STONES

Low-dose dual-energy CT

Dual-energy CT, which utilizes two sources of radiation at different voltages, shows further signs of becoming the imaging modality of choice for diagnosis of urinary calculi. Its major advantage over conventional CT is the ability to determine a stone's chemical composition; however, concerns regarding increased radiation doses have thus far prevented its use in the clinic. New data from two studies suggest that low-dose protocols can accurately distinguish between different types of calculi while limiting the patient's exposure to radiation.

In the first paper, Giorgio Ascenti and his colleagues from Messina, Italy, describe a combined protocol with an effective dose of 3.46 mSv *in vitro*—a reduction of up to 50% compared to standard methods. The researchers used low-dose single-energy CT to initially determine the presence of calculi in the urinary system of 39 patients (19 women; mean age 47 years), then performed targeted standard-dose dual-energy CT on the region containing the stone, for characterization purposes. Patients received effective radiation doses ranging from 1.89 mSv to 3.7 mSv, with a mean value of 2.66 mSv. After spontaneous passage or extraction, stone composition from 24 individuals was confirmed using stereomicroscopy and infrared spectrophotometry. Ascenti *et al*. report that this method accurately discriminated between uric acid stones ($n = 3$), calcium salt stones ($n = 18$) and combined uric acid–calcium salt stones ($n = 3$) with 100% specificity.

Christoph Thomas and his team from the University of Tübingen, Germany, performed a similar study in 112 patients (43 women; mean age 50 years), 40 of whom had urinary calculi that were subsequently classified using infrared spectroscopy. The investigators used a single-step low-dose dual-energy protocol, which resulted in a mean effective dose of 2.7 mSv. The composition of 38 stones was correctly determined using this custom-designed method; however, a struvite stone was mischaracterized as cystine, and a calcium-containing stone in the pelvis of an overweight individual was falsely identified as mixed uric acid. Thus, overall, uric acid stones and cystine calculi were detected with a sensitivity of 100% and specificity of 97%, whereas calcified stones were associated with a sensitivity of 97% and specificity of 100%. The authors caution that low-dose dual-energy CT is associated with increased image noise in patients with a high body mass index, and that struvite calculi cannot be differentiated from cystine stones owing to their similar dual-energy spectra.

The clinical implications of these findings are considerable. Current methods of composition analysis can only be performed once stones are removed from the body, whereas dual-energy CT allows preoperative examination that can guide treatment decisions. For example, whereas cystine stones are resistant to shock waves and must be removed surgically, if uric acid stones are identified early they can be managed with oral medication. This more tailored approach would prevent unnecessary invasive procedures while reducing the cost of treatment.

Sarah Payton

Original articles Ascenti, G. *et al.* Stone-targeted dual-energy CT: a new diagnostic approach to urinary calculosis. *AJR Am. J. Roentgenol.* **195,** 953–958 (2010) | Thomas, C. *et al.* Urinary calculi composed of uric acid, cystine, and mineral salts: differentiation with dual-energy CT at a radiation dose comparable to that of intravenous pyelography. *Radiology* **257**, 402–409 (2010)