Characterization of Renal Stones Using GSI

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Patient history
A 39-year-old male presented with acute pain in left upper abdomen and flank with no history of fever or hematuria. Ultrasound showed multiple calculi in the left kidney with mild hydronephrosis. Patient previously underwent surgery for right renal calculi. Urine biochemistry did not show any pus cells. Patient was referred for non-contrast CT urogram.

Findings
There were two calculi of average size, 1.3 cm, in the pelvis and middle calyx with mild hydronephrosis of the left kidney. Both the ureters and right kidney were normal. HU values of the stones were in the range of 450 to 490. Using a Gemstone* Spectral Imaging dual energy CT scan, the calculated effective atomic number of the calculi was approximately 6.95 suggesting uric acid. The effective atomic number of uric acid is 7.0. The spectral HU curve also showed a negative enhancement pattern.

These findings corroborated with the recurrent calculus disease in this patient. Further biochemical studies conducted on the patient showed high serum uric acid levels. Patient did not complain of joint pain.

Patient was diagnosed with gout, a disease of uric acid metabolism.

Discussion
Today in the practice of medicine, it is essential not only to treat the disease but also its etiology. A non-contrast urogram using a conventional CT scan would not demonstrate the constituents of the renal calculus. With the advent of dual energy scanners, we can now determine the constituents of calculi with the additional information, specifically calculation of effective atomic number, material density overlay and preparation of histogram and spectral HU curve.

Uric acid calculi occur in disorders affecting uric acid metabolism. Hence, apart from treating calculus, it is important to treat the basic metabolic disorder. Dual energy CT scans can also detect oxalic, mixed calcium, struvite, and cystine calculi. Using GSI we now have the ability to distinguish mixed non-uric acid calculi and characterize their chemical composition.

By demonstrating the constituents of the calculus, GSI assists in guiding effective patient management.
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Figure 1. Histogram with effective atomic number of Stone (left); Spectral HU Curve shows negative enhancement (right). Both are typical of uric acid calculus.

Figure 2. Material density overlay showing uric acid in different color (above); volume rendering of kidney stones (below). Calcium and uric acid are shown in different colors.