
Daniel L. Frem DVM
Heidi A. Hottinger DVM
Suzanne L. Hunter DVM
Nicholas J. Trout MA, Vet MB

From Gulf Coast Veterinary Specialists, 1111 West Loop South, Houston, TX 77027 (Frem, Hottinger, Hunter); and Angell Animal Medical Center, 350 S Huntington Ave, Boston, MA 02139 (Trout). Dr. Frem and Dr. Hunter’s present address is Las Vegas Veterinary Specialty Center, 8650 W Tropicana Ave, Ste B-107, Las Vegas, NV 89147.

Address correspondence to Dr. Frem (fremdvm@gmail.com).

OBJECTIVE
To determine frequency of postoperative complications in cats undergoing perineal urethrostomy (PU) in which poliglecaprone 25 was used for closure and identify possible predisposing factors for development of complications.

DESIGN
Retrospective case series.

ANIMALS
61 cats that underwent PU.

PROCEDURES
Medical records for cats that underwent PU at Gulf Coast Veterinary Specialists between 2007 and 2012 were reviewed. Information regarding signalment, perioperative conditions, surgical procedures, treatments, and postoperative complications were obtained from medical records and by telephone follow-up.

RESULTS
11 of 61 (18%) cats developed minor short-term (ie, ≤2 months after surgery) complications, 1 of 61 (1.6%) cats developed a major short-term complication requiring surgical revision, and 16 of 38 (42%) cats developed minor long-term complications. No major long-term complications were identified. Preoperative urinary tract infection was significantly associated with development of minor short-term complications, but use of an indwelling urinary catheter after surgery was not significantly associated with development of postoperative complications.

CONCLUSIONS AND CLINICAL RELEVANCE
Results suggested that poliglecaprone 25 may be an acceptable suture for apposition of mucosa to skin in cats undergoing PU. Short- and long-term complication rates and percentage of cats requiring revision surgery were comparable to values reported in previous studies in which slowly absorbable or nonabsorbable sutures were used. (J Am Vet Med Assoc 2017;251:935–940)

Abbreviations
FLUTD  Feline lower urinary tract disease
PU  Perineal urethrostomy

Perineal urethrostomy is predominantly performed in male cats to bypass the distal portion of the urethra and create a permanent opening between the pelvic urethra and perineal skin. Primary indications for PU include recurrent distal urethral obstruction secondary to FLUTD or urolithiasis (especially when medical attempts to prevent recurrent obstruction have failed), trauma to the distal portion of the urethra, and idiopathic distal urethral obstruction.1–11

Most surgeons currently use a variation of the PU technique described by Wilson and Harrison.11 Closure of the urethrostomy site requires accurate apposition of mucosa to skin to reduce the risk of urine extravasation, inflammation, irritation, and excessive granulation tissue formation, all of which predispose the site to scarring and stricture.1,12–14 The ideal suture for closure would maintain tissue apposition, degrade at a rate commensurate with the rate of tissue healing, have minimal tissue reactivity, and withstand repeated exposure to urine.15

Traditionally, the urethral mucosa has been sutured to the skin in a simple interrupted pattern with a nonabsorbable suture such as nylon or polypropylene.1,11,16 However, use of a nonabsorbable suture necessitates suture removal approximately 2 weeks after surgery, which may require heavy sedation or general anesthesia.1 Apposition of the mucosa and skin in a simple continuous pattern with polydioxanone, a synthetic absorbable monofilament suture, was found to be a viable closure option for PU, eliminating the need for suture removal.1 However, several studies17,18 have questioned the use of rapidly absorbable sutures in the urinary tract, especially when exposure to infected urine is possible. Despite these concerns, poliglecaprone 25, a rapidly absorbing suture, has been routinely used for closure of PU by numerous surgeons.19 To the authors’ knowledge, however, complications associated with the use of poliglecaprone 25 for PU closure in cats have not been clinically evaluated.
The purposes of the study reported here were to determine the frequency of postoperative complications in cats undergoing PU in which poliglecaprone 25 was used for closure and identify possible predisposing factors for development of complications. We hypothesized that the use of poliglecaprone 25 would be associated with short- and long-term complication rates comparable to rates previously reported for other sutures.

**Materials and Methods**

Electronic medical records of Gulf Coast Veterinary Specialists were searched to identify all cats that underwent PU between January 2007 and December 2012. Cats were included in the study if PU had been performed for resolution of distal urethral obstruction, the medical record was complete and available for review, and follow-up evaluation had been performed a minimum of 10 days after surgery. Cats undergoing revision of a previous PU procedure were excluded. Cats that required a second surgical procedure during the same anesthetic episode were eligible for inclusion in the study.

Information recorded from medical records of cats included in the study consisted of age, breed, weight, whether urinary tract infection was present (ie, positive bacterial culture results or clinically relevant bacteriuria on urinalysis), composition of urinary stones or crystals (if recorded), additional surgical procedures performed, whether a urinary catheter was placed after surgery, and any surgeon comments regarding visible trauma to the urethra at the time of surgery. All procedures were performed by 1 of 3 board-certified surgeons.

**Surgical procedure**

The PU procedure was a variation of that previously described by Wilson and Harrison. When exploratory laparotomy or cystotomy was to be performed concurrently with PU, the patient was positioned in dorsal recumbency. In all other instances, the patient was positioned in sternal or dorsal recumbency on the basis of surgeon preference.

In all cases, the tendinous attachments of the ischiocavernous muscles to the pelvis were transected to facilitate mobilization of the urethra. When possible, the bulbourethral glands were visualized and used as a landmark for proximal dissection of the urethra. The urethral incision was made with tenotomy scissors or a scalpel blade and was extended proximal to the bulbourethral glands or just proximal to the caudal margin of the pelvis. The aperture of the urethra was considered adequate if an 8F or 10F red rubber catheter could be easily inserted to the level of the box. When possible, the bulbourethral glands were visualized and served as a landmark for proximal dissection of the urethra. When possible, the bulbourethral glands were visualized and served as a landmark for proximal dissection of the urethra. When possible, the bulbourethral glands were visualized and served as a landmark for proximal dissection of the urethra. When possible, the bulbourethral glands were visualized and served as a landmark for proximal dissection of the urethra. When possible, the bulbourethral glands were visualized and served as a landmark for proximal dissection of the urethra. When possible, the bulbourethral glands were visualized and served as a landmark for proximal dissection of the urethra. When possible, the bulbourethral glands were visualized and served as a landmark for proximal dissection of the urethra.

In rare instances, a 6F red rubber catheter was the largest diameter catheter that could be passed through the urethral opening. The urethral mucosa was sutured to the skin with 4-0 or 5-0 poliglecaprone 25 on a taper-cut swaged-on needle. The needle was inserted from the urethral mucosa through the skin. The dorsal aspect of the urethrostomy was closed with 3 to 5 simple interrupted sutures or with a simple continuous pattern between the 10 o’clock and 2 o’clock positions. The remainder of the urethrostomy was closed with 2 simple continuous suture patterns as previously described.

An indwelling urinary catheter was placed postoperatively at the surgeon’s discretion. All patients were allowed to recover with an Elizabethan collar in place.

**Follow-up evaluation**

Follow-up information was obtained through recheck examinations performed at Gulf Coast Veterinary Specialists or by the referring veterinarian. Short-term follow-up was defined as evaluation of the PU site by the surgeon or referring veterinarian a minimum of 10 days and up to 2 months after surgery. Long-term follow-up was defined as reexamination at Gulf Coast Veterinary Specialists or by the referring veterinarian > 2 months after surgery. If a long-term follow-up examination was not performed, the owner was contacted by telephone.

All owners were asked about the occurrence of complications, including clinical signs associated with FLUTD (dysuria, hematuria, or inappropriate urination), bacterial urinary tract infections (identified on the basis of compatible clinical signs or confirmed by means of bacterial culture), signs of stricture or narrowing of the urethrostomy site, and whether revision surgery had been performed.

**Data analysis**

Perioperative conditions were classified into the following groups for statistical analysis: whether additional surgical procedures were performed, preoperative urinary tract infection had been identified, cystic calculi were present, urethral trauma was noted at the time of surgery, and an indwelling urinary catheter was placed postoperatively. Minor and major short-term and long-term postoperative complications were compiled. Short-term complications were defined as any complications occurring within the first 2 months after surgery; long-term complications were defined as any complications occurring > 2 months after surgery. Minor complications included those that resolved with medical management alone or without treatment; major complications were defined as those requiring surgical intervention.

For categorical data, the aforementioned groups were compared with the Pearson χ² test for independence or, if the expected frequency in ≥ 1 cell was < 5, the Fisher exact test. Values of $P < 0.05$ were considered significant. All statistical analyses were performed with commercially available software.

**Results**

The electronic medical record search identified 72 cats that underwent PU during the study period.
However, 11 cats were excluded because of a lack of follow-up a minimum of 10 days after surgery (n = 5), conversion to a transpubic urethrostomy during the initial surgery (3), incomplete medical records (2), and failure to survive to discharge owing to cardiac arrest in the immediate postoperative period (1). The remaining 61 cats were included in the study. Long-term (> 2 months) follow-up information was lacking for 23 cats, and these cats were excluded from long-term analyses.

Breeds of the 61 cats included in the study consisted of domestic shorthair (n = 45), domestic medium hair (8), domestic longhair (3), Siamese mix (2), Siamese (1), Siberian (1), and exotic longhair (1). Median age was 5.4 years (range, 1.1 to 15.0 years), and median body weight was 5.6 kg (12.3 lb; range, 3.6 to 9.1 kg [7.9 to 20.0 lb]). Urethral obstruction was the initial complaint for all 61 cats, with idiopathic FLUTD most common (n = 34 [56%]), followed by urethral calculi (21 [34%]), and urinary tract infection (10 [16%]). Four cats had both urethral calculi and bacterial urinary tract infection.

Ten cats were considered to have a urinary tract infection on the basis of positive bacterial culture results or clinically relevant bacteriuria on urinalysis. Specific pathogens were identified in 6 cats, including *Escherichia coli* (n = 3), *Corynebacterium* spp (2), and methicillin-resistant *Staphylococcus aureus* (1). The surgeon noted visible trauma to the urethra at the time of surgery in 11 of 61 (18%) cats. Additional surgical procedures were performed in 30 (49%) cats. Additional surgical procedures included cystotomy in 29 cats and abdominal exploration because of suspected uroabdomen (no abnormalities were identified) in 1. Four cats that underwent cystotomy also underwent intestinal biopsy, urinary bladder biopsy, repair of a tear in the urinary bladder, and ureterotomy to remove a ureteral calculus (1 each). An indwelling urinary catheter was placed after surgery in 46 (75%) cats; median time the catheter remained in place was 1.6 days (range, 0 to 4 days). Mean duration of hospitalization after surgery was 2.6 days (range, 1 to 6 days).

Eleven (18%) cats developed minor short-term complications, including dysuria (n = 2), urinary tract infection (2), incisional dehiscence due to self-trauma (2), incisional inflammation (1), urine scald (1), moist dermal necrosis (1), narrowing of the urethrostomy site (1), and obstipation (1). One (2%) cat developed a major short-term complication. This cat developed a stricture at the PU site 19 days after the initial surgery, resulting in reobstruction that required revision surgery. One cat in which ureterotomy was performed in conjunction with PU underwent surgery the day after the initial surgery because of uroabdomen. Dehiscence of the ureterotomy site was identified, and a ureteronephrectomy was performed. Because this complication was unrelated to the PU procedure, it was excluded from the data analysis.

Long-term follow-up information was available for 38 cats, with a median follow-up time of 35.4 months (range, 7.3 to 101.6 months). Of the cats available for long-term follow-up, 11 (29%) cats developed minor long-term complications, including dysuria (n = 4), urinary tract infection (2), incisional dehiscence due to self-trauma (2), incisional inflammation (1), urinary tract infection (1), and obstipation (1). One (3%) cat developed a major long-term complication. This cat developed a stricture at the PU site 6 months after the initial surgery, resulting in reobstruction that required revision surgery. One cat in which ureterotomy was performed in conjunction with PU underwent surgery the day after the initial surgery because of uroabdomen. Dehiscence of the ureterotomy site was identified, and a ureteronephrectomy was performed. Because this complication was unrelated to the PU procedure, it was excluded from the data analysis.

### Table 1—Results of univariate analysis of potential associations between various factors and development of postoperative complications in 61 cats undergoing PU in which poliglecaprone 25 was used for closure.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Minor short-term complications</th>
<th>Major short-term complications</th>
<th>Minor long-term complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional surgical procedures performed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6/30</td>
<td>0/30</td>
<td>8/21</td>
</tr>
<tr>
<td>No</td>
<td>5/31</td>
<td>1/31</td>
<td>8/17</td>
</tr>
<tr>
<td>Preoperative urinary tract infection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4/10</td>
<td>0/10</td>
<td>3/7</td>
</tr>
<tr>
<td>No</td>
<td>7/51</td>
<td>1/51</td>
<td>13/31</td>
</tr>
<tr>
<td>Cystic calculi or crystalluria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3/21</td>
<td>0/21</td>
<td>6/15</td>
</tr>
<tr>
<td>No</td>
<td>8/40</td>
<td>1/40</td>
<td>10/23</td>
</tr>
<tr>
<td>Postoperative indwelling urinary catheter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10/46</td>
<td>1/46</td>
<td>12/30</td>
</tr>
<tr>
<td>No</td>
<td>1/15</td>
<td>0/15</td>
<td>4/8</td>
</tr>
<tr>
<td>Urethral trauma noted at surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1/11</td>
<td>1/11</td>
<td>3/10</td>
</tr>
<tr>
<td>No</td>
<td>10/50</td>
<td>0/50</td>
<td>13/28</td>
</tr>
</tbody>
</table>

*Data are given as No. of cats with complications/total number of cats in the category.

Short-term complications were complications occurring ≤ 2 months after surgery; long-term complications were complications occurring > 2 months after surgery. Minor complications included those that resolved with medical management alone or without treatment; major complications were defined as those requiring surgical intervention.
able for long-term follow up, 16 (42%) developed minor complications, including ≥ 1 recurrence of clinical signs of FLUTD such as dysuria, hematuria, or inappropriate urination (n = 15); cystic calculi (2); and recurrent inflammation of the urethrostomy site (1). Thirteen of the 15 cats with recurrent signs of FLUTD were treated with antimicrobials with subsequent resolution of clinical signs, but only 2 of those cats had urinary tract infections confirmed by bacterial culture of a urine sample.

Neither the occurrence of minor complications (yes vs no) nor the occurrence of major complications (yes vs no) was significantly associated with whether additional surgical procedures were performed, cystic calculi or urinary crystals were present at the time of surgery, an indwelling urinary catheter was placed postoperatively, or trauma to the urethral mucosa was noted by the surgeon at the time of surgery (P values ranged from 0.213 to 1.000; Table 1). Occurrence of minor short-term complications was significantly (P = 0.049) associated with whether preoperative urinary tract infection had been identified, with 4 of 10 (40%) cats with preoperative urinary tract infection developing minor short-term complications (postoperative bacterial urinary tract infection, n = 2; moist dermal necrosis, 1; and incisional dehiscence due to self-trauma, 1), compared with only 7 of 51 (14%) cats without preoperative urinary tract infection. However, neither minor long-term complications nor major short-term complications were significantly associated with whether preoperative urinary tract infection had been identified.

Discussion

Results of the present study suggested that poliglecaprone 25 may be an acceptable suture for apposition of mucosa to skin in cats undergoing PU. Short- and long-term complication rates and percentage of cats requiring revision surgery were comparable to values reported in previous studies in which slowly absorbable or nonabsorbable sutures were used. In the present study, preoperative urinary tract infection was significantly associated with the development of minor short-term complications, but in contrast to previous studies, the use of an indwelling urinary catheter after surgery was not significantly associated with the development of postoperative complications. However, further studies should be performed to evaluate both of these findings.

Poliglecaprone 25 is a rapidly absorbable synthetic monofilament prepared from a copolymer of glycolide and epsilon-caprolactone that is virtually inert in tissue.20 It is rapidly degraded by hydrolysis, losing approximately two-thirds of its tensile strength in vitro within 14 days and being completely absorbed within 4 months.20,21 Degradation is hastened by immersion in urine, especially in the presence of bacteria or alkaline pH.17,18 Several authors15,17,18,22,23 have questioned the use of rapidly absorbable sutures, including poliglecaprone 25, in the urinary tract, especially when exposure to infected urine is possible or when healing may be delayed or compromised.

In the authors’ opinion, the rapid degradation of poliglecaprone 25 is a benefit, rather than a drawback, for closure of PU. The ideal suture for any application should maintain tensile strength and tissue apposition until healing is complete and then degrade rapidly and predictably.18 Previous studies17,18 of poliglecaprone 25 degradation in urine subjected samples to continuous immersion in urine for days at a time. This differs from the intermittent urine exposure at a PU site. In general, the urethral mucosa regenerates within 7 days.23,24 Therefore, for PU closure, use of a suture that can maintain tensile strength for at least 7 days, such as poliglecaprone 25, may be sufficient.

Nonabsorbable sutures such as nylon and polypropylene have been recommended for PU closure because of their low tissue reactivity, but require removal approximately 2 weeks after surgery.25 Polydioxanone, a monofilament absorbable suture, has been shown to be suitable for closure of PU, with complication rates comparable to those for nonabsorbable sutures, but without the need for suture removal.1 Similarly, the rapid degradation of poliglecaprone 25 precludes the need for suture removal following PU.

In the present study, 12 of 61 (20%) cats developed short-term complications and 16 of 38 (42%) cats developed long-term complications. These complication rates were comparable to short-term rates of 25% and long-term rates of 28% to 57% previously reported.1,3,5,8,9,13,14,26,27 Only 1 cat in the present study required revision surgery because of complications associated with PU. In contrast, in a previous study2 in which nonabsorbable polypropylene suture was used, nearly 50% of the short-term complications were major complications requiring revision surgery, a rate more than 5 times the rate in the present study.

Despite previous reports17,18 of rapid degradation of poliglecaprone 25 during immersion in urine, only 2 instances of incisional dehiscence were identified in the present study. In both instances, the owners reported self-trauma after removal of the Elizabethan collar. Mechanical stress and tissue irritation may have been the underlying cause of suture failure in these cases, but rapid degradation of the suture could not be ruled out.

Urethral stricture has been reported to occur after PU in 0% to 18.1% of cases.3,9,14,26 This compares favorably with findings in the present study, in which only 1 of 61 (1.6%) cats developed a stricture requiring revision. This cat had a large mucosal defect (approx 1 cm in diameter) at the time of surgery. This defect may have been a primary cause of stricture or may have contributed to secondary edema, inflammation, urine extravasation, or granulation tissue formation, leading to stricture formation. No evidence of bacterial urinary tract infection was noted at surgery, and no concerns regarding self-trauma after surgery were detailed in the medical record.
In 2 studies on surgical revision of PU, approximately 75% of cats had evidence of urethral stricture secondary to incomplete dissection of the penile attachments or failure to extend the urethral incision to the level of the bulbourethral glands. In cats, the internal diameter of the urethra at the level of the bulbourethral glands is nearly twice the internal diameter of the penile urethra, and incomplete dissection to the level of the bulbourethral glands is the most common cause of stricture in cats undergoing PU. Strictures have also been reported secondary to unhealthy urethral mucosa, surgical trauma, inaccurate tissue apposition, indwelling urinary catheterization, and self-mutilation. In a study that reported no postoperative strictures, the successful outcome was attributed to surgeon experience, prevention of self-mutilation through the use of Elizabethan collars after surgery, and avoidance of postoperative indwelling urethral catheters.

Placement of an indwelling urethral catheter after PU is a contentious topic. Previous studies have identified use of indwelling urinary catheters as a potential cause of urethral stricture. In addition, the presence of a catheter can incite inflammation and may promote ascending bacterial infection. However, urinary diversion reduces inflammation by reducing contact between the injured mucosa and urine and may reduce extravasation and subsequent inflammation. In the present study, an indwelling urinary catheter was placed after surgery at the surgeon’s discretion, and a significant association between postoperative indwelling urinary catheter use and development of postoperative complications was not identified. The presence of preoperative urinary tract infection was found to be significantly associated with development of minor short-term postoperative complications. However, this result should be interpreted with caution, given that only 4 cats with documented preoperative urinary tract infection developed such complications.

Fifteen of 38 (39%) cats in the present study had long-term minor complications attributable to recurrent signs of FLUTD. This was comparable to previously reported rates of recurrence of FLUTD signs even after PU. Development of recurrent urinary tract infection and clinical signs of FLUTD is likely partially due to underlying uropathy and may not be associated with surgical intervention. Although these cats were considered to have had complications secondary to surgery, clinical signs of FLUTD may have recurred regardless of whether PU was performed.

Limitations of the present study included its retrospective nature, the low case number, the limited follow-up for some cases, the inconsistent timing of patient reevaluation, and the inevitable variations in reporting for cats assessed by the surgeon versus the referring veterinarian or owner. Furthermore, assessment of urethral trauma at the time of surgery and of peristomal inflammation in the postoperative period was necessarily subjective. Thus, the incidence and severity of urethral trauma and inflammation may have been inaccurately reported. Additionally, because of the retrospective nature of the study and limitations on the availability of historical medical records, no direct comparison could be made between PUs performed at Gulf Coast Veterinary Specialists with poliglecaprone 25 versus other absorbable or nonabsorbable sutures. Ideally, a prospective study with poliglecaprone 25, polydioxanone, and nylon and comparing continuous and interrupted suture patterns would be performed to directly compare outcomes.

Acknowledgments
No third-party funding or support was received in connection with this study or the writing or publication of the manuscript. The authors declare that there were no conflicts of interest.

Footnotes
a. Microsoft Excel for Mac 2011, version 14.5.5, Microsoft, Redmond, Wash.

References


