

## Nephrolithiasis Stone Types (Part 2/2)

Struvite stones are typically caused by urinary tract infections. These stones are characterized by a "coffin-lid" appearance on microscopy, and are radiopaque in imaging studies. They precipitate when urine pH is increased. Calcium phosphate stones are commonly seen in hypercalcemia. These stones are characterized by a "wedge-shaped" appearance on microscopy, are radiopaque in imaging studies, and precipitate in the setting of increased urine pH.



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### Struvite

#### Struvite (Ammonium Magnesium Phosphate)

##### Stove Crystals

Struvite stones consist of magnesium ammonium phosphate (struvite) and calcium carbonate-apatite. They are often large, and are found in the renal pelvis. They are sometimes known as "staghorn calculi" if they get big enough to look like the horns on a stag. Struvite stones can present as a white or gray stone, commonly smooth and easily broken.

#### Urinary Tract Infections

##### Kidney-and-bladder-on-Fire

Urease-positive microorganisms that often cause UTIs are common etiologic agents for struvite stones. Examples include *Klebsiella*, *Staphylococcus*, *E. coli*, and *Proteus* spp.

#### "Coffin Lid" Appearance

##### Coffin

Struvite stones have a characteristic "coffin-lid", or rectangular prism, appearance.

#### Radiopaque

##### Radiopaque Image

Struvite stones are most commonly seen as radiopaque on imaging, but can be variable. Opacity can occur due to the presence of calcium.

#### Increased Urine pH

##### Up-arrow Urinal and pH-scale

Struvite stones only occur in the presence of increased urine pH (alkaline). Urease-producing microorganisms will break down urea into ammonia and carbon dioxide (CO<sub>2</sub>), resulting in alkaline urine. This increased pH will precipitate magnesium ammonium phosphate, contributing to stone formation.

### Calcium Phosphate

## Calcium Phosphate

### [Calcium-cow Phosphate-P](#)

Calcium phosphate stones are seen in 10% of patients with kidney stones. These are also known as brushite stones, and can be recurrent. Brushite stones are resistant to ESWL treatment, especially large stones, and 75% of cases need percutaneous nephrolithotomy (PNL).

## Hypercalcemia

### [Hiker-calcified-cow](#)

Hypercalcemia is a risk factor for calcium phosphate stone formation due to precipitation in the urine. Hyperparathyroidism and sarcoidosis commonly lead to hypercalcemia/uria and stone formation. Other potential causes include granulomatous diseases, milk-alkali syndrome, hypervitaminosis D, prolonged immobilization, and malignancy.

## Wedge-shaped Prisms

### [Wedge-shaped Prisms Stones](#)

On microscopy, calcium phosphate stones can be visualized as wedge-shaped prisms in rosettes or amorphous patterns.

## Radiopaque

### [Radiopaque Image](#)

Calcium phosphate stones are commonly radiopaque on imaging given the presence of calcium (a metal).

## Increased Urine pH

### [Up-arrow Urinal and pH-scale](#)

Increased urine pH (alkaline) promotes the formation of calcium and phosphate-containing stones. On the other hand, decreased urine pH (acidic) promotes formation of uric acid and cystine stones.