

# Urethral catheterization of the male guinea pig (*Cavia porcellus*)

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Urethral catheterization of the male guinea pig has potential diagnostic, therapeutic, and research applications. Urethral catheter placement requires an understanding of the unique anatomy of the lower urinary tract in order to avoid iatrogenic injury to the urethra and to ensure successful catheterization.

Urethral catheterization represents one method for obtaining urine in guinea pigs, although the risk of bacterial contamination of the sample, as well as introduction of infectious organisms from the lower urinary tract into the bladder, should be considered.

Urethral catheterization can be used as a therapeutic technique in animals suffering from urethral tract calculi, which is a common clinical finding in guinea pigs<sup>1</sup>. While no clear sex predilection has been found<sup>2-4</sup>, middle-aged or older guinea pigs seem to have a higher incidence of the disease<sup>3</sup>. The majority of the calculi are composed of calcium carbonate and the etiopathogenesis is not known<sup>4</sup>. Calculi in the lower urinary tract (bladder, urethra) can cause hematuria, stranguria, and dysuria<sup>5</sup>. Urethral catheterization allows retrograde flushing, which may relieve the urethral obstruction by flushing calculi back into the bladder, where they can be removed surgically<sup>1</sup>.

Guinea pigs are used as research models for the human urinary tract. The guinea pig's anatomy of the lower urinary tract and its urodynamic profile of micturation are similar to that of the human<sup>6,7</sup>. Moreover, guinea pigs can be used as research models for the microbial biofilms that readily develop on all types of devices, including urinary, endotracheal, intravenous, and other types of catheters and implants, which are inserted into more than 25% of patients during hospitalization. The incidence of bacterial infections in patients with urinary catheters is approximately 5–10% per day, with virtually all patients who undergo long-term catheterization ( $\geq 28$  days) becoming infected<sup>8</sup>.

## ANATOMY

The guinea pig penis is 's-shaped' (two curvatures). Starting from the glans penis, the distal end of the penis, it runs proximally to the level of the cranial border of the pubic symphysis. The penis is ~40–55 mm long and 4–6 mm in greatest diameter<sup>9</sup>.

The elongate glans penis is shorter than the body and is formed by the distal end of the corpus spongiosus. The glans has the same diameter as the body and is cylindrical in shape. The end of the glans penis is a rounded tip covered with saw-toothed white scales or spurs, a unique feature of hystricomorph rodents (including guinea pigs, chinchillas, porcupines, and nutrias)<sup>10</sup>. The os penis is found within the entire length of the glans and measures ~10 mm in length<sup>9,11</sup>.

The intromittent sac, another unique feature of hystricomorph rodents, is located within the ventral surface of the glans penis<sup>9</sup>, caudoventral to the external urethral opening<sup>12</sup>. It is a long cylindrical pouch, which opens as a wide transverse slit immediately below the urethral orifice. The intromittent sac everts during erection and two 3–5-mm keratinaceous styles, which are attached to the caudal end of the intromittent sac, become visible<sup>9</sup>.

The urethra in male guinea pigs is divided into the pelvic portion (*pars pelvina*) and the spongy portion (*pars spongiosa*). The spongy portion is ~33–50 mm long and 3 mm in diameter. The external opening is the urethral orifice (*ostium urethrae externum*) at the tip of the penis on the dorsal surface. The spongy portion of the urethra follows the s-shaped curve of the penis and has a

smooth internal lining. The pelvic portion is ~15–25 mm long and 4 mm in diameter and has a predominately straight cranio-caudal course. It extends from the urinary bladder neck through the pelvic canal to the penis. The internal lining is smooth, except for an area ~5 mm caudal to the bladder neck, where the accessory gland ducts protrude into the urethral lumen, the *colliculus seminalis*<sup>9</sup>.

## PROCEDURE

The guinea pig does not need to be fasted prior to sedation, but its mouth must be clear of all food or debris. Use cotton-tipped applicators to gently swab all residual food from the oral cavity. In preparation for general anesthesia, premedicate (30 minutes prior to induction of anesthesia) with

## EQUIPMENT

- Sterile lubrication
- Sterile surgical gloves
- 6-ml syringes
- Sterile saline (~100 °F)
- Buprenorphine
- Glycopyrolate
- Gas anesthesia machine (isoflurane/sevoflurane)
- Anesthesia mask and/or anesthesia induction box
- Urethral catheters:
  - flexible, soft, 3.0–5 French
  - Red rubber catheter
  - Feline urinary catheter
  - Feeding tube

buprenorphine (0.03–0.05 mg/kg i.m. or s.c.) for pain management and mild sedation, and glycopyrolate (0.01 mg/kg i.m. or s.c.) for minimization of hypersalivation/aspiration associated with the adverse response to inhalation of gas anesthetic. Inhalant anesthetic gas (isoflurane, sevoflurane) should then be delivered by face mask (or anesthetic induction box), until the guinea pig is unconscious.

Be sure to keep the head and thorax elevated above the level of the abdomen to prevent regurgitation of ingesta and possible aspiration. Also, avoid placing undue pressure on the stomach area, as this too can result in regurgitation and aspiration.

Place the animal in dorsal recumbency with the hind limbs towards the person performing the procedure (Fig. 1). Evert the glans penis from the preputial sac by gentle manipulation. Gently flush the glans and the preputial area with sterile saline to remove any gross debris.

Aseptic technique (including sterile gloves) should be followed for the rest of the procedure. Palpate the bladder and estimate the distance between the glans and the bladder to determine how far the urinary catheter should be inserted. Then, fix the glans between the index finger and the thumb in order to localize the external urethral opening dorsal to the glans (Fig. 2). Take care not to introduce the catheter into the intromittent sac (arrow, Fig. 2), the opening of which is ventral to the external urethral opening. In some cases the intromittent sac might become everted, exposing the two keratinaceous styles; these are normal penile structures.



**FIGURE 1** | Urethral catheterization in a male guinea pig in dorsal recumbency (with the hind limbs toward the person performing the procedure). The glans penis is everted, held between the thumb and forefinger, and extended for catheter placement.

Once the catheter is placed into the external urethral opening, further introduce it in a craniodorsal direction until reaching the first curve of the s-shaped penis. At this point, the penis needs to be further extended in a caudal direction in order to guide the catheter through the first curve. By further gentle manipulation, after passing the second curvature, the catheter will reach the bladder neck. Confirm the proper catheter placement in the urinary bladder by either free-flow of urine in or around the catheter or by retrograde flushing and aspiration with sterile saline. Radiographs and contrast media are other means to confirm correct catheter placement.

**POSTPROCEDURE CONSIDERATIONS**

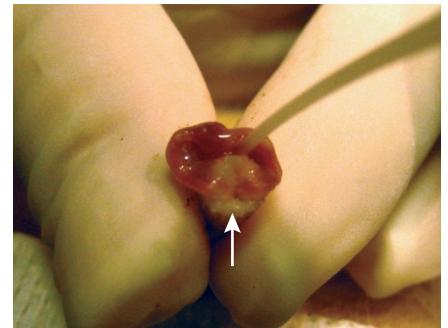
Gently withdraw the catheter after the urine samples are collected or the potential urethral blockage has been resolved. The catheter should be carefully examined for any signs of iatrogenic trauma, such as fresh or clotted blood. If the need exists for an indwelling urethral catheter, employ the same technique described above, then secure the catheter to the animal. Administration of a non-steroidal anti-inflammatory drug such as meloxicam (0.3 mg/kg by mouth every 12–24 hours) has been used in clinical settings in order to prevent or minimize urethral inflammation and spasms secondary to catheterization.

**COMPLICATIONS**

Iatrogenic damage to the periurethral tissue and urethra may occur during catheter placement. Gentle tissue handling is necessary to minimize such complications. It is also possible to tear the urethra, in which case an indwelling catheter is necessary until the urethra heals. Iatrogenic trauma has been reported to occur more often at the colliculus seminalis, ~5 mm caudal to the bladder neck<sup>11</sup>.

Introduction of bacteria into the urinary tract can be minimized during urethral catheterization by administering antibiotics, such as sulfonamides/trimethoprim combinations (30 mg/kg by mouth every 12 hours), after collecting urine samples.

Aspiration of food from the oral cavity into the trachea is a potential complication associated with anesthesia in guinea pigs. This can result in a life-threatening pneumonia. To help prevent this outcome, swab



**FIGURE 2** | The penis is held gently but firmly between the thumb and forefinger while a urinary catheter is placed into the external urethral opening dorsal to the glans penis. Care should be taken not to introduce the catheter into the intromittent sac (arrow).

the animal's oral cavity prior to and immediately after anesthetic induction. Also, maintain the head and chest of the animal above the level of the abdomen at all times.

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