

Randomized controlled trial to evaluate a novel two-catheter technique for urethral catheterization in anesthetized healthy female cats and small dogs

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OBJECTIVE

To evaluate a novel 2-catheter technique for urethral catheterization in female cats and small dogs and compare the time required for and success rates achieved by use of the novel technique versus traditional methods (blind technique in cats and digital palpation in dogs) as performed by personnel (catheter placers [CPs]) with different levels of experience in urinary catheter placement.

ANIMALS

39 healthy sexually intact female animals (24 cats and 15 dogs weighing < 10 kg).

PROCEDURES

2 CPs were board certified in veterinary surgery, 1 of whom had experience with the novel technique, and the other did not. The third CP was a veterinary surgical intern who was unfamiliar with the novel technique. For each animal enrolled in the study, 1 CP performed catheterization with the novel technique and traditional methods. Data recorded included the time required for successful catheterization and whether a successful catheterization was achieved within a 3-minute time limit.

RESULTS

The overall success rates were 79.5% (31/39 animals) with the novel technique and 43.6% (17/39 animals) with traditional methods. Median times for successful catheter placement were 48 seconds for the novel technique and 41 seconds for traditional methods. Among CPs, success rates or times to successful catheter placement did not differ significantly.

CONCLUSIONS AND CLINICAL RELEVANCE

Study results suggested that the novel 2-catheter technique for urethral catheterization may be a more efficient option than traditional methods for gaining access to the urinary bladder in cats and small dogs, particularly when patient size limits use of instrumentation or digital palpation. (*Am J Vet Res* 2020;81:448–452)

Indications for urethral catheterization include monitoring and quantification of urine output, collection of a urine sample for analysis, performance of radiographic contrast procedures, relief of an anatomic or functional obstruction, and evacuation of urine from the bladder for patient comfort during or after surgery.¹ Urinary catheter placement is also used during urologic or pelvic surgeries when identification of the urethra is imperative to avoid any risk of iatrogenic damage.

Described techniques for placement of urinary catheters in female animals include blind insertion, digital palpation, or use of instrumentation to directly visualize the urethral papilla.² However, these techniques can be technically challenging, particularly when small patient size precludes the use of instruments or digital palpation. As such, description of a

novel technique specifically for use in smaller animals that involves minimal to no training or instrumentation would benefit clinicians and patients alike by facilitating rapid urethral catheterization.

The purpose of the study reported here was to perform a randomized controlled trial to evaluate a novel 2-catheter technique for urethral catheterization in sexually intact female cats and small dogs. The intent was to assess the time required for completion and success rate of the novel technique when applied by persons with different levels of experience in urinary catheter placement and compare those findings with completion times and success rates of traditional methods of urethral catheterization (ie, blind technique in cats and digital palpation in dogs) performed by the same personnel. We hypothesized that the novel 2-catheter technique for urethral catheterization would take less time to complete, compared with traditional methods, across CPs of differing skill levels.

ABBREVIATIONS

CP Catheter placer

Materials and Methods

Animals

Animals owned by individuals or animal shelters that were undergoing elective ovariohysterectomy as part of veterinary student surgical training laboratories between February 1 and March 28, 2019, were used in the study. The study was conducted with approval by the Institutional Animal Care and Use Committee of The Ohio State University. Informed written consent was obtained from owners or authorized shelter personnel prior to animal participation in the study. Following recovery from surgery, all animals were returned to clients or shelters.

Animals that were considered candidates for the study were young or adult sexually intact female cats and dogs weighing < 10 kg with no abnormal physical examination or preoperative clinicopathologic findings. Variables assessed to determine an animal's overall health included body weight, estimated age, body condition score, rectal temperature, heart rate, pulse quality, respiratory rate and effort, mucous membrane color, and capillary refill time. An animal was excluded from the study if it had a history of clinical signs consistent with lower urinary tract disease, was receiving medications for a resolving illness, had a body condition score < 3 or > 7 (based on a 9-point scale where 1 = emaciated, 5 = ideal, and 9 = grossly obese), or had abnormal external genitalia (eg, recessed vulva).

Anesthesia

For purposes of routine ovariohysterectomy, all animals received standardized premedication prior to induction of anesthesia. Premedication protocols for dogs included buprenorphine hydrochloride^a (0.01 to 0.02 mg/kg, IM) combined with either dexmedetomidine^b (0.005 to 0.01 mg/kg, IM) or acepromazine maleate^c (0.025 to 0.1 mg/kg, IM). Cats received buprenorphine^d (0.12 mg/kg, SC) as well as either ketamine hydrochloride^e (5 mg/kg, IM) or dexmedetomidine (0.01 mg/kg, IM). Anesthesia was induced with either propofol^f (2 to 4 mg/kg, IV) or alfaxalone^g (3 mg/kg, IV) titrated to effect. Anesthesia was maintained with a mixture of isoflurane^h and oxygen delivered via an endotracheal tube.

CPs

To assess whether clinical skill level had an effect on outcome of catheterization, 3 CPs were recruited to participate in the study. One CP (CP 1 [LES]) was board certified by the American College of Veterinary Surgeons and had developed and had clinical experience with the novel 2-catheter urethral catheterization technique. Another CP (CP 2 [VAW]) was board certified by the American College of Veterinary Surgeons but was unfamiliar with the novel 2-catheter technique. The third CP (CP 3 [BEA]) was a veterinary surgical intern who was also unfamiliar with the novel 2-catheter tech-

nique. Both veterinarians who were unfamiliar with the novel 2-catheter technique were allowed a single trial run performed on 1 animal, during which CP 2 and CP 3 each executed the verbal instructions provided by CP 1 and received feedback.

Urethral catheterization procedures

Two CPs attended each of 9 training laboratories, and animals enrolled in the study were assigned to a CP in an alternating manner until 13 animals had been catheterized by each CP. For each animal enrolled in the study, 1 CP performed both catheterization procedures; a coin flip was used to randomize whether the novel 2-catheter technique or a traditional method of catheterization was performed first. For the purposes of this study, the traditional method that was performed in all cats was blind insertion of a catheter. The traditional method that was performed in all small dogs was digital palpation.

For urethral catheter placement, each animal was placed in sternal recumbency, and the perivulvar area was aseptically prepared. A rolled towel was placed beneath the caudal ventral portion of the abdomen to elevate the pelvis. Both hind limbs were left in a neutral, relaxed position and not fixed to the table by any restraints.

For both the novel 2-catheter and traditional catheter placements, sterile technique was used. A 5F polyvinyl red rubber catheter^{ij} was used for urethral catheter placement in cats, and an 8F polyvinyl red rubber catheter^{ij} was used in dogs. For the novel 2-catheter technique, an additional red rubber catheter (10F in cats and 18F in dogs)^{ij} was provided. The CP would inform an independent observer to start a stopwatch after donning gloves and holding a lubricated red rubber catheter in hand. When the CP believed that catheter placement was successful and this was confirmed by the presence of urine at the open external end of the red rubber catheter or urine was evacuated by use of an attached syringe, the elapsed time was recorded. A maximum time limit of 3 minutes was allowed for completion of each catheter placement. If the CP failed to place a catheter in the urethra of an animal within this time limit, the attempt was considered unsuccessful.

Novel 2-catheter technique for urethral catheterization

For the novel urethral catheterization technique, a larger well-lubricated red rubber catheter^{ij} (10F in most adult cats and 18F in small dogs) was introduced into the vestibule and gently passed far cranially into the vaginal vault until abrupt resistance was met. The open end of the red rubber catheter was reflected dorsally and held in place with the CP's nondominant hand. With the dominant hand, the CP then introduced a smaller red rubber catheter^{ij} (5F in cats and 8F in dogs) into the vestibule. The smaller catheter was directed along the

midline of the vestibule with a ventral trajectory at an approximately 45° angle. The tip of the catheter was used to gently probe the ventral surface of the vestibule until the catheter easily advanced through the urethral orifice (**Figure 1**; **Supplementary Video S1**, available at: avmajournals.avma.org/doi/suppl/10.2460/ajvr.81.5.448).

Statistical analysis

An a priori sample size calculation was performed. It was determined that a sample size of 10 animals catheterized twice by each CP was appropriate on the basis of an independent 2-sample *t* test assuming a mean difference of 15 seconds between the times required to successfully perform each technique, an SD of 10 seconds, a type I α error of 0.05, and power of 0.9.

Continuous variables were assessed for normality by use of skewness, kurtosis, and Shapiro-Wilk tests. If data for variables were normally distributed, the mean and SD are reported. If data for variables were nonnormally distributed, the median and interquartile (25th to 75th percentile) range are reported. A McNemar test was used to assess for a difference in success rate for all CPs between the novel 2-catheter technique and traditional methods of urethral catheterization. A difference in elapsed time for successful catheterization with the 2 procedures for all CPs was assessed with a Wilcoxon 2-sample test. Differences in success rates among CPs was assessed with a test for equal κ coefficients. A Kruskal-Wallis test was used to assess differences in elapsed times to complete catheterization by use of each of the methods for all CPs. All statistical analyses were performed with a standard computer-based statistical software program.^k A *P* value < 0.05 was considered significant.

Results

Animals

The data reported and analyzed were obtained from 39 healthy sexually intact female animals (24 cats and 15 dogs weighing < 10 kg). No animals were excluded. All cats were domestic shorthairs, and most dogs (*n* = 11) were mixed breeds. Purebred dogs included Chihuahua (*n* = 2), Shih Tzu (1), and American Eskimo Dog (1). The mean \pm SD weight of animals was 3.7 \pm 1.7 kg (range, 1.6 to 7.8 kg). Among all animals in the study, the mean estimated age was 12.8 \pm 17.2 months (range, 3 to 84 months), and median body condition score was 5 (range, 4 to 6). The study population characteristics for each CP were summarized (**Table 1**).

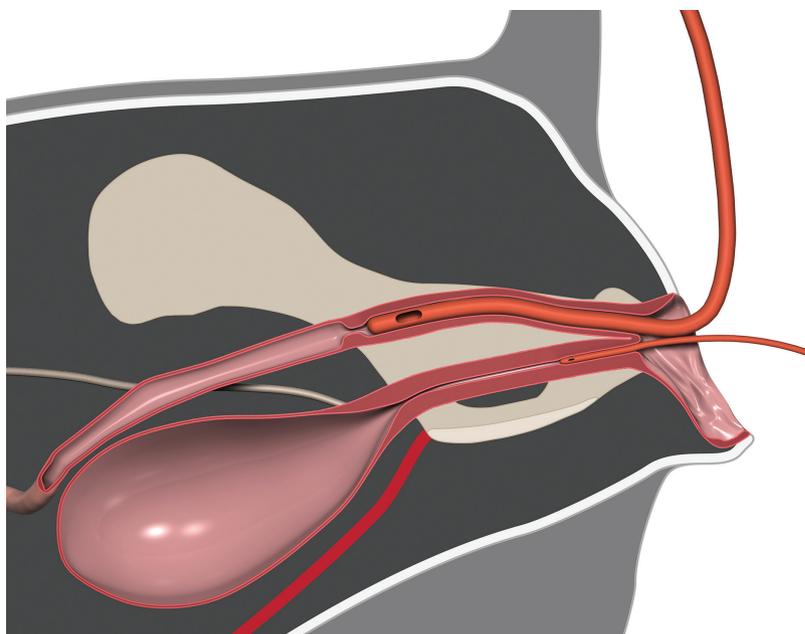


Figure 1—Illustration of the execution of a novel 2-catheter technique for urethral catheterization in anesthetized healthy sexually intact female cats and small dogs weighing < 10 kg. A large red rubber catheter (10F in most cats and 18F in dogs) is inserted into the vagina to completely occlude the vaginal orifice. An additional smaller red rubber catheter (5F in cats and 8F in dogs) is subsequently passed into the vestibule and advanced into the urethral opening. Reproduced with the permission of The Ohio State University.

Table 1—Characteristics of healthy sexually intact female cats and small dogs weighing < 10 kg that were anesthetized and underwent urethral catheterization by means of a novel 2-catheter technique and a traditional method (2 catheterizations/animal) performed by 1 of 3 CPs with different levels of experience with urethral catheterization.

| Variable | CP | | | Overall |
|---|---------------|---------------|---------------|---------------|
| | 1 | 2 | 3 | |
| No. of cats | 8 | 9 | 7 | 24 |
| No. of dogs | 5 | 4 | 6 | 15 |
| Mean \pm SD weight of animals (kg) | 3.5 \pm 1.9 | 3.7 \pm 1.9 | 3.8 \pm 1.5 | 3.7 \pm 1.7 |
| Median body condition score of animals* | 5 | 5 | 5 | 5 |

The CPs were a board-certified veterinary surgeon who had clinical experience with the novel urethral catheterization technique (CP 1) and a board-certified veterinary surgeon (CP 2) and a veterinary surgical intern (CP 3) who were unfamiliar with the novel technique.

*Body condition was scored on 9-point scale, where 5 = ideal.

Table 2—Proportions of successful urethral catheterizations in the 39 healthy sexually intact female cats and small dogs in Table 1 that were anesthetized and underwent urethral catheterization by means of a novel technique and a traditional method (2 catheterizations/animal) performed by 1 of 3 CPs with different levels of experience with urethral catheterization.

| Species | CP | | | | | | Overall total for all CPs | |
|-------------|-----------------|--------------------|-----------------|--------------------|-----------------|--------------------|---------------------------|--------------------|
| | 1 | | 2 | | 3 | | Novel technique | Traditional method |
| | Novel technique | Traditional method | Novel technique | Traditional method | Novel technique | Traditional method | | |
| Cat | 5/8 | 2/8 | 8/9 | 5/9 | 6/7 | 5/7 | 19/24 | 12/24 |
| Dog | 4/5 | 3/5 | 3/4 | 1/4 | 5/6 | 1/6 | 12/15 | 5/15 |
| Cat and dog | 9/13 | 5/13 | 11/13 | 6/13 | 11/13 | 6/13 | 31/39 | 17/39* |

*The overall success rate for the traditional method of urethral catheterization was significantly ($P = 0.001$) lower than that for the novel technique.

For each animal enrolled in the study, 1 CP performed both catheterization procedures; a coin flip was used to randomize which procedure was performed first. The traditional method of urethral catheterization was blind insertion of a catheter for all cats and digital palpation for all dogs. The novel technique involved insertion of a large red rubber catheter (10F in most cats and 18F in dogs) into the vagina to completely occlude the vaginal orifice. An additional smaller red rubber catheter (5F in cats and 8F in dogs) was subsequently passed into the vestibule and advanced into the urethral opening. Two kittens weighed 1.6 kg; urethral catheter placement with a traditional method was not successful in either kitten, whereas use of the novel technique was successful. Both veterinarians who were unfamiliar with the novel technique (CPs 2 and 3) were allowed a single trial run performed on 1 animal, during which the CPs each executed the verbal instructions provided by CP 1 and received feedback.

See Table 1 for remainder of key.

Table 3—Median time (seconds) for successful urethral catheterizations in the 39 healthy sexually intact female cats and small dogs in Table 1 that were anesthetized and underwent urethral catheterization by means of a novel technique and a traditional method (2 catheterizations/animal) performed by 1 of 3 CPs with different levels of experience with urethral catheterization.

| Species | CP | | | | | | Overall total for all CPs | |
|-------------|-----------------|--------------------|-----------------|--------------------|-----------------|--------------------|---------------------------|--------------------|
| | 1 | | 2 | | 3 | | Novel technique | Traditional method |
| | Novel technique | Traditional method | Novel technique | Traditional method | Novel technique | Traditional method | | |
| Cat | 53.0 | 112.0 | 31.0 | 38.0 | 48.5 | 38.0 | 25.0 | 41.5 |
| Dog | 80.0 | 41.0 | 72.0 | 106.0 | 48.0 | 74.0 | 63.5 | 63.0 |
| Cat and dog | 56.0 | 56.0 | 22.0 | 47.0 | 48.0 | 41.5 | 48.0 | 41.0 |

See Tables 1 and 2 for key.

The overall success rates with the novel 2-catheter technique and traditional methods of urethral catheterization were 79.5% (31/39 animals) and 43.6% (17/39 animals), respectively (**Table 2**). The overall success rates for the 2 types of procedure were significantly ($P = 0.001$) different. The overall median time for successful catheter placement by means of the novel 2-catheter technique was 48 seconds (**Table 3**). The overall median time to perform either the blind insertion method in cats or the digital palpation method in dogs was 41 seconds. There was no difference ($P = 0.63$) in the median time for successful catheter placement between the novel 2-catheter technique and traditional methods. No significant differences in success rates or time to successful catheter placement were found among CPs.

The smallest animals that were enrolled in the study were approximately 12-week-old kittens ($n = 2$) that each weighed 1.6 kg. Both kittens were assigned to CP 1. Urethral catheter placement with a traditional method was not successful in either kitten, whereas use of the novel 2-catheter technique was successful. There were 16 occasions on which CPs failed to catheterize animals with a traditional method; how-

ever, those animals were successfully catheterized by means of the novel 2-catheter technique.

Discussion

Results of the present study indicated that the novel 2-catheter technique for urethral catheter placement in sexually intact female cats and small dogs had a significantly greater frequency of successful attempts, independent of CP experience. However, contrary to our hypothesis, a difference in time to successful catheter placement between techniques was not evident.

The overall success of the novel 2-catheter technique highlighted the effectiveness of this simple, straightforward procedure. The lack of significant differences in the success rates and times to successful catheter placement among CPs with differing levels of catheterization experience illustrated that a specialized skillset is not necessary and minimal training is required to apply this technique in cats and small dogs. An additional benefit of this novel catheterization technique was its success when used in physically small animals (ie, those weighing 1.6 kg).

Some technique refinements and considerations were brought to light while we conducted the pres-

ent study. First, the catheter material may have influenced the success rate of the novel technique. Initially, the catheters used in the study were standard polyvinyl chloride, red rubber catheters¹ that are available at most veterinary practices. However, toward the end of the study, supply shortages and manufacturing back orders resulted in substitution of the large (10F and 18F) catheters with human-use urethral catheters² that were made from rubber latex. The pliable, flexible nature of the rubber latex urethral catheters made it challenging to achieve proper positioning and to hold them in place to occlude the vaginal orifice. Another consideration was the positioning of each animal's pelvis. Although animal positioning was not manipulated during the timing of each catheterization attempt, we found that adjustment of the positioning of the pelvis did appear to influence the success of the novel technique. Elevation of the rear portion of an animal's body with a towel and rotation of the hips so that the brim of the pelvis was positioned in a slightly ventral direction appeared to facilitate placement of the urethral catheter. This positioning orients the urethral papilla such that it is aligned with the trajectory of insertion of the urethral catheter as it is advanced into the vestibule. If the investigators had allowed CPs to adjust patient positioning during an attempt and if the standard red rubber catheters had been available for the duration of the study, the authors believe that the success rate for the novel technique would have been higher.

For the purposes of the present study, urethral catheterizations were performed when animals were anesthetized. However, on the basis of one of the authors' (LES) clinical experience with this technique, we believe that a tolerant animal may be amenable to undergoing this novel procedure while awake or with light sedation. Application of 2% lidocaine jelly into the vestibule prior to catheterization may also help to facilitate performance of this procedure in an awake animal.

A limitation of the present study was that animals that were overweight, were neutered, or had lower urinary tract conditions were not included. As such, the effectiveness of this novel technique in patient populations with those characteristics is not known.

No complications were reported for any animals that participated in the study; however, potential adverse events associated with urethral catheterization include irritation and infection of the urethra or urinary bladder.^{3,4}

The findings of the present study have suggested that the novel 2-catheter technique described may be a more efficient option for gaining access to the urinary bladder in cats and small dogs, compared with traditional methods. The novel 2-catheter technique may be particularly effective when patient size limits use of instrumentation or digital palpation. Performance of the novel technique is quick and simple and requires minimal training; all the necessary supplies to perform this procedure are readily available and stocked in most veterinary practices. On the basis of the study results, we propose that any veterinarian could learn and apply this novel technique to increase the success rate of urethral catheterization in cats and small dogs.

Footnotes

- a. Buprenex, Par Pharmaceutical, Chestnut Ridge, NY.
- b. Dexdomitor, Zoetis Inc, Kalamazoo, Mich.
- c. MWI Animal Health, Boise, Idaho.
- d. Simbadol, Zoetis Inc, Kalamazoo, Mich.
- e. Vetaket, Akorn Animal Health, Lake Forest, Ill.
- f. Diprivan, Fresenius Kabi, Lake Zurich, Ill.
- g. Alfaxan Multidose, Jurox Inc, Kansas City, Mo.
- h. Forane, Baxter, Deerfield, Ill.
- i. Kendall Feeding Tube and Urethral Catheter, Covidien, Mansfield, Mass.
- j. Dover Red Rubber Urethral Catheter, Covidien, Perlis, Malaysia.
- k. SAS, version 9.4 for Windows, SAS Institute Inc, Cary, NC.

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3. Lees GE, Osborne CA, Stevens JB, et al. Adverse effects caused by polypropylene and polyvinyl feline urinary catheters. *Am J Vet Res* 1980;41:1836-1840.
4. Nacey JN, Delahunt B, Tulloch AG. The assessment of catheter-induced urethritis using an experimental dog model. *J Urol* 1985;134:623-625.