EP017 Dual energy CT combined with infrared spectroscopy: Imaging to predict urinary stones composition and stiffness

EUR Urol Suppl 2019;18(10):e3401

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Introduction & Objectives: The aim of our in vitro study is to evaluate if last generation Dual Energy CT (DECT) can predict, with the same accuracy rate of Infrared Spectroscopy (SC-IR), the chemical composition of pure urinary stones. We also evaluate a new physical parameter: Stone stiffness.

Materials & Methods: We collected 65 urinary stones between December 2017 and December 2018. Samples were analyzed with SC-IR, which is the most accurate method to characterize the chemical composition of urinary stones, according to guidelines. 17 phantoms have been prepared, each one containing stones of the same chemical composition and stiffness, ordered by maximum to minimum diameter (from 1.2 cm to 0.2 cm). All samples were scanned using a dual source machine with single and dual-energy settings. The DECT protocol included three scans for each kVp range. Each scan was subsequently processed at Syngo.via workstation. The information obtained from the post-processing workstation were analyzed in blind by a 20-years old experienced Radiologist.

Results: Stones < 4 mm were not detected. Uric Acid (UA) stones were recognized with an accuracy of 96%. Oxalate stones were recognized as such with an accuracy of 100%. Comparison between single- and dual- energy settings scans resulted in a median overestimation of 50 – 150 – 400 HU for respectively Uric Acid, di-Hydrate Oxalates and mono-Hydrate Oxalates Stones (Figure 1). Among stones of the same chemical composition, DECT allowed the estimation of stone stiffness comparing the physical empirical hardness to their radiological attenuation values (HU) (Table 1).

Conclusions: Our experimental study showed that the analysis of the chemical composition of urinary stones with DECT is comparable to the SC-IR results for both UA and Oxalate stones. The chemical composition of urinary stones, combined with the analysis of stiffness, could have important implications for clinical practice.

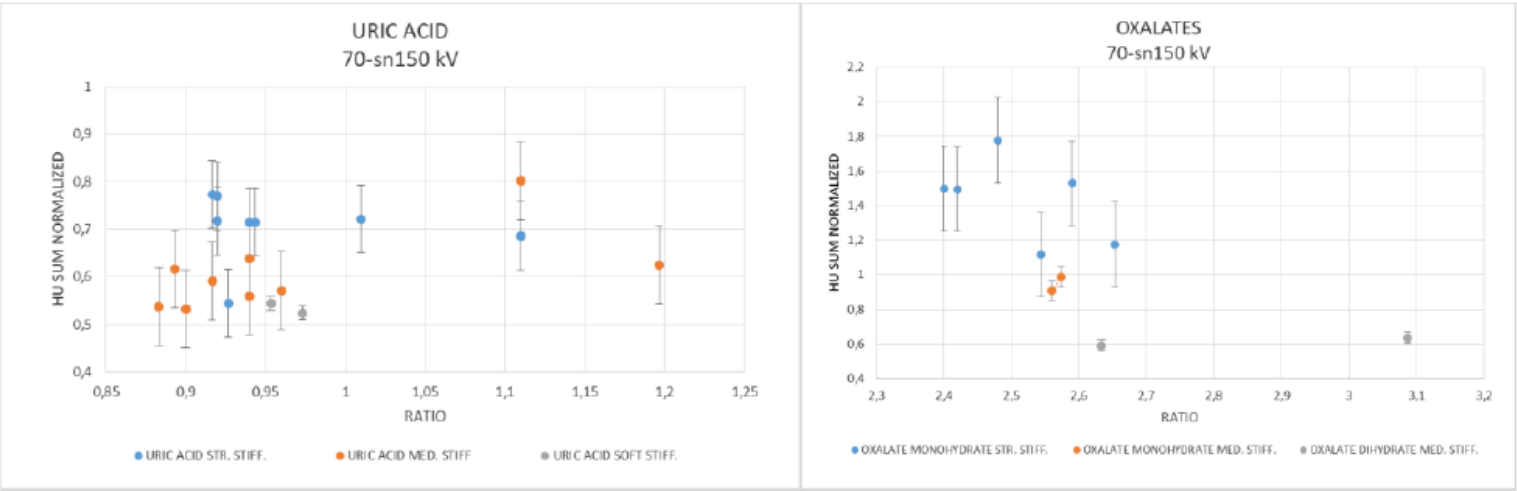

Figure 1 Sum normalized values of HU, obtained from the 70-150 kVp DECT scans of UA stones and NUA stones.

Stones	Composition/Stiffness	120 kV	70-sn150kV MIX	80-140kV MIX	80-150kV MIX	90-150kV MIX	100-150kV MIX
Uric Acid	Strong	434	353	347	355	356	357
	Medium	311	304	307	306	307	307
	Soft	316	265	263	268	263	263
Oxalates	Monohydrate/Strong	1350	716	738	675	647	624
	Monohydrate/Medium	995	493	493	599	425	415
	Dihydrate/Medium	490	306	312	397	306	280

Table 1 The table, comparing mixed DECT scans and standard 120kV SECT scans, shows a mean difference of +50 HU for SECT scans than DECT for UA stones; for oxalates the difference is in a range between +150 HU for di-hydrate stones and +400 HU for mono-hydrate stones.