



What bacteria cause infection-induced struvite stones, which are common in dogs?

Of the approximately 65,000 canine stones analyzed by the Minnesota Urolith Center in 2021, 41% were struvite of which most were infection-induced. In female dogs, struvite is the most common urolith type, representing 74% of submissions. The formation of infection-induced struvite stones depends on the generation of both ammonium ions and alkaline urine.

These conditions are met in clinical cases through the action of urease-producing bacteria. **The most common bacteria isolated from the urine of dogs with struvite stones or cultured from struvite stones was *Staphylococcus spp.*, which occurred in more than 85% of evaluations (1-3).** Many Staphylococcal bacteria produce urease, the enzyme that hydrolyzes urea into ammonia. Ammonia subsequently reacts with water producing ammonium ions and hydroxide ions, the latter of which alkalinizes the urine (see the making of infection-induced struvite below). In humans, *Proteus spp.* is the most common urease-producing bacterium causing infection-induced struvite stones.



The Making of Infection-Induced Struvite Uroliths

Step 1: Urea (NH_2CONH_2) + H_2O $\xrightarrow{\text{Urease}}$ $2\text{NH}_3 + \text{CO}_2$
Step 2: $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^{+1} + \text{OH}^{-1}$ (OH^{-1} producing alkaline urine)

Step 3: $\text{H}_2\text{PO}_4^{-1} + \text{OH}^{-1} \rightarrow \text{HPO}_4^{-2} + \text{OH}^{-1} \rightarrow \text{PO}_4^{-3}$

Step 4: Increasing urine concentrations of $[\text{NH}_4^{+1}]$ and $[\text{PO}_4^{-3}]$ with $[\text{Mg}]$ favors formation of struvite ($\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$)

To dissolve infection-induced struvite, administer appropriate antibiotics to eradicate infection (based on urine culture and sensitivity) and provide therapeutic foods to acidify the urine and lower phosphorus, magnesium, and urea until uroliths are no longer detected on imaging. The average time to complete dissolution of struvite uroliths in dogs is approximately 5 weeks (2,3).

[Canine Struvite Dissolution](#)
[Canine Struvite Risk Management](#)

Perry et al. J Vet Diagn Invest. 25;2013:199-202.

Dear et al. BMC Vet Res. 2019;15:273.

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