

Nephroliths and uroliths (calculi) in rabbits

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Warning: this file contains pictures that may be distressing for people.

Nephroliths and uroliths, also called kidney and bladder calculi or stones, are regularly seen in rabbits, independently from age and breed. Male rabbits are more prone to the development of stones, due to their long urethra. These stones are rock-hard crystal aggregations that exist in a range of shapes and sizes. When they are small, but present in large quantity, the condition is referred to as "sludge" or "sand".

The basic mineral components of urinary calculi are usually struvite (magnesium, ammonium, or phosphate), oxalate, carbonate, uric acid, urate, or cystine. In rabbits, they are commonly composed of calcium carbonate or oxalate dehydrate.

The presence of sand (sludge) or urinary calculi is irritating and will lead to damages, like kidney failure or the appearance of mucosal hemorrhages on the bladder wall. As a consequence, there is bleeding and appearance of (microscopic) hematuria (presence of blood in the urine). Smaller stones pose an additional danger as their presence can lead to the obstruction of one or both kidneys, or they pass into the ureter, where they cause



Christine Macey



Hilde Seep

Stones extracted from the bladder of rabbits, in relation to a US ruler (inch), or an Eastern chocolate egg



obstructions. The urine flow will be partially or totally blocked and the rabbit will not be able to urinate. This will lead to irreversible damage of the kidney and death if left untreated.



The exact cause leading to the formation of bladder or kidney stones is unknown, but a variety of predisposing factors are known to play a role. They include:

- Physiological causes:
 - a genetic predisposition, that affect the functioning of the kidney,
 - presence of bacteria in the bladder,
 - a kidney disease that influence the excretion of calcium,
 - a bladder disease, with a modification of the lining of the wall, due to the presence of pathogen bacteria or neoplasia (tumor, polyps),
 - obesity, arthritis, leading to urine retention due to reduced visits to the litterbox.
 - change of the pH of the urine.

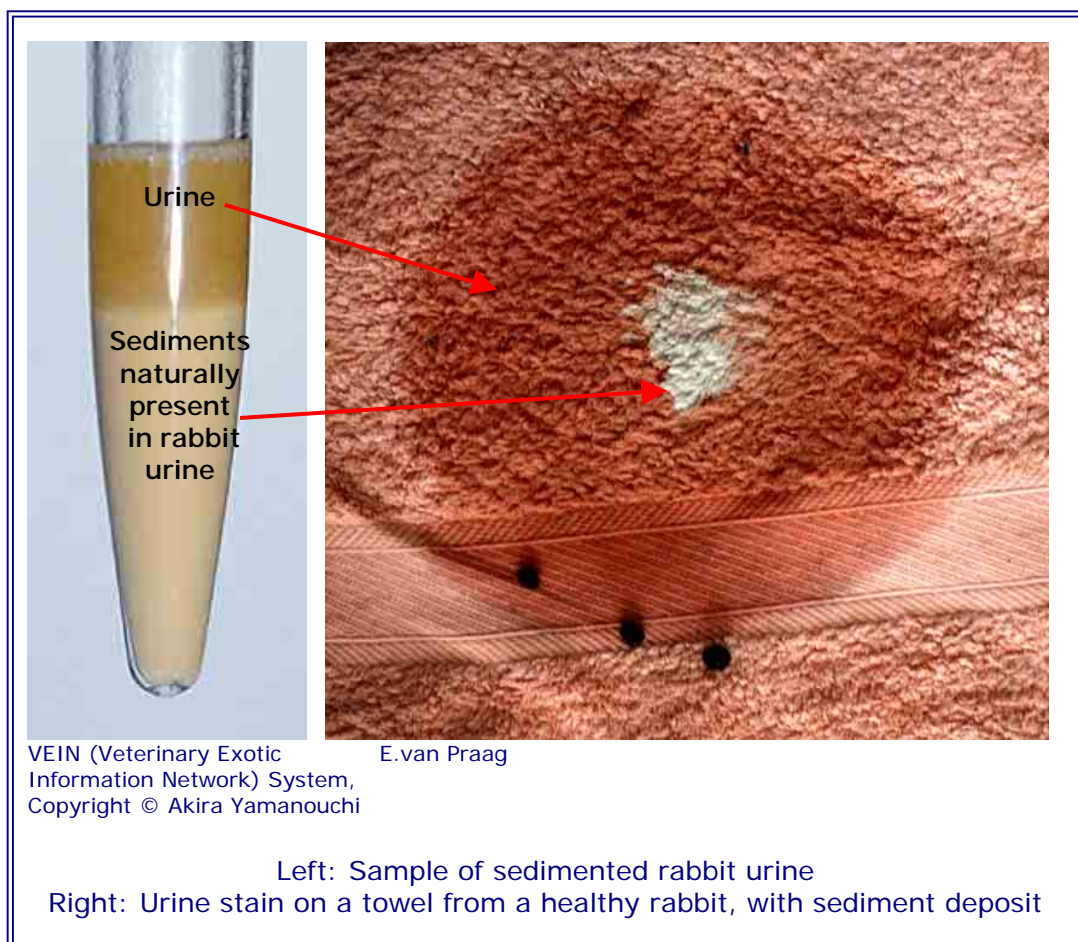


- Husbandry causes:
 - reduced water intake, due to a difficulty to drink from a bottle, a defective water bottle, overturned crock, lack of fresh water, or addition of medication in the drinking water.
 - improper litter possibilities, due to an unclean litter-box, or one place in a wrong location.
 - calcium supplementation
 - Vitamin B6 deficiency, leads to increase formation and excretion of oxalates.

High urine pH

The urine pH in rabbits is naturally high, between 7.6 and 8.8; with a specific gravity is around 1.003. The later is difficult to measure due to the presence of calcium and crystals (struvite, calcium carbonate, more rarely oxalate).

A high pH favors the development of bacteria and UTI. Most commonly found bacteria are *Escherichia coli*, *Proteus spp.* and *Staphylococcus spp.*, sometimes true-anaerobic bacteria are found. The bacteria will start to



excrete waste (ammonium) and an enzyme, urease that will break down the urea. The high pH will accelerate the precipitation of struvite crystal.

The presence of bacteria can be checked by sending a sample of urine for bacterial culture (urine is normally sterile). An alternative is to keep the removed uroliths, open it, and use the central part for bacterial culture or have the stone examined for the crystals composition. Indeed, some bacteria are associated with a particular type (e.g. *Staphylococcus* spp. is associated to struvite calculi).

Calcium in the diet

The calcium content of the diet is often pointed as a cause for the formation of nephro- and uroliths. While the equation "more calcium intake = more calcium excretion" is true, it has been shown that feeding a high calcium diet to rabbits resulted in the calcification of the kidneys (and the aorta), the excretion of the excessive calcium via the urine, and not in the formation of stones. It was, however, found that a short-time obstruction of the urinary ducts would inexorably lead to the formation of stones. Causes for such obstruction can be sludge, presence of a bacterial infection, an abscess or neoplasia (e.g. tumor, presence of polyps).

The calcium content of the diet is not the primary factor leading to the formation of stones in rabbits – rather a contributing factor – and it is important to look for the main cause or underlying diseases.

In an attempt to reduce the calcium intake, it is sometimes advised to feed a low-calcium diet and/or stop feeding pellets. This is not recommendable.

A diet low in calcium or devoid of pellets can lead to mineral and nutrient deficiencies.

Symptoms

A rabbit suffering from stones is often in pain. As a result, its appetite is decreased, it is depressed and it may whine when urinating. Often, frequent and long urination is observed, accompanied by urine dribbling. In some cases, the urine is so rich in sediments (calcium carbonate) that the urine takes a paste-like consistency, and stains the perianal region.

Hematuria is commonly seen. The amount of blood ranges between:

- microscopic amount, that can only be determined with help of a dipstick or by microscopy,



- large amounts of blood that color the urine in red or brown. The later condition must be differentiated from the presence of porphyrin, a plant pigment that naturally colors the urine in orange or red.

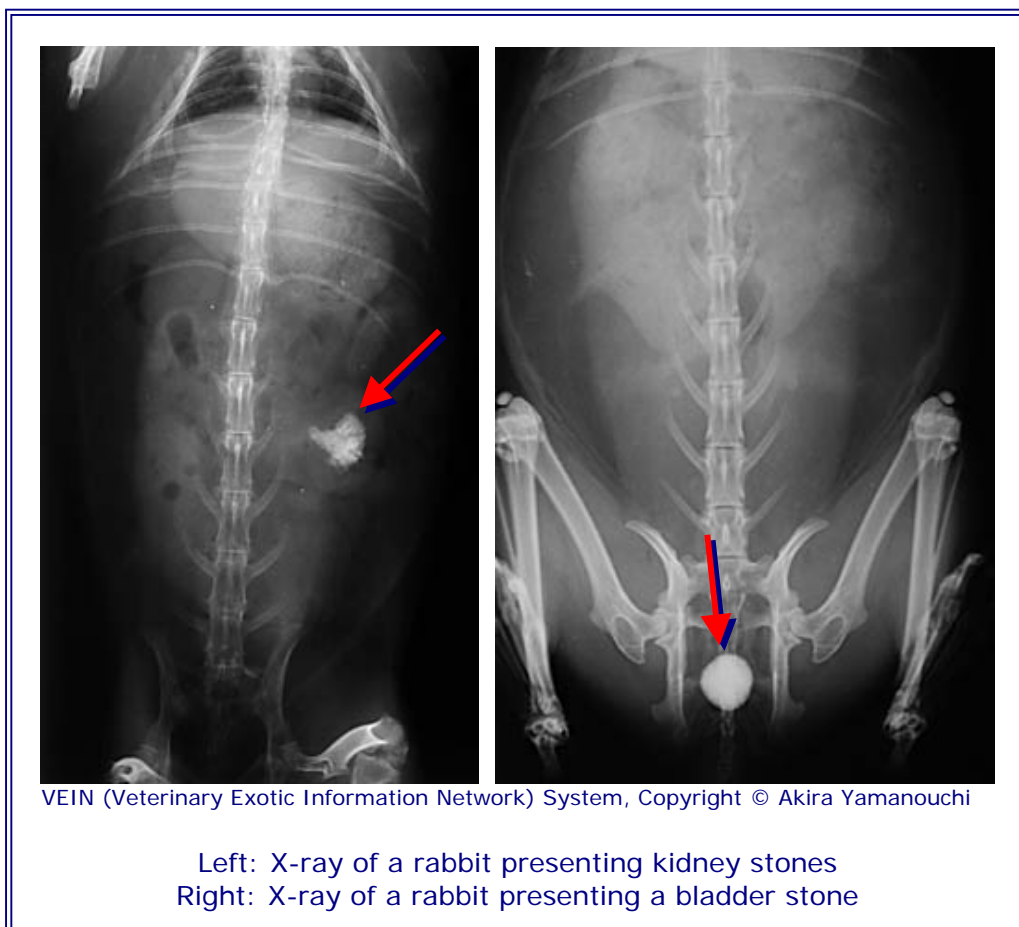
NOTE: in female rabbits, the origin of the blood in the urine must be determined, in order to rule out a uterine disease. In the later, the blood appears only at the end of the urination process, forming a stain in the middle of the urine puddle. This is a serious condition, which requires urgent treatment.

Diagnosis

The presence of stones may be detected by palpating the bladder, which located in the caudoventral abdomen. This must, however, be done with care, in a co-operative rabbit only.

More reliable and precise diagnostics tools are X-ray and ultrasonography.

A KUB (Kidney, Ureter, Bladder) X-ray picture will reveal all calcium based stones larger than 2 mm. Uric acid stones are not detected by X-ray, but those are exceptionally seen in rabbits. The X-ray picture will help determine the size, the location and the number of stones present. It is



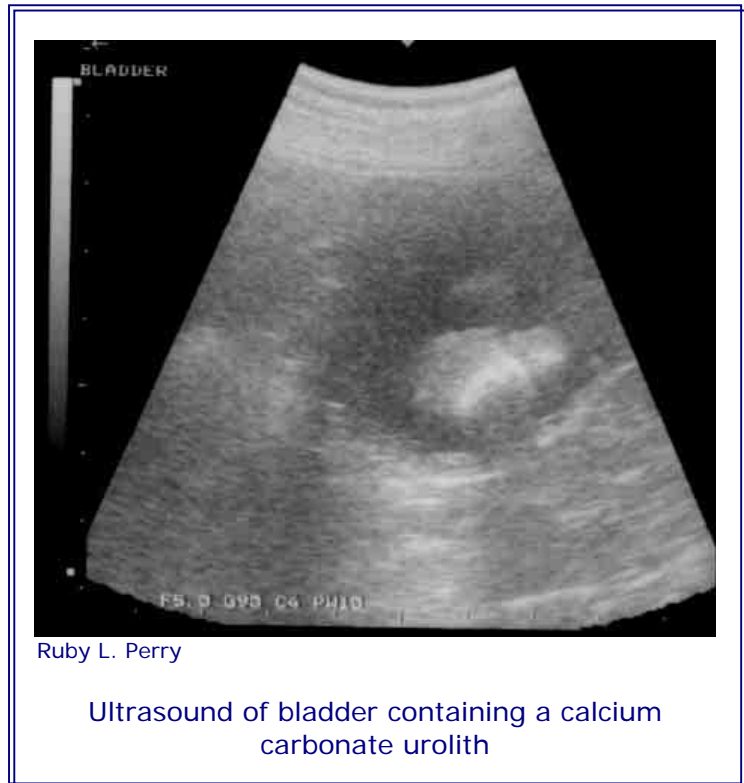
indeed important to verify the presence of stones in the kidney, the urinary ducts (urethra and ureter) and in the bladder, before starting their surgical removal.

It is advisable to accompany the X-ray examination of the urinary tract by ultrasonography (ultrasound examination), as it can detect stones of 1 to 2 mm of diameter, than remain unseen on X-ray. Besides stones, it enables to get a picture of the bladder wall, the kidney tissues, and can show the presence of a blockage inside the kidneys or the ureters.

Exceptionally, CT scans can be made, when an obstruction is suspected. It

may furthermore reveal further non-stone related problems, which may be mimicking the same symptoms or discomfort.

Last, but not least, an accompanying urine and complete blood panel analysis, including serum biochemistry, will help determine the general health condition of the rabbit, more particularly the functioning of the liver and the kidney.



Treatment

Depending on the size of the calculi, several treatment options are possible.

When sand is present in the bladder, catheterisation and flushing brings good results. Indeed, manual expression of the bladder is not recommended, as this organ can easily be ruptured, all the more in presence of a small calculus that can block the urethra. The placement of a urinary catheter (e.g 5 French polypropylene or rubber catheter) is relatively easy in male rabbits and requires only an injection of butorphanol tartrate and the application of lidocaine on the prepuce (fold of skin near the tip of the penis). Female rabbits often require a full anesthesia to place the catheter. The female rabbit is placed in ventral recumbency, with the rear limbs hanging off the edge of the table. The catheter is gently introduced (blind

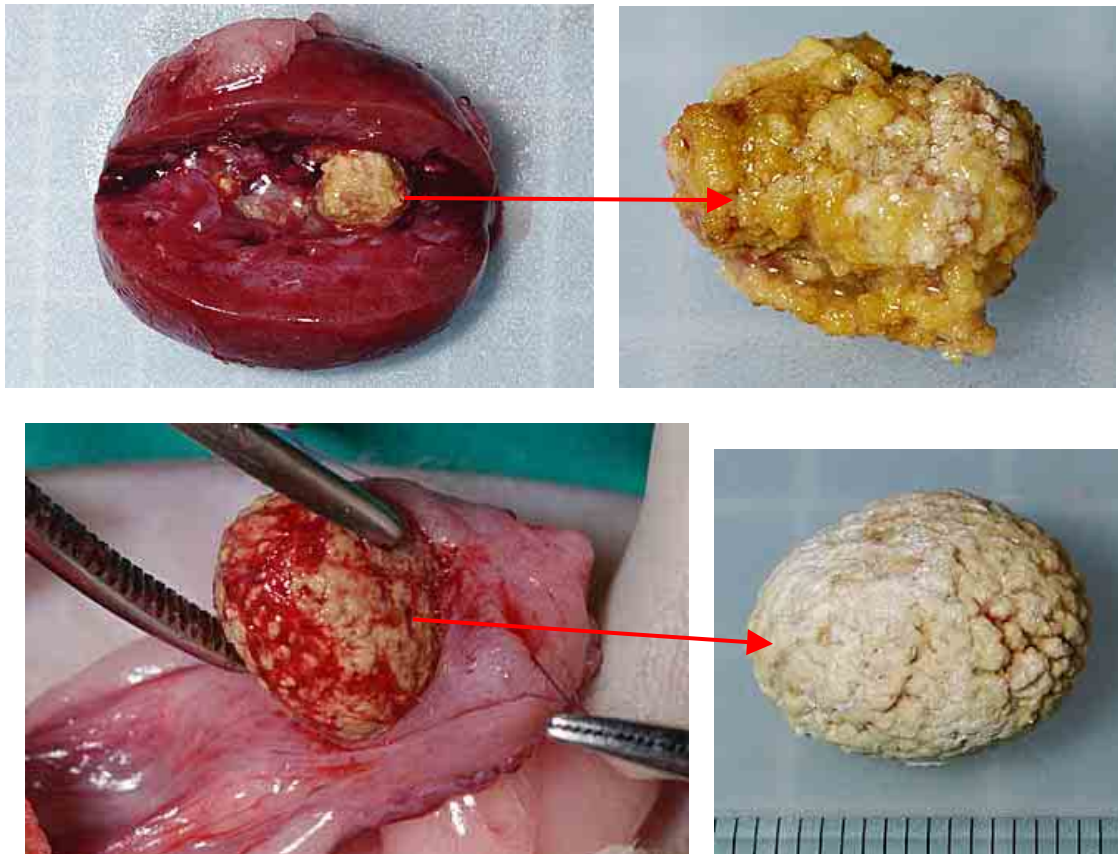


guide) and its placement is confirmed by X-ray. Another approach is to anesthetise the rabbit and administrate diazepam to relax the sphincter, before placing the catheter.

The bladder is carefully flushed with a lukewarm saline solution, after which the solution is removed with a syringe. Alkaline chemical solution that can dissolve urinary calculi are used (acidic solutions lead to bladder and urethra damage). The process is repeated several times.

In case the rabbit cannot be anesthetized, the alternative consists of massive administration of fluids (within safe range), followed by the administration of a diuretic drug (e.g. furosemide). This can be repeated over a few days, each time in well-hydrated rabbits.

Surgery remains the sole option when the urinary calculi are large. After induction of anesthesia, the bladder will be exteriorized and opened. After removal of the stone, it is advisable to take a sample of the bladder wall, for bacterial culture.



VEIN (Veterinary Exotic Information Network) System, Copyright © Akira Yamanouchi

Top: Surgically removed rabbit kidneys with stone (left) and detail of the stone (right)

Low: Surgical removal of a bladder stone (left) and details of the stone (right)



Post-surgical care includes pain medication, antibiotic therapy when necessary, and the analysis of the underlying cause leading to the formation of urinary calculi or sludge.

Long-term management includes increase of water intake by the rabbit, for example by administration on small amounts of subcutaneous fluids once every second day. This will help flush his kidney and bladder and avoid the accumulation of compounds prone to start a stone.

Various products can furthermore be given to the rabbit in order to decrease slightly the pH of the rabbit. They include:

- feeding fresh or dried cranberry daily or non-sweetened cranberry juice.
- feeding vitamin C. For smaller animals, the intake of Vit C is up to 100 mg, probably best between 25-50 mg/kg rabbit once a day. Part of the Vit C will be converted in oxalates, which may start a stone, but studies showed that high intake of Vit C did not contribute to the formation of stones. The subject remains a bit controversial among professionals.
- use of citrate based products (e.g. Polycitra®) in order to change the pH of the urine, in rabbits that suffer from chronic urinary tract infection or uroliths (bladder stones). The daily dosage in dogs is: 150 mg/kg dog per day. It has been used in rabbits and seems to have delayed the formation of new stones.
- use of acidifiers like ammonium chloride (200 mg/kg/day, PO, TID) and DL-methionine (1,000-1,500 mg/cat/day, PO) may help acidify the urine. It should be kept in mind that chronic urine acidification of the urine is harmful to the rabbit, and should be used only after careful examination of the animal.

It is not so much the product that is important, but the fact that the urine is acidified. This acidification dissolves the magnesium-ammonium-phosphates stones or prevents their formation.

Acknowledgement

Thanks are due to Christine Macey (USA), Hilde Seep (The Netherlands), Prof. Ruby L. Perry (College of Veterinary Medicine, Michigan State University, USA), and to Akira Yamanouchi (Veterinary Exotic Information Network, <http://vein.ne.jp/>, Japan), for the permission to use their pictures.

Further Information

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JULY 2004
updated: Mai 2006

