Urinary diversion - surgical consideration and long term outcome
Urinary diversion

1. **Non-continent diversion**: Urine drain continuously via an ostomy into collection device (ileal conduit, ureterostomy)
2. **Continent catheterizable reservoir**
3. **Orthotopic bladder replacement** – Continent reservoir which allows voiding per urethra (neobladder)
4. **Ureterosigmoidostomy & variation** – Continent reservoir, controlled by anal sphincter
Issues pertaining bowel into urinary tract
Electrolyte imbalance

- Type and severity depends on
  - Segment of bowel used (colon, jejunum, ileum)
  - Length of intestines used
  - Duration of urine contact (continent vs incontinent)
  - Baseline renal function – higher baseline $\rightarrow$ higher possibility of acidosis
Colon & ileum

- Hypokalaemic, hyperchloremic acidosis
  - Hypercholaraemia: active transport of NH3 by bowel. NH3 excretion is the main mode of acid elimination by kidney
  - Treatment: Pot Cit, Chlorpromazine, nicotinic acid
Stomach

- Hypokalaemic, hypochloraemic metabolic acidosis
  - Gastric secretion contains potassium, chloride, and acid
  - Treatment: H2 blocker
Jejunum

- Hyperkalaemic, hypochloraemic acidosis
  - Jejunum secretes sodium and chloride into urine & absorbs potassium and hydrogen
  - Water loss triggers aldosterone secretion
  - Treatment: Saline infusion, bicarbonate, correction of hyperkalaemia
  - Longterm → oral sodium chloride
Osteomalacia

- **Acidosis** causes bone demineralization
  - Reduced Vit D production
  - Excess proton (Acidosis) binds to bone and liberates calcium
- Treatment: Correct acidosis
- Calcium and vit D supplementation
Enteric hyperoxalouria after ileal resection
- Fat malabsorption: Fat chelates calcium, less fat to bind to oxalates $\rightarrow$ increased oxalate absorption
Infection with urease producing bacteria
Mucus production as nidus for stone formation
Acidosis increases risk of urolithiasis (demineralization, increased calcium liberation)
Dehydration from diarrhoea
Others

- Infection – bowel colonization by bacteria → causes UTI
- Mucus production → catheter occlusion & stone formation
- Diarrhoea → decreased transit time, fat malabsorption
- Increased risk of secondary malignancy
- Stoma complications
- Vit B12 deficiency
- Abnormal drug kinetics
Risk of cancer in bowel

- Ureterosigmoidostomy (2.5% - latency period 26 years)
- Enterocystoplasty (1.7% - latency period 22 years)
- Adenocarcinoma
- Conduit, neobladder, continent catheterizable diversion → no increased risk
Specific intestinal segments
Stomach

- Advantages
  - *option in patients with pelvic irradiation*, acidosis, renal failure.
  - *Reduced infection* because of acid
  - *Less mucus*
- Disadvantage
  - *Hypokalaemic, hypochloroenaemic acidosis*
Jejunum

- Disadvantages
  - Hyperkalaemic, hypochloraemic acidosis
  - Hyponatraemia
  - Bone demineralization
Ileum

- **Advantage**: Suitable location and pedicle for conduit and orthotopic neobladder

- **Disadvantage**
  - Hypokalaemic hyperchloRaemic acidosis
  - Fat and bile malabsorption
  - Diarrhoea
  - Vit B12 deficiency
  - Bone demineralization
  - Maybe unsuitable post pelvic irradiation

- Ileocaecal region has same disadvantages
Colon

- **Advantages**
  - Transverse colon less damaged after pelvic irradiation

- **Disadvantages**
  - Hypokalaemia, hyperchlohraemic acidosis
  - Most mucus production
  - Bone demineralization
Surgical consideration
Non continent cutaneous diversion

- Suitable length of bowel selected (small/large)
- Basic principles of intestinal continuity observed
- Preparation
- Uretero-intestinal anastomosis
  - Refluxing / Non-refluxing
Ileal conduit

- simplest type of conduit diversion to perform and is associated with the fewest intraoperative and immediate postoperative complications.
- not advisable to use ileum for a conduit in patients with a short bowel syndrome, in patients with inflammatory small bowel disease, and in those whose ileum has received extensive irradiation.
Reflexing ureterointestinal anastomosis

Figure 85–25. Bricker ureterointestinal anastomosis. **A,** The adventitia of the ureter is sutured to the serosa of the bowel. A small full-thickness serosal and mucosal plug is removed. Interrupted 5-0 polydioxanone sutures approximate the ureter to the full thickness of the mucosa and serosa. **B,** The anterior layer is completed by interrupted sutures placed through the adventitia of the ureter and the serosa of the small bowel.

Figure 85–26. Wallace ureterointestinal anastomosis. **A,** Both ureters are spatulated and laid adjacent to each other. **B,** The apex of one ureter is sutured to the apex of the other ureter with 5-0 polydioxanone sutures (PDS). The posterior medial walls of both ureters are then sutured together with interrupted or running 5-0 PDS, the knots tied to the outside. The lateral ureteral walls are then sutured to the intestine. **C,** A Y-type anastomosis is formed by completing the anterior row of the anterior lateral ureteral walls of the ureters as shown in **B** and then suturing the ends of the ureters directly to the intestine. **D,** The head-to-tail anastomosis involves suturing the apex of one ureter to the end of the other. The posterior medial walls are sewn together, and then the ends and lateral walls are sewn to the intestine.
Non refluxing

Figure 85–21. Leadbetter-Clarke ureterointestinal anastomosis. A, Injection of the submucosal tissues with saline facilitates the dissection. B, A linear incision is made in the taenia, the taenia is raised, and the mucosa is identified. A small button of mucosa is removed, and the ureter is spatulated and then sutured to the mucosa with 5-0 PDS. The seromuscular layer is sutured over the ureter, with care taken not to compromise or occlude the ureter.

Figure 85–23. Strickler ureterointestinal anastomosis. A, A small linear incision is made in the taenia, and the submucosa is dissected from the mucosa laterally. After a distance of 3 to 4 cm is achieved, a small hole is made in the serosa and the ureter is drawn through. B, A button of mucosa is excised, and the ureter is spatulated and sutured to the mucosa with 5-0 polydioxanone sutures. The rent in the taenia is closed with interrupted sutures, and an adventitial suture at the ureter’s entrance point into the colon secures it to the serosa of the colon.

Figure 85–24. Pagano ureterointestinal anastomosis. A, A linear incision is made in the taenia between 4 and 5 cm in length. B, The submucosa is dissected from the mucosa laterally on both sides to the level of the mesentery. The ureters are drawn into the submucosal tunnel distally and sutured to the mucosa with 5-0 polydioxanone sutures proximally. C, The serosa is reapproximated, with incorporation of the mucosa in the midline.
A 0.5-cm incision is made in the posterior mucosa, and with use of a curved hemostat the mucosa is dissected from the submucosal layer in an oblique fashion coursing from medial to lateral. The hemostat is passed beneath the mucosa for a distance of approximately 3 to 4 cm and rent. Where the ureters enter the serosa, they are also fixed with interrupted 5-0 PDS sutures. The anterior bowel wall is closed in two tunnels. A No. 5 feeding tube is passed through the ureter to be sure that there is no kinking as it passes through the bowel wall. The ureters should lie without tension or angulation. A No. 3 0.5-mm button of seromuscular tissue. A 2-cm tunnel is formed laterally beneath the seromuscular layer with a hemostat. The holding suture in Fig. 85–23 of a 2-mm button of seromuscular tissue. A 2-cm tunnel is formed laterally beneath the seromuscular layer with a hemostat. The holding suture in a manner that does not need to be aligned, one can form the tunnel according to the normal course of the ureter and avoid angulation. This technique reliably prevents reflux but results in a stricture rate of approximately 14% (see Table 1809). However, specific reliable data on the complication rate are not available.
Complications: Ileal Conduit*

<table>
<thead>
<tr>
<th></th>
<th>EARLY</th>
<th>LATE</th>
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<tbody>
<tr>
<td>Urine leak</td>
<td>2% (9/356)</td>
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<tr>
<td>Bowel leak</td>
<td></td>
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<tr>
<td>Sepsis</td>
<td>3% (7/230)</td>
<td>3% (4/142)</td>
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<tr>
<td>Acute pyelonephritis</td>
<td>3% (21/700)</td>
<td>18% (133/726)</td>
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<tr>
<td>Wound infection</td>
<td>7% (17/230)</td>
<td>2% (4/178)</td>
</tr>
<tr>
<td>Wound dehiscence</td>
<td>3% (11/326)</td>
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<tr>
<td>Gastrointestinal bleed</td>
<td>2% (2/90)</td>
<td></td>
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<tr>
<td>Abscess</td>
<td>2% (3/168)</td>
<td></td>
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<tr>
<td>Prolonged ileus</td>
<td>6% (14/230)</td>
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<tr>
<td>Conduit bleed</td>
<td>2% (3/178)</td>
<td>10% (18/178)</td>
</tr>
<tr>
<td>Intestinal obstruction</td>
<td>3% (18/610)</td>
<td>5% (42/878)</td>
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<tr>
<td>Ureteral obstruction</td>
<td>2% (14/610)</td>
<td>6% (56/878)</td>
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<tr>
<td>Parastomal hernia</td>
<td>2% (9/454)</td>
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<tr>
<td>Stomal stenosis</td>
<td>3% (143/486)</td>
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<tr>
<td>Stone formation</td>
<td>7% (59/822)</td>
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<tr>
<td>Excessive conduit length</td>
<td>9% (26/276)</td>
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<tr>
<td>Metabolic acidosis</td>
<td>13% (27/206)</td>
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<tr>
<td>Conduit infarction</td>
<td>2% (2/90)</td>
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<tr>
<td>Volvulus</td>
<td>7% (2/268)</td>
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<tr>
<td>Conduit stenosis</td>
<td>3% (11/320)</td>
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<tr>
<td>Conduit-enteric fistula</td>
<td>&lt;1%</td>
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LONG-TERM OUTCOME OF ILEAL CONDUIT DIVERSION

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ABSTRACT

Purpose: Ileal conduit is considered a safe procedure and the gold standard to which newer forms of urinary diversion should be compared, although few long-term results are known. We analyzed a consecutive series of patients who lived a minimum of 5 years after ileal conduit diversion.

Materials and Methods: A total of 412 patients underwent ileal conduit diversion between 1971 and 1995 at our institution. We analyzed all conduit related complications occurring later than 3 months after surgery in 131 long-term survivors (survival 5 years or greater).

Results: Median followup was 98 months (range 60 to 354). Overall 192 conduit related complications developed in 87 of 131 (66%) patients. The most frequent complications were related to kidney function/morphology in 35 patients (27%), stoma in 32 (24%), bowel in 32 (24%), symptomatic urinary tract infection (including pyelonephritis) in 30 (23%), conduit/ureteral anastomosis in 18 (14%) and urolithiasis in 12 (9%). Within the first 5 years complications developed in 45% of patients. This percentage increased to 50%, 54% and 94% in those surviving 10, 15 and longer than 15 years, respectively. In this last group 50% had upper urinary tract changes and 38% had urolithiasis, for which the respective numbers after 5 years were 12% and 17%.

Conclusions: This study demonstrates a high conduit related complication rate in long-term survivors and underlines the need for vigorous long-term followup. Only studies lasting more than 1 decade cover the entire morbidity spectrum.
as a shrunken kidney (for example caused by vesicoureteral reflux) or hydronephrosis mostly caused by tumor infiltration. After ileal conduit diversion morphological/functional deterioration occurred or the preoperatively existing upper urinary tract pathology deteriorated in 35 (27%) patients (fig. 2). Nephrectomy was required for pyonephrosis in 2 patients and for an upper urinary tract tumor in 1. The most common upper urinary tract changes were hydronephrosis (15 cases) and shrunken kidney (9). Hemodialysis after ileal conduit diversion was required in 3 patients, 1 of whom later received a kidney transplant. These 3 patients already had impaired renal function from prior surgery. Mean time between surgery and renal changes was 60 months. The rate of renal pathology was 40% within the first 5 years after surgery and approximately 80% after 10 years (fig. 3).

Parameters affecting long-term complications.

To evaluate whether the year of surgery had an impact on long-term complications, we analyzed complications occurring only within the first 5 years, thus avoiding the bias of a longer followup of patients operated on earlier in this series (fig. 4). Patients operated on in more recent years had a lower conduit related morbidity within the first 5 years. Patient age at surgery was not correlated to the incidence of long-term complications, yet differences in followup periods must be considered (table 2). Median followup of patients younger than 50 years at surgery (148 months) was almost twice as long as that of patients older than 70 years at surgery (78 months).

Incidences and patterns of complications changed during followup. The typical complication early in followup was related to the bowel, and almost 50% of these complications occurred within the first 2 years. The typical late complication was...

**Fig. 2.** Summary of ileal conduit related complications. All ileal conduit related complications recorded are listed. Several nominations per patient were possible. Percentages refer to total study population of 131 patients.
Long-Term Complications of Conduit Urinary Diversion

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Abbreviations and Acronyms
ECOG = Eastern Cooperative Oncology Group

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Study received institutional review board approval.
Nothing to disclose.
Supplementary material for this article can be obtained at http://mayoresearch.mayo.edu/diversion-complications/.
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Editor’s Note: This article is the fifth of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 758 and 759.

Purpose: We evaluated long-term surgical complications and clinical outcomes in a large group of patients treated with conduit urinary diversion.

Materials and Methods: We identified 1,057 patients who underwent radical cystectomy with conduit urinary diversion using ileum or colon at our institution from 1980 to 1998 with complete followup information. Patients were followed for long-term clinical outcomes and analyzed for the incidence of diversion specific complications.

Results: A total of 844 patients died at a median of 4.1 years (range 0.1 to 28.1) following cystectomy. Median followup of the surviving 213 patients was 15.5 years (range 0.3 to 29.1). There were 643 (60.8%) patients with 1,453 complications directly attributable to the urinary diversion performed with a mean of 2.3 complications per patient. Bowel complications were the most common, occurring in 215 patients (20.3%), followed by renal complications in 213 (20.2%), infectious complications in 174 (16.5%), stomal complications in 163 (15.4%) and urolithiasis in 162 (15.3%). The least common were metabolic abnormalities, which occurred in 135 patients (12.8%), and structural complications, which occurred in 122 (11.5%). Increasing age at cystectomy (HR 1.21, p <0.001), increasing Eastern Cooperative Oncology Group performance status (HR 1.23, p = 0.02) and recent era of surgery (HR 1.68, p <0.001) were significantly associated with a higher incidence of complications.

Conclusions: Conduit urinary diversion is associated with a high overall complication rate but a low reoperation rate. Long-term followup of these patients is necessary to closely monitor for potential complications from the urinary diversion that can occur decades later.
LONG-TERM COMPLICATIONS OF CONDUIT URINARY DIVERSION

These complications occurred at a median of 1.1 years (range 0.1 to 25.7) from surgery. The breakdown of complications according to age is shown in Table 3. At a median of 1.7 years (range 0.1 to 15.8) 61 patients (5.8%) required reoperation for complications. By 20 years following surgery the incidence of any complication was 79.9% (Fig. 2). Of 1,057 patients 527 (49.9%) experienced a complication within 5 years of surgery. Of the 276 patients who survived 5 years complication-free, 116 (42.0%) eventually experienced a complication.

Increasing age at cystectomy was associated with a higher incidence of complications (HR 1.21, \( p < 0.001 \)), as was a higher ECOG performance status (HR 1.23, \( p < 0.02 \)) and the most recent era of cystectomy (HR 1.68, \( p < 0.001 \)). Gender and perioperative chemotherapy were not significantly associated with a higher rate of complications (Table 4).

Bowel-related complications were reported in 215 patients (20.3%) at a median of 1.5 years (range 0.1 to 17.3). Bowel obstruction was the most common complication occurring in 169 patients (16.0%) at a median of 1.7 years (range 0.1 to 17.3), of whom 12 (7.1%) required reoperation. An abscess related to the bowel anastomosis occurred in 38 patients (3.6%) at a median of 0.9 years (range 0.1 to 21.6), of whom 3 (7.9%) required open drainage with the remainder treated percutaneously. Enteric fistulas occurred in 29 patients (2.7%) at a median of 1.9 years (range 0.1 to 21.1), none of whom required reoperation.

Renal complications were reported in 213 patients (20.2%) at a median of 2.2 years (range 0.1 to 29.6). From the overall cohort 6.9% (73 of 1,057) of patients had preexisting renal failure defined as a creatinine greater than 2.0 mg/dl and new onset chronic renal failure developed in 19.0% (201 of 1,057) at a median of 2.3 years (range 0.1 to 29.6). There were 26 patients (2.5%) with progression to renal replacement therapy at a median of 8.4 years (range 0.9 to 23.5), and 22 (2.1%) had loss of a functional renal unit at a median of 2.4 years (range 0.2 to 23.5).

Infectious complications occurred in 174 patients (16.5%) at a median of 1.8 years (range 0.1 to 25.7). Pyelonephritis occurred in 127 patients (12.0%) at a median of 1.8 years (range 0.1 to 25.7).

---

**Table 1.** Patient demographics

| No. pos family history (%)| 36 (3.4) |
| No. tobacco use: | |
| Never | 203 |
| Current | 329 |
| Historical | 525 |
| Mean kg/m² body mass index | 27.1 |
| No. ECOG performance status (%):* | |
| 0 | 773 (74) |
| 1 | 215 (20) |
| 2 | 53 (5) |
| 3 | 8 (1) |
| 4 | 1 (0.1) |
| 5 | 0 (0) |

* In 1,050 patients.

---

**Table 2.** 2002 American Joint Committee on cancer pathological staging of cohort

| No. Pts (%) | |
| Tumor:* | |
| Ta 31 (3) |
| TIS 222 (21) |
| T1 185 (18) |
| T2 230 (22) |
| T3 239 (23) |
| T4 72 (7) |
| Node: | |
| Nx 129 (12) |
| N0 802 (76) |
| N1 71 (7) |
| N2/3 55 (5) |
| Metastasis: | |
| Mx/M0 1,038 (98.2) |
| M1 19 (2) |

* In 1,047 patients.

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**Table 3.** Distribution of complications with age at cystectomy

| Pt Age | No. With Complications (%) |
| Younger than 50 | 24 (71) |
| 50–59 | 98 (67) |
| 60–69 | 235 (61) |
| 70–79 | 242 (68) |
| 80/ | 44 (66) |

In 988 patients.

---

**Figure 2.** Cumulative events curve of complications for each category and for all patients by year from surgery.
SECTION XV

Benign and Malignant Bladder Disorders

An appliance to be used on the abdomen. This procedure is particularly well suited to spinal cord injury patients or those with significant neurologic disease. The concept is that patients with a neurogenic bladder have an easier job of caring for themselves with an abdominal stoma. Patients who are particularly good candidates are those with significant detrusor-external sphincter dyssynergia. Those who have detrusor hyperreflexia, particularly women, may have an increased incidence of incontinence. The complications of the procedure include urethral incontinence requiring closure of the urethra in 20% of patients, stomal stenosis, and bladder and renal calculi.

The procedure is performed by spatulating an ileal segment and performing a generous transverse cystotomy. The spatulated ileum stoma prolapse, acute pyelonephritis, bowel obstruction, urinary stones, parastomal hernia, incisional hernia, stomal stenosis, and fecal leakage. There was no difference in the incidence of deterioration of the upper tracts with either form of diversion. Of some note is that at high pressures, a large portion of the ileocecal conduits experienced reflux. At low pressures, however, there was minimal or no reflux. Whenever a portion of colon is used for a conduit, chronic diarrhea may be a consequence.

Ileal Vesicostomy

An ileal vesicostomy uses spatulated ileum and a generous transverse cystotomy to decompress the bladder and to allow an

Continent cutaneous diversion

- ability to self-catheterize is essential to the patient undergoing continent diversion, the patient must be assessed for the ability to self care
- Patients with multiple sclerosis, quadriplegic individuals, and frail or mentally impaired patients will at some point in their lives require family or visiting nurses for basic care and are therefore viewed as poor candidates for any form of continent diversion
- Absolute contraindication: Renal impairment
- Relative contraindication: Advanced age
General techniques

1. For right colon pouches, appendiceal techniques, pseudoappendiceal tubes fashioned from ileum or right colon, and the ileocecal valve plication are applicable. Appendiceal tunneling procedures are the simplest of all to perform.

2. The second major type of continence mechanism used in right colon pouches is the tapered and/or imbricated terminal ileum and ileocecal valve.

3. Third surgical principle used in constructing the continence mechanism is the use of the intussuscepted nipple valve or, more recently, the flap valve, which avoids the need for intussusception.

4. The fourth major technique of continence mechanism construction is the provision of a hydraulic valve, as in the Benchekroun nipple.
Examples of CCD

Kock Pouch
Indiana
Mainz
Penn
Gilchrist
Mainz I pouch

Fig. 3 – (a) The appendix vermiformis is used as a stoma in the modified Mainz pouch I. (b) The appendix is submucosally embedded into the cecal pole [13,14].
Mainz III pouch

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].
Long-term outcome of CCD

1. Excellent continence, overall daytime/night 93%
2. Good quality of life
Orthotopic neobladder

1. the patient must have an adequate external sphincter mechanism and nonobstructed urethra

2. reservoir must be sufficiently compliant to maintain a low pressure throughout the filling phase. This is best achieved by splitting the bowel segment open longitudinally to completely detubularize it and folding it to create a spherical shape

3. Urethral recurrence must be kept in mind - male/female

4. Cancer surgery should not be compromised for the sake of reconstruction
Contraindication for neobladder

- Urinary stress incontinence;
- Damaged rhabdosphincter or incompetent urethra;
- Tumour infiltration of the distal prostatic urethra in men or bladder neck in women;
- Impaired renal function (serum creatinine >150 mmol/L);
- Severely impaired liver function;
- Severe intestinal diseases (e.g. Crohn’s disease);
- Inadequate intellectual capacity, dexterity and mobility;
- Uncompliant patients for active postoperative re-education and regular follow-up.
Reservoir

1. Reservoir shaping by detubularization is essential in creating a low pressure, compliant environment

2. Reservoir sizing - Viscoelastic property of bowel eventually allows capacity of approximately 500ml

3. Variation of pouches - Studer, Hautmann, Goneim, etc
Volume pressure consideration

1. The volume-pressure relationships depend on the configuration of the bowel.

2. The greater the ratio of length to diameter, the greater the volume change when the ends are closed.

3. The goal in reconfiguring the bowel is to achieve a spherical storage vessel. This configuration has the most volume for the least surface area.
of bowel that has both ends closed may be increased by adding storage vessels for continent diversions. Pressure within the lumen bulbarization on segments of ileum and colon used to construct volume decreases with time if they are nonfunctional one is attempting to make a reservoir.

It has been suggested that splitting the bowel on its antimesenteric wall and tension generated in it. The bowel (detubularization), coordinated activity fronts have been demonstrated clinically: Initially after reconfiguration of the coordinated state during a period of 3 months return to their normal interruptions of coordinated activity fronts, which can be readily shown to decrease. During extended periods, however, many of these segments return.

Over time, it can be demonstrated that there is a marked accommodation in volume of pouches made from intestinal segments. It has been suggested that splitting the bowel on its antimesenteric border increases sevenfold after 1 year (Berglund et al., 1978).

In any event, it seems desirable to achieve the ideal situation is to provide the intraluminal pressure. Clearly, the ideal situation is to provide the intrinsic wall does not conform to Hooke’s law but rather demonstrates viscoelastic properties, which tend to reduction in its length equal to the radius of the end. This limits the increase in volume that occurs by reconfiguration.

Each unique type of diversion has its own set of individual complications both independent of and dependent on the specific type of urinary intestinal diversion. This chapter has addressed complications both independent of and dependent on the specific type of urinary intestinal diversion.

SUMMARY

● The Mainz pouch, which employs both ileum and cecum, has an average pressure at capacity of 39 cm H₂O (Thuroff et al., 1987). Cecum has been observed to have the same number of pressure waves as reflected by changes in bowel wall tension, it is not sure of 63 cm H₂O (Hedlund et al., 1984). Maximum pressures in normal cecum have been shown to range from 18 to 100 cm H₂O (Hedlund et al., 1984). Others, comparing ileum to cecum, find no difference in pressure generated after a year (Hedlund et al., 1984). Notice that range between 5 and 25 cm H₂O (Jakobsen et al., 1988). As the res splitting the bowel wall on its antimesenteric therefore requires measurement as reflected by changes in bowel wall tension, it is not sure of 63 cm H₂O (Thuroff et al., 1987).

● Involuntary pressure waves occur in 25% of patients with Kock bladder and depend on the specific type of urinary intestinal diversion. These facts are often forgotten, and because pressure measurement as reflected by changes in bowel wall tension, it is not sure of 63 cm H₂O (Thuroff et al., 1987).

● Maximum pressures in normal cecum have been found to differ from later reports when coordinated activity fronts in bowel usually increases the volume, but its long-term effect on motor activity and wall tension is unclear at O (Philipson et al., 1987). Disordered Motor Activity muscle thickness of the bowel wall (Philipson et al., 1978). Involuntary pressure waves occur in 25% of patients with Kock bladder and depend on the specific type of urinary intestinal diversion. These facts are often forgotten, and because pressure measurement as reflected by changes in bowel wall tension, it is not sure of 63 cm H₂O (Thuroff et al., 1987).

● The literature is contradictory with respect to the effect of detubularization. Over time, it can be demonstrated that there is a marked accommodation in volume of pouches made from intestinal segments. It has been suggested that splitting the bowel on its antimesenteric wall and tension generated in it. The bowel (detubularization), coordinated activity fronts have been demonstrated clinically: Initially after reconfiguration of the coordinated state during a period of 3 months return to their normal interruptions of coordinated activity fronts, which can be readily shown to decrease. During extended periods, however, many of these segments return.

● Over time, it can be demonstrated that there is a marked accommodation in volume of pouches made from intestinal segments. It has been suggested that splitting the bowel on its antimesenteric wall and tension generated in it. The bowel (detubularization), coordinated activity fronts have been demonstrated clinically: Initially after reconfiguration of the coordinated state during a period of 3 months return to their normal interruptions of coordinated activity fronts, which can be readily shown to decrease. During extended periods, however, many of these segments return.

Figure 85–41. Effect of “detubularization.” The bowel is split on its antimesenteric border and divided in two. When the two segments are placed together, the circumference is doubled, thus doubling the volume. Closing the ends of the cylinder requires a reduction in its length equal to the radius of the end. This limits the increase in volume that occurs by reconfiguration.
However, ureteroileal strictures were fairly common and beginning in 1997, the author modified this technique and now employs a freely refluxing, open end-to-side anastomosis implanted into short tabularized segments at each end of the W. This resulted in a decrease in the risk of ureteroileal stenosis from 9.5% to 1% (Hautmann, 2001; Hautmann et al, 1999, 2006; Volkmer et al, 2009).

The potential downside of this reservoir is the large initial capacity, which may result in an increased incidence of late urinary retention and increased electrolyte reabsorption from the pouch. Sevin has reported a modified Hautmann ileal neobladder using only 40 cm of ileum to reduce these potential issues with acceptable clinical outcomes (Sevin et al, 2004).

The classic configuration of the pouch also could not accommodate short ureters, but in a popular revised technique one or both ends of the W could be left long to anastomoses to one or both shortened ureters (Hollowell et al, 2000).

**Orthotopic Kock Ileal Reservoir ("Hemi-Kock")**
The Kock ileal reservoir was first employed as a continent cutaneous ileal reservoir incorporating intussuscepted nipple valves for both the afferent (antireflux) and efferent (continence) limbs (Kock et al, 1982; Skinner et al, 1984). This subsequently evolved into an orthotopic form of diversion in which the afferent intussuscepted limb was maintained to prevent urinary reflux (Fig. 87–4) (Ghoneim et al, 1987; Skinner et al, 1991). Skinner and colleagues (1998) performed more than 500 of these procedures from 1982 to 1995, with excellent continence and a low ureteroileal stricture rate of less than 3% (Elmajian et al, 1996). However, the technique required the use of metal surgical staples to fix the intussuscepted nipple valve, which was a source of potential stone formation. In addition, many surgeons found the technique difficult to master. Schreiter and Deliveliotis each described ileal S bladder modifications of the orthotopic Kock ileal reservoir (Schreiter and Noll, 1989; Deliveliotis et al, 2001). Both involve forming the detubularized reservoir into an S shape instead of the double-folded U configuration.

With long-term follow-up, late complications associated with the afferent intussuscepted antireflux nipple developed in a small figure 87–2.

**Construction of the modified Camey II.**

A, The ileal loop is folded three times (Z shaped) and incised on the antimesenteric border.

B, The reservoir is closed with a running suture to approximate the incised ileum.

C, The urethral anastomosis is performed, and the ureters are implanted using a Le Duc antireflux technique. As an alternative, the two ends of the W may be left slightly longer as a short chimney on either side for implantation of the ureters.
Figure 87–4. Construction of the Kock ileal reservoir. A, A total of 61 cm of terminal ileum is isolated. Two 22-cm segments are placed in a U configuration and opened adjacent to the mesentery. The more proximal 17-cm segment of ileum will be used to make the afferent intussuscepted nipple valve. B, The posterior wall of the reservoir is then formed by joining the medial portions of the U with a continuous running suture. C, A 5- to 7-cm antireflux valve is made by removing the mesentery under that segment and then intussuscepting the afferent limb with the use of Allis forceps clamps. D, The afferent limb is fixed with two rows of staples placed within the leaves of the valve. E, The valve is then fixed to the back wall from outside the reservoir with additional surgical staples. F, After completion of the nipple valve, the reservoir is completed by folding the ileum on itself and closing it, leaving the most dependent end of the suture line open for the urethral anastomosis.
anastomosis is performed with the spatulated ureter and the intestinal mucosa at the distal end of the trough. The mucosal edges on each side are then approximated over the reimplanted ureter. The anterior wall of the pouch is then closed in a side-to-side fashion. The suture line of the most dependent portion of the pouch close to the urethral stump is reopened to make a hole that will be anastomosed to the urethra (Fig. 87–6). Good results with this technique have been reported by others (Papadopoulos and Jacobsen, 2001). A modification of this orthotopic substitute with a serous-lined extramural ureteral reimplantation technique has also been reported by Kato and colleagues (2001) with similar results. The primary disadvantage of this technique is the requirement for long ureteral length, inability to accommodate dilated ureters, and a possibly increased risk of ureteral strictures.

TPouch Ileal Neobladder

In an effort to preserve an antireflux mechanism but avoid the potential long-term complications seen with the Kock nipple valve, as well as allow for more flexibility in managing the ureters, Stein and Skinner developed the T pouch as a modification of Ghoneim and Abol-Enein's ureteral serous-lined tunnel and updated their results with intermediate follow-up of 209 patients (Abol-Enein and Ghoneim, 1994; Stein et al, 2004). The evolution of this technique is detailed elsewhere (Stein et al, 2005).

Serous-Lined Extramural Tunnel

On the basis of experimental studies, Abol-Enein and Ghoneim demonstrated that an effective reflux mechanism could be made by bringing the ureters into a reservoir through extramural serous-lined tunnels. The authors believed that the construction of an extramural serous-lined tunnel provides several advantages. Metallic staples or synthetic materials are not required. The serous-lined tunnel protects the implanted portion of the ureter from exposure to urine so that sound healing without scarring is ensured. Moreover, a relatively short segment of bowel is used, and the procedure is versatile and not technically difficult (Abol-Enein and Ghoneim, 1993, 1994). The authors updated their excellent results in 450 patients with this technique and demonstrated that the serous-lined extramural tunnel is an effective and durable antireflux technique, with more than 93% of patients with unidirectional, unobstructed urinary flow (Abol-Enein and Ghoneim, 2001).

A 40-cm ileal segment is isolated from the distal ileum and arranged in a W configuration. The antimesenteric border of the isolated intestine is opened, and the edges of the medial flaps are joined with a running absorbable suture. On either side, the two lateral flaps are joined by a seromuscular continuous suture of silk (3-0). This forms two serous-lined intestinal troughs. Each ureter is laid down in its corresponding trough. A mucosa-to-mucosa anastomosis is performed in a standard end-to-side technique to the proximal portion (afferent limb) of the ileum. Ureteral stents are used and brought out anteriorly through separate stab wounds. C, The reservoir is folded and oversewn (anterior wall). D, Before complete closure, a buttonhole opening is made in the most dependent (caudal) portion of the reservoir. E, The urethral anastomosis is performed. F, A cystostomy tube is placed, and the reservoir is closed completely.

Figure 87–5. Construction of Studer pouch ileal neobladder with an isoperistaltic afferent ileal limb. A, A 60- to 65-cm distal ileal segment is isolated, and the distal 40 to 45 cm are folded into a U configuration. It is opened on the antimesenteric border while the more proximal 20 to 25 cm of ileum remain intact (afferent limb). B, The posterior wall of the reservoir is closed with a continuous running suture. The ureteroileal anastomoses are performed in a standard end-to-side technique to the proximal portion (afferent limb) of the ileum. Ureteral stents are used and brought out anteriorly through separate stab wounds. C, The reservoir is folded and oversewn (anterior wall). D, Before complete closure, a buttonhole opening is made in the most dependent (caudal) portion of the reservoir. E, The urethral anastomosis is performed. F, A cystostomy tube is placed, and the reservoir is closed completely.
Lessons Learned From 1,000 Neobladders: The 90-Day Complication Rate

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Abbreviations and Acronyms
ASA = American Society of Anesthesiologists
BMI = body mass index
RC = radical cystectomy

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Editor’s Note: This article is the fourth of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 1234 and 1235.

Purpose: We report the 90-day morbidity of the ileal neobladder in a large, contemporary, homogenous series of patients who underwent radical cystectomy at a tertiary academic referral center using a standard approach.

Materials and Methods: Between January 1986 and September 2008 we performed 1,540 radical cystectomies. A total of 281 patients had an absolute contraindication for orthotopic reconstruction. The remaining 1,259 patients were candidates for a neobladder. Of these patients 1,013 (66%) finally received a neobladder and form the basis of this report. All patients had a thorough followup until December 2008 or until death. All complications within 90 days of surgery were defined, categorized and classified by an established 5 grade and 11 domain modification of the original Clavien system.

Results: Of 1,013 patients 587 (58%) experienced at least 1 complication within 90 days of surgery. Infectious complications were most common (24%) followed by genitourinary (17%), gastrointestinal (15%) and wound related complications (9%). The 90-day mortality rate was 2.3%. Of the patients 36% had minor (grade 1 to 2) and 22% had major (grade 3 to 5) complications. On univariate analysis the incidence and severity of the 90-day complications rate correlate highly significantly with age, tumor stage, American Society of Anesthesiologists score and preoperative comorbidity.

Conclusions: Radical cystectomy and ileal neobladder formation represent a major surgery with potential relevant early complications even in the most experienced hands. The rate of severe and lethal complications is acceptably low.
Twenty Years Experience With an Ileal Orthotopic Low Pressure Bladder Substitute—Lessons to be Learned

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Purpose: We present the long-term results of a large consecutive series of patients undergoing ileal orthotopic bladder substitution following radical cystectomy.

Materials and Methods: Between April 1985 and 2005 orthotopic bladder substitution with an ileal low pressure reservoir was performed in 482 patients (including 40 women) after radical and, if possible, nerve sparing cystectomy. In 447 cases the procedure was combined with an afferent ileal isoperistaltic tubular segment. The patients were followed prospectively.

Results: In the 482 patients 61 early (less than 30 days) diversion related complications requiring prolonged hospital stay or readmission were noted and 115 late complications required treatment. At 1 year continence was good in 92% of patients during the day and in 79% at night. At last followup 93% of patients could void spontaneously. Of 442 evaluable men 99 (22.4%) reported having erections without and 68 (15.4%) with medical assistance. Ureteroileal stenosis was observed in 12 of 447 (2.7%) patients. Urethral recurrence was detected in 25 of 482 (5%) patients. A total of 15 (5%) patients received vitamin B12 substitution. Renal parenchyma decreased only in patients with preoperative or postoperative ureteral obstruction. After 10 years patients with normal renal function had no long-term acidosis and in 20 patients the incidence of osteoporosis resembled that of the normal population.

Conclusions: Ileal orthotopic bladder substitution combined with an afferent ileal tubular segment allows for good long-term functional results provided patients are restrictively selected, postoperative instructions are followed carefully, and typical complications such as outlet obstruction and hernias are treated early.

Key Words: bladder, follow-up studies, cystectomy, metabolism
Urinary Functional Outcome Following Radical Cystoprostatectomy and Ileal Neobladder Reconstruction in Male Patients

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Abbreviations and Acronyms

BCI = bladder cancer index
BMI = body mass index
CIC = clean intermittent self-catheterization
DM = diabetes mellitus
ONB = orthotopic neobladder
UI = urinary incontinence

Purpose: Orthotopic neobladder reconstruction is the preferred method of urinary diversion after radical cystoprostatectomy. We evaluated urinary functional outcomes in male patients after orthotopic neobladder using a patient questionnaire.

Materials and Methods: Between 2002 and 2009 patients with bladder cancer were enrolled in a clinical trial, randomly assigned to undergo T pouch or Studer pouch diversion after radical cystoprostatectomy. Male patients were mailed a questionnaire 12 or more months after surgery including items on urinary function, intermittent catheterization, number/size/wetness of pads and mucus leakage.

Results: The questionnaire response rate was 68%. Mean followup was 4.5 years (range 1 to 8). Only 22.3% of patients did not use pads. In the daytime 47% of patients used at least 1 pad, 32.2% used small/mini pads and 22.6% used diapers. At night 72% used pads, 14.7% used small/mini pads and 38.9% used diapers. During the day and night 47% said their pads were dry/barely wet. Overall 62.5% of patients reported mucus leakage. Only 9.5% of patients performed clean intermittent self-catheterization, of whom 70.6% started clean intermittent self-catheterization within the first year after surgery. Increasing age and diabetes mellitus were predictors of urinary function (p = 0.005 and 0.03, respectively) but did not affect pad use.

Conclusions: Ileal orthotopic neobladder offers good functional results but most patients wear at least 1 pad and many require diapers at night. Increasing age and diabetes mellitus predict worse urinary function but are not associated with pad use. Emptying failure is uncommon and occurs early in the postoperative period. Pad size/wetness and mucus leakage should be considered when evaluating urinary incontinence.
Conclusion

Selection of urinary diversion must be individualised to each patient

Neobladder should be offered in experienced centres

Although cumulative late complication rates are high in ileal conduit reoperation rates are low, it has stood the test of time to be a very durable option