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Dr. Bharathidasan M
Assistant Professor, Department of Veterinary Surgery and Radiology, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India

Padmaja S
UG Intern Student, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India

Aathi Nagulan S
UG Student, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India

Dr. Shanmugasundaram A
Assistant Professor, Department of Wildlife Science, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India

Dr. Shiju Simon M
Assistant Professor, Department of Clinics, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India

Dr. Mohamed Shafiuzama
Professor and Head, Department of Veterinary Surgery and Radiology, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India

Corresponding Author:
Dr. Bharathidasan M
Assistant Professor, Department of Veterinary Surgery and Radiology, Madras Veterinary College, TANUVAS, Chennai, Tamil Nadu, India

Precision surgery for trigonal cystic calculi removal in a New Zealand white Rabbit: A case report

Bharathidasan M, Padmaja S, Aathi Nagulan S, Shanmugasundaram A, Shiju Simon M and Mohamed Shafiuzama

Abstract
A three-year-old, female New Zealand white rabbit (*Oryctolagus cuniculus*) weighing about 3 kg was presented with a history of anorexia, depression, constipation, dysuria & hematuria for the past 4-days. The abdomen was distended and animal evinced pain on palpation. Radiograph revealed a solitary radio-opaque cystic calculi. Haemato-biochemical analysis revealed elevated creatinine (3.5 mg/dL) and urea nitrogen (34 mg/dL) levels. Under general anesthesia with isoflurane in a non-rebreathing circuit, midventral celiotomy was performed followed by cystotomy and a solitary cystic calculus (2 cm diameter) removed. Postoperatively, parenteral antibiotics and analgesia were administered for five days. The owner was advised about feeding management. Prompt presentation, early diagnosis and immediate treatment contributed to a successful outcome in this case.

Keywords: Celiotomy, cystic calculi, cystotomy, distended abdomen, female rabbit

1. Introduction
Uroliths, also known as bladder calculi, are a common medical condition in rabbits, affecting individuals of all ages and breeds. These stones can occur anywhere in the urinary tract and may vary in composition. However, they are most commonly composed of calcium salts, predominantly calcium phosphate or calcium oxalate (Hoefer, 2006) [7], with calcium carbonate being the most frequently reported urolith in domestic rabbits (Osborne *et al*., 2009) [10]. The etiology of urolithiasis is multifactorial, involving both physiological factors, such as genetic predisposition, urinary tract infections, neoplasia, obesity, and alterations in urinary pH, as well as management-related factors, including insufficient water intake, poor litter hygiene, excessive dietary calcium supplementation, and vitamin B6 deficiency. A key contributor is the rabbit's distinctive mechanism of calcium absorption, filtration, and excretion (Harcourt-Brown, 2013) [6]. Rabbits are highly efficient at absorbing calcium from their diet, with excess calcium being excreted via urine, unlike most mammals, which excrete it through their feces. Intestinal absorption is also independent of vitamin D levels with a fractional excretion of 45-60% compared to 2% in other mammals (Quesenberry *et al*., 2011) [11]. An imbalance in calcium metabolism whether from excessive intake, impaired excretion, or both can lead to the precipitation of calcium salts within the urinary bladder. Clinical signs of urolithiasis include dysuria, stranguria, hematuria, lethargy, hunched posture, abdominal pain, and anorexia, all of which demand prompt diagnosis and intervention. Radiographic imaging is the preferred diagnostic method, as the calcium-rich uroliths are radio-dense and easily detectable on radiographs (Hoefer, 2006) [7]. Differentials include uterine adenocarcinoma, pyometra, dystocia, urinary tract neoplasia, uterine polyps, cystitis or renal infarcts (Redrobe, 2010) [13]. Treatment options depend on factors such as stone size, clinical signs, duration, and severity, with choices ranging from medical management to surgical removal (Smith, 2021; Wong *et al*., 2021) [14, 16]. This case report details the clinical presentation, diagnostic approach, and successful surgical removal of a solitary trigonal cystic calculus in a female New Zealand White rabbit.

2. Case History and Clinical Examination
A female New Zealand White rabbit (*Oryctolagus cuniculus*) was presented with a history of anorexia, depression, constipation, dysuria, and hematuria for the past four days.

The rabbit displayed signs of discomfort, including teeth grinding (bruxism), a hunched posture, and pressing its abdomen against the ground, all suggestive of abdominal pain. Upon general clinical examination, the rabbit appeared lethargic and depressed, with a placid expression and overall fair body condition. Notably, the abdomen was distended, and palpation elicited signs of pain, further raising suspicion of urological pathology. Haemato-biochemical analysis revealed elevated creatinine (3.5 mg/dL) and blood urea nitrogen (34 mg/dL) levels. Urinalysis was performed, revealing a positive dipstick test for blood, while urine culture showed no bacterial growth. The urine's specific gravity was recorded at 1.020. A radiographic examination, including lateral (Figure 1a) and ventro-dorsal views (Figure 1b), identified a solitary radio-opaque cystic calculus within the urinary bladder, confirming the diagnosis of cystic calculi. Given the history, clinical signs, physical examination, Haemato-biochemical analysis, urine analysis, and radiographic findings, the diagnosis of cystic calculi was confirmed, and surgical intervention was deemed necessary.

3. Surgical intervention

3.1 Preoperative Care

Prior to surgery, the rabbit was stabilized to minimize anesthetic risks and ensure a successful outcome. Supplemental oxygen was administered before induction to enhance myocardial oxygenation and improve the animal's tolerance to anesthesia. Pre-anesthetic medication included butorphanol (0.5 mg/kg, intramuscularly) to provide analgesia and reduce stress. Anaesthesia was induced with 4% isoflurane via mask induction. An indirect method of endotracheal intubation was performed using a 3mm ID tube, guided by an infant feeding tube to ensure a secure airway and maintained with 3% isoflurane in a non-rebreathing circuit (Figure 2). During the procedure, vital parameters such as respiratory rate and depth were meticulously monitored to ensure hemodynamic stability. These preoperative measures were pivotal in minimizing stress, optimizing anaesthesia, and preparing the rabbit for a successful surgical outcome.

3.2 Surgical procedure

The rabbit was positioned in dorsal recumbency, and the surgical site was aseptically prepared. A caudal celiotomy was performed and the urinary bladder was exteriorized (Figure 3a). Stay sutures were placed to secure the bladder to minimize the risk of contamination. A sterile laparotomy sponge was used to prevent urine spillage into the peritoneal cavity. A longitudinal incision was made over the ventral aspect of bladder away from the uthera (Figure 3b), revealing the urolith deeply lodged in the trigone. A buster urinary catheter was introduced through the urethra to assist in the retrograde movement of the calculi into the bladder (Figure 3c). The urolith, approximately 2.5 cm in diameter and roughly the shape of an egg (Figure 4), was carefully removed using atraumatic forceps. Great care was taken to avoid excessive manipulation to protect the delicate urethra. The bladder was thoroughly irrigated with sterile normal saline to ensure the complete removal of any debris and to reduce the likelihood of recurrence. The bladder wall incision was closed using polyglactin 910 (Vicryl) 4-0 in a single layer simple continuous pattern, ensuring a watertight seal. The *linea Alba* was sutured with polydioxanone (PDS) 3-0 in a simple continuous pattern, while the subcutaneous layer was closed with polyglactin 910 (Vicryl) 3-0 in a simple continuous pattern. Finally, the skin was closed using Polyamide 3-0 in an interrupted pattern to ensure proper wound apposition and minimize postoperative complications.

3.3 Post-Operative Recovery

Peri-operative monitoring was done to ensure a smooth induction and recovery from anesthesia. The animal was placed in a warm, quiet environment with minimal handling to reduce stress. Post-operative pain management with syrup. Meloxicam (0.1 mg/kg, twice daily for five days) to control inflammation. Syrup. Enrofloxacin (5 mg/kg, orally for seven days) was administered to prevent secondary bacterial infections. Additionally, enzymatic supplements (twice daily for five days) were given to aid in pain relief, reduce inflammation, and promote wound healing post-surgery. To prevent self-inflicted trauma to the surgical site, an Elizabethan collar was recommended to restrict excessive movement and licking of the incision.

Nutritional management was crucial in supporting the rabbit's recovery. A low-calcium diet, including fresh leafy greens, hay, and ad libitum water, was provided to promote urinary dilution and reduce the risk of stone recurrence. Over the following days, the rabbit showed steady improvement, with an increased appetite, normal urination, and a more active demeanor.

The successful post-operative management ensured a complete recovery, underscoring the importance of early diagnosis, timely surgical intervention, and diligent post-operative care in managing cystic calculi in rabbits.

4. Case discussion

Bladder stones in rabbits are most commonly composed of calcium salts, particularly calcium carbonate (Osborne *et al*., 2009) [10]. Other types of stones that have been identified include calcium phosphate, magnesium-calcium phosphate carbonate, calcium oxalate, silica, magnesium-calcium phosphate, struvite, and matrix stones. However, each of these stone types accounted for less than 5% of all uroliths during a given study period (Osborne *et al*., 2009) [10]. In addition to the rabbit's unique calcium metabolism, several other risk factors for urolithiasis have been proposed. Some researchers suggest that rabbits have a lifelong requirement for dietary calcium due to their continuously erupting teeth, which implies that the ingestion of a high-calcium di*et al*one is unlikely to be the sole cause of urolithiasis in this species (Redrobe, 2002; Harcourt-Brown, 2007) [12, 5]. Furthermore, wild rabbits tend to consume large quantities of calcium-rich legumes, indicating that these animals must be adapted to a high load of dietary calcium (Clauss *et al*., 2012) [1]. Other potential risk factors for urolithiasis, alongside high-calcium diets, include dehydration, inactivity, obesity, vitamin and mineral supplementation, and urine retention resulting from improper litter management (Harcourt-Brown, 2013; Quesenberry *et al*., 2011) [6, 11].

Rabbits increase their water intake when fed high-fiber diets, coupled with increased caecotroph consumption. Therefore, feeding a diet that is moderate in calcium, high in fiber, and accompanied by ad libitum access to water is recommended for the prophylaxis of urolithiasis in domestic rabbits (Clauss *et al*., 2012; Martorell *et al*., 2012) [1, 8]. Since the complete blood count (CBC) and biochemistry profile are typically part of the initial diagnostic tests, along with urinalysis,

identifying potential changes in blood work associated with urolithiasis is essential (Meredith, 2014) [9]. In this case, the blood work revealed neutrophilia, indicating the presence of infection, as well as a significant increase in creatinine levels, suggesting an excretory-related cause for the clinical symptoms. This could be attributed to renal damage caused by hydrostatic pressure on the kidneys, along with increased creatinine reabsorption from the bladder due to prolonged urine stasis in cases of urinary obstruction. Electrolyte analysis often shows hypercalcemia, with the normal total calcium concentration in rabbit serum being 14 mg/dL (Martorell *et al*., 2012) [8]. Urinalysis of healthy rabbits typically reveals dull yellow to brown urine with an alkaline pH of 8.2, a low specific gravity (ranging from 1.003 to 1.036), and a high quantity of triple phosphate and calcium carbonate crystals (Redrobe, 2010; Quesenberry *et al*., 2011) [13, 11]. Prerenal azotemia is suspected when specific gravity is increased, whereas renal azotemia is indicated by reduced specific gravity (Quesenberry *et al*., 2011) [11]. Radiography is an excellent screening tool for identifying radiopaque uroliths and is often the most accessible imaging modality for first-opinion practitioners, especially compared to ultrasound or CT (Fisher, 2006, 2007) [3]. Excretory urography, using serial radiographs, can also be performed to further assess renal architecture and ureteral patency if obstructive urolithiasis is suspected (Hallman & Brandão, 2020) [4]. In medical management, urinary acidifiers are of no use due to the alkaline pH of rabbit urine. Aggressive fluid therapy, dietary modifications, and catheterization appear to be the most effective treatment options. For larger uroliths, surgery is often the treatment of choice, typically performed after proper stabilization. Surgical complications can include bladder rupture, urine leakage from the incision site, urinary incontinence due to urethral damage, ureteral injury from improper incisions, and the formation of adhesions with surrounding tissues (Szabo *et al*., 2016) [15]. These potential complications were carefully considered during this case, and meticulous attention was paid during the procedure to ensure an uneventful recovery.

Figures

Fig 1a: Lateral view radiograph showing one large radio dense cystic caliculi lodged at the pelvic inlet

Fig 1b: Ventrodorsal view radiograph showing radio dense caliculi in the bladder.

Fig 2: Positioning in dorsal recumbency after endotracheal intubation maintaining anesthesia with Isoflurane in an open circuit.

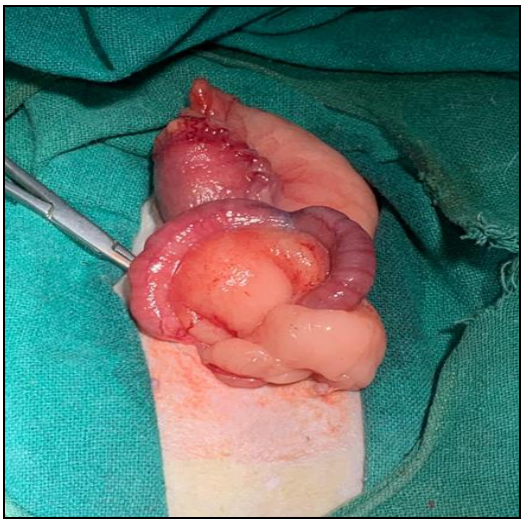

Fig 3a: Exteriorization of the bladder and uterus

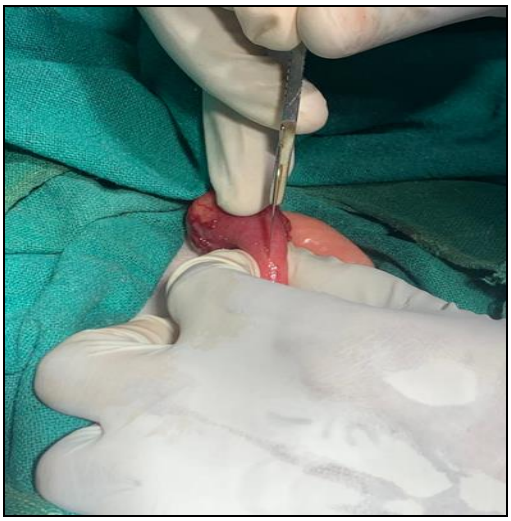

Fig 3b: Cystotomy incision made in the less vascular area of the ventral surface of the bladder

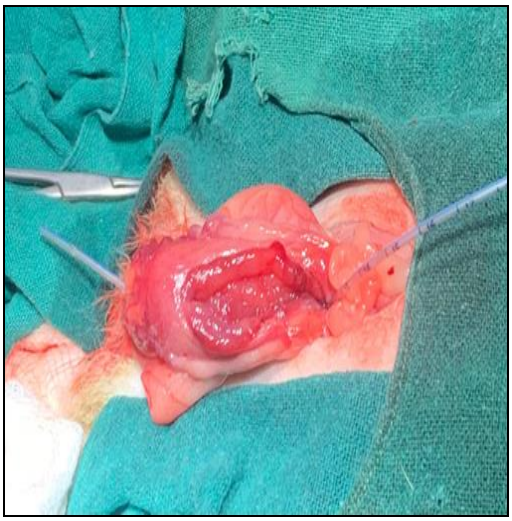

Fig 3c: Retrograde catheterization after removal of the caliculi

Fig 3d: Closure of the cystotomy incision in a single layer simple interrupted pattern

Fig 4: The removed large cystic caliculi resembling an egg with a 2.5 cm diameter

5. Conclusion

Long-term dietary adjustments, emphasizing a reduction in calcium intake, increased hydration, and the encouraging regular physical activity, were crucial in preventing recurrence. This case highlights the critical importance of prompt veterinary intervention in suspected urolithiasis in rabbits, while also reinforcing the need for proactive dietary and management strategies to minimize the risk of stone formation in pet rabbits.

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Conflict of Interest

Not available

Financial Support

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