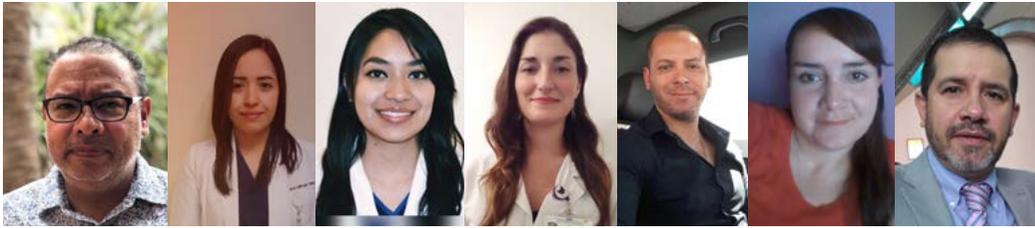




HOW TO REMOVE URETHRAL OBSTRUCTION IN CATS

AUTHORS



Javier Del-Angel-Caraza

Elvia Aguiñaga-Negrete

Alejandra Cristina Bernal-Torres

Sofía Perini-Perera

Rafael Morán-Muñoz

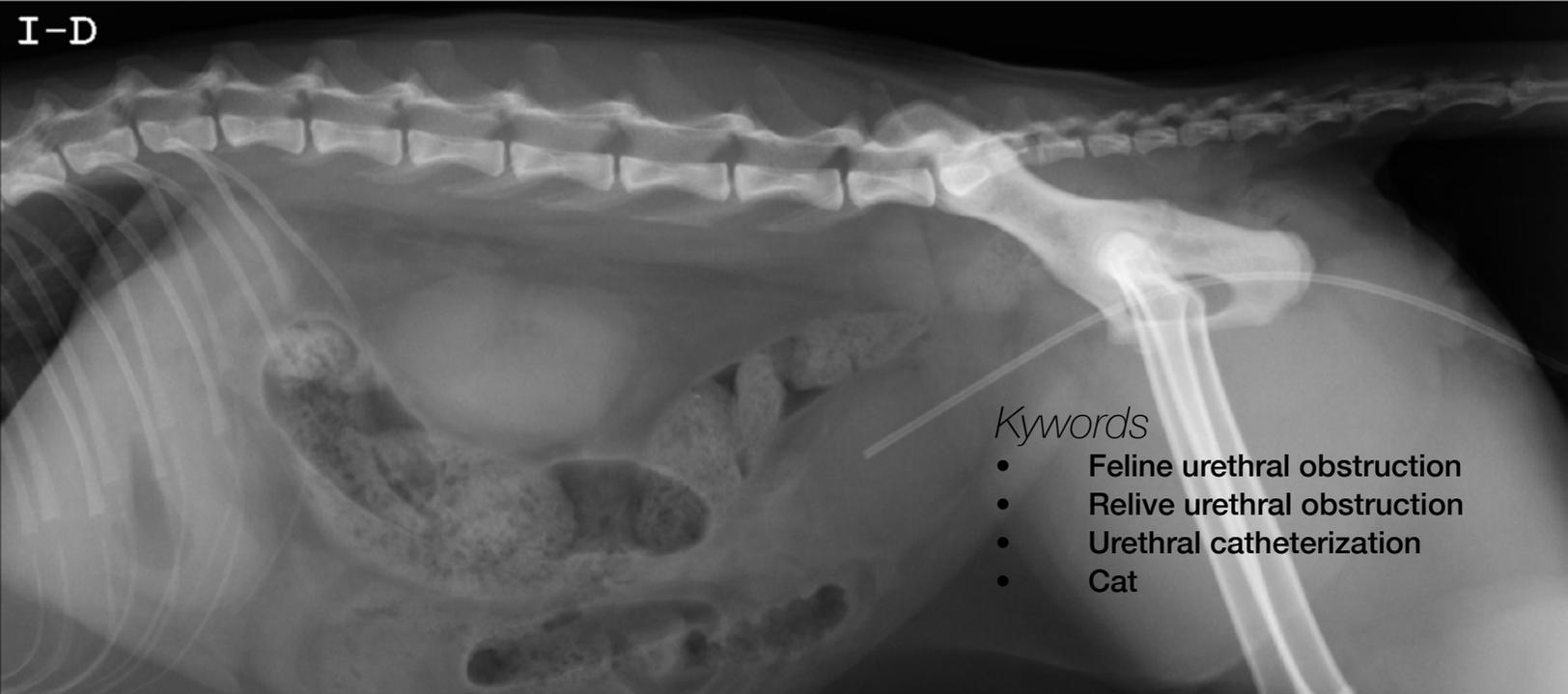
Alicia Pamela Pérez-Sánchez

Israel Alejandro Quijano-Hernández

Hospital Veterinario para Pequeñas Especies, Facultad de Medicina Veterinaria y Zootecnia de la Universidad Autónoma del Estado de México, Toluca-México.

Contact: delangelvet@hotmail.com RRSS: @delangelvet // IG: @delangelvetmex // #NUVetMex // #delangelvet // #hvpeuaemex

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Keywords

- Feline urethral obstruction
- Relieve urethral obstruction
- Urethral catheterization
- Cat

Introduction

Urethral obstruction (UO) is one of the complications most frequently observed in cats with feline lower urinary tract disease (FLUTD) and is mainly associated with idiopathic cystitis, urolithiasis and bacterial infection of the urinary tract. The most common causes of obstruction are urethral plugs, uroliths, urethral spasm, inflammation and edema of the urethral mucosa (1–3). Clinical signs of FLUTD usually include stranguria, periuria, excessive grooming of the perineal area, vocalizations, lethargy and anorexia (1, 4). These are not specific to any particular disease, so the comprehensive diagnostic approach is of great importance when considering the primary cause of UO.

- The article by Del-Angel-Caraza et al. (2017) describes in detail the diagnostic approach to FLUTD.



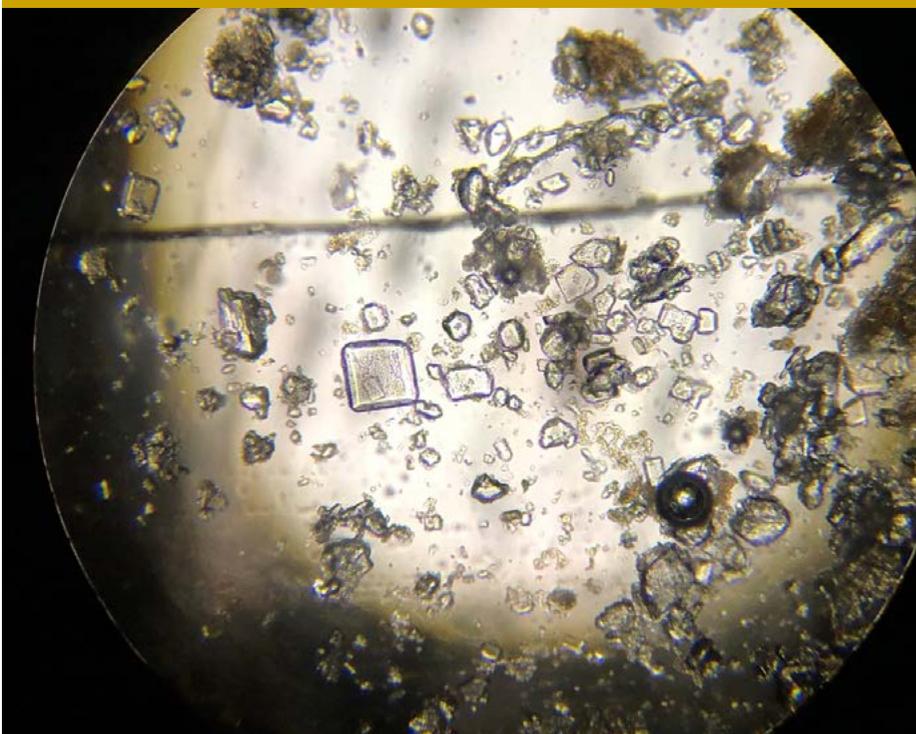
In the patient with UO, physical examination may show a distended and painful urinary bladder, tenderness of the abdomen, penis scoriation by licking, and sometimes the urethral plug can be seen sticking out of the external urethral orifice. In turn, clinical signs associated with dehydration can be seen, such as prolonged skin turgor, dry mucous membranes, bradycardia and hypothermia (2).

Some authors consider urethral plugs to be a primary FLUTD (Figure 1); however, pathophysiologically, these are formed as a result of vasodilation resulting from a chronic inflammatory process, where the permeability of the blood vessels of the submucosa are altered, increasing secretion of mucoproteins in the urinary tract lumen, which act as a agglutinating factor of structures such as erythrocytes, leukocytes, epithelial cells, crystals – struvite or calcium oxalate – and bacteria, increasing their size and making the plug denser (1).

Figure 1. Male cat with blocked urethra. Left: On the inspection of the penis the presence of the urethral plug is observed at the external urethral orifice. Right: Appearance of a part of the urethral plug that was removed with the help of penile massage.



Figure 2. Microscopic image of the urethral plug. Note the large number of struvite crystals.



The presence of urinary crystals in a greater or lesser degree depends on metabolic particularities typical of the species. In cats, the oversaturation of urine with phosphate and ammonium is normal because they are strict carnivores; therefore, struvite crystals are considered a normal component of urine and can commonly form part of the urethral plug (Figure 2).

Some authors suggest that the secretion of mucoproteins and their degradation products can lead to alkaline urine, favoring precipitation of more proteins and struvite crystals, making it very common to find these types of crystals as part of the urethral plug (1).

So, a matrix plug, an inflammatory process that creates pain and causes urethral spasm, and/or the presence of sand or small uroliths, can block the urethra, especially the penile urethra, which is the longest and narrowest area in the case of males, and therefore predisposed to UO (5, 6) (Figure3). However, UO may also be present in females, with lower frequency.

A UO for more than 48 hours can lead to azotemia, hyperkalemia, hyperphosphatemia, metabolic acidosis and acute kidney injury, so it should be considered a medical emergency (1), as the patient may die in 3 to 6 days if not attended to (7). Despite this, it is a treatable emergency with a rate of survival greater than 90% (2).

In addition to the serious alterations described, UO can cause the urinary bladder to be distended severely increasing the internal pressure and causing mucosal injury and urinary bladder wall necrosis (6). The goal of the medical management of UO in the cat is to achieve stabilization of the patient, to seek to reverse the hydroelectrolytic disorders, maintain an appropriate tissue infusion, minimize visceral pain, and provide rapid obstruction relief without traumatizing the urethra when placing the urethral catheter (7).



Figure 3. Male cat with UO by urolithiasis. Left: X-ray where multiple uroliths are observed in the penile urethra. Right: Endoscopic images: by transvesical access, the urinary bladder trigone with uroliths of different shapes and sizes, and the urinary catheter that emerges from the urethral lumen; note inflammation and ulcers in the urinary mucosa due to the trauma generated by the uroliths.



Procedure for relief of UO

The first step in the process of relieving the UO is to perform a decompressive cystocentesis to provide immediate relief to the severe distension, so reducing the risk of bladder necrosis and also to facilitate the retropulsion of any urethral plugs or uroliths and placement of a urethral catheter. In turn, this allows you to obtain a urine sample for urinalysis and urinary culture (4, 8) (Figure 4).

– The article by Aguiñaga-Negrete et al. (2019) describes in detail the technique for correctly performing a cystocentesis.

Sedation, anesthesia and epidural blockage

It is important to consider that trauma or urethral rupture can occur during the process of UO relief if the urethral catheterization is not properly carried out, so the use of general anesthesia or deep sedation is necessary, except in patients who are in a critical condition (9–11).

Because of the severe condition that such patients may have, it is vitally important to place a vascular catheter as a gateway for fluid and emergency drug therapy, in addition to the monitoring of systems during the procedure and recovery. Different anesthetic protocols have been described in the literature that are useful for sedation or anesthesia of the feline UO patient. In our experience, the use of adrenergic alpha-2 receptor agonists such as dexmedetomidine (5–7 $\mu\text{g}/\text{kg}$ IV), pure opiates such as fentanyl, or partial agonists such as buprenorphine (0.005–0.02 mg/kg IM or IV), which can be used in combination with a sedative such as midazolam (0.2–0.3 mg/kg IV), are of great use for sedation and favor the relaxation of the urethra.

Sometimes the combination of intravenous anesthetics is necessary: phenols such as propofol at doses of 2–4 mg/kg IV, or dissociative anesthetics such as N-methyl-d-aspartate antagonists such as ketamine (2–5 mg/kg IV) or the use of inhaled anesthetics such as isoflurane or sevoflurane (12,13). Along with sedation, it is possible to use a sacrococcygeal epidural, which produces anesthesia in the perineum, penis, urethra, colon and anus by blocking the

Figure 4. Male cat with UO. Up: X-ray image with non-presence of uroliths, which was confirmed by ultrasonography. Down: Decompressive cystocentesis in the same patient prior to urethral catheterization.



pelvic and caudal nerves without causing loss of motor function of the pelvic nerves (4) (Figure 5).

The epidural technique uses lidocaine, which generates regional blockade 5 minutes post administration, lasting up to 60 minutes. The use of 2% lidocaine is recommended without any mixture of drugs – for example, epinephrine – at a dose of 0.1–0.2 mL/kg , as it requires a low-volume injection and the effect can be achieved with a single dose. The technique of blocking has been described in different publications (14, 15) (Video 1).

The risk of complications is relatively low, as the spinal cord ends at around the first sacral vertebra in cats, so the risk of penetrating the subarachnoid space is low. Possible complications include infection or abscess at the injection site and the possibility of systemic absorption of lidocaine, although the dosages described for this procedure are considerably lower than those recommended for intravenous administration (14,15); however, continuous monitoring of the patient is necessary.

Figure 5. Sacrococcygeal epidural in a male cat with UO assisted by a neurostimulator device.



Video 1. Sacrococcygeal epidural in a cat with UO with assistance by neurostimulator device.



Initial maneuvers to relieve the UO

Once the patient is relaxed, it is placed in dorsal decubitus. In some cases, it may be necessary to cranially stretch the pelvic limbs in order to expose the perineal region and be able to inspect the prepuce and penis more easily. The penis is exposed and a gentle massage is performed, exerting a slight pressure with gentle rotations with your fingers, by which it is possible to extract the urethral plug or sand, especially if they are near the external urethral orifice (Video 2); this maneuver should be avoided when there are evident uroliths blocking the urethra. A gentle bladder compression should be tried, to induce urination with very little resistance; aggressive compression should be avoided if there is any difficulty in emptying. In many cases, these maneuvers clear the UO and make it unnecessary to place a urethral catheter; however, hospitalization of the patient for medical observation and management is advisable, with 8, 12 or 24 hours of dexmedetomidine (0.0025–0.02 mg/kg c/8 hours VO) and buprenorphine (0.01–0.02 mg/kg c/8 hours VO); with acepromazine (2.5 mg total c/8 hours VO) in cases of very nervous cats (modified from Coopers et al., 2010). It is worth mentioning that some animals may present a greater sedative effect, so the dose should be adjusted. When the patient manages to urinate without difficulty during the first 24 hours, it can be discharged. When it is not possible to relieve the UO with penile massage it is necessary to place a urethral catheter.

Video 2. Penis massage in a cat with blocked urethra. With this maneuver it was possible to remove a urethral plug lodged in the penile urethra.



Types of urethral catheter

The urethral catheterization procedure consists of two maneuvers: first, release the UO; and the second, to place the urethral catheter. Each process requires different material (Table 1) (Figure 6).

Table 1. Material to release UO and for the urethral catheterization procedure in the cat.

<p>Asepsis and antisepsis</p> <ul style="list-style-type: none"> • Shaver • Disinfectant solution (chlorhexidine) • Sterile gloves 	<p>Urethral catheters</p> <ul style="list-style-type: none"> • Flexible, 3.5 Fr x 10, 14 or 18 cm <ul style="list-style-type: none"> • polytetrafluoroethylene (Teflon) • polyethylene with or without barium • Semi-rigid <ul style="list-style-type: none"> • polypropylene
<p>UO release</p> <ul style="list-style-type: none"> • Water-based sterile lubricating gel • Olive-tip catheter (Minnesota catheter) – 21 G x 1/2, 1, or 1 1/2" • 3-, 5- and 10 mL syringes • Venoclysis extensions • 23 G needles • Saline solution 	<p>Other</p> <ul style="list-style-type: none"> • Needle holder and scissors • Nylon suture (2–0 or 3–0) • Sterile urine collection bag

Figure 6. Material to release UO, and urethral catheterization procedure in the cat.





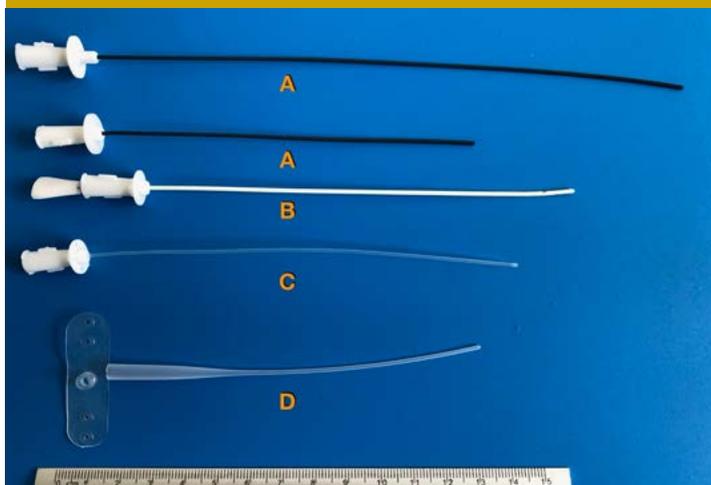
The release of UO is performed with washes. The use of an olive-tip catheter (Minnesota catheter) is recommended. This catheter is metallic and has in its tip an olive with a frontal opening; these are available in 21 G caliber with lengths of 1/2, 1, and 1 1/2"; its special shape facilitates its introduction into the urethral lumen without causing injury and gives a greater pressure when performing washing or irrigation of the urethra with sterile saline solution when used with a venoclysis extension and a 3- or 5 ml syringe (Figure 7).

Figure 7. Olive-tip catheters (Minnesota catheters) of different lengths.



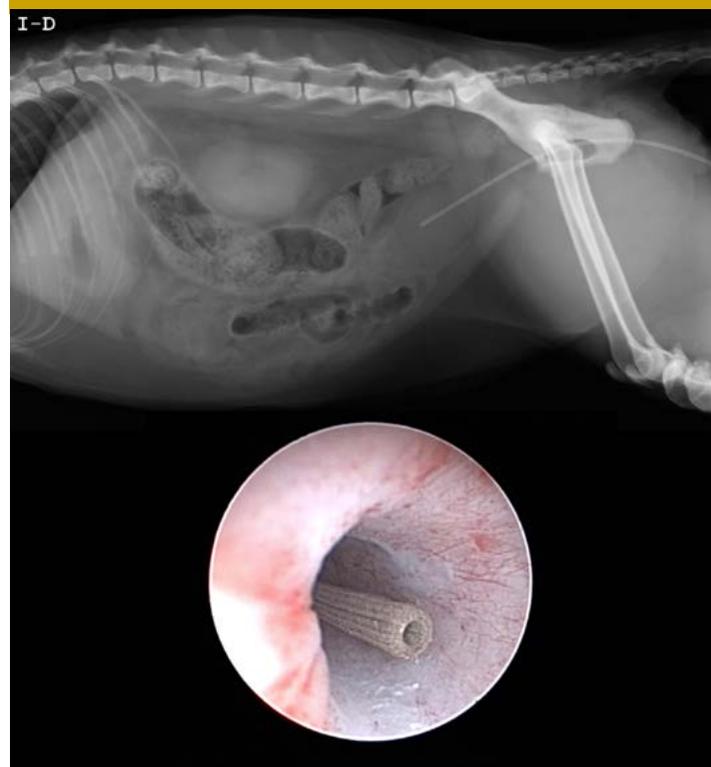
Once the release of the UO has been performed, the use of flexible urinary catheters of polytetrafluoroethylene (Teflon) or low-density polyethylene with barium (radiopaque) or without barium (radiolucid), with or without stylet, is recommended to facilitate the continued emptying of the bladder. The use of conventional semi-rigid polypropylene catheters should be avoided, as these tend to be more traumatic and irritant to the urethral mucosa (Figure 8). In an average-size cat, it is suggested to use 3.5 Fr catheters; those of larger diameter, for example 5 Fr, are associated with

Figure 8. Different feline urinary catheters. A: Flexible polytetrafluoroethylene (Teflon); B: Flexible polyethylene with barium and stylet; C: Flexible polyethylene without stylet D: Semi-rigid polypropylene.



increases in UO due to a greater trauma and inflammation of the urethral mucosa. Catheter length is variable (11, 14 or 18 cm) depending on the size of the patient; the tip should reach the urinary bladder trigone (Figure 9).

Figure 9. Urinary catheter in a male cat. Top: The X-ray image showing the position of a urethral catheter. Down: Endoscopic image of the urinary bladder trigone, the urinary catheter emerging from the urethral lumen. Note how with magnification it is possible to observe the longitudinal grooves in the catheter walls; this characteristic of the Teflon catheter allows its insertion into the urethral lumen without trauma to the urethral mucosa.



Maneuvers to release the UO and urethral catheter placement

The olive-tip catheter should be selected based on the diameter of the urethra and the size of the patient's penis. It should then be connected to a venoclysis extension and a 3- or 5 mL syringe containing saline solution and water-soluble lubricant placed on the tip of the catheter. Because the penile urethra is at an angle of approximately 45° in relation to the pelvic urethra, to insert the catheter the penis must be pulled in a caudodorsal direction to align the urethra parallel to the vertebral column (6) (Figure 10). Introduce the catheter gently into the urethra opening, turning it on its axis and irrigating (washing) with saline solution while at the same time moving it forward with slight pressure on the penis around the catheter so the pressure of the fluid moves the element that is blocking the urethra (16) (Video 3). Avoid pushing the catheter sharply, as this may severely injure the urethral mucosa. Obstructions should be released only by irrigation of the urethra. Once

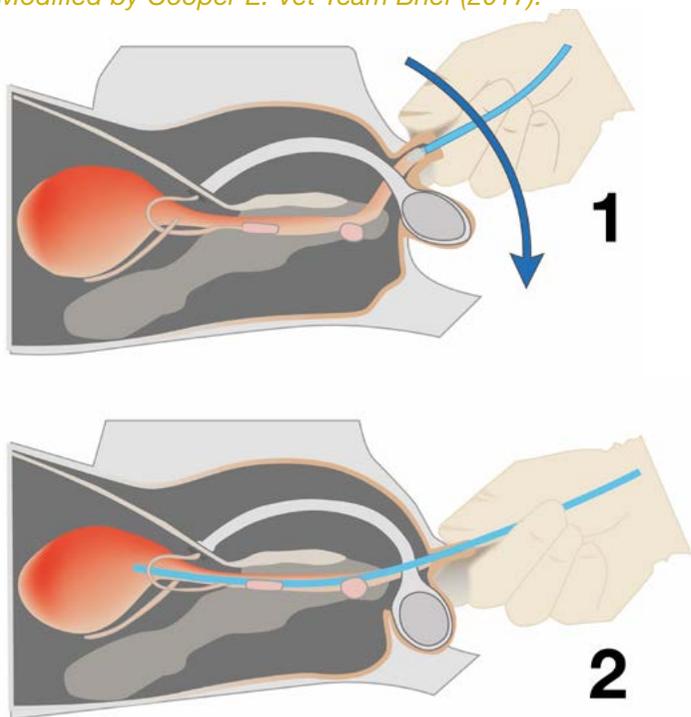


the introduction of the olive-tip catheter is accomplished and there is no resistance to the solution, it is gently removed. If an olive-tip catheter is not available a flexible urethral catheter with frontal opening can be used.

The tip of a flexible urethral catheter should be lubricated with a sterile water-soluble gel and introduced into the urethra, advancing with rotating movements on its axis and pushing it gently; insertion must be with relative ease (Videos 4 & 5). If the catheter does not advance, check the penis position; remember that it must be pulled in the caudo-dorsal direction to align the urethra, aiming for it to be parallel to the vertebral column, which will facilitate the introduction of the catheter. If, even after this it is not possible to advance the catheter, it is necessary to repeat the washing of the urethral lumen. A flexible urethral catheter should not be pushed if it finds resistance as it will bend, damaging it and hurting the urethral mucosa.

Figure 10. Anatomical scheme of the urethra in cats. Observe the traction maneuvers of the penis in a caudo-dorsal direction that allows the alignment of the urethra, facilitating insertion of the urethral catheter.

Modified by Cooper E. *Vet Team Brief* (2017).



Video 3. Release of UO with olive-tip catheter in a cat with a urethral plug.



Video 4. Placement a flexible urethral catheter of polytetrafluoroethylene (Teflon). Note the position of the penis that allows alignment of the urethra and facilitates catheter advancement.



Video 5. Placement a flexible polyethylene urethral catheter with barium and stylet.



In our experience, with this technique the release of a UO and placement of the urethral catheter is easy and without complications, mainly in patients who have not had any type of manipulation of the urethra beforehand. In some animals it is possible to find a rupture of the urethra or urinary bladder associated with maneuvers performed abruptly or incorrectly; so, if there is a suspicion of rupture of the urinary tract it is recommended to perform a retrograde urethrocytography with a contrast agent (17).

Once the flexible urethral catheter is placed, it should be attached to the skin of the prepuce by four simple stitches of Nylon 2-0 or 3-0 and connected to a collection system (Figure 11). It is important to place the collection bag below the level the patient to allow urine to escape by gravity and prevent retrograde flow; the placement of an Elizabethan necklace is necessary to prevent the patient from damaging the collection or urethral catheter (2) (Figure 12). Once the obstruction is resolved, an X-ray study is recommended, as well as an ultrasound of the abdomen, to assess the presence of uroliths and to confirm the correct placement of the catheter (6).

In animals with severe hematuria, the urinary bladder can be gently washed with saline, avoiding distending the bladder (10 mL per wash), to remove the greatest amount of cellular detritus and crystals (18). Washes should be repeated until the liquid is relatively clear. It is recommended that these washes should only be performed just after the urethral catheter has been placed; intermittent bladder washes on subsequent days is not recommended, as they do not reduce significantly the



Figure 11. Patient with urethral catheterization. Top: Urethral catheter fixation system. Note how the clamping plate with holes attaches to the skin of the prepuce with four simple stitches. Down: Closed collection system connected to the urethral catheter.



recurrence of obstructions or shorten the permanence of the catheter or hospitalization duration (18). In our experience, hematuria is controlled in 24–48 hours without further intervention.

Catheter placement allows urethral permeability to be maintained and urine production and characteristics to be monitored; it can be maintained for 36–48 hours until metabolic alterations and urine cellularity have improved (6,7). It is important to mention that some cats with UO may have post-obstructive diuresis on the days following the release of the UO, so urinary density and production should be monitored. This problem is usually gradually corrected with fluid control therapy in the first 36 hours.

It is recommended to continue with oral pharmacological management with dexmedetomidine and buprenorphine and,

Figure 12. The collection bag should be placed below the patient to allow urine to be evacuated by gravity; the use of the Elizabethan collar will prevent the patient from removing the catheter or the collection system



if necessary, acepromazine, adjusting the dose according to the patient's needs, in addition to feeding with a feline therapeutic urinary diet. The use of antibiotics as prevention, together with the placement of aseptic catheters is controversial. Some authors have reported that significant bacteriuria is associated with the placement of urinary catheters, such as of *Escherichia coli* and *Staphylococcus* spp. because these bacteria can ascend into the bladder during catheter placement or when permanently in place in the urethra (19).

So, it is therefore considered prudent to use them in a prophylactic way, avoiding the complications of bacterial cystitis. Once the patient is stable, without abdominal pain and the urine has better characteristics, the urethral catheter must be removed, observing the micturition characteristics for 24 hours. If the patient has no trouble urinating, it may be discharged.

This article considers only the general management of UO in the cat; each patient will present complications of different severity, such as acute kidney injury, hyperkalemia, metabolic acidosis, etc., which should be managed with detailed analysis of each case (10,20).

Remember that UO in a cat is the result of an FLUTD and that with diagnosis and proper medical management of the disease recidivism of the problem can be prevented.



Thanks

Thanks to LMDG Irma Aguiñaga-Negrete for the design and editing of Figure 10.

Original version to this paper (Spanish):

Del-Angel-Caraza J, Aguiñaga-Negrete E, Bernal-Torres AC, et al. Manejo médico de la obstrucción uretral en el gato. REMEVET Septiembre-Octubre 2019;3(15):88-96. <http://remevet.com> Last access: January 6, 2020.

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