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## Urinary Diversion

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# Urinary Diversion

Jerilyn M. Latini, MD

## INTRODUCTION

Following the description of the original surgical technique for internal urinary diversion in 1852 by Simon, numerous procedures have been devised to divert or reconstruct the urinary tract. Historically, 3 major categories of urinary diversions have been described: (1) formation of a fistulous tract between the ureters and intact bowel, (2) implantation of ureters into a partially excluded segment of the gastrointestinal tract, and (3) implantation of ureters into an artificial bladder formed from a completely excluded part of the gastrointestinal tract.<sup>1</sup> The first 2 types of diversions include continent diversions with the anal sphincter (in which urine is eliminated by evacuation) and have declined in popularity with time. The third category has come to the forefront and continues to be expanded and modified internationally. It is subdivided into appliance-dependent urinary diversions (based on creation of a conduit), continent catheterizable reservoirs, and orthotopic bladder replacements (neobladders). Continent urinary diversions utilize 1 of 3 mechanisms for continence: the anal sphincter, an intestinal valve, or the urethral sphincter. This review considers continent urinary diversions with the anal sphincter but focuses more on appliance-dependent diversions, continent catheterizable reservoirs, and orthotopic bladder replacements.

## SURGICAL CONSIDERATIONS

### PATIENT SELECTION

Indications for urinary diversion are presented in **Table 1**. The goals of diversion include control over urine elimination, preservation of renal and intestinal function, avoidance of metabolic abnormalities, and prevention of malignancy. Patients and procedures are selected based on disease status, comorbidities, renal and hepatic function, prior surgery and/or radiation, inherent gastrointestinal disease, life expectancy, motor ability, willingness to self-catheterize and perform self-care, com-

prehension of the regimen required, quality of life, and type of urinary diversion or reconstruction planned.

Adequate renal function (ie, renal blood flow, glomerular filtration/permeability, tubular transport, and concentrating/diluting ability) to blunt the metabolic effects of the gastrointestinal reabsorption of urinary solutes is critical for patients being considered for urinary diversion. Continent diversions require a greater degree of renal function than do conduit diversions. Generally, those with normal urine protein levels, a glomerular filtration rate (GFR) of greater than 40 mL/min, and a serum creatinine level of less than 2 mg/dL do well with urinary diversion. Patients with creatinine levels greater than 2 mg/dL should have renal function studies performed prior to diversion to demonstrate values: creatinine clearance greater than 60 mL/min, GFR greater than 35 mL/min, the ability to acidify urine to a pH of less than 5.8 after an ammonium chloride load, urine osmolality greater than 600 mOsm/kg following water deprivation, and minimal urine protein. Those with obstructive renal insufficiency or failure should undergo pre-operative upper tract decompression and then have true baseline renal function reassessed prior to urinary diversion. Reabsorption and recirculation of urinary solutes also requires normal liver function.

### SURGICAL ANATOMY

Urinary diversions have been performed using all gastrointestinal segments, sometimes in combination. Each segment is associated with particular advantages that are capitalized upon and disadvantages that hinder usefulness. The type, length, function and metabolic impact of the gastrointestinal segment used is critical, with significant effects on long-term sequelae and outcomes.

#### Stomach

The capacity of the stomach varies with age, averaging approximately 30 mL at birth, 1000 mL at puberty, and 1500 mL in adulthood. The stomach has an extensive, interconnected vascular supply (**Figure 1**), and 3 of its 4 major nutrient arteries can be divided without necrosis or significant dysfunction. A pedicle of antrum/pylorus or a wedge of fundus based on the gastrotroepilic arteries can be mobilized to the pelvis for