URINARY DIVERSION SURGERY: WHAT THE RADIOLOGIST NEEDS TO KNOW

Poster No.: C-2327
Congress: ECR 2012
Type: Scientific Exhibit
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Keywords: Urinary Tract / Bladder, CT, Complications, Acute
DOI: 10.1594/ecr2012/C-2327

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Purpose

To understand the surgical techniques of urinary diversion after radical cistectomy.

To highlight the most adequate technique for an accurate diagnosis with multidetector row CT (MDTC).

To describe the typical imaging findings of postsurgical anatomic changes and complications.

Methods and Materials

Urinary diversion surgeries are complex and aggressive techniques that are performed with increasing frequency.

That's why it's getting common the occurrence of postoperative complications.

The main indication for radical cistectomy is muscle-invasive bladder cancer (T2 or greater), or at high risk of invasion, without metastases.

Other less common indications include neurogenic bladder, interstitial cystitis, ot radiation lesions.

The criteria for choosing a technique are the following: patient age, sex, performance status, vs curative, palliative surgery, renal function, tumor stage, bowel disease, previous RT.

We perform a radiological review of the main surgical techniques, postsurgical expected changes and most frequent complications either early or late, using clinical cases. We also show how to perform the multiphase scan to get the maximum benefit from the exploration.

Results
INCONTINENT DIVERSION TECHNIQUES

1. CUTANEOUS URETEROSTOMY

It consists of the direct anastomosis of the ureters to the abdominal wall. It's faster and easier than other techniques, and so it is recommended for patients in poor conditions or if it's not possible to use intestinal segments for reconstruction.

2. ILEAL CONDUIT (BRICKER):

Described by Bricker in 1950 and it remains one of the most used techniques, despite the years. It is the creation of a conduit with an isolated segment of ileum approximately 12-15 cm, heading the ureters to the proximal end, and distal-end-anastomosis to the abdominal wall. Preserving the last 10-15 cm of ileum to prevent malabsorption of bile salts, B12 and fat soluble vitamins.

As disadvantages we would highlight the aesthetic, and stoma complications variable hydronephrosis with impaired renal function.

CONTINENT TECHNIQUES

It is the method of choice in young patients with good prognosis, as they allow a good quality of life.

It is the creation of spherical reservoirs capable of storing urine from intestinal segments.

This means to cut the antimesenteric border of the loop, avoiding increase peristaltic filling pressure and therefore the leakage of urine reflux, and gives the tubular morphology a spherical configuration.

CONSIDERATIONS FOR THE USE OF INTESTINAL SEGMENTS

• Good renal function:

It is essential since the contact of urine with the intestinal mucosa leads to resorption of urea and ammonia and therefore kidneys must compensate the metabolic acidosis.

• The most widely used bowel segment is the ileum due to the following advantages:

- Short resections are performed more easily, that do not cause malabsorption.
- It can accumulate larger volumes than colonic reservoirs.- reduced risk acidosis.
- It does not require dissection of the retroperitoneum and therefore lower risk of postoperative ileus.

**Disadvantages of the ileum:** absence of submucosa, which does not allow making an ureteral tunnel, being necessary to use other antireflux systems.

**Advantages of the use of colonic segments:**
- Easier access
- Presence of a long vascular pedicle to perform an anastomosis without tension. (1,2)

1. CONTINENT CUTANEOUS DIVERSION

This technique is rarely used today.
Consists of low-pressure reservoirs that are brought to the skin through a duct.
Valve system is required to do so competent, for which there are numerous techniques that can be catheterized through a cutaneous stoma.
The urination is done by intermittent self-catheterization.

2. URETEROSIGMOIDOSTOMY

It is considered the first urinary competent technique.
Today it is a technique rarely used, due to metabolic causes and the high incidence of pyelonephritis

3. NEobladder CONSTRUCTION

This is the most used technique after ileal conduit (Bricker).
It allows a better quality of life, without stoma or external diversions with collection bags, and total retention of urine.
The disadvantages include increased surgical time, the need of negative results for malignancy in the margins of the urethra, which takes place at the time of the anastomosis, and a longer period until you get optimal function of the neobladder.

**STUDER** technique and its variants are the most commonly used today.
Described by Studer in 1989, it consists of the isolation of an ileal segment of 50-60 cm, from which a segment of 40 cm is detubularized and an intestinal reservoir is formed. The remaining proximal 10-20 cm form the afferent limb, which is an isoperistaltic segment decreasing filling pressure and reflux, and where the ureters are anastomosed.

These patients usually present with incontinence, and ultimately, incomplete emptying increasing.

**MDCT TECHNIQUE**

Intravenous urography and retrograde cystourethrography has been the traditional techniques for the assessment of potential complications of urinary diversion surgery.

MDCT-urography has certain advantages over others:

- Detection of findings extraurinary (collections, intestinal complications, tumor recurrence ...)
- Does not interfere with the presence of gas or stool in the bowel.

Allows for multiplanar reformatting and 3D reconstructions.

Must be performed after the administration of 500-700 ml of water, or 5-10 mg of furosemide intravenously 15-20 minutes before the study, to increase renal excretion.

It is important to carry out 3 phases:

- **WITHOUT CONTRAST**: assessment of stones or other calcifications.
- **NEPHROGENIC PHASE** (80s): characterization of renal or utrteral lesions, and collections.
- **EXCRETORY PHASE** (10 min or more in patients with delayed excretion or obstruction): assessment of urinary leakage or fistula and urothelial lesions.

In case of nephrostomy is necessary to close.

The optimum time of completion of the excretory phase is variable in each patient, so it should be assessed by the arrival of contrast topograms before the series.
The type of the complication depends on the patient's condition, and the surgical technique.

We can classify them between early and late complications. The early ones usually present within the first 30 days after surgery and are frequently due to the procedure performed.

**EARLY COMPLICATIONS**

1. **INTESTINAL COMPLICATIONS**
   
   **PARALYTIC ILEUS**: it is the most common complication, affecting approximately 20% of patients.

   On CT generalized dilatation of both small and large bowel obstruction, without a cause, can be seen.

   It is resolved mainly the 5th to 7th postoperative day.
   
   **MECHANICAL OBSTRUCTION**: often caused by adhesions adjacent to the anastomosis.

   On CT, dilated small bowel obstruction proximal to the point where it appears the abrupt change of bowel caliber, is identified.

   If partial obstruction occurs, can be managed conservatively, but if there is a complete or high grade obstruction, emergency surgery will be required.

2. **URINARY LEAK**

   Occurs in approximately 4% of patients.

   Should be suspected when there is an increase in debit any drains or leakage of urine in the surgical wound.

   The most common site is the anastamosis of the ureter into the reservoir.

   To make the diagnosis it is important to perform excretory phase in order to identify contrast leakage.

3. **FLUID COLLECTIONS**

   **URINOMA**: It is formed by an urine leakage that is not drained through the catheters and accumulates into a collection.
For diagnosis the excretory phase is important, where contrast accumulation within the collection can be identified.

Draining the collection is needed sometimes.

**HEMATOMA**: heterogeneous collection near the surgical site without enhancing after contrast administration.

**LYMPHOCELE**: it appears in patients in whom cystectomy was performed with lymphadenectomy.

CT shows a homogeneous collection of water content and very thin wall, in proximity to the surgical clips.

It usually resolves spontaneously, although sometimes percutaneous drainage is required.

**ABSCESS**: any of the above collections can become infected and form an abscess. On CT a collection of thick enhancing walls and air bubbles inside can be identified. It is important not to misstake air bubbles due to abscess drainage.

4. **FÍSTULAS**

Usually found in the intestinal anastomosis and may be:

- Entero-urinary (most common)
- Enterogenital
- Enterocutaneous

Radiotherapy treatment is a predisposing factor for fistula formation

5. **URINARY OBSTRUCTION**

It is rare in the first month after surgery.

If it occurs often due to an error in the technique of anastomosis, or edema of it.

Another possible cause of obstruction is extrinsic compression of collections or masses.

In moderate-severe obstruction may require reconstruction of the anastomosis.
6. URETERAL PERFORATION

Often due to traumatic catheterization of the ureter.

The TC appears to present a periureteral collection, and surrounding air bubbles can sometimes be identify

7. ISCHEMIA / NECROSIS

May occur at the site of the anastomosis due to excessive tension on it.

LATE COMPLICATIONS

1. INFECTION:

May appear as early or late complication.

There are several factors that make patients with urinary diversion surgery are more susceptible to infections, as the failure of defense mechanisms against bacteria and the presence of ureteral obstruction, reflux and a higher incidence of urolithiasis.

2. CALCULI

Can be located in the reservoir, in the ileal conduit or in the upper urinary tract.

They appear more often within the left ureter in cases of neobladder or ileal conduit, as it must cross to the right side, presenting a more horizontal path than the native urether, predisposing to precipitation.

Can cause obstruction and renal failure.

An unenhanced phase is necessary, as in the excretory phase contrast in the urether can make us miss the calculi.

3. HERNIATION

Parastomal hernias are common in patients with ileal conduit creation (Bricker).

Obesity and advanced age are predisposing factors.

CT is a useful tool for the diagnosis of these hernias, especially in obese patients and to assess associated complications.
4. URETERAL STENOSIS

Usually occur at the uretero-enteric anastomosis and often one to two years after surgery.

The main cause is the ischemia of the distal ureter, that causes fibrosis. Other causes may be an error in technique (most frequently causing obstruction early) or tumor recurrence.

The stenosis causes progressive hydronephrosis and often appears as an accidental finding in follow-up examinations.

It is important to remember that some degree of hydronephrosis due to reflux is normal after surgery.

5. TUMORAL RECURRENTNESS

The recurrence rate is related to tumor stage.

Patients with advanced stage or lymph node involvement are at increased risk.

It usually occurs in up to 18% of patients with orthotopic neobladder.

In the TC may present as a soft tissue mass, ureteral stenosis and hydronephrosis or lymphadenopathy.

Images for this section:
Fig. 1

84 year old woman who underwent radical cistectomy and ureterosigmoidostomy. Excretory phase axial CT from proximal to distal. A) Contrast in renal pelvis and ureters can be seen. Air bubble in the left urethra (arrow) is a normal finding in ureterosigmoidostomy technique and should not be mistaken with infection signs. B) Iodinated contrast in descending colon (+). C) Both urethers reaching sigma. Right urether (discontinuous arrow) crosses midline to anastomose the sigma. D) Contrast filling sigma (arrow).

Fig. 2

Axial CT in a patient with radical cistectomy and neobladder construction (Studer). A) Nephrogenic Phase CT. B) Excretory phase CT where the reservoir (*) and the afferent limb (arrow) are filled of contrast.
Correlation between excretory phase CT scout view and CTMD volume rendering reformatting in the same patient. Anastomosis of the ureters to the aferent limb (arrow) and reservoir (+) can be seen.

Fig. 3

Non-contrast

Nephrogenic phase

Excretory phase

Fig. 4
## COMPLICATION CLASSIFICATION

<table>
<thead>
<tr>
<th>EARLY (&lt;30days)</th>
<th>LATE (&gt;30days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• INTESTINAL COMPLICATIONS</td>
<td>• INFECTION</td>
</tr>
<tr>
<td>– PARALITIC ILEUS</td>
<td>• LITHIASIS</td>
</tr>
<tr>
<td>– MECHANICAL OBSTRUCTION</td>
<td>• HERNIATION</td>
</tr>
<tr>
<td>• URINARY LEAK</td>
<td>• URETERAL STENOSIS</td>
</tr>
<tr>
<td>• FLUID COLLECTIONS</td>
<td>• TUMORAL RECURRENCE</td>
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<tr>
<td>– URINOMA</td>
<td></td>
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<tr>
<td>– HEMATOMA</td>
<td></td>
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<tr>
<td>– LIMPHOCELE</td>
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<td>– ABSCESS</td>
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<td>• FISTULA</td>
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<tr>
<td>• URINARY OBSTRUCTION</td>
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</tbody>
</table>

### Table 1

Small bowel obstruction in a patient with radical cystectomy and cutaneous ureterostomy. Nephrogenic phase axial CT where small bowel dilated loops with parietal enhancement can be seen. Presence of tutoring catheters in both ureters (arrows).

### Fig. 5
**Fig. 6**

**Fig. 9**

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Fig. Excretory phase axial CT in patient with radical cystectomy and ureterosigmoidostomy. Contrast leak adjacent to sigma is identified (circle).

Fig. 75 year old male with radical cystectomy and neobladder construction (Studer), with entero-urinary fistula. Excretory phase axial CT.  
A) Neobladder filled with contrast (+) and presence of contrast in sigma (arrow) is identified.  
B) Contrast leak to peritoneum (discontinuous arrow) and contrast in the neobladder (+) and rectum (arrow).  
C) Contrast leak around the urinary catheter (discontinuous arrow) and contrast in the rectum (arrow).
**Fig. 7**

Nephrogenic phase axial CT after retrograde injection of contrast by both urethers in a patient with cutaneous ureterosigmoidostomy. A) Low density fluid collection (*) is identified adjacent to the anastomosis of the urethers to the anterior abdominal wall. B) Two different density contrast leaks (*) is seen related to urinoma, with urinary leak from both urethers.

**Fig. 10**

Patient with cistectomy and cutaneous ureterostomy, presenting yatrogenic perforation of the left urether. Axial CT on excretory phase. Fig. a) catheters in both urethers, periurethral fluid collection (arrow) and intraabdominal free fluid (*). B) Pneumoperitoneum gas bubbles adjacent to the left urether and right flank (discontinious arrow). C) Gas bubbles in the right flank (discontinious arrow) and catheters inside the urether leading to the abdominal wall. C) Detail of the periurethral fluid collection and gas bubble within it.
Fig. 8

72 year old woman with cystectomy and ureterosigmoidostomy. Axial CT (excretory phase).

Fig A) enlarged right kidney with multiple hypodense areas poorly defined, that are compatible with the diagnosis of focal nephritis areas (arrows).

B) nephrostomy catheters within both kidneys are shown (discontinuous arrows).

Fig. 12

Fig. Nephrogenic phase axial CT 6 days after cystectomy and ileal conduit creation (Briker). Thick wall fluid collection with peripheral contrast enhancement in the surgical site is identified.
Fig. 14

64 year old male who has undergone cistectomy due to bladder carcinoma and neo-bladder reconstruction (Stanford). Excretory phase axial CT one year after surgery. Bilateral hidronephrosis one year after surgery without an underlying apparent cause, suggests ureteronevesical anastomosis stenosis. Fig. a) bilateral grade 3 hydronephrosis and delayed right kidney function, where non opacified renal pelvis is shown ('). Fig. b) non opacified right ureter crossing midline to anastomose the neo-bladder (white arrow) and opacified left ureter (discontinuous arrow). Fig. c) neo-bladder [*].Fig. d) Coronal MIP reformatted image where left ureterohidronephrosis along the whole ureter is seen (arrows).

Fig. 13

Fig. 71 year old male who underwent radical cistectomy and Studer type neobladder reconstruction. Nephrogenic phase axial CT, where left renal pelvis (arrow) (a) and uretheral wall enhancement (discontinous arrow) can be seen, suggesting infection.
Fig. 11 CT (nephogenic phase) one year after cystectomy and neobladder construction (Studer). A stone within the most horizontal aspect of the left urethra is shown (arrow).
Conclusion

Given the increasing influx of patients undergoing urinary diversion surgery and therefore of complications, it is necessary for the radiologist to be familiar to the most adequate diagnostic technique, postoperative findings and imaging findings of the possible complications, in order to provide an accurate diagnosis and early treatment of these patients.

Three phase MDCT is a valuable image technique for the complete evaluation of kidney’s parenchima, collecting system, urethers and bladder.

References


Personal Information