In principle, radical oncological surgery for bladder cancer and urinary diversion are two independent procedures, but they are none the less linked. For tumor treatment, the question of which method of urinary diversion to use is secondary. However, for the patient and the medical indication for oncosurgery, this question takes on paramount importance. The reason for this unusual situation is the fact that in the past, the specter of “mutilating” surgery had surrounded urinary diversion. Carrying a pouch to collect urine, having a stoma, depending on a catheter, living in fear of leakages, being exposed to the danger of infection, and the high rate of repeat surgery have not been widely accepted by patients. The question

**SUMMARY**

**Introduction:** Advice to patients facing a urinary diversion procedure should be directed at maximal tumor control and minimal complications, while aiming for the best possible quality of life. **Methods:** Selective literature review. **Results:** Despite the fact, that a neobladder provides the ideal method of urinary diversion after cystectomy, many patients treated outside of centers that are dedicated to neobladder reconstruction receive an ileal conduit. Despite a strong desire to offer a neobladder whenever possible, 40% of patients do not qualify. An ileal conduit remains a safe method in 30%. Continent diversion to the skin generally is the third choice in 10% of patients. The main indication is when urethral removal is deemed necessary. The use of rectal reservoirs is becoming less popular. Tubeless cutaneous uretero-stomy (UCN) is the first choice for patients who can undergo cystectomy but not tolerate urinary diversion using a bowel segment. Percutaneous nephrostomy (PCN) is the first choice for patients with short life expectancy, who develop obstructive renal failure due to cureless malignancy. The Double-J-catheter may be a valuable aid in patients with obstruction outside the pelvic cavity. **Discussion:** Many factors go into the decision to perform a urinary diversion and must be kept paramount in discussing each method with the patient.

**Key words:** urinary diversion, conduit, pouch, neobladder, palliative diversions

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**Box 1**

**Urinary diversion – acceptance by patients**

**Low:**
- Pouch for collection
- Stoma
- Catheterization
- Rate of repeat surgery
- Infection

**High:**
- Undisturbed body image
- Natural micturition
- Continence
- Safe upper urinary tract
of whether the treatment is worse than the disease looms large when urinary diversion is under discussion. Ideal urinary diversion should meet the following requirements: complete continence; maintaining natural micturition; a safe, infection-free upper urinary tract; and an undisturbed body image are essential (box 1).

The expectations associated with urinary diversion after cystectomy have changed from simple diversion without protecting the upper urinary tract to anatomic and functional reconstruction of the urinary tract that is almost equal to the natural, preoperative state. Progress was achieved in three different ways: subsequent to incontinent cutaneous diversion (conduit), continent cutaneous diversion (pouch) was introduced, and continent diversion was followed by the intact urethra (neobladder, orthotopic reconstruction). In the past 15 years, the neobladder has become the standard procedure conducted in urologic centers – when, initially, it had been merely an experimental surgical method. In giving advice to patients who have to have urinary diversion after radical cystectomy, doctors want to decide on the method that offers the greatest safety for tumor control and the lowest rates of short term and long term complications; which suits patients’ lifestyles best, and which thus interrupts their quality of life least (1, 2).

**Method**

An expert panel, selected from UICC/ICUD/ SIU/EORTC-GU, and WHO, analyzed the English language and German language literature on urinary diversion from the past 25 years under the aspect of evidence based medicine, in the context of a world consensus conference on bladder carcinoma (4). None of the 453 selected studies into urinary diversion is a controlled prospective study. This means that all recommendations that doctors can make regarding urinary diversion have a low evidence level (good quality retrospective case-control studies) and the level of recommendation is mostly grade C (expert opinion). After a consensus had been reached (4), the chair of the committee “urinary diversion” asked for the frequency distribution and frequency of urinary diversions from the committee members’ individual institutions, in order to compare these as “expert opinion” with the result from evidence based medicine (table). This review article is based on both those.

**Results**

In altogether 7,687 cystectomies that had been undertaken at the institutions of the committee members, the neobladder was the most commonly used procedure (50%). Both sexes had expressed a preference for this procedure (1). The ileal conduit is the second most common form of urinary diversion (30%; table). Anal and continent urinary diversions with catheterizable stoma (pouch) accounted for 20%. This distribution is remarkably consistent with the consensus result. It shows that patients’ acceptance of urinary diversion techniques is similar worldwide (box 1).

**TABLE**

<table>
<thead>
<tr>
<th>Distribution of urinary diversion methods among the hospitals of the participants of the world consensus conference 2004 (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of cystectomies</strong></td>
</tr>
<tr>
<td>Ann Arbor</td>
</tr>
<tr>
<td>Bern</td>
</tr>
<tr>
<td>Dallas</td>
</tr>
<tr>
<td>Kobe</td>
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<td>Los Angeles</td>
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<td>Lund</td>
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<td>Mansoura</td>
</tr>
<tr>
<td>Ulm</td>
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<tr>
<td>Total</td>
</tr>
</tbody>
</table>
Neobladder/orthotopic reconstruction

A paradigm shift has occurred in the indication and patient selection for urinary diversion. In 2007, all cystectomy patients are initially candidates for a neobladder, and the aim is to filter out those for whom the neobladder is less than ideal (1, 2). As the table shows, at least 50% of patients in large centers are suitable candidates for a neobladder. Absolute contraindications for any type of continent urinary diversion are disrupted renal function (serum creatinine >150-200 µmol/l), severe liver function problems, and intestinal disorders (4). An absolute contraindication for orthotopic reconstruction exists in all patients in whom a urethrectomy has to be performed simultaneously. The indication for total urethrectomy at the same time as cystectomy has changed notably. In men, urethrectomy was performed in the past in case of multifocal bladder carcinoma, diffuse carcinoma in situ, and tumor involvement of the prostatic urethra. Today, it is common knowledge that only tumor infiltration or the prostatic stroma and diffuse carcinoma in situ of the prostatic urethra are primary risk factors. Even the traditional preoperative biopsy of the prostatic urethra is not necessary any more today. The high speed biopsy of the resection margin of the urethra during the cystectomy facilitates the decision whether it can remain in place and a neobladder can be constructed (4).

In women, the urethra has traditionally been resected together with the bladder. Newer studies have shown, however, that the tumor involvement of the urethra in biopsy confirmed bladder cancer of all grades and stages after a mean follow up of 5.5 years is only 2%. It is common knowledge today that in women the urethra can be saved without any risk of a urethral recurrence as long as the cancer has not affected the bladder neck (5).

![Figure 1](image-url)

**Figure 1**

Technique of new implantation of the ureter: use of an afferent intestinal segment, 3–4 cm in length, bilaterally, and a simple, freely refluxive uretero-intestinal anastomosis.
The importance of relative contraindications and comorbidities (mental disturbances, malfunctions of sphincter, and urethral strictures) is continually decreasing. A neobladder is feasible in principle, but it has to be weighed up whether, because of the more adverse circumstances, the patient’s quality of life may be impaired more by repeated surgery than by not having a neobladder.

The prerequisite for the construction of a neobladder is what the patient wishes. The patient has to be sufficiently motivated to be able to tolerate the potential side effects associated with nocturnal incontinence. Most patients accept these transient complaints in return for the advantage of being able to avoid catheter and stoma of the pouch. But this is not the case for all patients. Realistic expectations of the functional result are essential for the surgeon as well as the person treated. For some patients, treatment with an ileal conduit has a more favorable outcome than with a neobladder. Affected persons’ reasons for deciding against a neobladder are a lack of motivation (“wanting to return home as quickly as possible” and “spending most of one’s life sitting down”), social isolation, and a lack of interest in body image (2). Thanks to current experiences with the orthotopic bladder substitute, oncologic aspects – e.g. progressive local tumor stage, positive but resectable lymph nodes, and an increased local recurrence rate or likelihood of metastases – are no longer contraindications. No evidence exists that patients with a neobladder suffer more from adjuvant chemotherapy or that a local recurrence is more difficult to treat in a patient with a neobladder than with a conduit. Today’s treated patients can expect a normal bladder function (1).

One controversy surrounding orthotopic bladder substitution concerned the question whether the vesico-urethral/intestinal anastomosis has to be done reflexively (5, 6, 7). Agreement had almost been reached that a simple, freely refluxive end to side anastomosis into the afferent ileal limb of a low pressure reservoir – combined with regular micturition and appropriate postoperative observation – is the method with the lowest rate of complications (figures 1 and 2). The potential use of implanting a conventional antirefluxive ureter into a neobladder is cancelled out by a rate of repeat surgery in ileo-ureteral stenosis that is at least double as high (4). After more than 10 years of observation of neobladders with an afferent ileal limb it is known that the loss of renal function is minimal if at all present (6). Close follow-up is required in any case, however, to ensure that a potential ileo-ureteral stenosis with accompanying urinary tract infection is recognized and corrected as early on as possible. The highest risk of a deterioration in renal function is present in patients with a pre-existing renal congestion.
Patients with a normal renal and intestinal function and regular follow-up are usually free from metabolic sequelae for a long time period. About 50% of patients will develop a barely compensated, asymptomatic acidosis and will require bicarbonate substitution. If Bauhin’s valve has been resected, many patients will require vitamin B-12 supplementation 3 to 5 years after the operation.

The continence results need to be considered separately for day and night, and men and women, respectively. 90% of men achieve perfect continence during the day and 65% during the night (not requiring incontinence pads) (9). The probability that a patient does not learn the micturition process and has to use a sterile one-way catheter is 10–15%. Continence results in women are generally better, but the retention rate is 30%. Cystectomy and urinary diversion are extensive surgical procedures. Early and late reoperation rates are 5% and 15% (10). The complications of these procedures can be divided into early complications (within the first 30 days) and late complications. Distinction also has to be made with regard to whether the problems are related to urinary diversion (after lymphadenectomy) or not (after cystectomy). Box 2 shows typical complications associated with each urinary diversion method, which doctors should know and diagnose, to be able to avoid serious impairments. They all constitute reasons why patients with urinary diversion need to be followed up very closely. The sequelae listed in box 2 have been selected according to the risk they constitute for the patient and not according to how common they are. Only one third of patients will not have follow-on problems. Another third will have minor complications that won’t require an extended stay in hospital. The remaining patients will develop serious symptoms.

**Box 2**

Typical late complications related to urinary diversion

**Neobladder**
- Stenosis of uretero-intestinal anastomosis
- Metabolic acidosis
- Rupture
- Mucus tamponade
- Urinary tract infection
- Urinary retention/residual urine

**Continent cutaneous urinary diversion**
- Lithiasis/Formation of calculi (stapler)
- Urinary tract infection (acidosis)
- Parastomal hernia
- Stenosis of stoma
- Malfunction of the invagination nipple

**Ileal conduit**
- Parastomal hernia
- Stenosis of stoma
- Urinary tract infection
- Loss of renal function

**Anal urinary diversion**
- Carcinogenesis
- Urinary tract infection
- Incontinence
- Reflux
- Ureterocolic stenosis
- Metabolic acidosis

Neobladder and sexuality sparing cystectomy

In this procedure, the prostatic apex, the prostatic capsule, the entire prostate, and even seminal vesicles and ductus deferentes are left in place. In the past 15 years, 13 centers worldwide have reported their experiences with superficial or at least organ-limited bladder cancer (11). The local recurrence rate matches that after radical cystectomy. In 6% of cases, a prostate carcinoma remains (12) and an unusual metastatic pattern occurs. At least 5% of patients develop distant metastases that cannot be explained with the tumor stage (13). Daytime continence is equal to that after radical cystectomy; night-time continence is generally better, but the retention rate is higher. The sexuality sparing effect is clearly better than with radical cystectomy. In conclusion, this procedure should not be used in bladder carcinoma but only in cystectomies for other reasons and in very young men.

Continent cutaneous urinary diversion

Even in large centers where continent cutaneous urinary diversion used to be the method of choice (for example, Los Angeles, see table) it is performed notably less often nowadays. Fewer than 10% of patients have this type of treatment. This concerns exclusively urinary diversion in bladder carcinoma. If the indication is based on other diagnoses – e.g. a neurogenic bladder (myelomeningocele), urinary incontinence (hypospadias/exstrophy, loss of the urethra in women, etc), and combined dysfunction of the bladder/sphincter (radiogenic, interstitial cystitis) – then the indication for continent cutaneous urinary diversion will be different. In bladder cancer the indication is mainly given in cases where the urethra has to be resected simultaneously to the cystectomy because of an increased risk of urethral recurrence.

Sometimes patients demand a continent urinary diversion because they fear the risk of a urinary leakage from the neobladder. At the consensus conference, it was unanimously agreed that the decisive element of a catheterizable pouch, the invagination nipple, is regarded as an out of date procedure. The recommendation is to use an appendix stoma or a correspondingly narrowed and stapled ileal segment as the continence organ for a catheterizable pouch. Functional safety, metabolic safety, and the complication rate of the catheterizable pouch are equal to that of the orthotopic bladder substitute. The reoperation rate, however, is clearly higher especially in cases where an invagination nipple is used (14, 15, 16).

Incontinent cutaneous urinary diversion

The ileal conduit was described by Bricker in 1950 and has been the standard method of urinary diversion since then, against which all other methods have been measured. There is still a sizeable number of patients in whom an ileal conduit is a more beneficial solution than any other form of urinary diversion. Despite the desire to offer orthotopic reconstruction to patients, even in large centers (table) there is up to a third of patients who require urinary diversion and for whom ileal conduit is a perfectly safe and sufficient method. For this reason, the pros and cons of all methods of urinary diversion should be discussed with patients and their families. The placement of a conduit is technically simpler than a continent reconstruction. But early and late complications are at least equally as common as after orthotopic bladder substitution. Some long term studies even show that the complications in the area of the upper urinary tract increase with the length of follow-up and are altogether clearly higher than with other urinary diversion techniques (18). As in all urinary diversion methods, lifelong treatment after the procedure is required. Control by a stoma therapist and regular aftercare are essential. For developing countries, this procedure presents an insurmountable problem because of the stoma problems, especially the costs associated with the pouches.

Anal urinary diversion

In theory, such methods have advantages, especially compared with an ileal conduit:
- Control of micturition by will power
- Avoidance of an external stoma and its complications
- No pouch
- Shorter duration of surgery
- Simpler surgical technique
- Better acceptance by patients.
Although the earlier morbidity and mortality after anal urinary diversion have been reduced substantially, some complications remain problematic, particularly the complex metabolic aspects, the cancer risk in the area of the ureterocolic anastomosis, the risk of infection, and the loss of continence with increasing age (4). As the table shows, most centers do not perform anal urinary diversion. This trend is increased by the increased use of orthotopic reservoirs in men and women, owing to the availability of continent cutaneous reservoirs, and for emotional reasons. As the follow-on operation after ureterosigmoidostomy, the Mainz pouch II is available even in indications for urinary diversion outside of bladder carcinoma (19, 20), e.g., in failed extrophy closure.

**Palliative urinary diversions**

A stent-less ureterocutaneous fistula is still the method of choice for patients who can tolerate a cystectomy but in whom urinary diversion using intestinal segments is not advisable. Because of its high complication rates – mainly stoma stenosis and urinary tract infection – the ureterocutaneous fistula is almost never performed these days. However, different improvements to surgical techniques and progress in laparoscopic surgical techniques have revived it as a treatment method for patients with bladder cancer in certain scenarios (4). It has to be remembered that a prognosis for a patient with an inoperable bladder tumor who requires a palliative urinary diversion is much worse than that of patients with prostate cancer or gynecologic tumors. In this context, percutaneous nephrostomy is a realistic option for urinary diversion in patients with advanced bladder tumors. It is the method of choice in patients with a short life expectancy, who develop obstructive renal failure on the basis of an incurable malignancy. A Double-J catheter is an alternative solution in obstructive renal failure on patients with non-urologic pelvic tumors, such as a cervical carcinoma (4).

**Outlook**

Prosthetic organs are used in many parts of the human body. If a complex organ such as the heart can be replaced by a mechanical pump, then it might be assumed that a biological reservoir such as the bladder can be prosthetically substituted without any problems. In spite of many attempts over the past 50 years, however, this goal has not been achieved. Even functional reconstruction with the options presented by tissue engineering has not developed beyond an enlargement of the bladder. Bladder transplantation is possible in principle but is currently still in the animal experimental stage.

**Conflict of Interest Statement**

The authors declare that no conflict of interest exists according to the Guidelines of the International Committee of Medical Journal Editors.

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