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Sample Collection and Handling

The method of urine collection and the subsequent handling of the sample can influence the interpretation of results. The following discussion is a review of urine collection and handling techniques.

Collection of Urine Samples

The three techniques for urine collection are: free-catch, catheterization, and cystocentesis. Each of these methods of collection and their associated advantages and disadvantages will be discussed. General considerations related to urine sample collection, handling, and submission, regardless of collection method, are listed in Box 1.1 (Figures 1.1–1.4).

Free-Catch Urine Collection

The free-catch method of urine collection (Box 1.2 and Figures 1.5–1.9) is often easy to perform but is dependent upon the cooperation of the patient and may be difficult to accomplish in patients with conditions producing urge incontinence. Samples are usually collected during normal voiding or by manual external compression of the urinary bladder. Normal voiding free-catch urine sampling can often be performed by the owners and does not pose a risk to the pet. The manual compression of a distended urinary bladder (Box 1.3 and Figures 1.10–1.14) may be at the convenience of the collector; however, drawbacks include sample contamination, urinary bladder trauma, and reflux of infected urine into the ureters, kidney, and prostate. Furthermore, this technique cannot be used following a cystotomy operation and may be unpleasant in other postoperative laparotomy patients.

Collecting a midstream urine sample is preferred to minimize sample contamination; however, some contamination with cells, bacteria, and debris from the distal urethra, genital tract, and external skin and hair coat is unavoidable. Obtaining an optimal free-catch sample can be facilitated by using one container to collect the beginning of the urine stream and then changing to a second collecting container as the urine stream continues. The urine in the second container should be more representative of a true midstream sample. In some cases, a free-catch sample containing white cells, bacteria, and/or protein may be an indication to collect a subsequent patient urine sample via cystocentesis or catheterization in order to help establish the source of the abnormalities identified in the voided sample.

Sometimes a satisfactory free-catch sample cannot be obtained either during normal voiding or via manual expression, most commonly due to the pet's behavior or urge incontinence. Manual expression can be especially problematic in male cats as a result of resistance to handling and difficulty in initiating voiding due to the small diameter of the male feline urethra. Collecting urine by catheterization or cystocentesis are alternative options but not readily accomplished

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Box 1.1 General considerations for urine sample collection, handling, and submission.

Collection

1. Observe principles of aseptic technique as much as possible
2. Collect adequate volume (minimum of 5 mL recommended) (Figure 1.1)
3. Clean and/or sterile container provided by veterinarian preferred for collection for UA
4. Sterile container preferred for collection of sample to be cultured
5. When possible, withhold drugs and fluid administration prior to sample collection

Handling

1. Ideally UA should be performed within 60 minutes of sample collection and no longer than 6 hours following collection
2. Refrigerate and cap the sample when UA cannot be performed within 60 minutes of collection (if possible, perform the dipstick portion prior to refrigeration)
3. Refrigerated samples should be brought to room temperature prior to performing UA

Submission

1. Container submitted should identify sample as urine, be capped, and have adequate patient identification (Figure 1.2)
2. Consider using preservative tube* for storage and submission of sample for culture
3. Sample for cytologic evaluation should include one or more air-dried slides of urine sediment prepared by the blood smear or squash preparation technique along with a urine sample placed in an EDTA tube (Figure 1.3)
4. Pertinent information should be provided for samples submitted for evaluation to an outside laboratory, including patient signalment, history, and method of urine collection
5. Fasted samples submitted for evaluation frequently have increased specific gravity values, more cells and casts, and decreased pH values compared to non-fasted samples

UA=urinalysis

*e.g. BD Vacutainer®Culture and Sensitivity Preservative Tube. The BD 4-mL urine culture preservative tube kit includes a urine transfer straw which can be used to facilitate aspiration of urine into the tube (Figure 1.4). Use of the transfer straw is optional. Although the manufacturer recommends adding a minimum of 3 mL of patient urine for an optimum preservative to urine ratio, obtaining that amount for urine from canine and feline patients can be challenging. It has been the authors' experience that the BD 4-mL urine culture preservative tube can be employed successfully for culture using a much smaller volume (≥0.5 mL) of urine, when necessary.

Figure 1.1 The minimum recommended volume for routine urinalysis is 5 mL or 1 teaspoon.

in all patients. Consequently, analysis of post-voided urine collected from a variety of surfaces may be necessary in select cases (Box 1.4 and Figure 1.15). Voided cat urine can sometimes be collected from a clean litter pan to which nonabsorbable plastic beads (e.g. Uri-Void^{TM}) or hydrophobic sand (Kit4Cat^{TM}) has been added. Cat owners may also use clean glass aquarium beads, straws which have been cut up, or plastic craft beads as litter substitutes. In some cases urine can

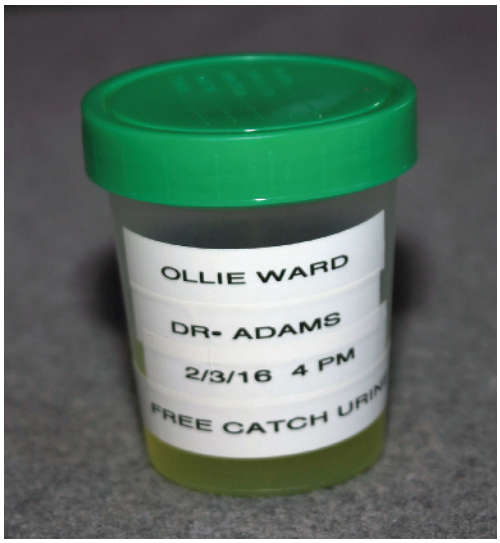
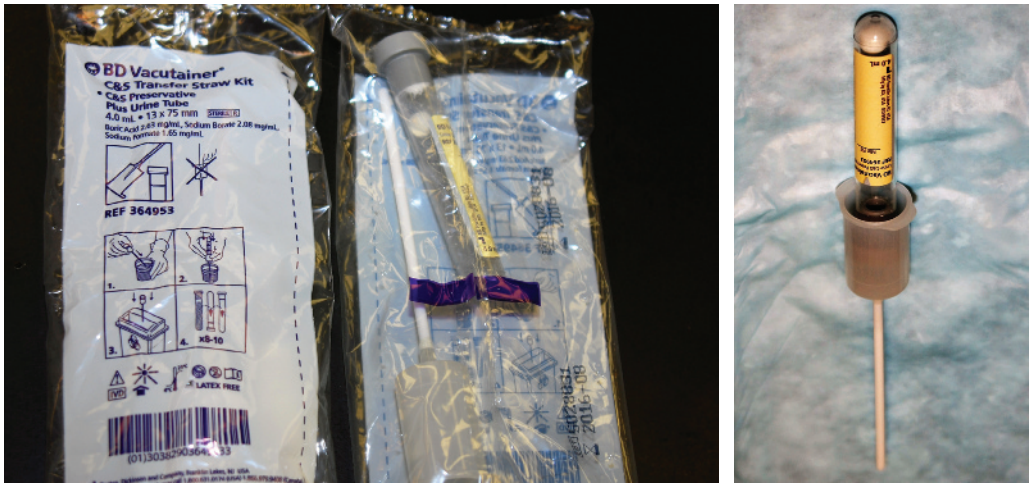


Figure 1.2 Urine submitted for analysis should be submitted in a suitable, capped container with appropriate labeling.

be successfully collected from a litter pan after a feline patient has voided on top of clinging plastic wrap that has been placed over the cat's usual litter or, in the case of outdoor cats, over a layer of dirt (Figure 1.16). At times the only available urine for analysis is a sample that has been voided onto a floor, tabletop, or other contaminated surface. This

Figure 1.3 Cytologic evaluation of urine can be enhanced by including a urine sample submitted in an EDTA tube.

contamination factor must be taken into consideration when evaluating such a sample. Prompt examination of the collected urine sample should decrease the level of artifacts encountered. As would be expected, the less contaminated the collection surface, the more reliable the urinalysis results obtained. However, disinfectants used in cleaning the surface from which a urine sample is subsequently obtained also have the potential to alter the urinalysis results, particularly when performing dipstick colorimetric tests. Postvoided urine samples obtained from a surface are generally unsatisfactory for accurate identification of infectious agents, especially if there is a time delay in analysis. At minimum, specific gravity of the urine specimen can usually be determined with reasonable accuracy.



(a) (b)

Figure 1.4 (a) BD Vacutainer® 4-mL urine culture preservative tube kit. (b) Culture preservative tube attached to urine transfer straw.

Box 1.2 Techniques for obtaining free catch urine samples – normal voiding.

Canine Technique

1. If the dog's hair coat around the vulva or prepuce is notably dirty, clean the area and pat dry
2. Walk the dog on a leash early in the morning, after feeding, or at another time that the dog is accustomed to urinating
3. Observe the dog for initiation of micturition and be prepared to collect a sample at the beginning of urination. If desired, latex gloves can be worn by the collector for his/her protection. The collector can plan on positioning the urine container with his/her hands or with a device designed to hold and position the container. Commercial collection devices are available (e.g. Olympic Clean-Catch™) or can be made at home. One such homemade device consists of a yardstick or pole/broom-type handle taped to the handle of a ladle or suitable plastic measuring cup (Figure 1.5). Have one or two suitable containers available for urine collection. The container(s) should be clean and dry and appropriate for the size of the dog. Container(s) may be provided by the veterinarian or a suitable clean, dry household plastic or glass container may be used for urine collection. Smaller dogs may require a flatter collecting receptacle such as a shallow plastic tray, a Styrofoam plate with a raised rim, or a metal, disposable pie plate (Figure 1.6)
4. As soon as micturition is initiated or a micturition posture is assumed, place the collection container as unobtrusively as possible under the vulva, immediately anterior and ventral to the prepuce, or directly in the urine stream produced. If possible, obtain at least 5–10 mL (1–2 tsp) for urinalysis. If the collector is able, a second container (midstream sample) should be positioned for urine collection provided the dog is continuing to urinate after a sample of the initial urine stream has been obtained in the first container (Figure 1.7)
5. The collector should thoroughly wash his/her hands following the collection process
6. After an appropriate urine sample has been obtained, the specimen may need to be transferred to a different, more secure container for transport, depending upon the receptacle used for collection. A lid or plastic wrap cover should be placed over the transport container holding the specimen. In the case where two urine samples have been obtained, an initial stream sample (first container) and a midstream sample (second container), the midstream specimen is the preferred sample for submission. If the urine cannot be taken to a veterinarian or examined within 60 minutes, the sample should be refrigerated unless the collector has been instructed otherwise by the veterinarian. If the specimen was not obtained at the veterinarian's office, the sample should be submitted to the veterinarian as soon as possible

Feline Technique

1. The collector should gradually accustom the cat to being approached and having its hindquarters or tail touched while it is voiding or getting ready to void in the litter box
2. The collector should take note of times when the cat is most likely to urinate to improve his/her opportunity to obtain a urine sample. It is sometimes helpful to restrict the cat's access to the litter box overnight so that the cat will void shortly after regaining access to the box
3. Observe the cat for initiation of micturition in the litter box and have a suitable clean, dry container/device ready to collect urine. The collector may wish to wear latex gloves for his/her protection. The veterinarian may provide a container for urine collection. Usually cats require a flatter container for collection. Often the lid of a veterinarian-provided container will work better for obtaining a sample than the container itself (Figure 1.8). Household containers suitable for feline urine collection include clean, dry, small plastic or glass bowls, small rimmed plates, metal or plastic spoons, or shallow plastic trays – see Figure 1.6

4. As soon as micturition is initiated or a micturition posture is assumed, approach the rear end of the cat and place the collection container as unobtrusively as possible underneath the cat or directly in the urine stream if it can be seen. It may be necessary to gently lift the base of the tail to position the collection receptacle (Figure 1.9). If possible, obtain at least 5–10 mL (1–2 tsp) for urinalysis. Although a midstream sample (urine obtained after initiation of urination and while the cat is producing a steady stream) is preferred for submission, obtaining a true midstream specimen is often difficult to accomplish in the cat
5. The collector should thoroughly wash his/her hands following the collection process
6. After an appropriate urine sample has been obtained, the specimen may need to be transferred to a different, more secure container for transport, depending upon the receptacle used for collection. A lid or plastic wrap cover should be placed over any open transport container holding a specimen. If the urine cannot be taken to a veterinarian or examined within 60 minutes, the sample should be refrigerated unless the collector has been instructed otherwise by the veterinarian. If the specimen was not obtained at the veterinarian's office, the sample should be submitted to the veterinarian as soon as possible

(a) (b)

Figure 1.5 (a) Homemade urine collection device consisting of a long-handled ladle attached to a yardstick with duct tape. (b) Homemade urine collection device appropriately positioned for collecting urine from a male dog by free-catch method.

Figure 1.6 Common household containers which may be used for free-catch urine collection, depending upon the size of the dog or cat.

(a) (b)

Figure 1.7 (a) Appropriate positioning of standard veterinarian-issued urine collection container for a free-catch sample from a male dog. (b) Preparing to hand off a second urine collection container to obtain a mid-stream free-catch sample after an initial micturition sample of 5–10 mL has been obtained.

Figure 1.8 Typical veterinarian-issued urine collection container with lid. For cats and small canine patients the container lid often works better for collecting a urine sample during micturition than the container itself.

Figure 1.9 Positioning a large spoon or other receptacle posterior and ventral to the hindquarters for free-catch urine collection in the cat may require gently lifting the base of the tail.

Box 1.3 Techniques for obtaining free-catch urine samples from dogs and cats – manual expression.

The manual expression technique for urine collection should ***not*** *be used postoperatively in cystotomy patients and be used with caution in other laparotomy patients. Excessive force should never be used when attempting bladder expression. Initiating a urine stream by manual expression in a male cat can be particularly difficult due to the length and diameter of the urethra, heightening awareness of the potential to produce trauma in the male, feline patient.*

1. If the patient's hair coat around the vulva or prepuce is notably dirty, clean the area and pat dry
2. An assistant may be necessary to help restrain the patient and/or catch the expressed sample depending upon the patient's size, attitude, and health status
3. Have one or two suitable containers available for urine collection:
   a. The container(s) should be clean and dry and appropriate for the size of the patient
   b. Container(s) may be provided by the veterinarian or a suitable clean, dry, household plastic or glass container may be used for urine collection. Smaller dogs and cats may require a flatter collecting receptacle such as a shallow plastic tray, collection container lid, Styrofoam plate with a raised rim, or a metal, disposable pie plate – see Figures 1.6 and 1.8
4. If desired, latex gloves can be worn by the collector for his/her protection
5. For urine collection the patient is most commonly placed in a laterally recumbent or standing position
   a. Dogs or cats in lateral recumbency:
      i. The individual expressing the bladder of a cat or small to medium-sized dog is commonly positioned adjacent to the posterior spine or ventral abdomen or behind the hindquarters of the patient. For a large to giant-sized dog the individual attempting manual compression is usually positioned adjacent to the posterior ventral abdomen. Prior to or during the application of bladder pressure a collection container should be placed immediately posterior to the canine or feline vulva or immediately anterior to the canine prepuce or posterior to the feline prepuce for urine collection, adjusting the container as necessary when urine is expressed
      ii. The bladder can often be palpated as a lemon to orange-sized or larger, fluid-filled structure similar to a water balloon. For cats or small to medium-sized dogs the cupped hand of the individual attempting manual expression should be placed against the patient's ventral abdomen just in front of and, in some cases, slightly under the hind legs. The thumb of the hand should be on one side of the abdomen and the fingers on the other side. The cupped hand should gently push the patient's abdomen up toward the spine while steadily squeezing the walls of the abdomen to produce pressure on the urinary bladder (Figure 1.10). For large to giant-sized dogs the individual attempting bladder expression should place one hand on either side of the caudal abdomen with the fingers of each hand extended toward the spine in front of and slightly under the hindquarters. When both hands are used in bladder expression, the hands should be pressed together gently and steadily to exert pressure on the bladder (Figure 1.11)
   b. Dogs or cats in standing position:
      i. The individual expressing the bladder is generally positioned alongside the body and facing the hindquarters or behind the hindquarters and facing the head. Prior to or during the application of bladder pressure in the dog a urine collection container should be placed immediately posterior and ventral to the vulva or immediately anterior and ventral to the prepuce. For urine collection in the cat the container should be placed immediately posterior to the vulva or prepuce. In both canine and feline patients the position of the container should be adjusted as necessary for collection when urine is expressed

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ii. The bladder can often be palpated as a lemon to orange-sized or larger, fluid-filled structure similar to a water balloon. For cats or small to medium-sized dogs, the cupped hand of the individual should be placed against the ventral abdomen in front of or slightly under the hind limbs with the thumb on one side of the abdomen and the fingers on the other side. The cupped hand should gently push the patient's abdomen up toward the spine while steadily squeezing the walls of the abdomen to produce pressure on the urinary bladder (Figure 1.12). When expressing the bladder of a large to giant-sized dog while behind the dog and facing the head, one hand is usually placed on each side of the abdomen with the palm placed below the spine directly in front of the hindquarters and the extended fingers angled downward and cranially. When standing alongside the body of a larger dog while facing the hindquarters, one hand should be placed on each side of the abdomen with the palm positioned below the spine in front of the hindquarters and the extended fingers angled downward and caudally; alternatively, the hands may be placed in a lower position on each side of the abdomen in front of the hindquarters with the extended fingers angled caudally and upward toward the spine (Figure 1.13). Once positioned, the hands should be pressed together gently and steadily to exert pressure on the bladder

c. The two-handed techniques described above for bladder expression of larger dogs may also be used for cats and small to medium-sized dogs. The individual performing manual expression in smaller patients may need only the fingers for application of pressure to the bladder with the palms commonly placed lateral to the spine or below the ventral abdomen

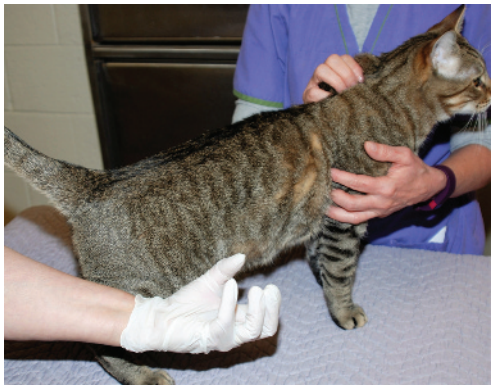
6. Whether the patient is standing or laterally recumbent, if a urine stream has not been produced after 6–10 seconds of appropriate pressure, the hand(s) can be repositioned anteriorly or posteriorly from the original site and pressure reapplied. Because the bladder is a very distensible organ the individual attempting bladder expression may wish to position the hand(s) on the lower abdomen near the thorax and gradually move the hand(s) posteriorly and dorsally as the pelvis is approached; this technique may optimize the chances for bladder palpation and urine expression, especially in larger dogs (Figure 1.14). When a urine stream is produced, the hand or hands should continue to apply pressure inwardly and posteriorly toward the pelvis until a satisfactory specimen is collected (5–10 mL) or only urine dribbling occurs. If the collector is able, a second container (midstream sample) should be positioned for urine collection provided an adequate urine stream is continuing to be expressed following collection of the initial sample
7. Although manual expression attempts do not always produce the desired urine sample, these attempts will sometimes induce the dog or cat to void naturally. Therefore, if manual expression attempts fail to produce a satisfactory urine sample or cause the patient to become too agitated or uncomfortable, the canine patient should be immediately leash-walked or a litter box promptly provided for the feline patient in an attempt to collect a urine sample by natural voiding – see Box 1.2)
8. The collector and person performing manual expression should thoroughly wash their hands following the collection process
9. After an appropriate urine sample has been obtained, the specimen may need to be transferred to a different, more secure container for transport, depending upon the receptacle used for collection. A lid or plastic wrap cover should be placed over any open transport container holding a specimen. In the case where two urine samples have been obtained, an initial stream sample (first container) and a midstream sample (second container), the midstream specimen is the preferred sample for submission. If the urine cannot be taken to a veterinarian or examined within 60 minutes, the sample should be refrigerated unless the collector has been instructed otherwise by the veterinarian. If the specimen was not obtained at the veterinarian's office, the sample should be submitted to the veterinarian as soon as possible

Figure 1.10 Positioning the cupped hand for manual expression of the urinary bladder of the laterally recumbent patient with the hand anterior to the hindquarters, pressing the bladder upward and posteriorly.

(a)

(b)

Figure 1.11 (a) Demonstration of two-handed manual expression of the urinary bladder of a laterally recumbent dog. Note that the individual performing expression is positioned adjacent to the ventrocaudal abdomen with one hand on either side of the lower abdomen and the fingers extended toward the spine in front of and slightly under the hindquarters. (b) Two-handed manual expression of the urinary bladder of the laterally recumbent dog with the urine collection container appropriately placed anterior to the prepuce of the male patient.



(a)

(b)

Figure 1.12 (a) Demonstration of cupping of hand for manual expression of the urinary bladder of a cat or small to medium-sized dog. (b) Using a cupped hand with the thumb on one side of the patient's abdomen and the fingers on the other side to compress the urinary bladder upward and posteriorly. Note that a collection container is placed appropriately posterior to the hindquarters for catching expressed urine.

(a) (b)

Figure 1.13 (a) Demonstration of the two-handed technique for manual expression of the urinary bladder in the dog with the patient standing and the individual performing expression positioned behind the hindquarters and facing the dog's head. Note that one hand is placed on either side of the caudal abdomen with the palm primarily anterior to the hindquarters below the spine and the fingers angled downward and cranially. (b) Demonstration of the two-handed technique for manual expression of the urinary bladder in the dog with the patient standing and the individual performing expression positioned alongside the body of the dog and facing the hindquarters. Note that one hand is placed on each side of the caudal abdomen with the palms positioned below the spine in front of the hindquarters and the extended fingers angled downward and caudally. A urine collection container has been placed appropriately posterior and ventral to the vulva with the patient's tail directed upward to prevent interference with urine collection.

(a) (b) (c)

Figure 1.14 Abdominal palpation technique for optimizing bladder localization and subsequent expression, especially in larger patients. Standing behind the dog, the individual attempting to localize the bladder places a hand on either side of the anterior ventral abdomen behind the ribs (a), gently compressing the abdomen inward while gradually moving the hands posteriorly and dorsally (b) until the bladder is palpated or the individual's hands are positioned high in the abdomen in front of the pelvis (c).

Box 1.4 Techniques for obtaining post-voided urine samples.

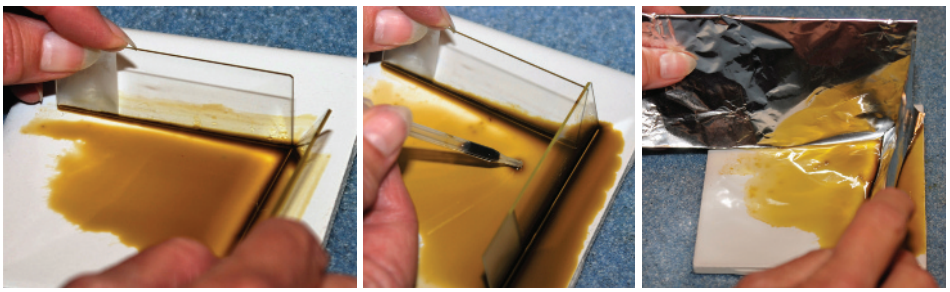
Canine Technique

1. Most post-voided samples obtained in the dog are collected as an unanticipated event, as a planned attempt to obtain a specimen from a dog known to be difficult to collect using other methods, or immediately following unsuccessful attempts to acquire a urine sample through manual expression, transurethral catheterization, or cystocentesis. When planning to obtain post-voided urine or in preparation for voiding that may occur as an inadvertent consequence of attempts to collect urine by other methods, the collector should try to have the dog in a location that has a clean, dry, nonabsorbent surface that will optimize any post-voided sample collection
2. If desired, latex gloves can be worn by the collector for his/her protection
3. When possible, have a suitable device available for aspirating the voided urine such as a clean syringe, pipette, eyedropper, or vacutainer apparatus. These devices can be obtained from the patient's veterinarian or from a commercial source. The minimum amount of urine recommended for collection and submission is 5 mL, although smaller amounts may sometimes be useful, depending on the primary urinalysis objective(s). Collection of post-voided urine, especially when the volume voided is minimal, may be facilitated by consolidating the available urine on the collection surface. Consolidation can be accomplished by placing the straight edge of a microscope slide in contact with the collection surface lengthwise on each side of the available voided urine. One end of each slide should be angled outward so that the two slides form a V-shape. The two slides should be advanced toward each other, causing the urine to run along the bottom of each slide and pooling the urine between them as the end of the slides angled toward the urine come into contact with each other. The pooled urine can then be more easily aspirated or, if the collection surface is elevated such as a table, can be pushed off the edge and caught in a clean container. If microscope slides are unavailable, the clean, straight edges of two stiffly folded pieces of aluminum foil may be used as a substitute (Figure 1.15)
4. The collector should thoroughly wash his/her hands following the collection process
5. After the urine sample has been obtained, the specimen may need to be transferred to a different, more secure container for transport, depending upon the receptacle used for collection. A lid or plastic wrap cover should be placed over any open transport container holding a specimen. The urine submitted should be marked as a post-voided specimen and, ideally, the collection surface should be identified. If the urine cannot be taken to a veterinarian or examined within 60 minutes, the sample should be refrigerated unless the collector has been instructed otherwise by the veterinarian. If the specimen was not obtained at the veterinarian's office, the sample should be submitted to the veterinarian as soon as possible

Feline Technique

1. Most post-voided samples obtained in the cat are collected as a planned attempt to obtain a specimen from a cat known to be difficult to collect using other methods or as a more client- and pet-friendly way of obtaining a specimen. Post-voided sample collection may also be necessary subsequent to an unanticipated voiding event or following voiding precipitated by unsuccessful attempts to acquire a urine sample through manual expression, transurethral catheterization, or cystocentesis. When planning to obtain post-voided urine or in preparation for voiding that may occur as an inadvertent consequence of attempts to collect urine by other methods, the collector should try to have the cat in a location that has a clean, dry, nonabsorbent surface that will optimize any post-voided sample collection. Post-voided urine

collection may be facilitated by providing the feline patient with a commercial pet waste disposal pan with a grate or, more commonly, a typical litter pan that is clean and dry, has litter covered with plastic wrap clinging to the litter, or has a nonabsorbent litter suitable for urine collection (see text for additional information about litter pan urine collection)
2. If desired, latex gloves can be worn by the collector for his/her protection
3. When possible, have a suitable device available for aspirating the voided urine such as a clean syringe, pipette, eyedropper, or vacutainer apparatus. These devices can be obtained from the patient's veterinarian or from a commercial source. In some cases the voided urine may be poured into a receptacle directly from the collecting surface. Suitable urine receptacles include veterinarian-provided containers and common household items such as clean, dry, plastic or glass containers. The minimum amount of urine recommended for collection and submission is 5 mL although smaller amounts may sometimes be useful, depending on the primary urinalysis objective(s). Collection of post-voided urine, especially when the volume voided is minimal, may be facilitated by consolidating the available urine on the collection surface. Consolidation can be accomplished by placing the straight edge of a microscope slide in contact with the collection surface lengthwise on each side of the available voided urine. One end of each slide should be angled outward so that the two slides form a V-shape. The two slides should be advanced toward each other, causing the urine to run along the bottom of each slide and pooling the urine between them as the end of the slides angled toward the urine come into contact with each other. The pooled urine can then be more easily aspirated or, if the collection surface is elevated such as a table, can be pushed off the edge and caught in a clean container. If microscope slides are unavailable, the clean, straight edges of two stiffly folded pieces of aluminum foil may be used as a substitute (Figure 1.15)
4. The collector should thoroughly wash his/her hands following the collection process
5. After the urine sample has been obtained, the specimen may need to be transferred to a different, more secure container for transport, depending upon the receptacle used for collection. A lid or plastic wrap cover should be placed over any open transport container holding a specimen. The urine submitted should be marked as a post-voided specimen and, ideally, the collection surface should be identified. If the urine cannot be taken to a veterinarian or examined within 60 minutes, the sample should be refrigerated unless the collector has been instructed otherwise by the veterinarian. If the specimen was not obtained at the veterinarian's office, the sample should be submitted to the veterinarian as soon as possible



(a) (b) (c)

Figure 1.15 Demonstration of technique for consolidation and collection of small amounts of post-voided urine for analysis. (a) The straight edge of a microscope slide is placed in contact with the collection surface on each side of the available voided urine and advanced toward each other, forming a V-shape and causing urine pooling. (b) The consolidated pool allows easier aspiration of urine with a pipette or other instrument. (c) If microscope slides are unavailable, the clean, straight edges of two stiffly folded pieces of aluminum foil may be substituted.

(a) (b) (c)

Figure 1.16 (a) Commercial nonabsorbent beads are available for use in a clean litter pan (b) to assist in collecting voided urine for analysis. (c) Post-voided urine can sometimes be collected from the patient's litter pan by covering the cat's usual litter with clinging plastic wrap.

Transurethral Catheterization

Transurethral catheterization of the urinary bladder is typically performed by trained personnel using a sterile urinary catheter after aseptically cleaning the external genital area and distal urethral opening. Sedation and/or anesthesia may be required for successful catheterization, especially in cats. Advantages with this method are the urinary bladder does not need to be distended to obtain a sample and collection does not depend upon the patient's willingness to urinate. This method does increase the number of red blood cells, transitional cells, and squamous cells present in the urine sample when cells slough off as the catheter passes through the urethra. Catheterization may increase the risk for iatrogenic urinary tract infections (UTIs) as bacteria are introduced into the urinary bladder from the genital tract and distal urethral opening. Patients with hyperadrenocorticism, diabetes mellitus, and renal disease are more at risk for developing UTIs post catheterization. There is risk of both urethral and bladder irritation/trauma and a small risk of perforation for all patients during catheterization. Catheterization may not be possible if there is urethral obstruction.

The risks described for catheterization and potential for alteration of the urine samples obtained by this collection method should limit the use of catheterization to select cases. In addition to adhering to proper technique, the incidence of undesirable sequelae can be diminished through appropriate catheter selection. Ideally, the smallest diameter catheter which is appropriate for the patient should be chosen. Urinary catheters are usually measured in French (Fr) units (1 Fr unit = 0.33 mm) corresponding to the external diameter of the portion of the catheter inserted into the patient's urethra. Suitable catheters for urine collection will vary in diameter depending upon the size of the patient. Typical urinary catheter diameter sizes used in the dog range from 3–10 Fr in both male and female. Typical urinary catheter diameter sizes used in the cat range from 3–5 Fr in male patients and 3–8 Fr in female patients. Urinary catheters will also vary in composition, causing them to fall into flexible, semiflexible, and rigid categories (Figure 1.17). More flexible catheters, especially those composed of silicone, nylon, latex, Teflon, or rubber, will generally create a lesser degree of trauma to the urinary tract and subsequently reduce the number of red blood cells introduced iatrogenically into the urine sample obtained. Some of these more flexible catheters have stylets (Figure 1.18) available to facilitate insertion. Although not as flexible, polypropylene catheters (Figure 1.19) are also commonly used for urine collection. Urinary catheter length ranges from 13 cm (typically used for feline catheterization) to approximately 50 cm (commonly used for canine catheterization). Stainless steel urinary catheters with insertion ends that are angled to facilitate entry into the urethral orifice have sometimes been used for transurethral catheterization of the female dog and cat. Metal catheters usually have a flange attached near the external

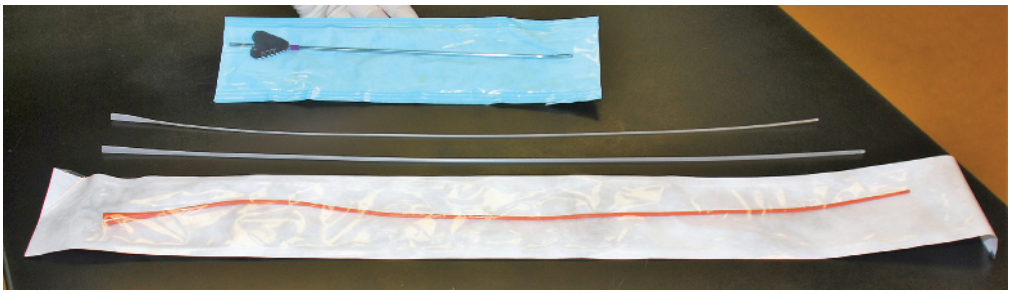


Figure 1.17 Urinary catheters commonly used in male dogs, female dogs and cats. Length and diameter will vary depending upon size of patient. The composition of the catheter also varies, resulting in flexible, semiflexible, and rigid categories of catheters. Pictured top to bottom: stainless steel rigid catheter (female dogs and cats only) – 8 Fr; polypropylene semiflexible catheter – 5 Fr; polypropylene semiflexible catheter – 10 Fr; red rubber flexible catheter – 8 Fr.

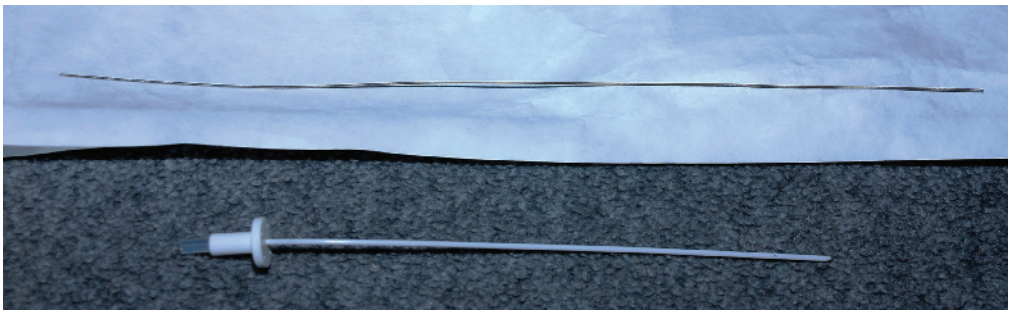


Figure 1.18 Flexible tomcat catheter with appropriate wire stylet.

(a) (b)

Figure 1.19 (a) Standard polypropylene "tomcat" catheter (3.5 Fr, 13 cm) with an open insertion end and a flared external end to prevent catheter migration into the urethra and accommodate syringe attachment. (b) Close-up of catheter open insertion end.

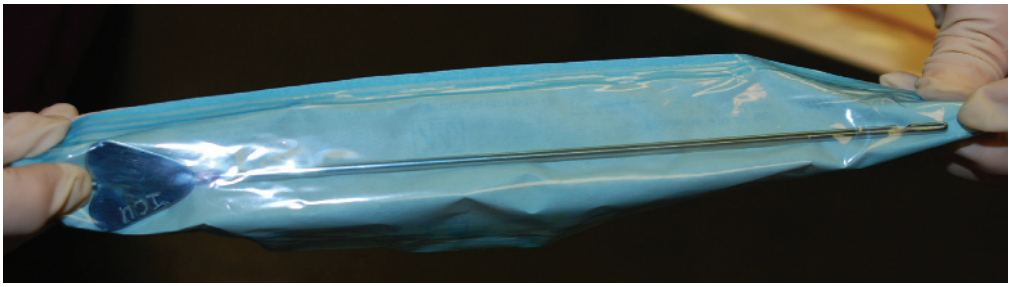


Figure 1.20 Metal female urinary catheter with a flange attached near the external end and a closed-tip insertion end.

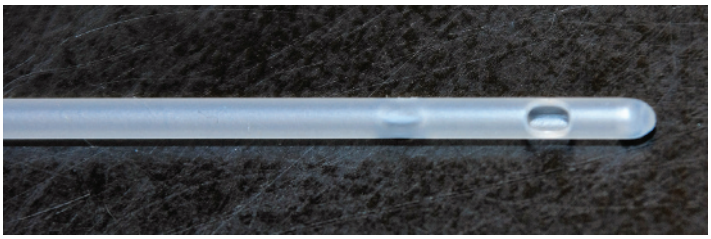


Figure 1.21 Example of a urinary catheter (polypropylene) with a closed insertion end with "eye" openings.

end which helps with both manipulation of the catheter and awareness of the direction in which the insertion end is tipped (Figure 1.20). However, these rigid catheters are not routinely recommended due to the increased likelihood of excessive urethral trauma. Catheters used for urine collection typically have a flared end to prevent migration of the catheter into the urethra and to accommodate a syringe for aspiration. The urethral insertion end of the catheter is commonly tapered and closed. "Eye" openings near the closed end allow urine to enter into the catheter (Figure 1.21). Some catheters do not have eye openings at the insertion end, but are open-ended – see Figure 1.19. Closed-end catheters with eye openings are often preferred for routine urine collection. In the event that the selected catheter does not have a flared end, which is frequently the case for metal catheters, a short segment of flexible tubing can often be used as an adapter to allow the attachment of a syringe (Figure 1.22). Disposable, prepackaged sterile catheters intended for one time use are preferred for patient catheterization rather than using re-sterilized catheters which may create additional iatrogenic change in the urinalysis results due to products used in the cleaning process.

Although accomplishing transurethral catheterization of the male dog and cat relies on visualization of the urethral orifice (Box 1.5 and Figures 1.23–1.28), there are multiple techniques which can be used to perform transurethral catheterization of the female dog and cat. The technique chosen depends on patient factors such as size, temperament, and vaginal conformation, as well as the experience of the individual performing catheterization. The visualization method for the female of both species uses a speculum and a light source to visualize the urethral papilla and orifice to facilitate catheterization (Box 1.6 and Figures 1.29–1.36). The digital palpation method accomplishes catheterization by use of a finger inserted into the vagina which subsequently directs the tip of the catheter into the urethral orifice (Box 1.7 and Figure 1.37). The digital palpation technique is inappropriate for the cat due to the animal's small size. The blind technique

Figure 1.22 A short segment of a flexible red rubber tube is used here to act as an adapter for the external end of the metal catheter to allow syringe attachment.

uses neither visualization nor digital palpation but relies on blindly sliding the urinary catheter along the ventral floor of the vagina until it slides through the urethral orifice (Box 1.8 and Figures 1.38, 1.39). The blind technique is most commonly used in smaller patients where visualization or digital palpation methods can be difficult. The digital palpation and blind catheterization techniques put the patient at greater risk for iatrogenic UTIs and urinalysis changes when compared to visualization methods.

Techniques for obtaining canine or feline urine through transurethral catheterization are described in Boxes 1.5, 1.6, 1.7, and 1.8. Transurethral catheterization techniques should always be performed by adequately trained personnel and are **not** recommended for routine use in obtaining urine samples due to the potential risks associated with these techniques. Regardless of the technique chosen, avoiding excessive urogenital trauma should be a primary consideration.

Box 1.5 Male canine and feline transurethral catheterization techniques – visualization method.

Canine Technique

1. Prepare for urine collection:
   a. Have one or two clean/sterile appropriate containers or syringes available for urine collection
   b. Select a suitable sterile urinary catheter appropriate in composition, diameter, and length for the patient (see text for guidelines). The adequacy of catheter length can be checked by holding the catheter lateral to the patient with the flared end just cranial to the prepuce/penis and approximating the urethral pathway by following the length of the catheter as it is extended toward the hind end of the patient. As the hind end of the patient is reached, the catheter should be curved upward and then cranially in the area of the pelvis to approximate the curvature of the urethra as it traverses the ischial arch prior to entering the bladder. If, after following the ischial arch, the insertion end of the catheter will extend anterior to the hindquarters, the catheter should be of sufficient length to reach the bladder. Care should be taken to keep the catheter to be used for urine collection sterile by approximating length while the catheter remains in the sterile packaging or wearing sterile gloves when handling a catheter that has been removed from its wrap and held adjacent to the patient for catheter length evaluation (Figure 1.23)
   c. Sedate the patient, if needed, due to patient temperament or pain (sedation is generally unnecessary for the majority of canine patients)
2. Male dogs are typically positioned in lateral recumbency by an assistant, but larger patients are sometimes catheterized while in a standing position. After positioning the patient, the assistant should retract the prepuce and expose the distal portion of the penis by using one hand to gently push the dorsal aspect of the prepuce at its juncture with the ventral abdomen caudally while using the other hand to grasp the penis through the prepuce, pushing the penis and urethral orifice forward cranial to the prepuce (Figures 1.24, 1.25). Ideally, the urethral orifice of the penis should remain exposed until the catheterization process has been completed
3. The distal end of the prepuce and exposed penis should be gently cleaned with water, sterile sponges, and a disinfecting soap such as chlorhexidine, and then thoroughly rinsed to prevent both infection and iatrogenic changes in urinalysis results. Longer hair that may interfere with or contaminate the catheterization process may be clipped, if necessary
4. Wearing sterile gloves, the person performing catheterization should apply sterile lubricant to the insertion end of the catheter and place it into the urethral orifice. The catheter is then slowly and steadily advanced, remembering that resistance will be met during passage, especially at

the level of the base of the os penis and at the ischial arch. Resistance to catheter passage may sometimes be overcome by gentle rotation of the catheter while pushing it forward. The catheter should be advanced until just past the point where urine starts dripping from the end of the catheter or until the catheter has been inserted to the point where it starts to flare. If the selected catheter meets severe resistance, consideration should be given to attempting passage of a urinary catheter which is smaller in diameter. As an alternative approach to catheterization, the end of the package containing the sterile catheter can be cut open and a section of the packaging can be cut off and freed from the remainder of the catheter sleeve; subsequently, the insertion end of the catheter can be exposed and lubricated, using the freed section of the catheter packaging to handle the catheter in a sterile manner while advancing it through the urethral orifice and on into the bladder lumen. Sterile gloves are not required for the alternative method of catheterization (Figure 1.26). Ideally, the final placement of the catheter tip should be no more than a few centimeters cranial to the neck of the bladder, avoiding over-insertion. Over-insertion can cause bladder trauma, make urine collection more difficult, and/or cause the catheter tip to wrap around the bladder lining and retroflex back through the bladder neck. Discontinuing further catheter advancement after 1–2 cm past the point at which urine first begins to flow from the external end of the catheter will help avoid over-insertion

5. Ideally, a 5–10-mL sample of urine should be collected for submission by catching urine flowing freely out of the catheter into a suitable container or by aspirating the desired amount through a syringe attached to the flared catheter end. If urine is flowing freely or can be aspirated after obtaining the initial sample, a second sample should be collected into a different container or syringe. If obtained, the second urine sample is the preferred sample for submission and analysis or culture since it has a lesser chance of contamination or collection artifact
6. Following completion of urine collection, the urinary catheter should be gently removed by steadily withdrawing the catheter from the urogenital tract in a sterile manner

Feline Technique

1. Prepare for urine collection:
   a. Have one or two clean/sterile appropriate containers or syringes available for urine collection
   b. Select a suitable sterile urinary catheter appropriate in composition, diameter, and length for the patient (see text for guidelines). Although the catheter should be of sufficient length to reach the bladder, the relatively short length of the urethra in the male cat generally permits transurethral catheterization using a standard "tomcat" catheter (3.5 Fr, 13 cm) – see Figure 1.19a. Longer catheters can be used but are usually not needed for short-term feline catheterization. If a longer catheter is used, care should be taken to prevent over-insertion so that complications, such as bladder trauma, urine collection impairment, and catheter retroflexion into the urethra, do not occur. Although the diameter of the feline urethra may accommodate a larger catheter than the 3.5 Fr size often chosen for short-term use, catheterization with larger-diameter catheters increases the possibility of excessive urethral trauma
   c. Sedation of the male feline patient is often required for humane, successful transurethral catheterization
   d. Sterile gloves should be worn when performing transurethral catheterization
2. Male cats are typically positioned in lateral recumbency when sedated. Using an assistant or mechanical restraint such as ties or adhesive wrap, the hind limbs should ideally be extended cranially and the tail dorsally and cranially to optimize exposure of the prepuce (Figure 1.27). When catheterization is performed in the awake patient, positioning may vary depending upon the condition of the cat, but optimizing preputial exposure should still be a primary objective

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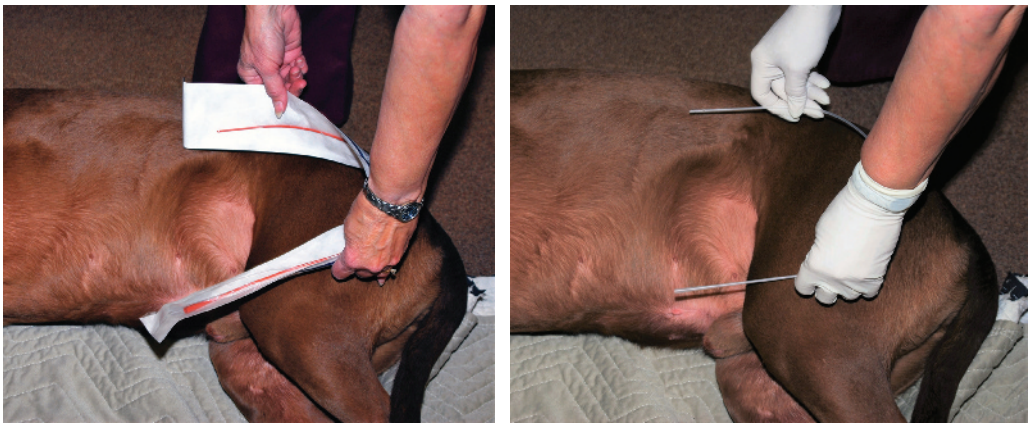
3. The prepuce and adjacent tissue should be cleaned with sterile sponges, water, and a disinfecting soap such as chlorhexidine, and then thoroughly rinsed to prevent both infection and iatrogenic changes in the urinalysis results. Longer hair that may interfere with or contaminate the catheterization process may be clipped, if necessary (Figure 1.27)
4. Wearing sterile gloves, the person performing catheterization should apply sterile lubricant to the insertion end of the selected catheter. Using one gloved hand, the penis should be exposed by pushing the prepuce back against the body. With the other gloved hand, the lubricated catheter tip is inserted into the urethral orifice. With the fingers gently compressing the penis against the inserted catheter, the penis should be extended away from the body posteriorly and approximately parallel to the long axis of the body to facilitate further catheter insertion (Figure 1.28). The catheter should then be gently but firmly pushed retrograde through the urethra and into the bladder until urine is dripping freely from the flared end or the catheter has been fully inserted up to the flared end (or a length approximating the 13-cm length of a typical "tomcat" catheter if using a catheter of longer length). Excessive force should be avoided in order to prevent urethral trauma and iatrogenic urine artifact. Over-insertion of longer catheters can be avoided by discontinuing catheter advancement 1–2 cm after the point at which urine flow is initially observed
5. Ideally, a 5–10-mL sample of urine should be collected for submission by catching urine flowing freely out of the catheter into a suitable container or by aspirating the desired amount into a syringe attached to the flared catheter end. If urine is flowing freely or can be aspirated after obtaining the initial sample, a second sample should be collected into a different container or syringe. If obtained, the second urine sample is the preferred sample for submission and analysis or culture since it has a lesser chance of contamination or collection artifact
6. Following completion of urine collection, the urinary catheter should be gently removed from the urogenital tract by steady withdrawal in a sterile manner

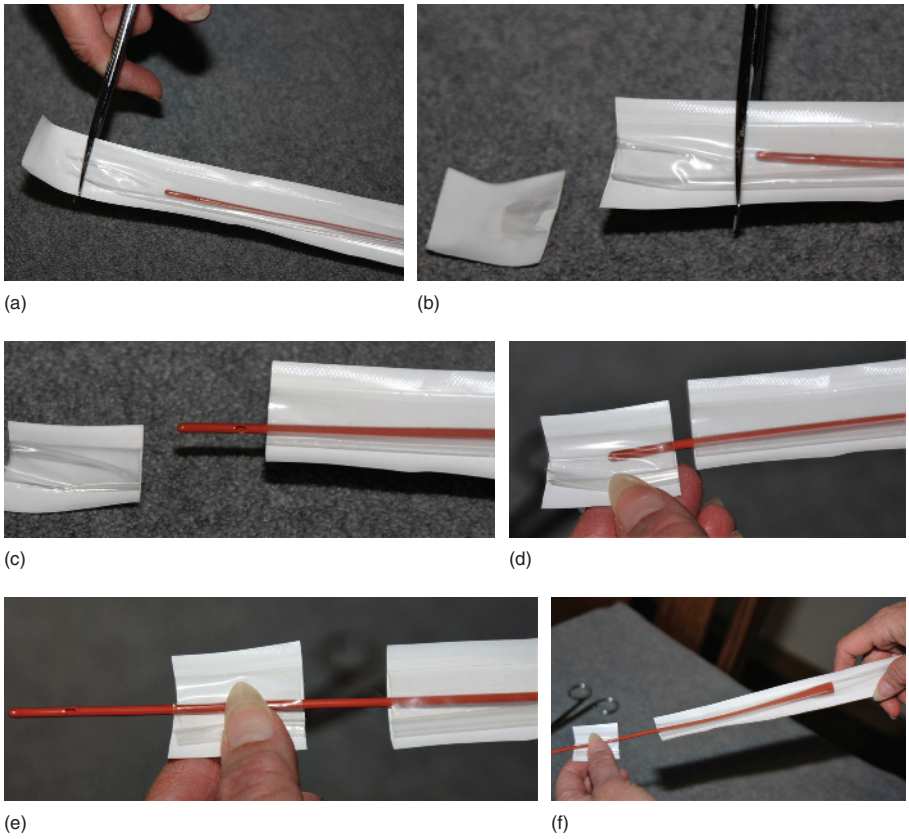


(a) (b)

Figure 1.23 Demonstration of determining adequacy of urinary catheter length in the male dog without (a) and with (b) sterile gloves by holding the catheter adjacent to the lateral aspect of the patient's body and approximating the course of the urethra from the urethral orifice to the neck of the bladder. Catheter length is judged to be sufficient if the insertion end extends anterior to the hindquarters when the flared end is held just cranial to the prepuce/penis and the curve around the ischial arch has been approximated.

Figure 1.24 Demonstration of canine penis and urethral orifice exposure for urinary catheterization. An assistant can expose the penis/urethral orifice by using one hand to gently push the dorsal aspect of the prepuce caudally.

Figure 1.25 Urethral orifice exposure is enhanced by the assistant continuing to push the dorsal aspect of the prepuce caudally while using the other hand to grasp the penis through the prepuce and push it forward cranial to the prepuce. (The patient pictured has an incidental urethral prolapse.)



(a) (b) (c) (d) (e) (f)

Figure 1.26 Demonstration of urinary catheter handling technique in which a sterile segment of catheter packaging can be used to handle the catheter, eliminating the need for sterile gloves. (a) The end of the catheter packaging is cut off to open the catheter sleeve. (b) A second segment of the catheter packaging is cut and separated from the sterile insertion end of the catheter still in the sleeve. (c) The sterile insertion end is pushed out of the open sleeve. (d) The sterile insertion end is inserted through the freed segment of sterile packaging without directly touching the exposed sterile catheter. (e) The freed packaging segment can now be used to handle the urinary catheter, keeping it sterile for lubrication of the insertion end and subsequent introduction into the urethra. (f) The remainder of the catheter can be gradually pulled out of the sterile sleeve and pushed progressively into the urethra, using the freed packaging segment.

Figure 1.27 Preparation for transurethral catheterization of the male feline patient. The cat has been sedated, placed in lateral recumbency, and the genital area has been scrubbed and clipped (clipping is optional). Note that the hind limbs have been pulled cranially and the tail has been pulled dorsally and cranially to optimize exposure of the prepuce.

(a) (b)

(c) (d)

Figure 1.28 Demonstration of initial steps in transurethral catheterization of the male cat. (a) Using sterile gloves, the prepuce of the sedated and prepped patient is pushed back against the body to expose the penis. (b) The lubricated insertion end of the sterile urinary catheter is inserted into the urethral orifice. (c, d) The penis is gently compressed around the catheter, extending the penis away from the body dorsally and approximately parallel to the long axis of the body in order to facilitate further catheter insertion.

Box 1.6 Female canine and feline transurethral catheterization techniques – visualization method.

Canine Technique

1. Prepare for urine collection:
   a. Have one or two clean/sterile appropriate containers or syringes available for urine collection
   b. Select a suitable sterile urinary catheter appropriate in composition, diameter, and length for the patient (see text for guidelines). Sterile red rubber or other catheters of flexible materials and polypropylene catheters are frequently used in the transurethral catheterization of female dogs. Although care should be taken to choose a catheter of sufficient length to reach the bladder, most catheters standardly used for catheterization of female dogs are several centimeters in length and capable of reaching the bladder. If uncertain that the catheter length is sufficient, the catheter in its sterile packaging, or held with sterile gloves when out of its wrapper, can be placed lateral to the hind end of the patient with the flared end just caudal to the vulva and the remainder of the catheter approximating the urethral pathway upward and then cranially to the bladder. If the insertion end of the catheter extends anterior to the hindquarters, catheter length should be sufficient to reach the bladder (Figure 1.29)
   c. If anticipating the use of a stylet with a flexible catheter, select a sterile stylet appropriate for the catheter chosen. Sterile lubricant should be lightly applied to the end of the stylet prior to its insertion into the catheter in order to facilitate withdrawal of the stylet when appropriate (Figure 1.30)
   d. A sterile speculum suitable for the patient and an external light source should be provided. An otoscope consisting of a handle, a head with an attached light source and a movable lens, and appropriately sized cones for attachment can be used (Figure 1.31). Larger otoscope cones will allow better visualization, but size of the patient, diameter of the selected urinary catheter, and vulvar conformation can be limiting factors. Stainless steel human nasal speculums can also be used (author prefers Killian nasal speculum with 2–3.5-inch [5–9-cm] blades depending upon patient size), but require a light source such as an adjustable, free-standing light, an assistant-held penlight or transilluminator, or a head lamp (Figure 1.32)
   e. Sedate the patient, if needed, due to patient temperament or pain (sedation is generally unnecessary for the majority of canine patients)
   f. Sterile gloves should be worn when performing this method of transurethral catheterization
2. An assistant will be needed to restrain the nonsedated female patient in a standing (most common position for nonsedated patient) or ventrally recumbent position. Dogs with longer tails will need to have the tail directed away from the vulva by the assistant or using ties or adhesive wrap. Patients in ventral recumbency should have the hind legs positioned so that the limbs are not interfering with the catheterization process
3. The vulva and adjacent skin should be cleaned with water, sterile sponges, and a disinfecting soap such as chlorhexidine, and then thoroughly rinsed to prevent both infection and iatrogenic changes in urinalysis results. Longer hair that may interfere with or contaminate the catheterization process may be clipped, if necessary
4. Wearing sterile gloves, the person performing catheterization should apply sterile lubricant to the outside of the insertion end of the sterile cone that has been attached to the otoscope with the light source on. The assembled otoscope can be held with a sterile wrap or the hand holding the otoscope can be considered nonsterile and subsequently not be allowed to contact sterile surfaces or equipment. The lubricated cone is inserted gently through the vulva, sliding it along the dorsal wall of the vestibule until past the clitoral fossa. The cone should then be directed cranially and ventrally toward the vagina. Observing through the lens of the otoscope,

the individual catheterizing the patient should be able to see the urethral orifice in the urethral papilla come into view as the floor of the pelvis is approached. After the urethral orifice is visualized, the lubricated insertion end of the selected catheter should be passed by the sterile-gloved hand through the otoscope cone, urethral orifice, and urethra into the bladder lumen (Figure 1.33). Over-insertion of the catheter should be avoided by discontinuing advancement of the catheter 1–2 cm after the point at which urine flow is initially observed. If a stylet has been used to assist in the catheterization process, it should be withdrawn from the catheter lumen. The otoscope handle with head can be detached from the cone and set aside. However, the flared end of the inserted catheter will generally not allow the otoscope cone to be completely separated from the catheter inserted through it until the catheter is withdrawn following urine collection. Alternatively, a sterile, stainless steel human nasal speculum appropriate for the size of the patient may be used in conjunction with a separate external light source to accomplish visual transurethral catheterization. After sterile lubricant is applied to the blades of the nasal speculum, the individual performing catheterization uses his/her gloved hand to hold the handle of the speculum in an upward direction with the blades positioned below. The lubricated blades are then passed in a closed position through the vulva, gently sliding the blades dorsally along the vestibule wall to avoid the clitoral fossa. Once the blades have been introduced as far as possible dorsally and meet resistance, they are then directed cranially and ventrally until the blades are well inserted into or near the vagina in a position parallel to the long axis of the dog. Once insertion is completed, the blades of the speculum are opened gently, and the external light source is positioned so that the urethral orifice can be observed. After the urethral orifice is visualized, the lubricated insertion end of the selected catheter is passed by a sterile-gloved hand through the urethral orifice and urethra into the bladder lumen. Over-insertion of the catheter should be avoided. If a stylet has been used to assist in the catheterization process, it should be withdrawn from the catheter lumen. When urine appears in the catheter by free flow or aspiration with a syringe, the speculum blades may be left in place until a sample is obtained or gently withdrawn from the genital tract, being careful not to dislodge the catheter from the bladder lumen (Figure 1.34)

5. Ideally, a 5–10-mL sample of urine should be collected for submission by catching urine flowing freely out of the catheter into a suitable container or by aspirating the desired amount into a syringe attached to the flared catheter end. If urine is flowing freely or can be aspirated after obtaining the initial sample, a second sample should be collected into a different container or syringe. If obtained, the second urine sample is the preferred sample for submission and analysis or culture since it has a lesser chance of contamination or collection artifact
6. Following completion of urine collection, the urinary catheter and speculum, if still present, should be gently removed from the urogenital tract by steady withdrawal in a sterile manner

Feline Technique

1. Prepare for urine collection:
   a. Have one or two clean/sterile appropriate containers or syringes available for urine collection
   b. Select a suitable sterile urinary catheter appropriate in composition, size, and length for the patient (see text for guidelines). Although the catheter should be of sufficient length to reach the bladder, the relatively short length of the urethra in the female cat generally permits transurethral catheterization using a standard "tomcat" catheter (approximately 3.5 Fr, 13 cm); see Figure 1.19a. Longer catheters can be used but are usually not needed for short-term feline catheterization. If a longer catheter is used, care should be taken to prevent over-insertion so that complications, such as bladder trauma, urine collection impairment,

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and catheter retroflexion into the urethra, do not occur. Although the diameter of the feline urethra may accommodate a larger catheter than the 3.5 Fr size often chosen for short-term use, catheters larger in diameter can potentially produce more trauma to the urethra

c. If anticipating the use of a stylet with a flexible catheter, select a sterile stylet appropriate for the catheter chosen (see Figure 1.18). Sterile lubricant should be lightly applied to the end of the stylet prior to its insertion into the catheter in order to facilitate withdrawal of the stylet when appropriate (see Figure 1.30)
d. A sterile speculum, suitable for the patient, and an external light source should be provided. An otoscope consisting of a handle, a head with an attached light and a movable lens, and appropriately sized cones for attachment can be used (Figure 1.35). A larger cone will allow better visualization, but the small size of most feline patients limits both the size of the speculum and the size of the catheter that can be passed through an otoscope cone
e. Sedation of the female feline patient is usually required for humane, successful transurethral catheterization
f. Sterile gloves should be worn when performing this method of transurethral catheterization

2. Sedated female cats are often positioned in ventral recumbency. Using an assistant or mechanical restraint such as ties or an adhesive wrap, the tail should be positioned away from the area of the vulva. The hind limbs should be positioned in a flexed position alongside the body or, assuming the patient is sufficiently sedated and has been placed on an elevated surface, can be allowed to hang downward from the table top
3. The vulva and adjacent skin should be cleaned with water, sterile sponges, and a disinfecting soap such as chlorhexidine, and then thoroughly rinsed to prevent both infection and iatrogenic changes in urinalysis results. Longer hair that may interfere with or contaminate the catheterization process may be clipped, if necessary
4. Wearing sterile gloves, the person performing catheterization should apply sterile lubricant to the outside of the insertion end of the sterile cone that has been attached to the otoscope with the light source on. The otoscope handle can be held with a sterile wrap or the hand holding the otoscope can be considered nonsterile and subsequently not be allowed to contact sterile surfaces or equipment. The lubricated speculum is inserted gently through the vulva, sliding it along the dorsal wall of the vestibule until past the clitoral fossa. Observing through the lens of the otoscope, the individual catheterizing the patient should be able to see the urethral orifice in the urethral papilla come into view as the floor of the pelvis is approached (Figure 1.36). After the urethral orifice is visualized, the lubricated insertion end of the selected catheter is passed by the sterile-gloved hand through the otoscope cone, urethral orifice, and urethra into the bladder lumen. Discontinuing catheter advancement 1–2 cm after the point at which initial urine flow from the catheter has been observed will help avoid over-insertion of the catheter. If a stylet has been used to assist in the catheterization process, it should be withdrawn from the catheter lumen. The otoscope handle with head can be detached from the cone and set aside. However, the flared end of the inserted catheter will generally not allow the otoscope cone to be completely separated from the catheter inserted through it until the catheter is withdrawn following urine collection
5. Ideally, a 5–10-mL sample of urine should be collected for submission by catching urine flowing freely out of the catheter into a suitable container or by aspirating the desired amount into a syringe attached to the flared catheter end. If urine is flowing freely or can be aspirated after obtaining the initial sample, a second sample should be collected into a different container or syringe. If obtained, the second urine sample is the preferred sample for submission and analysis or culture since it has a lesser chance of contamination or collection artifact
6. Following completion of urine collection, the urinary catheter and otoscope cone should be gently removed from the urogenital tract by steady withdrawal in a sterile manner

Figure 1.29 When uncertain if the length of the urinary catheter chosen is sufficient to reach the urinary bladder in the female dog, the catheter can be held lateral to the body of the dog, holding the flared end caudal to the vulva and approximating the course of the urethra upward from the vagina and then cranially to the neck of the bladder. The length should be sufficient if the insertion end of the catheter extends anterior to the hindquarters of the patient. Sterile gloves should be worn and care taken not to contaminate the catheter if the catheter is not wrapped in sterile packaging when the length is evaluated.

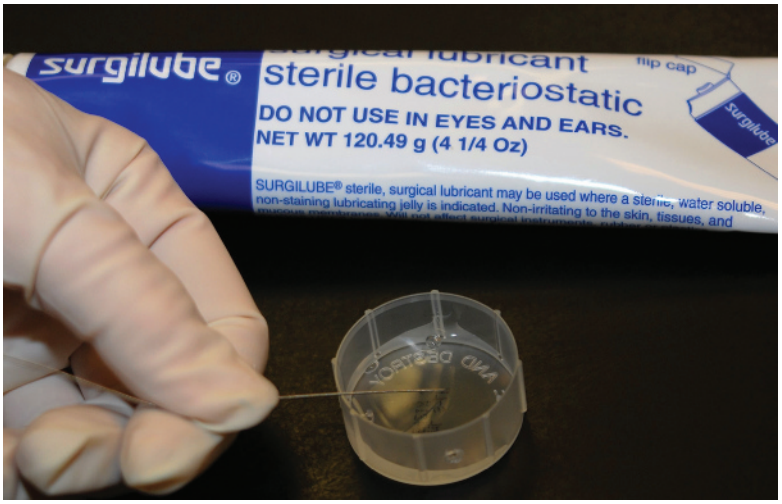
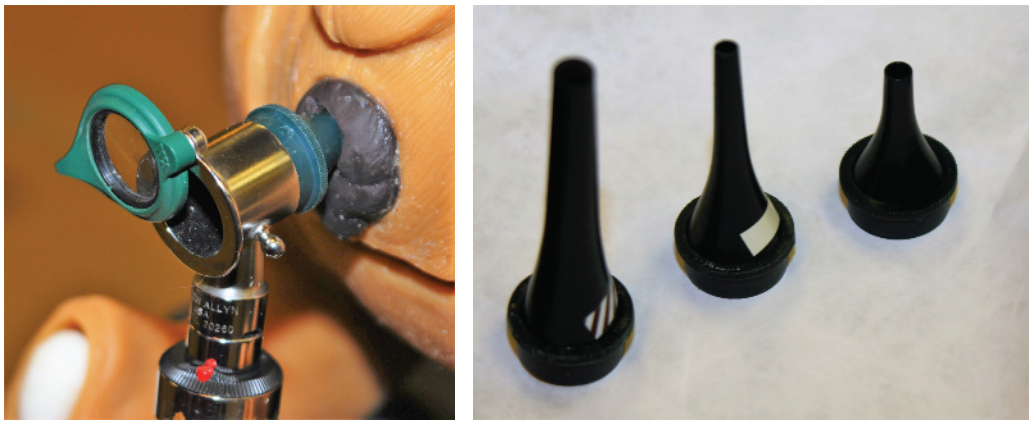


Figure 1.30 If a urinary catheter stylet is used in the transurethral catheterization process, sterile lubricant should be lightly applied to the end of the stylet prior to its insertion into the catheter in order to facilitate withdrawal of the stylet when appropriate.



(a) (b)

Figure 1.31 (a) Otoscope with handle, head with attached light source and movable lens, and fitted with a cone speculum suitable for transurethral catheterization of the female patient by the visualization method. (b) Varying otoscope cone sizes which can be used for visualization of the female canine urethral orifice in transurethral catheterization.

(a) (b)

Figure 1.32 (a) Stainless steel nasal speculums for humans which can be used for female canine transurethral catheterization by the visualization method. (b) A transilluminator is one possible light source which can be used for visualization when using a stainless steel nasal speculum for transurethral catheterization.

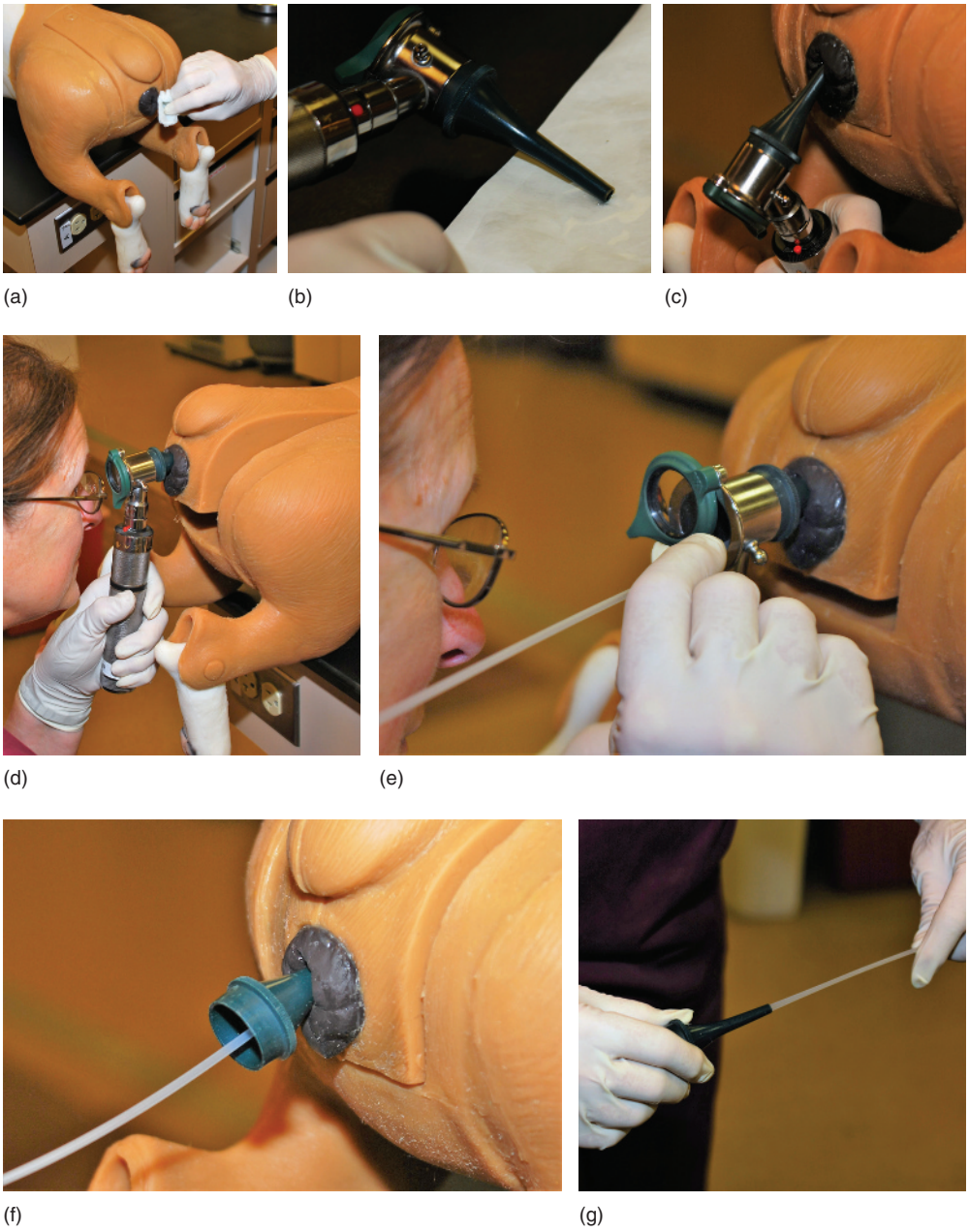


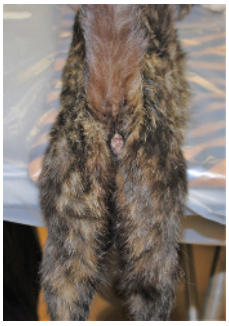
Figure 1.33 Demonstration of transurethral catheterization by visualization of the urethral orifice with an otoscope using a female canine catheterization mannequin positioned in ventral recumbency. (a) The vaginal area has been cleansed. (b) Sterile lubricant is applied to the narrow end of the sterile cone attached to the otoscope. (c) The otoscope cone is inserted through the vulva and upward along the dorsal wall of the vestibule until past the area of the clitoral fossa. (d) The individual performing the procedure then directs the cone cranially and slightly ventrally until the urethral orifice comes into view. (e) After pushing the otoscope lens partially to the side, the selected lubricated catheter is passed in a sterile manner through the cone, urethral orifice, and urethra into the urinary bladder. (f) After catheter entry into the bladder, the otoscope head and handle can be detached from the cone and set aside. (g) The cone can be removed from the genital tract, but generally not completely separated from the catheter until catheter removal subsequent to urine collection.

Figure 1.34 Demonstration of transurethral catheterization by visualization of the urethral orifice with a nasal speculum and external light source using a female canine catheterization mannequin positioned in ventral recumbency. (a) Wearing sterile gloves, the individual performing catheterization applies sterile lubricant to the blades of the selected nasal speculum. (b) Holding the handle of the speculum in an upward direction with the blades below in a closed position, the speculum blades are inserted into the vulva in an upward direction in order to traverse the vestibule dorsally. (c) After passing through the vestibule dorsally, the blades are directed cranially and slightly ventrally until they are well inserted into the vagina. (d) The blades are then gently opened and a transilluminator or other external light source is used to locate the urethral orifice. (e) Sterile lubricant is applied to the insertion end of the selected catheter. (f) The catheter is then passed by a sterile-gloved hand between the blades and through the urethral orifice and urethra into the urinary bladder. (g) After the catheter is placed into the bladder, the speculum blades can be left in place until a urine sample is obtained, or can be removed from the genital tract, being careful not to dislodge the catheter.

(a)

(b)

Figure 1.35 (a) An otoscope with a handle and a head with an attached light and movable lens is suitable for transurethral catheterization by the visualization method in the female cat. (b) Cone speculums suitable for otoscope attachment and visualization of the urethral orifice of cats.



(a)

(b)

(c)

Figure 1.36 Use of otoscopic speculum for transurethral catheterization in the female cat. (a) Sedated female cat in ventral recumbency with limbs hanging down from table top and tail directed upward away from vulva. (b) Cleansed vulva and perivulvar area. (c) Small, sterilized cone attached to otoscope head and handle. The lubricated insertion end of the cone is inserted through the vulva approximately parallel to the long axis of the cat's body, sliding it along the dorsal vestibule wall and into the vagina until the urethral orifice is visualized. A small-diameter, lubricated catheter can then be sterilely introduced through the cone, urethral orifice, and urethra into the urinary bladder for urine collection.

Box 1.7 Female canine transurethral catheterization technique – digital palpation method.

1. Prepare for urine collection:
   a. Have one or two clean/sterile appropriate containers or syringes available for urine collection
   b. Select a suitable sterile urinary catheter appropriate in composition, diameter, and length for the patient (see text for guidelines). Sterile red rubber or other catheters of flexible materials and polypropylene catheters are frequently used in the transurethral catheterization of female dogs. Although care should be taken to choose a catheter of sufficient length to reach the bladder, most catheters standardly used for catheterization of female dogs are several centimeters in length and capable of reaching the bladder. If uncertain that the catheter length is sufficient, the catheter, in its sterile packaging or held by sterile gloves when out of its wrapper, can be placed lateral to the hind end of the patient with the flared end just caudal to the vulva and the remainder of the catheter approximating the urethral pathway upward and then cranially to the bladder. If the insertion end of the catheter extends anterior to the hindquarters, catheter length should be sufficient to reach the bladder (see Figure 1.29)
   c. If anticipating the use of a stylet with a flexible catheter, select a sterile stylet appropriate for the catheter chosen. Sterile lubricant should be lightly applied to the end of the stylet prior to its insertion into the catheter in order to facilitate withdrawal of the stylet when appropriate (see Figure 1.30)
   d. Sedate the patient, if necessary due to patient temperament or pain (sedation is generally unnecessary for the majority of canine patients)
   e. Sterile gloves should be worn when performing this method of transurethral catheterization
2. An assistant will be needed to restrain the nonsedated female patient in a standing (most common position for nonsedated patient) or ventrally recumbent position. Dogs with longer tails will need to have the tail directed away from the vulva by the assistant or through ties or adhesive wrap. Patients in ventral recumbency should have the hind legs positioned so that the limbs are not interfering with the catheterization process
3. The vulva and adjacent skin should be cleaned with water, sterile sponges, and a disinfecting soap such as chlorhexidine, and then thoroughly rinsed to prevent both infection and iatrogenic changes in urinalysis results. Longer hair that may interfere with or contaminate the catheterization process may be clipped, if necessary
4. Depending on the size of the dog and the finger size of the individual performing catheterization, a finger on one hand is selected to perform digital palpation. After gloving, sterile lubricant is applied to the selected finger, which is then inserted through the vulva and advanced along the wall of the vestibule dorsally and then cranially into the vagina until the tip of the finger can be rested on the floor of the pelvis. The other gloved hand is used to insert the lubricated insertion end of the catheter through the vulva into the vestibule and vagina, sliding it underneath the finger resting on the pelvic floor. The catheter end is pushed cranially until it can be felt to slip into the urethral orifice. The urethral papilla and orifice often cannot be distinguished by initial palpation, but upon entry into the orifice, the catheter will push up mucosa dorsally against the fingertip as it is advanced into the urethra. If the catheter continues to be advanced cranially, but only the catheter is felt underneath the finger rather than mucosa overlying the dorsal urethra, then it is probable that the catheter has bypassed the urethra and is being advanced vaginally. If it is suspected that the catheter has bypassed the urethral orifice, the catheter should be withdrawn and re-directed by the finger inserted into the vagina until the urethral orifice can be identified as previously described or it is determined that another

method of urine collection is necessary. Excessive trauma should be avoided in the catheterization process. After the insertion end of the catheter has entered the urethral orifice, the catheter should be steadily and gently advanced until urine flows freely from the catheter or urine can be aspirated into the catheter by a syringe. Over-insertion should be avoided. The finger used to direct the catheter into the urethral orifice can be withdrawn from the urogenital tract after the catheter has entered the urethral orifice or bladder lumen (Figure 1.37). If a stylet has been used in the catheterization process, it should be removed prior to any urine aspiration attempts

5. Ideally, a 5–10-mL sample of urine should be collected for submission by catching urine flowing freely out of the catheter into a suitable container or by aspirating the desired amount into a syringe attached to the flared catheter end. If urine is flowing freely or can be aspirated after obtaining the initial sample, a second sample should be collected into a different container or syringe. If obtained, the second urine sample is the preferred sample for submission and analysis or culture since it has a lesser chance of contamination or collection artifact
6. Following completion of urine collection, the urinary catheter should be gently removed from the urogenital tract by steady withdrawal in a sterile manner

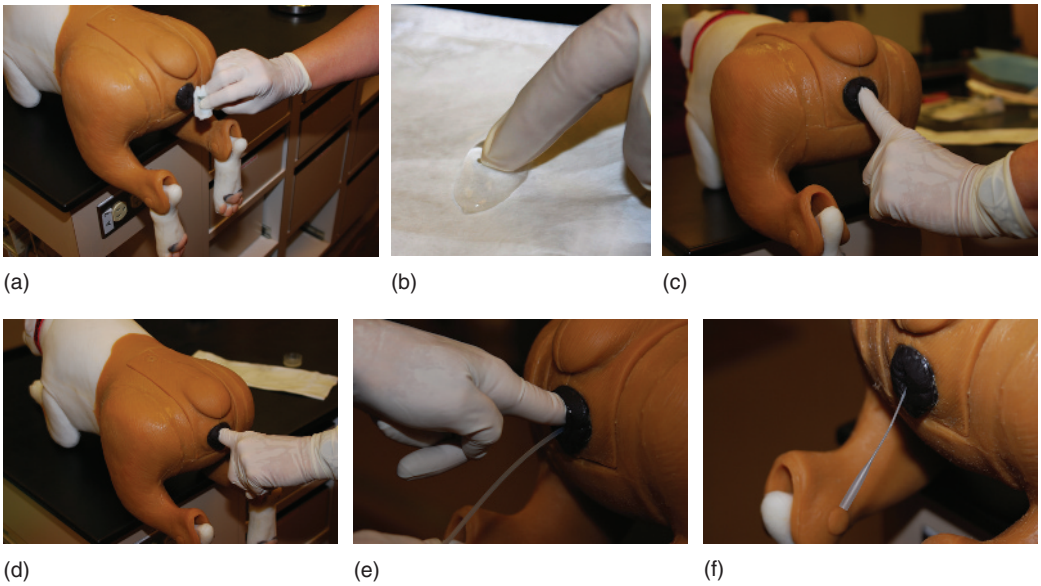


Figure 1.37 Demonstration of transurethral catheterization of the female dog by the digital palpation method using a canine female catheterization mannequin positioned in ventral recumbency. (a) The vaginal area is cleansed. (b) Sterile lubricant is applied to the sterile glove covering the finger selected for digital palpation. (c) The finger is then inserted through the vulva in an upward direction, sliding along the dorsal wall of the vestibule. (d) The finger is then moved cranially and slightly ventrally until the it rests on the pelvic floor. (e) Using the other gloved hand, the lubricated insertion end of the selected urinary catheter is inserted through the vulva and underneath the finger resting on the pelvic floor. As the catheter tip is pushed further cranially, the inserted finger helps direct the catheter into the urethral orifice. (f) When catheterization of the urinary bladder has been accomplished, the inserted finger can be withdrawn from the genital tract, being careful not to dislodge the catheter, and the catheter can then be used for urine collection.

Box 1.8 Female canine and feline transurethral catheterization techniques – blind method.

Canine Technique

1. Prepare for urine collection:
   a. Have one or two clean/sterile appropriate containers or syringes available for urine collection
   b. Select a suitable sterile urinary catheter appropriate in composition, diameter, and length for the patient (see text for guidelines). Sterile red rubber or other catheters of flexible materials and polypropylene catheters are frequently used in the transurethral catheterization of female dogs. When more flexible catheters are used for the blind technique, it is often helpful to employ a stylet, giving added stiffness to the catheter in an attempt to facilitate tip insertion into the urethral orifice. Stainless steel catheters with angled insertion tips can also be advantageous in facilitating blind insertion, but must be used with the utmost care because of increased potential for urogenital trauma (see Figure 1.17). Although care should be taken to choose a catheter of sufficient length to reach the bladder, most catheters standardly used for catheterization of female dogs are several centimeters in length and capable of reaching the bladder. If uncertain that the catheter length is sufficient, the catheter, in its sterile packaging or held with sterile gloves without its wrapper, can usually be placed lateral to the hind end of the patient with the flared end just caudal to the vulva and the remainder of the catheter approximating the urethral pathway upward and then cranially to the bladder. If the insertion end of the catheter extends anterior to the hindquarters, catheter length should be sufficient to reach the bladder (see Figure 1.29)
   c. Sedate the patient, if necessary, due to patient temperament or pain (sedation is generally unnecessary for the majority of canine patients)
   d. Sterile gloves should be worn when performing this method of transurethral catheterization
2. An assistant will be needed to restrain the nonsedated female patient in a standing (most common position for nonsedated patient) or ventrally recumbent position. Dogs with longer tails will need to have the tail directed away from the vulva by the assistant or through ties or adhesive wrap. Patients in ventral recumbency should have the hind legs positioned so that the limbs are not interfering with the catheterization process
3. The vulva and adjacent skin should be cleaned with water, sterile sponges, and a disinfecting soap such as chlorhexidine, and then thoroughly rinsed to prevent both infection and iatrogenic changes in urinalysis results. Longer hair that may interfere with or contaminate the catheterization process may be clipped, if necessary
4. Wearing sterile gloves, the person performing catheterization should apply sterile lubricant to the insertion end of the chosen catheter (with sterile, lubricated stylet already inserted, if used). If using a metal catheter, make certain the insertion end is tipped downward prior to insertion. Note if the metal catheter flange attachment corresponds to the side toward which the catheter insertion end is tipped or to the opposite side, since this will help the individual performing catheterization ensure that the insertion end remains tipped downward during the catheterization process. The insertion end of the lubricated catheter is advanced into the vulva and along the dorsal wall of the vestibule in an upward direction initially to attempt to bypass the clitoral fossa. After the initial dorsal advancement, the catheter should be directed more cranially, sliding the catheter gently toward the ventral surface of the vagina and observing

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the external end of the catheter for the appearance of urine. If the catheter advances into the urethra and the bladder lumen, less resistance to advancement is often noted. If entry into the bladder lumen is suspected but no obvious urine flow is observed, a syringe should be attached to the flared end of the catheter (with stylet removed, if used) and aspiration performed to determine if urine can be obtained (Figure 1.38). Attaching a syringe to the external end of a metal catheter may require the use of flexible tubing as an adapter (see Figure 1.22). If no urine appears by natural flow or aspiration, the catheterization attempt can be continued either with the same catheter or a catheter of different composition and/or diameter. Access to the urethral orifice can sometimes be facilitated by lightly compressing the urinary bladder through the abdomen while advancing the catheter along the ventral vaginal wall. Over-insertion of the catheter should be avoided

5. If a stylet has been used in the catheterization process and is still in place, it should be removed once successful catheterization is believed to have been achieved
6. Ideally, a 5–10-mL sample of urine should be collected for submission by catching urine flowing freely out of the catheter into a suitable container or by aspirating the desired amount into a syringe attached to the external catheter end. If urine is flowing freely or can be aspirated after obtaining the initial sample, a second sample should be collected into a different container or syringe. If obtained, the second urine sample is the preferred sample for submission and analysis or culture since it has a lesser chance of contamination or collection artifact
7. Following completion of urine collection, the urinary catheter should be gently removed from the urogenital tract by steady withdrawal in a sterile manner

Feline Technique

1. Prepare for urine collection:
   a. Have one or two clean/sterile appropriate containers or syringes available for urine collection
   b. Select a suitable sterile urinary catheter appropriate in composition, size, and length for the patient (see text for guidelines). Sterile red rubber or other catheters of flexible materials and polypropylene catheters can be used in the transurethral catheterization of female cats. When more flexible catheters are used for the blind technique, it is often helpful to employ a lubricated stylet, giving added stiffness to the catheter in an attempt to facilitate tip insertion into the urethral orifice (Figure 1.39). Stainless steel catheters with angled insertion tips can also be advantageous in facilitating blind insertion, but must be used with the utmost care because of increased potential for urogenital trauma. Although the catheter selected should be of sufficient length to reach the bladder, the relatively short length of the urethra in the female cat generally permits transurethral catheterization using a standard "tomcat" catheter (approximately 3.5 Fr, 13 cm) (see Figure 1.19a). Longer catheters can be used but are not necessarily needed for short-term feline catheterization. If a longer catheter is used, care should be taken to prevent over-insertion so that complications, such as bladder trauma, urine collection impairment, and catheter retroflexion into the urethra, do not occur. Although the diameter of the feline urethra may accommodate a larger catheter than the 3.5 Fr size often chosen for short-term use, catheters larger in diameter can potentially produce more trauma to the urethra

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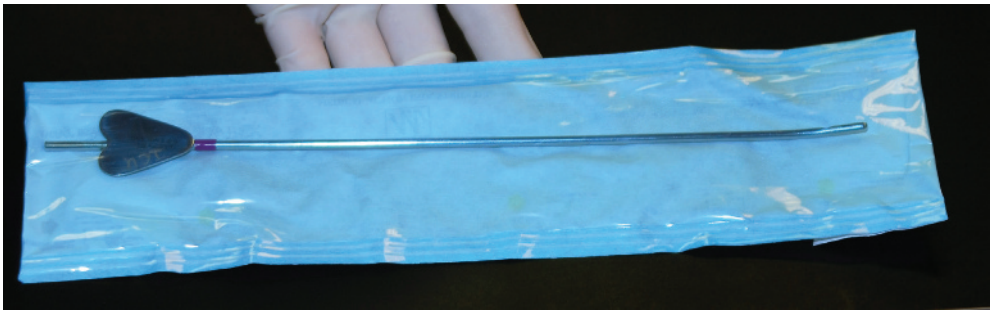
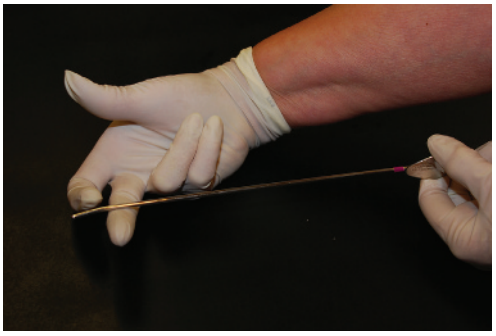
   c. Sedation of the female feline patient is usually required for humane, successful transurethral catheterization
   d. Sterile gloves should be worn when performing this method of transurethral catheterization
2. Female cats are typically positioned in ventral recumbency. Using an assistant or mechanical restraint such as ties or an adhesive wrap, the tail should be positioned away from the area of the vulva. The hind limbs should be positioned in a flexed position alongside the body or, assuming the patient is sedated and has been placed on an elevated surface, can be allowed to hang downward from the supporting surface (see Figure 1.36a)
3. The vulva and adjacent skin should be cleaned with water, sterile sponges, and a disinfecting soap such as chlorhexidine, and then thoroughly rinsed to prevent both infection and iatrogenic changes in urinalysis results. Longer hair that may interfere with or contaminate the catheterization process may be clipped, if necessary
4. Wearing sterile gloves, the person performing catheterization should apply sterile lubricant to the insertion end of the chosen catheter (with sterile, lubricated stylet already inserted, if used). If using a metal catheter, make certain the insertion end is tipped downward prior to insertion. Note if the metal catheter flange attachment corresponds to the side toward which the catheter insertion end is tipped or to the opposite side, since this will help ensure that the insertion end remains tipped downward during the catheterization process. The insertion end of the lubricated catheter is advanced cranially through the vulva and vestibule into the vagina, observing the flared or external end of the catheter for the appearance of urine. If the catheter advances into the urethra and the bladder lumen, less resistance to advancement is often noted. If entry into the bladder lumen is suspected but no obvious urine flow is observed, a syringe should be attached to the flared or adapter end of the catheter (with stylet removed, if used) and aspiration performed to determine if urine can be obtained. If no urine appears by natural flow or aspiration, the catheterization attempt can be continued either with the same catheter or a catheter of different composition and/or diameter. Access to the urethral orifice can sometimes be facilitated by lightly compressing the bladder through the abdomen while advancing the catheter along the ventral vaginal wall. Over-insertion of the catheter should be avoided by discontinuing advancement of the catheter 1–2 cm after initial urine flow through the catheter has been observed
5. If a stylet has been used in the catheterization process and is still in place, it should be removed once successful catheterization has been achieved
6. Ideally, a 5–10-mL sample of urine should be collected for submission by catching urine flowing freely out of the catheter into a suitable container or by aspirating the desired amount into a syringe attached to the external catheter end. If urine is flowing freely or can be aspirated after obtaining the initial sample, a second sample should be collected into a different container or syringe. If obtained, the second urine sample is the preferred sample for submission and analysis or culture since it has a lesser chance of contamination or collection artifact
7. Following completion of urine collection, the urinary catheter should be gently removed from the urogenital tract by steady withdrawal in a sterile manner



(a)



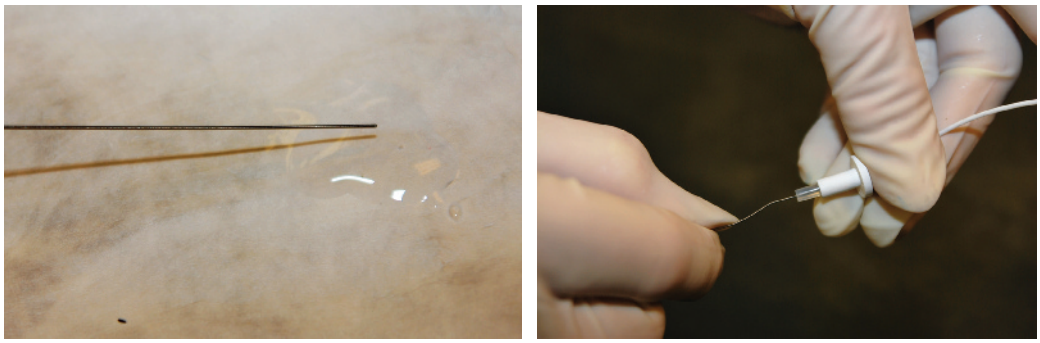
(b)

(c)

(d)

(e)

Figure 1.38 Demonstration of transurethral catheterization in a female dog by the blind method using a canine female catheterization mannequin positioned in ventral recumbency. (a) A stainless steel urinary catheter is chosen; note that the chosen catheter does not have a flared end for syringe attachment. (b) The position of flange attachment should also be noted; in the catheter pictured the side of flange attachment corresponds to the side toward which the insertion end of the catheter is tipped. (c) Sterile lubricant is applied to the insertion end of the selected catheter. (d) Wearing sterile gloves, the individual performing catheterization inserts the catheter (with the tip pointing downward) through the cleansed vulva and gently slides the catheter upward along the dorsal aspect of the vestibule. (e) When resistance is met after the initial dorsal advancement, the catheter should be directed gently cranially along the ventral aspect of the vagina, noting if less resistance is suddenly detected and if urine appears at the outer end of the catheter since these features indicate successful entry into the bladder lumen. It should also be noted in the metal catheter pictured that the flange attachment is on the down side of the catheter, indicating that the insertion end is tipped in the preferred downward position. If syringe attachment to the metal catheter is desired, flexible tubing can be attached to the outer catheter end, allowing a syringe to be connected for urine aspiration (see Figure 1.22).



(a) (b)

Figure 1.39 (a) Applying sterile lubricant to stylet to be inserted into selected catheter. (b) Inserting lubricated stylet into flexible tomcat catheter to provide added stiffness for blind transurethral catheterization.

Cystocentesis

Cystocentesis (Box 1.9) is a method of obtaining urine from the urinary bladder by means of transabdominal needle puncture. This urine collection technique is performed by trained personnel and is generally easy to carry out in small animals without sedation, especially with the assistance of ultrasonography. It is often the preferred technique when establishing the significance of cells or bacteria in a urine sample or when collecting urine for culture. When properly performed, there is a low risk of iatrogenic urinary tract infection. Surgical preparation of the abdominal skin site selected for needle penetration is not generally required, although removal of excessive hair and application of antiseptic solution is often recommended. Samples obtained via cystocentesis typically contain microscopic blood contamination, limiting the usefulness of this urine collection method for monitoring patients in which microscopic hematuria has been identified as the primary urinalysis abnormality. Additional drawbacks of cystocentesis include difficulty in sampling due to inadequate bladder urine volume, potential patient resistance to restraint and positioning, inadvertent intestinal or blood vessel sampling, urinary bladder laceration, induction of a vagal response, seeding of neoplastic cells along the needle path in patients with transitional cell carcinoma, and leakage of urine into the abdomen. The risk of bladder laceration and urine leakage is small unless the urinary bladder is over-distended or there is bladder wall pathology. This technique is generally contraindicated in animals with a coagulopathy or on anticoagulant therapy and should be used with caution in patients that have had recent cystotomy.

Using a 22- or 23-gauge needle 1–1.5 inches (2.5–3.8 cm) in length is generally preferred for obtaining a sample suitable for urinalysis or culture and minimizing the opportunity for undesirable consequences to the patient. In very large or obese patients a 3-inch (7.6-cm) 22-gauge spinal needle may be needed to reach the bladder (Figure 1.40). Although syringes used for cystocentesis to obtain diagnostic urine samples generally range from 3 to 12 mL, a 5-mL syringe is easily handled and usually of adequate volume to obtain a specimen suitable for most urinalysis evaluations.

Techniques for canine and feline cystocentesis using palpation, ultrasound-guided, and blind methods are described in Box 1.9 (Figures 1.41–1.44). The box includes technique modifications related to the species and sex of the patient.

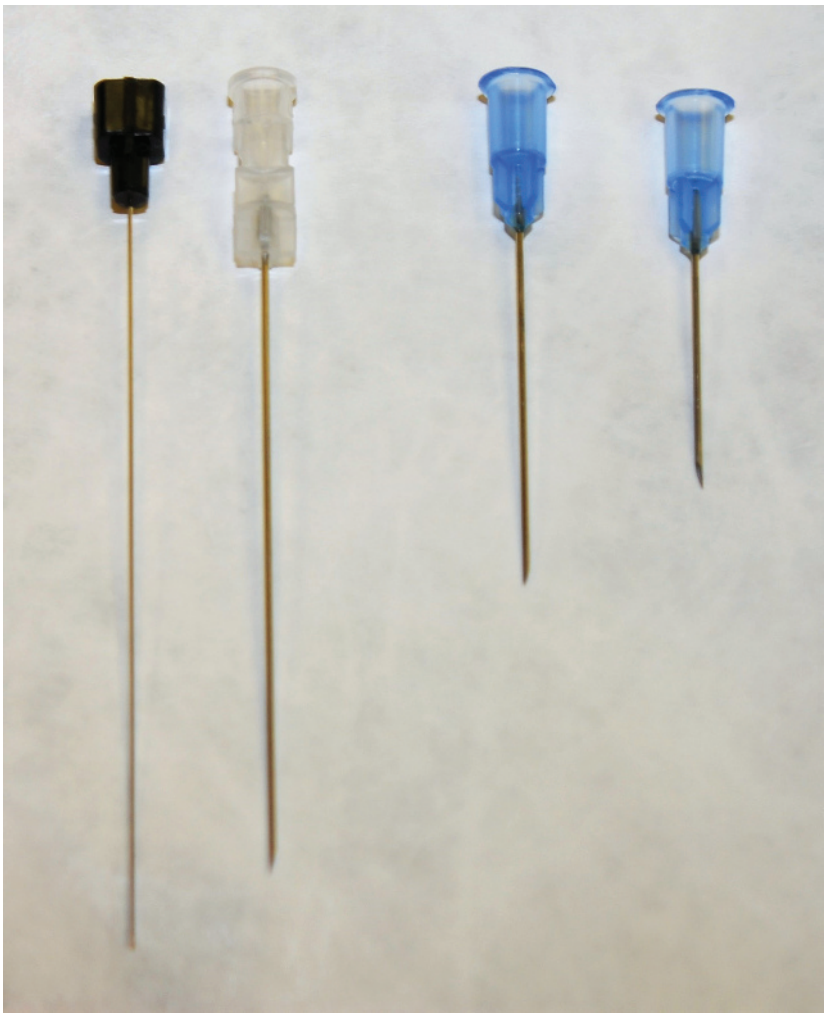


Figure 1.40 Needles typically recommended for cystocentesis in the dog and cat. Left to right: 22-gauge 2.5-inch spinal needle with stylet removed; 22-gauge 1.5-inch cystocentesis needle; 22-gauge 1-inch hypodermic needle.

Box 1.9 Canine and feline cystocentesis techniques.

1. Prepare for urine collection:
   a. Palpate the patient's abdomen to assess the degree of bladder distention and if any potentially complicating factors are present such as a palpable bladder mass suggestive of transitional cell carcinoma (increases patient risk for neoplastic cell seeding), nonpalpable or very small bladder volume (decreases chances for successful urine collection or may alter performance of cystocentesis technique), or a descending colon distended with feces (increases chance of inadvertent intestinal sampling, especially, in patients with small bladder volume). Ultrasonography may also be used to help determine the presence of complicating factors
   b. When the bladder is unable to be palpated and ultrasonography assistance is not an option, the patient can be hospitalized and cage confined until the bladder is distended sufficiently to be palpable. If hospitalization is not possible, the patient's physical characteristics make bladder palpation difficult, or pollakiuria makes it unlikely that the bladder will achieve palpable distention, the blind method of cystocentesis can be considered or a technique for urine collection other than cystocentesis can be chosen
   c. Have a suitable hypodermic/spinal needle, syringe, and a clean/sterile container appropriate for urine submission available. See the text for guidelines regarding appropriate needle and syringe selection. Box 9.1 point 4 provides some additional comments regarding the use of a spinal needle for cystocentesis. In some instances, especially when placing collected urine into culture tubes, it is beneficial to have an additional sterile hypodermic needle available for specimen transfer in order to decrease the possibility of specimen contamination by the needle used in obtaining the cystocentesis sample
   d. If ultrasonographic assistance in location and aspiration of the patient's bladder is anticipated, the ultrasound unit, transducer, and coupling gel (if used) should be readily available. A convex or curvilinear 5–7 MHz transducer is commonly used in performing cystocentesis
   e. Unless the patient is sedated/anesthetized, an assistant or assistants should be available to help in patient restraint for the procedure
2. Determine the cystocentesis technique to be used and position the patient appropriately for the procedure. The patient's temperament and size, ease of bladder palpation, presence of complicating factors, the necessity/availability of ultrasonographic assistance, and the availability of personnel for restraint are all factors which play a role in determining the method of cystocentesis and associated positioning of the patient. The patient can be placed in a standing, laterally recumbent, or dorsally recumbent position. All of these positions are common choices for patients undergoing cystocentesis by the bladder palpation method. Smaller patients or larger patients with distended bladders often have cystocentesis performed when in a standing or laterally recumbent position. A laterally or, frequently, dorsally recumbent position is the position of choice for patients undergoing ultrasound-assisted cystocentesis or patients requiring a greater degree of restraint for the cystocentesis procedure. Dorsal recumbency may be beneficial in obtaining a cystocentesis sample from patients with smaller, less palpable bladders and is the position of choice for performing cystocentesis by the blind technique. One assistant for restraint is generally adequate for a patient placed in a standing or laterally recumbent position (larger or agitated patients may require two assistants for adequate restraint). Patients placed in dorsal recumbency often require two assistants for restraint with one assistant restraining the head and front limbs and the second assistant extending the hind limbs away from the posterior abdomen (Figure 1.41)

3. Cystocentesis methods include:
   a. Bladder palpation method (see text for guidelines related to needle and syringe selection). After the patient has been positioned, the palpable bladder should be immobilized with one hand, pushing it gently dorsally and posteriorly. The anticipated area of needle insertion into the bladder is usually ventral or ventrolateral. The abdominal skin overlying the area of bladder puncture is often sparsely haired, but may be clipped, if necessary. The skin insertion site does not have to be surgically prepped, but should be moistened with alcohol or disinfectant, wetting down any hair in the area to enhance skin exposure. The hand which is not immobilizing the bladder should be used to insert the selected needle with attached syringe into the bladder through the abdominal wall. Ideally, when inserted through the abdomen, the needle should be posteriorly angled approximately 45° from the long axis of the patient. Angling the needle inserted not only helps maintain the needle in the bladder lumen but also reduces the possibility of urine leakage from the bladder into the abdomen (Figure 1.42)
   b. Ultrasound-guided method (see text and earlier in this box for guidelines related to needle, syringe, and ultrasound transducer selection). Ultrasound-guided cystocentesis is ideal to successfully obtain a urine sample with the least potential for undue patient trauma and blood or bowel contamination, especially in patients with minimal to moderate bladder distention. The patient is commonly placed in dorsal recumbency although lateral recumbency is also an option. If dorsally recumbent, the use of a foam trough can enhance patient comfort and positioning. The abdominal site for positioning of the transducer and needle is the posterior ventral or ventrolateral abdomen. Hair can be clipped, if needed. The selected site should be moistened with alcohol. Coupling gel can be applied directly to the transducer or conservatively to the selected skin site. Once the bladder has been located with the transducer an area directly adjacent to the tranducer should be cleaned of coupling gel, if used, and moistened with alcohol. The needle selected for cystocentesis with syringe attached should be inserted through the cleaned skin site and directed to the bladder, taking care to keep the needle tip within the plane of the ultrasound beam so that insertion into the bladder can be observed (Figure 1.43)
   c. Blind method (see text for guidelines related to needle and syringe selection). In the blind cystocentesis technique the canine or feline patient is positioned in dorsal recumbency, and an area on the abdominal midline halfway between the umbilicus and the pelvic brim is selected for insertion of the selected needle (typically 22-gauge, 1–1.5-inch) with an attached syringe. Alternatively, in the female dog and the male or female cat, the needle insertion site can be determined by dripping alcohol on the posterior ventral midline and observing the midline point at which the alcohol pools. The point of alcohol pooling is more easily assessed in patients with lesser amounts of hair obscuring the midline and trapping the dripped alcohol. Blind cystocentesis approximates a point in the abdomen where, at least, a portion of the bladder is frequently located. Prior to needle insertion the site should be moistened with alcohol or, if alcohol was pooled to select the site, excess alcohol should be absorbed with a clean cotton ball. Unlike the other variations of cystocentesis technique described in this box, needle insertion in blind cystocentesis is usually perpendicular to the long axis of the patient rather than at a more acute angle (Figure 1.44). When inserting the needle and attached syringe in the male dog, the prepuce and penis are pushed laterally to allow unhindered access to the patient's midline. Without the input of palpation or ultrasound, the depth of needle insertion is dependent upon the length of the needle and the body condition of the patient. It should be remembered that the blind cystocentesis method has the highest risk of the three cystocentesis methods described here for causing complications, such as sample contamination and injury to the patient

4. When a spinal needle is chosen for the cystocentesis procedure, the stylet which usually accompanies the needle can often be removed and the needle inserted with syringe attached in the manner previously described for the various cystocentesis methods. However, if more resistance to insertion is anticipated due to the condition of the skin at the site of insertion, the stylet can be left in place until abdominal penetration has occurred, to provide more needle stability and decrease the chances of obstructing the needle with tissue or blood. Following penetration, the stylet can be removed and the syringe for aspiration quickly attached to the needle hub to limit the introduction of any free air into the abdominal cavity. Insertion of the spinal needle into the urinary bladder lumen can then proceed
5. Regardless of any technique variations, once needle penetration into the bladder lumen is believed to have occurred, negative pressure should be applied to the syringe attached to the insertion needle. Aspiration should continue until the desired amount of urine is obtained (5 mL is considered the ideal minimum amount for standard urinalysis), urine flow stops, or frank blood or no urine appears in the syringe barrel. Recommendations for these outcomes are as follows:
   a. Adequate urine sample obtained: stop applying negative pressure and withdraw needle from the abdomen
   b. Inadequate or no urine sample obtained: negative pressure is discontinued. The needle can be moved slightly outward or inward in a direct line with the insertion angle and then aspiration can again be attempted. Frequently, if re-aspiration is attempted, the needle is totally withdrawn from the abdomen and then re-inserted in a position and angle suggested by the palpation or ultrasound information available. When performing cystocentesis by the blind method, re-insertion of the needle through the abdomen should occur slightly cranial or caudal to the original midline insertion point. *The insertion needle should never be re-directed from one angle to another while located in the bladder regardless of how cystocentesis is attempted. Re-direction when the needle is in the abdomen but outside the bladder can be cautiously attempted with the assistance of ultrasonography.* Three unsuccessful attempts to obtain an adequate urine sample using any of the cystocentesis methods should cause further cystocentesis attempts to be delayed until the bladder becomes more distended with urine and consideration should be given to alternative means of obtaining a urine sample
   c. Frank blood appears: discontinue aspiration attempts. Observe the patient for any signs of weakness, pale mucous membranes, or other signs of patient instability. Abdominal ultrasonography can also be considered to check for accumulation of abdominal fluid. Wait at least 24–48 hours prior to re-attempting cystocentesis or attempting urine collection by a different technique
6. Negative pressure should always be discontinued when withdrawing the insertion needle from the bladder and abdomen. Excessive pressure on the bladder should be avoided when using palpation as part of the cystocentesis technique or in the immediate post-cystocentesis period regardless of the method used, in order to minimize the possibility of urine leakage from the bladder
7. The urine obtained by cystocentesis should be submitted in a timely manner and in an appropriate container for the desired analyses

Figure 1.41 Restraint for cystocentesis when the patient is dorsally recumbent usually requires two assistants, one for restraint of the head and front limbs and one for caudal extension of the hind limbs away from the abdomen.

Figure 1.42 Cystocentesis by bladder palpation method. The cat is placed in dorsal recumbency. The bladder is immobilized by pushing the bladder posteriorly and dorsally with one hand while the other hand directs a 22-gauge needle with syringe attached through the alcohol-moistened ventral abdominal wall at a 45° angle to the long axis of the patient. Although the patient's abdomen has been shaved and the individual performing the cystocentesis is wearing gloves, neither of these components is required to perform the procedure.

(a) (b)

(c) (d)

(e)

Figure 1.43 Cystocentesis performed by the ultrasound-guided method. (a) An ultrasound transducer is used to locate the urinary bladder in a dorsally recumbent canine patient with sparse abdominal hair. (b) The selected needle with syringe attached punctures the abdominal wall adjacent to the transducer and is guided to the bladder for urine aspiration, taking care to keep the needle tip within the ultrasound beam. (c) Alcohol is sprayed on the abdomen of a dorsally recumbent canine patient with a denser hair coat than the patient pictured in (a) and (b). (d) The ultrasound screen can be seen as the transducer is used to locate the urinary bladder in the area of the posterior abdomen. (e) When the urinary bladder has been located with the transducer, the selected needle with syringe attached punctures the abdominal wall adjacent to the transducer and is guided to the bladder for urine aspiration, keeping the needle tip within the ultrasound beam.

(a) (b)

Figure 1.44 (a) Alcohol is dripped on the shaved abdominal midline of a cat in dorsal recumbency to observe the point of alcohol pooling and locate a transabdominal needle insertion site for blind cystocentesis. (b) A 22-gauge hypodermic needle with a 6-mL syringe attached is inserted through the midline abdominal wall and perpendicular to the long axis of the cat's body at the site of alcohol pooling as part of the blind cystocentesis technique.

Urine Sample Handling

Urine samples should be examined within 1 hour after collection to avoid artifactual changes. If the urine cannot be examined within that time period or is to be shipped to a commercial laboratory, it can be refrigerated with a tightly secured lid (Figure 1.45) for up to 6 hours. If the sample is sent to a commercial laboratory, sending the urine sample with a cold pack may delay the onset of some artifactual changes (Box 1.10). Urine samples submitted to a diagnostic laboratory for cytologic evaluation should be sent in an EDTA tube (see Figure 1.3) to delay cell deterioration and prevent the overgrowth of bacteria (if urine culture is desired some urine should be submitted in a clean, sterile container with no additives or in culture tubes as EDTA can inhibit the growth of some bacteria and the tubes may not be sterile). Cells in urine deteriorate rapidly and the evaluation of cellular morphology is best accomplished using fresh urine samples; therefore, it is always prudent to include one or two air-dried urine sediment slides.

Figure 1.45 If a urine sample cannot be analyzed within 1 hour after collection, the sample should be refrigerated in a suitable container with a tightly secured lid.

Culture

Cystocentesis is the preferred collection method when evaluating urine for evidence of infection, including submission of a sample for culture. When a urine sample obtained by cystocentesis is transferred to a container appropriate for culture, the needle which was used to obtain the sample should be discarded and a new, sterile hypodermic needle should be used for transfer to the culture tube. Although catheterized or free-catch, midstream, voided or manually expressed samples can be used in determining the presence of urinary tract infection (UTI),

Box 1.10 Changes in urine samples from delayed processing.

Color change
Increased odor
Increased turbidity
Increased pH
Decreased glucose
Decreased ketones
Decreased bilirubin
Decreased cellularity
Increase or decrease in number of crystals (dependent on type, temperature, and urine pH)
Deterioration of casts
Deterioration of cells
Deterioration of crystals
Increased bacterial growth at room temperature
Decreased bacterial growth with prolonged refrigeration

urine collected by these methods is subject to contamination from the genital tract, skin, and hair. The potential for bacterial contamination is particularly high in urine samples collected by voiding or manual compression even when a midstream specimen has been collected. Consequently, submission of midstream voided or manually compressed urine samples for culture is not routinely recommended.

Regardless of the urine collection technique, diagnosis of UTI through urinalysis and culture is best determined when the patient undergoing evaluation has not received antimicrobial therapy for at least 3–5 days prior to sample collection. Cultures should be performed immediately after urine collection, although this is seldom practical unless in-house agar plating of the collected urine sample is possible. In most circumstances urine will be sent to a diagnostic laboratory. Urine should be placed in a sterile container, with a tightly secured lid, and placed in the refrigerator within 30 minutes of collection; ideally, culture should be performed on the refrigerated sample within 12 hours of collection. Some organisms may be killed with prolonged refrigeration. Freezing urine samples may kill bacteria. When submitting a urine sample for culture to a laboratory, consider saving and sending the sample in a preservative tube (see Figure 1.4a), which can aid in stabilizing organism content of the urine specimen for up to 72 hours post-collection without refrigeration (see Box 1.1). Preservative tubes help maintain original pathogen numbers, decrease proliferation of contaminant organisms, and allow time for evaluation of concurrent diagnostic procedures prior to culture submission. Urine submitted in EDTA is not appropriate for culture as EDTA can inhibit the growth of some bacteria and the tubes may not be sterile.

To be an effective diagnostic and therapeutic tool, urine culture should be evaluated in conjunction with the following information:

- patient signalment, history, and physical findings;
- method of urine collection;
- specific identification of the cultured organism(s);
- quantitative bacterial numbers of the cultured organism(s);
- antimicrobial susceptibility testing of the cultured organism(s);
- results of urinalysis and other indicated diagnostic procedures.

Knowledge of patient signalment, history, and physical findings can raise the index of

suspicion that UTI exists, identify predisposing causes, help localize the site of potential infection, and determine further diagnostic procedures. Knowledge of urine collection method is important due to the potential for microorganism contamination. Identification and/or quantification of organisms help establish the presence of UTI, give an indication of whether the organisms represent reinfection versus relapse in patients with a history of multiple UTI episodes, and help direct therapy.

Bacterial quantification in conjunction with knowledge of the urine collection technique can assist in verifying UTI versus contamination, given that bacterial numbers in colony-forming units per milliliter (CFU/mL) have been established for the various collection methods and likelihood of canine and feline UTI (Lulich and Osborne, 1999). In general, lower bacterial numbers from urine culture are most likely to be representative of true UTI when the sample has been collected by cystocentesis (≥1000 CFU/mL, cat and dog) rather than by catheterization (≥10 000 CFU/mL, dog and ≥1000 CFU/mL, cat) or midstream voided and manual compression techniques (≥100 000 CFU/mL, dog and ≥10 000 CFU/mL, cat). Bacterial numbers from urine culture most compatible with contamination have been reported as ≤100 CFU/mL (dog and cat) for cystocentesis samples, ≤1000 CFU/mL (dog) and ≤100 CFU/mL (cat) for catheterized samples, and ≤10 000 CFU/mL (dog) and ≤1000 CFU/mL (cat) for midstream voided and manual expression samples. It should be noted that cats are more resistant to UTI than dogs and lower bacterial numbers from urine culture may have more significance in terms of indication of infection for cats in contrast to dogs. In any case, the significance of quantified bacterial culture results should always be interpreted in conjunction with the other evaluation aspects listed above. Antimicrobial susceptibility testing is essential for establishing an appropriate therapeutic regimen. Although UTI can be present without the identification of inflammatory cells on urinalysis, the presence of inflammatory cells increases the probability that bacteria observed on urinalysis and/or culture are truly associated with UTI. Additional diagnostic procedures performed on patients with suspected UTI, such as diagnostic imaging and biochemistry profiles, can help provide further evidence of UTI, identify complicating factors, and help localize the site of infection.