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Diversion ahead: imaging appearance of urinary diversions and reservoirs

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ABSTRACT

The imaging appearance of urinary diversion is determined by the indication and type of surgical procedure performed. These patients often undergo an imaging follow-up to detect complications or recurrence. Understanding the postoperative anatomy and early detection of complications are keys to adept interpretation of radiological evaluation of urinary reservoirs. The purpose of following review is to offer a brief account of commonly used surgical techniques, relevant anatomy, and concise overview of the imaging techniques for evaluation of the urinary diversions and features of their complications.

1. Introduction

Since the first urinary diversion by Simon in 1852, the surgical practice of urinary diversions has evolved significantly, providing improved function and quality of life. These patients are subjected to imaging surveillance routinely to assess for postoperative complications or recurrent tumors. Hence, it is important to be familiar with the postoperative anatomy and imaging signs of early complications and recurrent tumor. The purpose of this review is to highlight the postoperative 'altered' anatomy and techniques of evaluation of commonly performed urinary reservoirs and dwell on imaging manifestations of postsurgical complications.

Diversions are performed to substitute the functions of bladder. Indications include (a) tumors involving urinary bladder and (b) dysfunctional bladder, e.g., neurogenic bladder, detrusor over activity, and chronic inflammatory diseases of the bladder. During the surgery for tumors, the urinary bladder and pelvic lymph nodes are resected. Surgery is tailored depending on the sex of the patient and indication for the diversion. In men, usually, the prostate and bladder are removed en bloc. Anterior exenteration is commonly performed in women who require removal of the uterus, fallopian tubes, ovaries, bladder, urethra, and a segment of the anterior vaginal wall. Stage of the tumor dictates the type and extent of removal of these organs.

Types of urinary diversions: The urinary diversions are classified depending on the continence status. Fig. 1 shows this classification along with frequency of common types of diversions [1].

2. Ileal conduit

For more than half a century, the ileal conduit technique first described by Bricker has been a standard method for reconstruction postcystectomy [2]. Ileum is preferred for reconstruction because of minimal absorption of urinary electrolytes compared to colon; this is especially helpful in patients with poor renal function and increased risk for metabolic disorders [3,4]. In the formation of the ileal conduit, the ureters are transected from the bladder. Ureteroenteric anastomosis is made to drain the urine into a detached section of 15–20-cm ileum (conduit). The end of the ileum is then brought out through the subcutaneous tissue to the anterior abdominal wall (stoma) (Fig. 2). Terminal and adjacent distal ileum (total of 20–30 cm) is preserved for sake of absorption of bile salts and vitamins, particularly vitamin B12. The Wallace technique (where both ureters are spatulated and conjoined together before they are anastomosed to the ileal conduit) for ureteroileal anastomosis has the lowest complication rate amongst all ureterointestinal anastomosis. Conjoining ureters may pose a problem in case of recurrence at the anastomotic site by obstructing both ureters. Mild dilatation of the upper tract is expected as the ureteroileal anastomosis lacks antireflux mechanisms. Progressive or asymmetric dilatation, however, should raise a suspicion of worsening reflux.

3. Continent catheterizable urinary diversion

Continent urinary diversions offer urinary continence over the commonly used cutaneous ileal conduit (Fig. 3). This technique involves formation of a pouch with tapered aperistaltic segment of either bowel or appendix, which prevents spillage of urine. The patient empties the reservoir by self-catheterization [5]. Multiple

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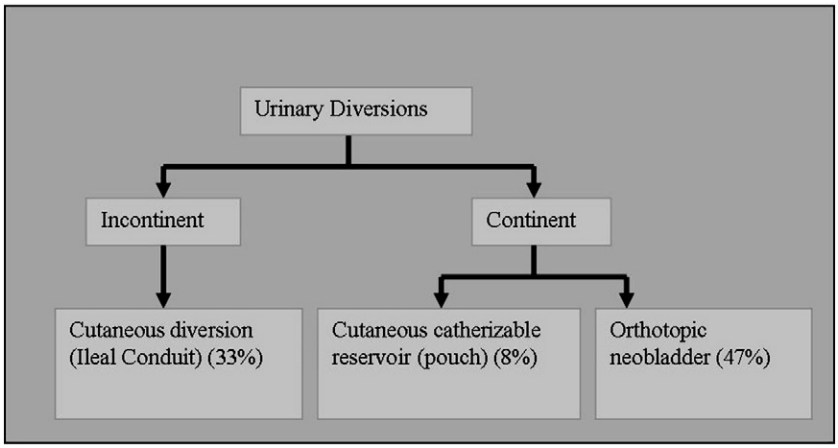

Fig. 1. Classification of urinary diversions based on continence.

surgical techniques or approaches (Mainz, UCLA, Indiana, and Kock pouch) exist (Table 1). Each one utilizes different bowel loop as reservoir, antireflux, and continent mechanisms. Continent mechanisms include intussuscepted nipple valve, appendiceal tunneling technique, and the tapered or imbricated terminal ileum and ileocecal valve. The number of complications may increase because of complexity of surgical technique [6]. Besides, continent reservoirs are more prone to stone formation (due to urinary stagnation) or spontaneous or traumatic rupture.

4. Neobladder

This technique eliminates need for percutaneous stoma and utilizes patient's intact external urinary sphincter. Hence, tumor involvement of the distal apical margins in both male and female patients is an absolute contraindication to perform an orthotopic bladder diversion [5]. Studer ileal neobladder technique is the most popular type of orthotopic diversion nationally and uses an ileal loop to replace the native urinary bladder [7,8] (Fig. 4).

5. Imaging techniques: pouchogram, computed tomography (CT) and magnetic resonance imaging (MRI)

Imaging is performed 3–4 weeks after surgery to exclude reservoir leakage irrespective of the type of pouch before removing the urinary catheter. The radiological examination starts with a scout image, which provides valuable information about the ureteric stents (if present). The percutaneous stoma is catheterized using a Foley catheter, and 150–300 ml of water-soluble contrast media is allowed to flow into the pouch by gravity (30–40 cm high). The flow of contrast media is evaluated for extravasation, reflux, and fistula, and anteroposterior, bilateral oblique views are obtained (Figs. 5, 6).

We perform a low-dose CT scan of abdomen postpouchogram. CT provides extraluminal information and is helpful in detecting complications at early stage. We perform follow-up imaging every 6 months for a period of 2 years and annually after that if the surgery is

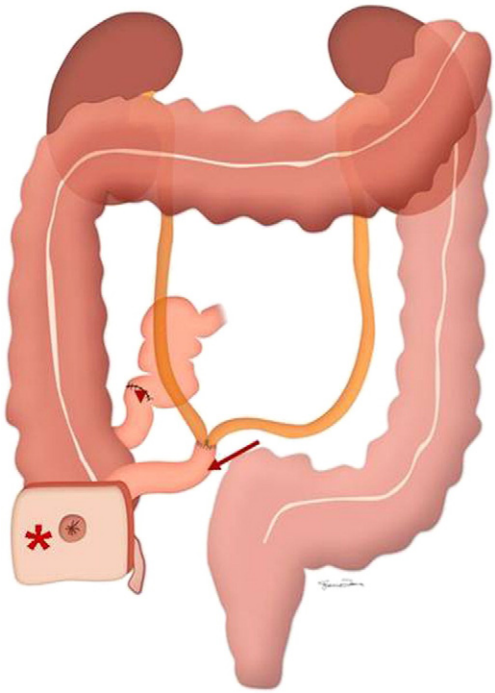

Fig. 2. Schematic illustration of ileal conduit: Note the ureters draining into the ileal conduit (arrow) which is brought out through the subcutaneous tissue as stoma (asterisk). The terminal ileum (arrowhead) is preserved for absorption of bile salts and vitamins.

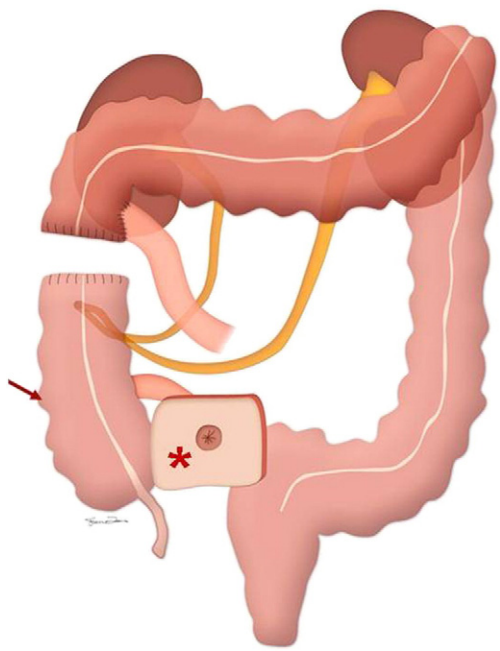

Fig. 3. Schematic illustration of continent catheterizable urinary diversion: Note the ureters draining into isolated segment of ascending colon (arrow). The patient typically self-catheterizes through the ileal stoma (asterisk) to empty the reservoir.