Diagnosis of ectopic ureter should be made on the basis of the characteristic signalment, history, physical examination, clinical pathology, and imaging findings. Once a diagnosis has been established, surgery is the treatment of choice for ectopic ureter.\textsuperscript{1,2} Choosing the technique to surgically correct ectopic ureter is based on location and morphology of the ectopic ureter(s) and the associated abnormalities and pathology of the upper and lower urinary tract.\textsuperscript{3} Treatment of ureteroceles in dogs must also be individualized to the patient.\textsuperscript{4} This article discusses the commonly described repair techniques for ectopic ureter, including neoureterostomy with urethral-trigonal reconstruction, neoureterocystostomy, and nephroureterectomy, as well as treatment of ureteroceles and postoperative management and complications of both conditions.

**MEDICAL MANAGEMENT**

To our knowledge, there have been no reported cases of ectopic ureters that have been successfully managed with medical management alone. Ectopic ureters are the most common cause of urinary incontinence in young dogs, and when the appropriate history and clinical signs are present, a diagnostic investigation is always warranted. Anecdotally, young dogs with urinary incontinence and evidence of bacterial cystitis may initially be managed with antimicrobials. Although clinical signs may temporarily improve, these dogs generally relapse after treatment has been completed, making additional investigation necessary. Dogs presenting later in life, without the typical ectopic ureter history, are more likely to have acquired urethral sphincter mechanism incompetence and may be managed accordingly.

**SURGICAL TREATMENT**

The choice of technique for surgical correction of ectopic ureters is based on the location and morphology of the ectopic ureter(s) and the associated abnormalities and pathology of the upper and lower urinary tract.\textsuperscript{3} Similarly, treatment of ureteroceles in dogs must be individualized to the patient.\textsuperscript{5} The commonly described

\*A companion article on presentation, cause, and diagnosis appears on p. 303.
Repair techniques for ectopic ureter include neoureterocystostomy, neoureterostomy, and nephroureterectomy. Full details of the surgical procedures have been well described in the major veterinary surgical texts.\textsuperscript{5,6} The bladder should be approached using a ventral midline celiotomy, with the incision extending to the pubis.\textsuperscript{3} The use of stay sutures in the apex of the bladder and urethra reduces trauma associated with tissue manipulation and retraction.\textsuperscript{3} The upper and lower urinary and reproductive tracts should be thoroughly examined to confirm the results of the imaging and/or cystoscopic studies. The ureters should be identified in the lateral ligaments of the bladder and their course traced to their insertion on the bladder wall.\textsuperscript{7} Ureters entering a site other than the bladder should be classified as extramural.\textsuperscript{8} Ventral longitudinal cystotomy and proximal urethrotomy allow visualization of the luminal surface of the bladder and urethra to check for intramural ureters, ureteroceles, submucosal tunnels, ureteral troughs, double ureteral openings, and ectopically displaced ureteral orifices.\textsuperscript{3} An intramural ectopic ureter attaches to the serosal surface of the bladder in a relatively normal anatomic position but fails to terminate and open into the bladder lumen at the tip of the trigone.\textsuperscript{3} The ureter instead continues to tunnel through the trigone in the submucosa to open at a site distal to the bladder neck.\textsuperscript{3} Urinary incontinence may result from the ectopic position and/or disruption of the smooth muscle of the proximal urethral sphincter mechanism by the submucosal ureteral tunnel.\textsuperscript{3} Ureteral orifices located at the extreme terminal aspect of the urethra or vagina may not be visualized from this approach\textsuperscript{1} (Figure 1).

**Neoureterostomy and Urethral-Trigonal Reconstruction**

Neoureterostomy and urethral-trigonal reconstruction are indicated to repair intramural ectopic ureters.\textsuperscript{1} Traditional techniques that have been described create a new ureteral opening within the bladder lumen and ligate the distal submucosal ureteral segment.\textsuperscript{1,3,6,9–11} However, this approach fails to address the mechanical interference of the ureter on the proximal urethral sphincter mechanism.\textsuperscript{1,3} Restoring the functional anatomy with full resection of the distal ureter may improve continence after surgery.\textsuperscript{3}

The resection technique involves retrograde placement of an appropriately sized urinary catheter in the displaced ureteral orifice.\textsuperscript{12} If the ureteral orifice is located caudally, beyond the extent of the urethrotomy, a small incision can be made into the lumen of the submucosal ureter.\textsuperscript{3} The distal ureteral segment should then be ligated, which is unlikely to contribute to urinary incontinence.\textsuperscript{3} With the aid of the catheter, the intramural ureter should be dissected from the surrounding tissues of the bladder neck and urethra, taking care to preserve the seromuscular layer.\textsuperscript{1} The remaining defect should be closed with 4-0 or 5-0 synthetic absorbable suture in a continuous or interrupted pattern.\textsuperscript{3} When closing the mucosa, a portion of the underlying smooth muscle layer should be included.\textsuperscript{3} If hemorrhage from the mucosa is excessive, it can be controlled by alternating between ureter dissection and closure of the mucosal layer.\textsuperscript{3} The ureter should be completely dissected to the site where it passes through the bladder wall.\textsuperscript{3} The ureter should be transected, leaving 5 mm to create a new ureteral opening.\textsuperscript{3} The ureteral and bladder mucosal layers should be sutured together using 5-0 absorbable suture in an appositional pattern.\textsuperscript{3} The technique should be minimally traumatic to the blood and nervous supply of the ureter and can be performed in small bladders.\textsuperscript{1,11}

**Neoureterocystostomy**

Ureteral reimplantation is indicated to repair an extramural ectopic ureter.\textsuperscript{3,6} The goal of surgery is to restore the ureteral orifice to a position proximal to the urethral sphincter, thereby restoring urinary outflow control.\textsuperscript{3} Extramural ectopic ureter tends to be overdiagnosed from radiographic studies, and its incidence based on surgical investigation appears to be rare.\textsuperscript{9–11}
The ureter should be isolated and ligated at the most distal point with 3-0 absorbable suture and should be transected cranial to the ligature. The ureter should then be isolated, taking care to avoid damaging the ureteral blood supply that runs longitudinally within the fascial ligament. Reimplantation has been described using a short oblique or transverse pull-through. The bladder should be opened and a new insertion site chosen cranial to the bladder neck. A small area of mucosa should be excised and a small hemostat pushed through the muscular and serosal layers. A 4-0 stay suture placed in the distal ureter should be used to manipulate the ureter through the bladder wall and into place. Once in position, the distal 2.5 mm of ureter should be excised and discarded. The end should be spatulated and sutured with 5-0 monofilament absorbable suture to the bladder mucosa with a simple appositional pattern. Care should be taken to avoid suturing a twisted ureter because this may compromise ureteral blood supply.

Neoureterocystostomy has the disadvantage of potentially disrupting ureteral blood supply and innervation. Radiographic evaluation of reimplanted ureters often demonstrates mild to moderate hydroureter and hydronephrosis. These radiographic signs may occur because of complete or partial obstruction of the ureter at the ureterovesical junction, resulting from soft tissue trauma, mucosal edema, blood clot, or stricture. Ureteral dilation that results from surgical manipulation of the ureter generally resolves within 4 to 6 weeks after surgery. If hydroureter was present before surgery, it may improve with ectopic ureter surgery but is unlikely to completely resolve. Therefore, if bilateral ectopic ureter is corrected during the same surgery (or if there is significant impairment in the contralateral kidney), the animal should be monitored for signs of ureteral swelling, obstruction, and subsequent renal failure.

Nephroureterectomy

Removal of the kidney and ipsilateral ureter is a salvage procedure. It is indicated in treating ectopic ureters and ureteroceles when a kidney is determined to be nonfunctional and the contralateral kidney is normal. Traditionally described nephroureterectomy methods would finish with ligation of the distal ureter. However, it has been proposed that urethral-trigonal reconstruction must also be performed to reduce interference with urethral sphincter control and, therefore, improve the likelihood of postoperative urinary continence.

Ureteroceles

Treatment of ureteroceles in humans remains controversial because of the wide variety of anatomic and clinical presentations. Without large numbers of published veterinary cases, most veterinary recommendations have been extrapolated from human studies. Cystoscopic incision is commonly used to initially treat intravesical ureteroceles in humans. This technique has decreased the need for surgical intervention. In humans, open resection of intravesical ureteroceles is also an option, and if vesicoureteral reflux is present, neoureterocystostomy can be performed. However, ectopic ureteroceles in humans commonly require open surgical reconstruction. For large dogs, cystoscopic incision has been suggested as an appropriate treatment of intravesical ureteroceles when there are no other reasons for a celiotomy. Repair of canine ectopic ureteroceles involves the same basic techniques described for canine ectopic ureter repair. The choice of technique or combination of techniques depends on the preoperative and intraoperative evaluation of both the upper and lower urinary tracts.

Postoperative Management and Complications

Dysuria is a commonly reported short-term complication after surgery. Therefore, a urethral catheter and closed urine collection system should be maintained for 24 to 48 hours after surgery. A red rubber feeding tube or polypropylene catheter of an appropriate diameter should be used. A Foley-type catheter, as used by us in female dogs, has improved retention attributable to the inflatable balloon tip. Most dogs void freely and comfortably within 2 to 3 days after surgery.

Perioperative pain relief should be administered as required. In otherwise healthy patients, we routinely use a preoperative epidural opioid, perioperative parenteral opioids, and postoperative NSAIDs. Antibiotic therapy should be administered based on culture and sensitivity results from samples collected before and/or during surgery. Persistent urinary incontinence after ectopic ureter surgery has been reported in 42% to 67% of dogs. However, 55% of dogs that failed to regain urinary continence showed clinical improvement. Suggested reasons for a lack of surgical success have included poor surgical technique, recanalization of the occluded distal ureter, a hypoplastic bladder with poor storage capacity, and concurrent urethral sphincter mechanism incompetence. Removal of the urethral portion of the
ectopic ureter during neoureterostomy has been anecdo-
tally reported to dramatically improve results.\textsuperscript{3} To our knowledge, however, specific data supporting the bene-
fits of this technique have yet to be published.

Eleven cases of ureterocele have been described in the
English-language literature.\textsuperscript{17} Although the number of
cases is small, results of ureterocele repair have been
good.\textsuperscript{17} Seven of eight dogs that underwent surgical re-
pair achieved continence.\textsuperscript{17} However, long-term progno-
sis depends on coexisting upper urinary tract disease,
such as bilateral hydroureter, hydronephrosis, or chronic
renal disease.\textsuperscript{17}

If incontinence continues for longer than 2 to 3
months after surgery, IV urography or cystoscopy should
be performed to reevaluate the ureters.\textsuperscript{6} Occasionally,
the distal end (if ligated) is patent or bilateral ectopia is
initially missed.\textsuperscript{6}

\textit{α}-Adrenergic agonists such as phenylpropanolamine or
ephedrine sulfate have been used to successfully manage
some patients with mild postoperative urinary inconti-
nee\textsuperscript{5–6,7,11} (Table 1). In patients with unrelenting
urinary incontinence despite ectopic ureter repair, other
treatments (e.g., colposuspension, endoscopic submucosal
injections of Teflon or collagen) have been suggested to
improve urinary continence in female dogs with primary
sphincter incompetence.\textsuperscript{1,3,20} Injected Teflon particles in
dogs have been shown to migrate and establish granulo-
mas in other tissues.\textsuperscript{21} Because of similar safety concerns
regarding Teflon in humans, collagen has been the most
commonly reported injectable used in women.\textsuperscript{22}

Colposuspension was performed at the same time as
ectopic ureter repair in a group of seven dogs.\textsuperscript{8} Although
the population was small, results were promising: Five of
seven (71\%) dogs showed long-term continence
without complications.\textsuperscript{8} Breakdown of colposuspension
suture was the suspected reason for incontinence in the
two dogs in which treatment failed.\textsuperscript{8} In our opinion,
the suitability of adjunctive treatments must be assessed
based on the individual patient.

**CONCLUSION**

Surgical treatment options for ectopic ureters include
neoureterostomy, neoureterocystostomy, and nephroure-
rectomy. Prognosis for a return to complete urinary conti-
nence is uncertain. However, patients with residual urinary
incontinence may be successfully managed with additional
medical therapy. Recently described modifications in surgi-
cal procedures may improve the success rate in the future.

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**Table 1. Suggested Drugs and Dosages for Urethral Sphincter Mechanism Incompetence**\textsuperscript{6}

<table>
<thead>
<tr>
<th>α-Adrenergic Agonist</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenylpropanolamine hydrochloride</td>
<td>12.5–50 mg/dog PO q8h or 1.1 mg/kg PO q8h</td>
</tr>
<tr>
<td>Ephedrine sulfate</td>
<td>4 mg/kg PO q8–12h or 12.5–50 mg/dog PO q8–12h or 5–15 mg/dog PO q8h</td>
</tr>
</tbody>
</table>


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**ARTICLE #5 CE TEST**

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1. Neoureterostomy and urethral-trigonal reconstruction are indicated to repair an __________ ectopic ureter with a _______ ipsilateral kidney.
   a. extramural; functional
   b. extramural; nonfunctional
   c. intramural; nonfunctional
   d. intramural; functional
   e. none of the above

2. Neoureterocystostomy is indicated to repair an ______ ectopic ureter with a _____ ipsilateral kidney.
   a. extramural; functional
   b. extramural; nonfunctional
   c. intramural; nonfunctional
   d. intramural; functional
   e. none of the above

3. Nephroureterectomy is indicated to repair an_______ ectopic ureter with a ______ ipsilateral kidney.
   a. extramural; functional
   b. extramural; nonfunctional
   c. intramural; nonfunctional
   d. intramural; functional
   e. b and c

4. Which of the following techniques can be used for perioperative pain relief in otherwise healthy patients with ectopic ureter?
   a. preoperative epidural opioid
   b. perioperative parenteral opioids
   c. postoperative NSAIDs
   d. all of the above
   e. none of the above

5. A urethral catheter and closed urine collection system should be maintained for _______ hours after ectopic ureter surgery.
   a. 6 to 12
   b. 12 to 24
   c. 24 to 48
   d. 48 to 72
   e. No catheter should be used.

6. Persistent urinary incontinence following ectopic ureter surgery has reportedly occurred in ______ of cases.
   a. 42% to 67%
   b. 55%
   c. 62% to 77%
   d. 64%
   e. 89% to 95%

7. What percentage of dogs that fail to regain urinary continence show clinical improvement after surgery?
   a. 40% d. 55%
   b. 45% e. 60%
   c. 50%

8. What drug class has been successful in managing some patients with mild postoperative urinary incontinence?
   a. α-adrenergic agonists d. serotonin antagonists
   b. β-adrenergic agonists e. none of the above
   c. antimuscarinics

9. When postoperative incontinence occurs, available options include
   a. repeat IV urography or cystography.
   b. treatment with phenylpropanolamine hydrochloride or ephedrine sulfate.
   c. colposuspension.
   d. endoscopic submucosal injection of Teflon or collagen into the bladder neck.
   e. all of the above

10. What percentage of the small group of dogs that underwent colposuspension during ectopic ureter repair achieved long-term urinary continence?
    a. 67% d. 82%
    b. 71% e. 89%
    c. 75%