelling catheter should be performed in the early postoperative period [4]. Patients with continuously high secretion of mucous may receive a recurrent intermittent irrigation of their pouch during self-catheterization. Furthermore, in these patients, local use of mucolytic agents (N-acetylcysteine or urea) during irrigation might be beneficial [56]. Another general problem in patients with continent diversions is chronic bacteriuria. Rates of positive urine cultures range between 50% and 90% [57,58]. In most cases, however, bacteriuria is asymptomatic [58] without clinically significant signs of a urinary tract infection (UTI). Recently it has been reported that only 22% of patients with cutaneous continent reservoirs or orthotopic neobladder exhibit symptomatic UTIs in 1 yr [59]. A lack of hygiene does not seem to be the reason for UTI after urinary diversion in patients with self-catheterization [59]. Still, the reasons for the increased incidence of bacteriuria remains unclear. It has been suggested that the intestine, in contrast to the urothelium, is incapable of inhibiting bacterial proliferation [36]. Patients with asymptomatic bacteriuria without clinical or laboratory signs of a UTI do not regularly require antibiotic treatment [60].

3.6.2. Specific complications
Early pouch-related complications are rare. In contemporary publications, specific complications occur in <20% of nonirradiated patients [31,46,47]. Early complications in patients with CCUD are urinary leakage from the uretero-intestinal anastomosis or partial pouch necrosis/perforation, early uretero-intestinal anastomotic stricture, and pyelonephritis [4,31,47]. The incidence of early complications requiring operative intervention is <10% [47]. A conservative approach with a prolonged indwelling catheter is feasible in case of urinary leakage. For treatment of strictures in the early postoperative period, balloon dilatation or less-invasive endoscopic treatment can be used [31,47].

Substantial, catheterizable pouch-related, late complications include catheterizing difficulties, stoma stenosis, stones in the reservoir, incontinence, and stenosis of the uretero-intestinal implantation. Most complications were apparent in the first 3 yr postoperatively [38,46]. Catheterization difficulties are mainly based on stomal stenoses a few years after urinary diversion. Stenoses rates in the efferent limb range from 4% to 36% [4,24,32,35–39,46,51]. In a large series of 977 patients with Mainz pouch diversion, published by Wiesner et al, significantly higher incidence of stomal stenosis was observed for the appendiceal stoma compared with the intussuscepted ileal nipple (23% vs 15%) [38]. The median duration to appearance of stoma stenoses was significantly shorter for appendiceal stoma compared with the intussuscepted ileal nipple (22 vs 34 mo) [51]. Abdallah et al reported a stenosis rate of only 8% for the Charleston pouch I with appendix for continent outlet [46]. The incidence of stoma stenosis was 5% in the Mansoura ileal reservoir with the serosa-lined extramural valve [31] and 4% in patients with Florida pouches [37]. The smaller the diameter of the efferent segment, the higher the incidence of stenosis [51]. Treatment options include endoscopic approaches, buccal or tongue mucosa grafts, YV plasty, and complete stoma revisions [31,37,38,46,52,61]. However, endoscopic treatment by incision is most common and performed with high success rates. An acknowledged disadvantage of the endoscopic incision is the higher recurrence rate of stenoses [31,46,51].

The incidence of pouch calculi is remarkable (5–42%) with a significant number of endoscopic (15–76%) and open surgical interventions (17–80%) [4,31,37–39,46,51,58]. Pouch stones can grow to the considerable size of 20 cm [37]. Treatment options are primarily influenced by the number and size of stones. The greater the number or size of stones, the more frequently open surgical revisions are used [37]. Frequent and complete catheterization of the pouch [37,46,62], as well as avoiding metal staples in surgery may lower the risk of stone formation [58]. A clear relationship between urinary bacteriology and calculus formation was not established [58]; however, urinary infections and metabolic factors seem to play an important role in stone formation [62].

As previously discussed, incontinence rates with cutaneous pouches are low (2–16%) [24,38,46]. Reported continence rates are marginally superior for the appendix
The incidence of uretero-intestinal obstruction depends on the technique used for ureteric implantation. Overall rates range from 2.4% in nonirradiated to 42% in irradiated patients [4,24,31,37,38,46,48,51,52,64]. In their previously mentioned, large, Mainz pouch I series, Wiesner and colleagues compared 1422 renal units with uretero-intestinal reimplantation by the submucosal tunnel with 121 renal units with the serosa-lined extramural tunnel reimplantation technique. Obstruction rates were 6.5% and 5.0%, respectively [38]. Abol-Enein et al reported a stenosis rate of 5.2% with the serosa-lined extramural tunnel [31]. Mansson et al [4] and Stein et al [64] reported stenoses rates of 2.4% and 4% for the antirefluxive Le Duc technique in the Lundiana pouch and in the afferent antirefluxive nipple of the Kock pouch, respectively. However, a trend towards direct refluxing implantation has been reported, as complications caused by reflux seem to be less harmful than those caused by obstruction. As the typical patient with bladder cancer is generally older and has limited life expectancy, reflux of the uretero-intestinal anastomosis might not be of clinical relevance [53]. Furthermore, especially in patients with irradiated ureters, high obstruction rates of 11–42% have been reported [47,48,52]. Although obstruction rates of the afferent limb have decreased, they are still significantly higher than nonirradiated ureters, according to more recent publications [47]. However, only in irradiated patients receiving the transverse colonic pouch were obstruction rates comparable to nonirradiated patients (4%) [24]. Treatment of strictures is most commonly performed with open revision, which has low restenosis or reoperation rates. In case of endoscopic balloon dilatation, incision with a knife or laser and ureter stent implantation are used [37,38].

4. Conclusions

Cutaneous catheterizable pouches represent an established and good opportunity for CUD after radical cystectomy for treatment of bladder cancer. Many techniques have been developed and significantly improved over the last half century. Technical feasibility and surgical versatility have been proven. Reservoirs with high volume and low pressure can be fashioned by antimesenteric opening and spherical reconfiguration of the bowel. Different simple and reproducible mechanisms offer highly satisfactory continence rates. Long-term data on different surgical techniques are comparable regarding functional outcome and QoL. The incidence of complications is acceptable and most complications can be treated endoscopically.

Conflicts of interest

The authors have nothing to disclose.

Funding support

None.

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