Metabolic and Electrolyte Abnormalities Related to Use of Bowel in Urologic Reconstruction

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KEYWORDS

• Metabolic • Electrolyte • Bowel • Urologic reconstruction

KEY POINTS

- Use of bowel in urologic reconstruction can result in acid-base and electrolyte abnormalities.
- Severity can vary based on type of segment, length of segment, and contact time with urine.
- Patients with impairment in renal or hepatic function are at greatest risk.

INTRODUCTION

There is a long history of the utilization of bowel segments for urologic reconstructive surgery. The first known urinary diversion using the intestine was accomplished in 1851 by Sir John Simon, with the completion of the first urinary colic fistula.[1] This initial procedure led to the development of a variety of techniques using autologous bowel for urinary diversion and bladder augmentation. Since that time, there has been a growing understanding to the potential electrolyte and metabolic complications associated with the utilization of bowel in urologic reconstruction. These complications depend on a variety of factors, including the length and type of bowel segment used for the reconstruction, and the amount of time that urine is in contact with the

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bowel segment.[2] These primary factors can also be affected by several patient comorbidities, including hepatic and renal insufficiency. The most common acute and chronic complications of these procedures include metabolic acidosis or alkalosis, electrolyte imbalance, malabsorption of vitamins, abnormalities in bone metabolism, abnormal drug absorption, and formation of renal and bladder calculi. This article reviews the types of urologic reconstructions and their potential metabolic and electrolyte complications that result from the use of gastrointestinal segments in these surgeries.

RECONSTRUCTION: INDICATIONS AND TYPES

The goal of a urinary diversion or augmentation is to create a method for urine storage and elimination when the bladder is impaired either structurally, functionally, or as a result of malignancy. The most common indications for urologic reconstruction are:

- Bladder cancer
- Other malignancies in the pelvis that require removal of the bladder
- Congenital bladder abnormalities
- Bladder dysfunction (ie, neurogenic bladder)
- Bladder trauma

Depending on underlying pathologic condition, patients may undergo urinary diversion with an orthotopic neobladder, continent cutaneous diversion, or conduit. The neobladder most closely resembles the natural bladder's function. Although techniques may vary, it often consists of ileum or colon segments that are detubularized and folded in different variations to form the neobladder that is then connected to the native urethra.[2] A continent cutaneous diversion is a similar procedure to the formation of a neobladder, with the exception of the creation of a catheterizable channel that is brought to the skin surface on the abdomen. This form of urinary diversion requires the patient to be able to catheterize a stoma. Finally, the conduit is the most commonly used type of urinary diversion.[2] It involves taking the ends of the ureters and anastomosing them to a segment of small bowel, most commonly ileum, which forms a conduit to the skin surface. Urine then drains through the ostomy into a bag on the patient's abdomen. These types of diversions may be performed for structural impairment, functional impairment, or cancer.

In contrast to a diversion, patients may undergo augmentation of their native bladder known as cystoplasty. The procedure involves opening the bladder and suturing on a segment of bowel.[3] For this procedure, cecum, colon, or stomach may be used but ileum is the most common segment. This procedure is reserved for patients with either a low capacity bladder or those who store urine under high pressure.

COMPLICATIONS RELATED TO BOWEL IN URINARY TRACT

Severity of metabolic and electrolyte derangements arising from use of bowel in the urinary tract can vary based on several factors: contact time with urine, underlying renal or hepatic dysfunction, and what type of bowel is used. Potential complications are best understood by considering the original function of the bowel segment that is used. Transport of water across bowel segments follows the osmotic gradient and depends on intracellular junctions.[4] Although gastric mucosa offers the least absorptive properties, absorption decreases antegrade as it moves from the jejunum, which has the highest absorption, to the colon, which has the least.[5] The absorptive ability is related to the decreased permeability of the tight junctions moving from jejunum to