



Administration of *Strobilanthes crispus* in an Angora Cat with Feline Lower Urinary Tract Disease

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ABSTRACT

The occurrence of feline lower urinary tract disease (FLUD) in Indonesia has not been widely reported. However, the incidence of the disease has increased due to dietary cat patterns. The diet habitually consists of commercial dry food only, without wet food, such as meat. FLUD often affects certain breeds of cats. Surgical therapy is the first option to remove kidney stones; however, rural areas in Indonesia often lack animal surgical facilities. This condition requires alternative therapies to cure the disease. A one-year-old male Angora cat was brought to Rumah Satwa veterinary clinic in Tanah Datar, Indonesia, for examination, with a history of urination difficulties or dysuria, pain in the abdomen when being handled, and lack of desire to mate. A macroscopic examination of urine showed a cloudy and dense appearance. The ultrasound examination revealed a stone (struvite) and a thickening of the urinary bladder wall. The Angora cat was diagnosed with obstructive FLUD caused by urolithiasis. A capsule containing 125 mg Keji Beling (*Strobilanthes crispus*, BI) extract was administered to the cat once daily to aid the struvite stone dissolution. Keji Beling is a herbal plant easily found in Indonesia and used to treat human kidney stones. After 32 days of therapy, the clinical condition of the cat improved. The ultrasound examination did not find any stones left in the bladder. In conclusion, based on local wisdom, Keji Beling leaves can potentially be an alternative therapy for FLUD in Angora cats with certain conditions.

Keywords: Angora cats, Keji Beling, Urinary bladder, Urolithiasis

INTRODUCTION

Indonesia is a tropical country with abundant biodiversities. One of its natural wealth is the diversity of plants that the community can use to treat various health conditions. Keji Beling (*Strobilanthes crispus* BI) is a herb plant with various nutrients and active compounds; therefore, it can serve as an herbal remedy (Ismail et al., 2000). Keji Beling can be found easily and generally planted by the community as a home fence replacement. Keji Beling grows in clumps because it has many branches and leaves (Artanti and Fatimah, 2017).

Keji Beling is found in Madagascar, Africa, to Indonesia in Asia. Keji Beling is widely available in Asia, stretches from Japan and Korea in the north, from Afghanistan and Pakistan in the west, and even reaches only northern Australia in the south. Its diversity can be found in the Indian subcontinent, southern China, and mainland Southeast Asia, and it also occurs in Maritime Southeast Asia. A few species can be found in the Himalayan in altitudes above 3000 meters and in southwest China (Wood et al., 2003; Wood and Scotland, 2021).

Keji Beling is an herbal plant in Malaysia and is locally known as *Pecah Kaca*, *Pecah Beling*, *Karang Jin*, and *Bayam Karang*. It is also known as *Hei Mian Jiang Jun* to the local Chinese community (Ghasemzadeh et al., 2015). The part of the Keji Beling plant that is efficacious is the leaf which contains polyphenols, saponin, alkaloids, potassium, calcium, coumarin, flavonoid, and steroids (Ghasemzadeh et al., 2015; Ramadhani et al., 2021). However, the efficacy of Keji Beling is not well known by the public, whereas Keji Beling is a plant that is easy to grow, affordable, and does not need expensive treatment. Keji Beling, as herbal medicine, is generally available in capsule form and could be used for some diseases medications, such as kidney stones, obstipation, or diabetes mellitus (Fadzelly et al., 2006; Endrini et al., 2014; Artanti and Fatimah, 2017; Silalahi, 2020). In Indonesia, although Keji Beling is easy to grow, the utilization of this herbal plant is still rare. This also contributed to the infrequent publication of the efficacy of Keji Beling, especially as a remedy for feline lower urinary tract disease cases in pets.

CASE REPORT
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Feline lower urinary tract disease (FLUD) is a disease that causes disturbances in the bladder and/or urethra. Many factors are involved in the occurrence of FLUD (Abdel-Saeed et al., 2021). The disease can be classified into obstructive or non-obstructive types. The most common cause of non-obstructive FLUD is idiopathic cystitis at 65%. In comparison, the common cause of obstruction FLUD is a urethral plug at 59%, cystitis at 29%, urolithiasis at 10%, and urolithiasis with bacterial infection at 2% (Gunn-Moore, 2003).

Mainly, obstructions of the urinary tract are caused by kidney stones. Urolithiasis is the discovery of stones in the cat's urinary tract. Depending on the mineral content composition, urinary tract stones are divided into struvite and oxalate stones. Struvite stones commonly found in male cats comprise magnesium, ammonium, and phosphate. As a result of giving dry food containing high magnesium, there will be excessive magnesium absorption (Nikousefat et al., 2018; Abdel-Saeed et al., 2021). In addition, bacteria that infect the urinary tract can produce urease, ammonia, and carbonate ions that increase ammonium levels and pH. Increased concentrations of magnesium, ammonium, and phosphate in urine will cause supersaturation and struvite crystal formation (Dokuzeylül et al., 2015; Nikousefat et al., 2018). Struvites are colorless, shaped like a prism, and vary in size (Syme, 2012; Nururrozi et al., 2020). Appropriate treatments for FLUD are directed to restore the body's fluid balance, restore the urine flow and apply antibiotic therapy to eliminate the secondary infection (Prasetyo and Darmono, 2018). Surgery is a common method to remove kidney stones in felines. This case report described Keji Beling utilization, containing high sodium and potassium as alkaline properties to dissolve kidney stones and alkalize the urine. Moreover, potassium in Keji Beling acted as a strong diuretic (Dharma et al., 2014). Keji Beling also contains cystolith, mainly composed of calcium carbonate, in which the infuse was alkaline. In addition, high saponin content in Keji Beling had impacts on oxalate crystal nucleation and aggregation in artificial urine solution, in an *in vitro* assay. The fraction of saponin also increased levels of glycosaminoglycan, a stone inhibitor macromolecule found in urine, and facilitated glomerular filtration (Patel et al., 2012; Ghasemzadeh et al., 2015).

MATERIALS AND METHODS

Case report

A one-year-old male Angora cat was brought to Rumah Satwa veterinarian clinic in Tanah Datar, Indonesia, on January 29, 2021, for examination (Figure 1). The cat has a history of Feline Rhinotracheitis, Calici-Panleukopenia, and *Chlamydia psittaci* vaccines (Felocell, Zoetis), according to the vaccination record book. Informed consent was approved and obtained from the owner before the examination. During the observation, the cat showed anorexia, anuria, and dysuria symptoms. The urinary bladder was distended and slightly enlarged. Other physical examinations indicated normal vital signs (body temperature was 37.6°C, pulse was 104 beats/minute, respiratory rate was 28 times/minute, and normal turgor). The ultrasound examination of the urinary bladder indicated the presence of a prism-shaped stone and thickening of the vesica urinary wall (Figure 2). Therefore, the diagnosis was determined as FLUD caused by urolithiasis and cystitis. We preferred ultrasonography because it is more accurate to detect radioopaque struvite calculi compared to radiography (Hostutler et al., 2005)

Keji Beling capsules, made from Keji Beling's leaves, were given to the cat as a single dose/with a dose of 1 capsule/day for 3 consecutive days (dose was 80 mg/kg body weight, according to Package Leaflet, Keji Beling Capsule, Figure 4). Hematophan and biosolamine injections were also given as supportive therapy in the clinic. The patient was also prescribed glucosamine and vitamins for home therapy (Lew-Kojrys et al., 2017). The cat should consume a capsule of glucosamine three times daily. Glucosamine is also used to treat urinary tract inflammation. In addition, the daily feed was temporarily discontinued and replaced with diet feed supplemented with struvite stones dissolution formula, Royal Canin Urinary S/O (MARS Petcare, France). The food should have a low magnesium level and lead to more acidic urine; therefore, it can reduce the occurrence of struvite stones. The cat was previously given commercial dry cat food. This product contains a high level of phosphorus and magnesium that tend to form struvite stones in the urinary tract (Jukes et al., 2019; Tefft et al., 2021).

Eighteen days after the first visit, the cat returned to the clinic. Anamnesis, with the owner, revealed clinical symptoms of haematuria, anorexia, and pollakiuria. Ultrasound examination indicated decreased bladder stone size and reduced bladder wall thickness. The cat was administered the same therapies as the first clinic visit and given Lactate Ringer's solution infusion (contains electrolyte of Na⁺ 130 mEq/L, Cl⁻ 3mEq/L, lactate 28 mEq/L) at 50 ml/kg/day to replace lost body fluids, maintain a balance of water levels in the body, stimulate nerves and support the metabolism process (Lavin et al., 2020).

After 32 days since the first visit, on February 29, 2021, the cat returned to the clinic for a follow-up visit. The clinical examination showed that the urine color was back to normal, and the patient had no urination difficulties. The cat's appetite recovered, and even the cat was mated with a female cat. The ultrasonography examination showed that the bladder stone had disappeared (Figure 5). The Keji Beling administration lasted 6 days, and the cat recovered from FLUD without performing any surgical procedures.

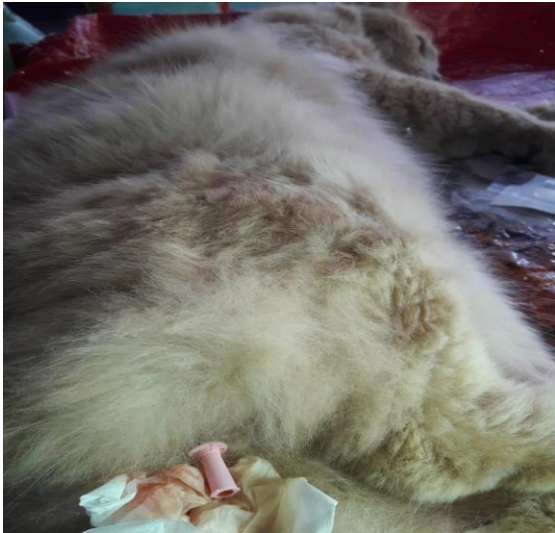


Figure 1. Physical examination of the male Angora cat with feline lower urinary tract disease caused by urolithiasis and cystitis

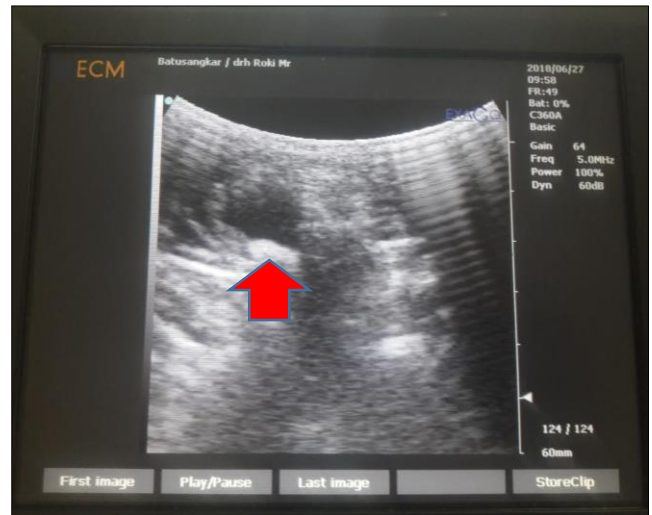


Figure 2. Ultrasonography examination (first day) of a male Angora cat. The presence of stones in the urinary bladder is indicated with the red arrow.



Figure 3. Keji Beling leaves (A) and flowers (B)



Figure 4. Ultrasonography examination of a male Angora cat on day 32 after treatment. No stone was seen in the urinary bladder (arrow).

DISCUSSION

The diagnosis of obstructive FLUD was established by struvite finding in the cat's bladder and the presence of pollakiuria without polyuria (Lew-Kojrys et al., 2017; Abdel-Saeed et al., 2021). The administration of Keji Beling can facilitate kidney stone dissolution and improve the obstructions that occur (Setyawan et al., 2016). Kidney stones are formed by calcium ions reacting with oxalate and carbonate compounds and forming crystals. Kidney stones can be treated with high mineral content, such as sodium and potassium, in the Keji Beling leaves. The potassium content in Keji Beling leaves could reach 51% of the dry weight of leaves. Keji Beling leaves provide a diuretic effect that enables potassium or sodium to bind oxalate and carbonate compounds or calcium ions through the urine, therefore urine will be alkalized. An infusion of dried Keji Beling leaves is mildly alkaline (Endrini et al., 2014).

After the bond formation between potassium, oxalate, and carbonate compounds, the strong diuretic effect on Keji Beling promotes the K_2CO_3 and Ca^{2+} binding formation to be excreted in the urine. This process will drive the urine to be alkaline, and this condition does not support the formation of kidney stones. As a result, in addition to treating kidney stones, Keji Beling can also inhibit the formation of new kidney stones (Fadzelly et al., 2006). Although the sodium content of Keji Beling leaves is not as high as potassium, only 24% of the total mineral, sodium also contributes therapeutic effects for treating kidney stones (Fadzelly et al., 2006).

Natrium performs a similar mechanism as potassium does. Natrium also binds oxalate and carbonate from calcium. With Keji Beling diuretic effect, the Natrium oxalate or natrium carbonate complexes will be excreted into urine and increase the urine pH. This strong diuretic effect acts on the epithelium of the kidney by inhibiting the reabsorption of electrolytes and increasing renal blood flow without an enhancement in the glomerular filtration rate. This results in a fluid decline, electrolyte reabsorption in the proximal tubular, and an increased diuretic effect (Iqbal et al., 2010; Dokuzeylül et al., 2015).

Keji Beling also increased K^+ , Ca^{++} , and Mg^{++} excretion. The surge of electrolyte excretion will cause water excretion, leading to the elevation of urine excretion. In addition, the strong diuretic properties of Keji Beling inhibit the carbonic anhydrase enzyme. Carbonic anhydrase is an enzyme that catalyzes the reaction of $CO_2 + H_2O \rightarrow H_2CO_3$. Balance of H_2CO_3 with H^+ and HCO_3^- ions is very important as a blood buffer in the body. These H^+ dan HCO_3^- ions are also important in the ions reabsorption process in the renal tubules, gastric acid secretion, and others. Due to carbonic anhydrase enzyme inhibition, the formation of H^+ and HCO_3^- in the tubular cells will be depleted. Therefore, it will decrease the H^+ ion secretion by the tubular cells and ultimately will inhibit the exchange of Na^+ and H^+ ions. As a result, bicarbonate, potassium, and sodium excretion in urine increase and drive the urine pH to alkaline. Elevation of electrolyte excretion also induces an increased water excretion (Iqbal et al., 2010; Dharma et al., 2014).

The diuretic property of Keji Beling leaves can inhibit the formation of kidney stones because it increases the excretion of electrolytes and water. Urinary tract stones can be determined based on the type of stone. The most common stones in the urinary tract of cats are struvite and calcium oxalate, and they can be differentiated by their morphology. Struvite is round or square-shaped, and has white, yellow, or brown color. Like chalk, struvite also has brittle consistency and a smooth or rough surface without protrusions. Calcium oxalates were square-shaped with X inside. It can also be described as looking like the back of an envelope and colorless (Syme, 2012).

The unpleasant odor of urine that contains struvite can be eliminated through modification in diet, but different treatments if the stone is oxalate, that 1 requires surgical procedures to remove them. The unpleasant odor originated from the urea breakdown process and the levels of erythrocytes in the cat urine.

CONCLUSION

In conclusion, Keji Beling can be suggested as an alternative therapy for feline urolithiasis caused by struvite stones. The authors suggest further studies on *Strobilanthes crispus*, BI efficacy in different species of mammals, such as murine, canine, or even human, with more comprehensive clinical and laboratory evaluations.

DECLARATIONS

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Authors' contributions

I Gede Wempi Dody Surya Permadi and Risqa Novita contributed to the conception of this work, data interpretation, drafting, and revising the work; Roki Martarika contributed to the acquisition, analysis, and interpretation of data; Lisa Andriani Lienggonegoro contributed to draft revision. All authors approved the final version of the manuscript.

Competing interests

The authors declare that there is no conflict of interest.

Ethical consideration

Ethical issues such as plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and or submission, and redundancy have been checked by all the authors.

Availability of data and materials

The authors are ready to send the dataset of this study upon reasonable request.

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