Preputial ureterostomy and uteroureterostomy for total cystectomy in 3 dogs

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Abstract

Three client-owned dogs presented with dysuria and stranguria. Prostatic and bladder trigone neoplasms were diagnosed, and these patients also exhibited flat ribbon-like stools. One patient had previously undergone cutaneous ureterostomy after radical cystectomy but experienced recurrent ostia stenosis and severe uremic dermatopathy. Ureterostomy was performed as a salvage procedure, diverting urine to either the uterine stump or the prepuce. The patients recovered well, resulting in an improved quality of life. Unfortunately, one patient died during the immediate postoperative period due to pulmonary metastasis. The uterine stump is considered a better option for ureterostomy as it provides a greater barrier against ascending infections compared to ureteral anastomosis in the vagina, theoretically. These modified ureteral anastomoses offer a viable urinary diversion for patients undergoing complete cystectomy, maintaining an anatomic route for urination. The procedure of modified preputial ureterostomy, without the performance of penectomy, reduces postoperative morbidity and provides increased protection for the ostia. This study aims to describe a modified technique for ureterostomy following total cystectomy in dogs, diverting ureters either to the prepuce or the uterine stump, while preserving the original voiding ostium.

Urogenital surgery, dog, ureter, cystectomy, prepuce

Ureterostomy is a rescue procedure performed in veterinary medicine in the presence of bladder, prostate, or urethral neoplasia (Allevi et al. 2021) or situations where the bladder trigone becomes nonviable (Knapp and McMillan 2012), such as bladder devitalization (Boston and Singh 2014). This procedure involves creating a neostoma in the gastrointestinal tract or constructing a neobladder to establish a patent urinary diversion (Vanderbruggen et al. 2019).

Various techniques are described for urinary diversion, including creating an ileal conduit, ureterocolonic anastomosis, and ureteroanastomosis in the remaining urethra (Gondo et al. 2012). However, ureterocolonic anastomosis has been associated with numerous complications due to the partial reabsorption of urine by the intestinal mucosa, resulting in a poor prognosis for this surgery (Stone et al. 1988). Consequently, its use is strongly discouraged (Huppes et al. 2017).

In human medicine, ileal conduit surgery is widely performed, but cutaneous ureterostomy emerges as an alternative in critically ill patients who are suitable candidates for this procedure (Nogueira et al. 2013). This cutaneous procedure avoids surgical complications associated with the gastrointestinal tract and central nervous system (Nogueira et al. 2013). Late complications of the cutaneous ureterostomy include ureteral stenosis, leading to urinary tract infections or irreversible kidney damage (Nogueira et al. 2013), as well as the ongoing need for cutaneous and hygienic handling of patients.

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In 2015, a technique for preputial and vaginal ureterostomy was described, allowing continuous urine elimination through the prepuce or vulva (Saeki et al. 2015). This technique involved performing a preputial ureterostomy after resecting the penis and distal urethra through the perineal region, while leaving the prepuce incision open to create a new ostium (Saeki et al. 2015).

This study aims to present patent ureteral diversion as an alternative to cutaneous ureterostomy, which is currently the most performed technique in cases of total cystectomy. Here, we reported three cases that underwent patent ureteral diversion without the complications associated with cutaneous ureterostomy.

Case description

The medical records of patients presented to the Veterinary Teaching Hospital (VTH) at UNESP, FCAV, Brazil, and a private clinic in Brazil, between 2021 and 2022, were reviewed and are reported in this paper. All patients exhibited a progressive disease, either resulting from cutaneous ureterostomy stenosis or an invasive tumour in the bladder trigone, leading to ureteral obstruction and the development of progressive hydroureter and hydronephrosis (cases 1 and 3).

Case 1

A 3-month-old, 7 kg intact male Border Collie was referred to the VTH by the responsible physician with a history of ureteral obstruction. Initially, the patient underwent exploratory laparotomy after being diagnosed with urethral obstruction. During the procedure, it was found that the bladder had necrosis and rupture, leading to the performance of cutaneous ureterostomy when the patient was 58 days old. Following this initial procedure, the patient underwent two additional procedures to prevent ureteral obstruction, but the stenosis persisted. Upon presentation to the VTH with recurrent stenosis in both ureteral ostia and significant uremic dermatitis, a new attempt at cutaneous ureterostomy was performed, along with a dermatoplasty to enlarge the ostia. During surgery, hydronephrosis was observed in the left kidney. The accumulated fluid in the left renal pelvis, which exhibited purulent characteristics, was drained and sent for analysis. The analysis revealed the presence of *Escherichia coli*, and the decision was made to continue treatment with cephalexin. However, the owner reported urinary stasis, oliguria, apathy, and signs of stenosis two days after the surgery, leading to the performance of a preputial ureterostomy.

Case 2

An 8-year-old, 5 kg male, neutered Yorkshire Terrier was presented to a private clinic with a 15-day history of flat ribbon-like stools with mucus, dysuria, and stranguria. During the examination, an attempt was made to perform urethral catheterization, but difficulties were encountered in advancing the catheter. Ultrasonography revealed an enlarged and heterogeneous prostate with a mass extending into the bladder trigone, as well as a distended bladder and urethral obstruction. Moderate amounts of abdominal free fluid were also observed. Positive contrast cystourethrography demonstrated leakage of contrast fluid from urethral tissue in the prostatic region into the pelvic cavity. Tumour staging revealed pulmonary metastasis on thoracic radiography. Despite a poor prognosis, the owner consented to surgery to establish a functional urinary diversion and excise the neoplasm, enabling future chemotherapy. During laparotomy, the patient exhibited abdominal free fluid consistent with urine and a prostatic mass that affected the vesical trigone, a significant portion of the bladder, and the distal portion of both ureters. Total cystectomy was performed, followed by preputial ureterostomy.

Case 3

A 12-year-old, 7 kg female, neutered Poodle was brought to the VTH with a history of dysuria and haematuria lasting for 3 months. The patient had previously received treatment for a urinary infection. However, due to the persistence and worsening of the symptoms, an abdominal ultrasound was performed. The ultrasound revealed a mass in the bladder trigone region, obstructing the passage of urine to the urethra and resulting in hydronephrosis and bilateral hydroureter. The urinary bladder was lavaged, and a diagnosis of transitional cell carcinoma was made on the positive *braf* gene mutation (Macro & Micro Test, Beijing, China) in the obtained sample. Subsequently, the patient underwent exploratory celiotomy to excise the mass. However, due to the size and invasiveness of the tumour, the intraoperative decision was made to perform a total cystectomy with anastomosis and reimplantation of the ureters into the uterine stump, considering that the patient had previously undergone an ovariohysterectomy.

Surgical technique

All patients underwent evaluation by an anaesthetist and were pre-medicated according to protocols established by the responsible clinician. Following anaesthetic induction with propofol [5 mg/kg i.v. (União Química, Embu-Guaçu, Brazil)], patients were maintained under inhalation anaesthesia using isoflurane in oxygen. They were then placed in dorsal recumbency and underwent celiotomy via a ventral midline approach to access the bladder and ureters. The ureters were dissected near the bladder orifice using iris scissors, ensuring they were preserved as long as possible. Immediate postoperative care for all patients included analgesia and anti-inflammatory medication for 5 days (dipyrone 25 mg/kg, orally, every 8 h; tramadol hydrochloride 4 mg/kg, orally, every 8 h; and prednisolone 1 mg/kg, orally, every 12 h), as well as antibiotics (amoxicillin with potassium clavulanate 22 mg/kg, orally, every 12 h) and omeprazole (1 mg/kg, orally, every 12 h) for 7 days.

Prepuce

In cases 2 and 3, principles of oncological surgery were followed by transecting the ureters with a macroscopically healthy margin in patients with bladder masses. As for the dog in case 1 that had previously undergone a cutaneous ureterostomy, the ureters were disconnected from the skin, and the passage through the abdominal musculature was reversed. A stay suture was placed at the distal extremity of both ureters, and a preputiotomy was performed to gain access to the preputial cavity (Plate III, Fig. 1A). A full-thickness, ventral midline incision was made over the central third of the prepuce to reach the mucosa. Subsequently, a 2–3 cm incision was made in the abdominal wall, specifically in the rectus abdominis muscle, parallel to the linea alba and 1 cm cranial to the penis. Through these tunnels, the ureters were guided towards the prepuce, each one in its respective tunnel (Plate III, Fig. 1B). In the preputial mucosa, two incisions were made in the dorsal aspect according to the length of the remaining ureters, and a Halsted forceps (EDLO, Canoas, Brazil) was used to facilitate the passage of the ureters through the mucosa incisions. The ostia were enlarged by performing a longitudinal spatulation of the ureters, which involved incising the distal end by approximately 3–4 mm using iris scissors (Plate III, Fig. 1C). Following this, ureteromucosal anastomosis was performed using a 4-0 poliglecaprone 25 (Bioline, Anapólis, Brazil) in a simple interrupted pattern (Plate III, Fig. 1D). To prevent stenosis, the ureters were catheterized with 8Fr urethral tube (Mark Med, Bragança Paulista, Brazil) for 7 days. The preputial ostium was enlarged to exteriorize both urethral tubes and a single suture was used to restore the ostium to its original size.

Uterine stump

Once the intravesical mass was identified, cystectomy was performed, including the affected portion of the urethra. The ureters were isolated and catheterized with a 6Fr urethral tube (Bioline, Anapólis, Brazil) (Plate IV, Fig. 2A). Longitudinal incisions were made in each ureter to create spatulation, and a simple interrupted suture using 4.0 polypropylene (Bioline) was used to connect both ureters, creating a single and wider urine outlet (Plate IV, Fig. 2B). The pelvic cavity was explored, and the remaining uterine stump from a previous hysterectomy was utilized for ureteral diversion. After debriding the uterine stump, the connected ureters were sutured to the stump with a simple interrupted pattern with a 4.0 polypropylene (Bioline) (Plate IV, Fig. 2C, D). Following the procedure and confirming the absence of urine leakage, the suture site was omentalized to promote improved healing and reduce the risk of leakage. Both ureters remained catheterized during the immediate postoperative period, and the catheters, which were exteriorized through the vulva, were removed within 7 days.

Results

Case 1

Preputial ureterostomy was successfully performed as described. The previous cutaneous ureterostomy had not yielded satisfactory results due to excess skin obstructing the ureteral ostia and resulting in severe uremic dermatitis. Furthermore, penectomy was not performed, avoiding another inflammatory and potentially painful procedure. A bacterial culture and antibiogram were performed, identifying *Escherichia coli* sensitive to amoxicillin with potassium clavulanate. During the immediate postoperative period, amoxicillin with potassium clavulanate (22 mg/kg, orally, every 12 h) and omeprazole (1 mg/kg, orally, every 12 h) were prescribed for two weeks. Fifteen days after surgery, urinalysis tests indicated the persistence of bacteriuria. A new bacterial culture and antibiogram were performed, and *E. coli* was still present, leading to a change in antibiotics to cefalexin (30 mg/kg, orally, every 12 h). Following this adjustment, the patient no longer exhibited pyelonephritis. Two weeks after the surgery, complete blood count and biochemical indices (creatinine 0.61 mg/dl; urea 34 mg/dl) were within reference ranges. At the five-month follow-up, the patient showed favourable progress with no signs of ureteral obstruction, dysuria, haematuria, or uraemic dermatopathy.

Case 2

A combined procedure of preputial ureterostomy and complete cystectomy with prostatectomy was performed, including the *en bloc* removal of peritoneal and retroperitoneal fat. Following urinary diversion, the proximal urethra was resected and ligated 2 cm caudal to the prostate using 3-0 poliglecaprone 25 (Bioline) to ensure safe margins. The prostatic artery and veins were ligated near their origins. Unfortunately, the patient experienced anaesthetic complications characterized by changes in oxygen saturation, possibly attributed to pulmonary metastasis. Immediate postoperative care involved providing oxygen therapy in the intensive care unit. However, despite these efforts, the patient evolved to death one day after the surgery. The cause of death was presumed to be unrelated to the surgical procedure itself, but rather due to the progression of metastatic disease associated with the primary condition.

Case 3

Following the excision of the mass, which exhibited extensive invasion throughout the vesical triangle, encompassing 360° and affecting the distal ureters and proximal urethra, a decision was made to perform a total cystectomy with the connection and

reimplantation of both ureters into the uterine stump. Histopathological examination confirmed the presence of transitional cell carcinoma, and as a result, the patient was referred to an oncologist and nephrologist for further management. Periodic serial evaluations were conducted, and after 4 months, the patient remained in good health, with no reported occurrences of urinary infections or other complications.

Discussion

Cystectomy is a surgical procedure commonly performed in cases involving neoplasms affecting the bladder, prostate, and urethra, as well as in instances of traumatic or iatrogenic bladder devitalization (Boston and Singh 2014). In situations where malignant neoplasms are located in the bladder trigone or the distal portion of the ureters, or when there is complete devitalization of the bladder tissue, radical cystectomy followed by anastomoses of the ureters is considered as an alternative treatment approach (Carvalho and Brum 2008).

It is important to note that the cutaneous ureterostomy technique may present late complications, including ureteral stenosis, which can lead to urinary tract infection and irreversible kidney damage (Nogueira et al. 2013). Consequently, some authors discourage the use of this method (Nogueira et al. 2013).

Urinary diversion to the prepuce or uterus offers several advantages, leading to an improved quality of life for patients. These benefits include the elimination of the need for constant shaving in the abdominal region and the prevention of contact dermatitis that often occurs with cutaneous urinary diversions. By preserving the physiological urinary excretion orifice, the risk of pyelonephritis is reduced, both from exposure to the external environment and from licking. Additionally, the use of preputial or uterine diversion can significantly decrease the occurrence of side effects associated with ureterocolostomy, as there is no absorption of urine by the gastrointestinal tract.

In cats, a modified perineal urethrostomy technique utilizing the preputial mucosa has been reported, demonstrating potential advantages in preventing urine scalding and hair ingrowth when compared to conventional perineal urethrostomy (Yeh and Chin 2000). Similarly, preputial urethral anastomosis has been documented in two dogs requiring a prepubic urethrostomy following intrapelvic urethral trauma with subsequent stricture formation (Bradley 1989). These dogs were able to urinate through the preputial orifice, thus avoiding dermatological complications (Bradley 1989).

Complications associated with ureteral anastomosis in the prepuce and vagina can include suture dehiscence at the site of urinary diversion, obstruction of the connection ostium with the ureters leading to an increased risk of hydronephrosis, oliguria resulting from renal impairment caused by previous hydronephrosis or the perioperative period, and pyelonephritis due to bacterial contamination (Saeki et al. 2015).

The lower portions of the urinary tract possess various natural defence mechanisms that contribute to their resistance against bacterial infections (Lees and Osborne 1979). These mechanisms include frequent and complete urination, which mechanically eliminates organisms, the intrinsic antibacterial activity of the urethral mucosa, and the urine's osmolarity, which is sufficient to kill or inhibit certain bacteria (Lees and Osborne 1979). However, these protective properties are lost in the case of ureterostomy, except for urine osmolarity. Therefore, the presence of a physical barrier, such as the preputial or vaginal mucosa, plays a crucial role in preventing ascending infections.

In contrast to the technique described by Saeki et al. (2015), our modified approach did not require the maintenance of an incision in the ventral portion of the prepuce, which was sutured after securing the ureters. Additionally, penectomy was also not performed in these cases, as the presence of the penis did not interfere with the surgical technique, especially in

Case 1 where the patient had an infantile penis. Fortunately, no postoperative complications were observed, and diuresis remained normal in the immediate postoperative period.

The modified technique presented in this study offered several advantages and improved prognosis. It allowed for an anatomical route of urination, preventing urine dribbling and skin scalding frequently associated with cutaneous ureterostomy, without the need for penectomy which can result in additional morbidity. Furthermore, it reduced the incidence of ascending urinary infections, leading to a better prognosis in the late postoperative period.

The preputial cavity in males and the vaginal vestibule in females served as physical barriers against dirt, limiting bacterial colonization and the risk of pyelonephritis. One notable advantage of this technique in males is the maintenance of the penis, which reduced surgical trauma and postoperative inflammation. In females, the placement of the ureteral anastomosis in the most cranial region - the uterine stump rather than the vagina - minimized the risk of pyelonephritis.

Patients that undergo total cystectomy procedures require permanent monitoring due to the potential for complications (Skinner et al. 2020). The development of pyelonephritis resulting from ascending infection is a particular concern in these cases (Boston and Singh 2014; Saeki et al. 2015; Bradbury et al. 2021), highlighting the necessity for thorough follow-up that includes physical examinations, evaluation of serum creatinine levels, urinalysis, culture, and antibiogram testing (Weese et al. 2019).

This study has limitations, including a small number of patients and procedures, a heterogeneous dog population, and incomplete long-term follow-up due to the retrospective nature of the study. Despite these limitations, the techniques proposed in this study offer improved quality of life for patients compared to cutaneous ureterostomy, primarily due to the physical barrier provided by the prepuce or vagina.

In conclusion, the alternative techniques described in this study for urinary diversion proved crucial in maintaining the patients' quality of life. This case series highlights the need for training and the development of new techniques for performing urinary diversion in dogs, as commonly performed surgeries often result in a high rate of adverse effects.

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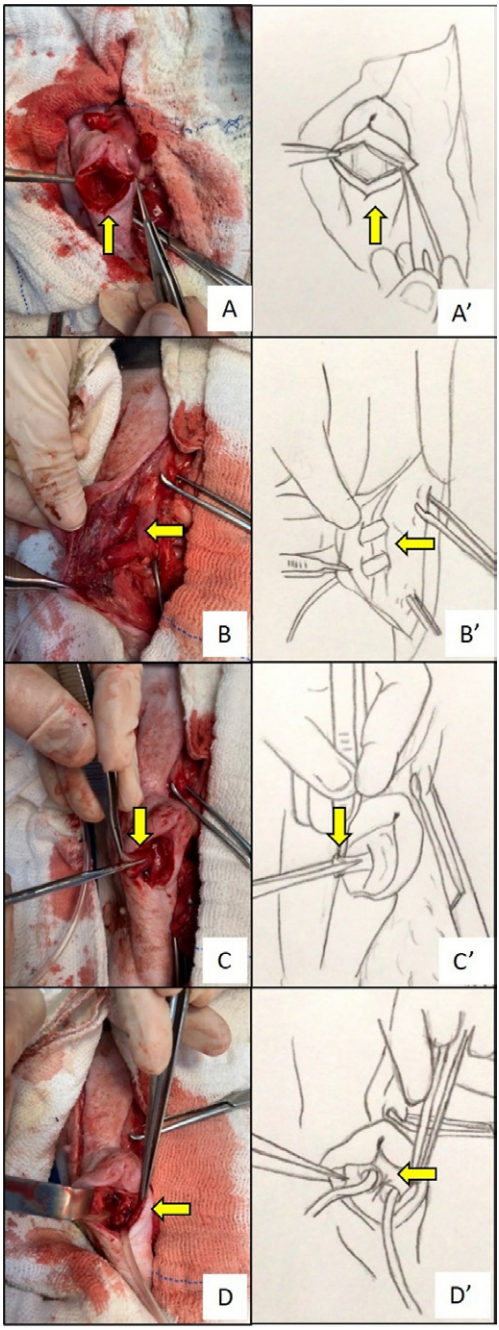

Fig. 1. Photographic (A, B, C, D) and illustrative (A', B', C', D') images of the preputial ureterostomy procedure. A and A': Ventral opening of the prepuce, identifying the lumen (arrow); B and B': Tunnel in the rectus abdominis muscle with the ureters diverted towards the lumen of the prepuce (arrow); C and C': Enlargement of the ureteral lumen through spatulation with delicate scissors; D and D': Ureteral ostia catheterized in the lumen of the prepuce (arrow).

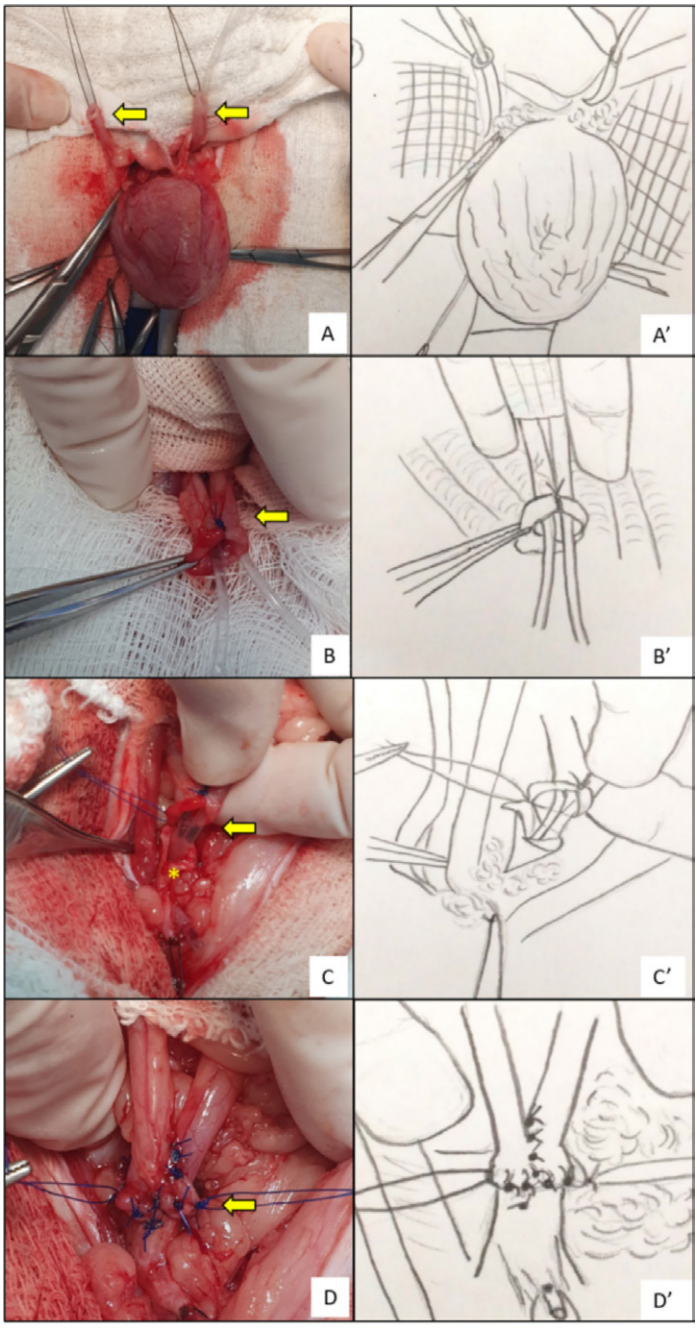

Fig. 2. Photographic (A, B, C, D) and illustrative (A', B', C', D') images of the uterine ureterostomy procedure. A and A': Identification and catheterization of the ureters before cystectomy (arrow); B e B': Union of the ureters forming a single ostium (arrow); C e C': Beginning of the suture of the ureters (arrow) with the uterine stump (asterisk); D and D': Anastomosis finalized (arrow).