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Comparison of photon-counting and energy-integrating detector CT systems for the characterization of cystic renal lesions on virtual noncontrast imaging

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Abstract:

***Purpose:** The purpose of this study is to compare the absolute CT attenuation errors of cystic renal lesions and abdominal organs on virtual noncontrast images (VNC) between photon-counting (PCCT) and energy-integrating (EID) detector CT systems.

***Methods and Materials:** In this HIPAA compliant, IRB-approved retrospective study, multiphase CT scans from one commercially available PCCT (NAEOTOM Alpha, Siemens Healthineers) and two EID dual-source dual-energy CT systems (SOMATOM Definition Flash and SOMATOM Force, Siemens Healthineers) were retrieved. A total of 56 BMI-matched patients (26 women, 30 men; mean age 58.5 ± 15.3 years; range 19-81 years, mean BMI 29.0 ± 6.8 kg/m², range 13-47 kg/m²) were included: 16 for PCCT and 20 each per EID systems. Attenuation measurements of abdominal organs (liver, pancreas, spleen, kidney, and aorta) were recorded on VNC and True Noncontrast (TNC) datasets. Furthermore, attenuation measurements of 16 cystic renal lesions (eight for PCCT and eight for EID) were compared on VNC and TNC datasets. Absolute CT attenuation errors $|HU_{VNC} - HU_{TNC}|$ were calculated and compared between PCCT and EID systems for the entire population and a subset of 20

obese patients (BMI: >30 kg/m²), using paired t-tests. Absolute CT attenuation errors were also compared for all cystic renal lesions and for renal lesions <1 cm, separately.

***Results:** PCCT yielded significantly lower absolute CT attenuation errors than EID using VNC in comparison with TNC images for the liver (4.3 ± 5.4 vs 8.8 ± 10.4), spleen (2.6 ± 6.2 vs 8.0 ± 10.3) and pancreas (4.4 ± 1.8 vs 7.7 ± 9.7) for all patients (P<0.01) and for spleen and pancreas in the obese patient cohort (P<0.05). Furthermore, PCCT yielded significantly lower absolute CT attenuation errors compared to EID for all cystic renal lesions (2.0 ± 1.3 vs. 12.0 ± 8.9; P<0.01) and for renal lesions <1 cm (1.4 ± 0.9 vs. 19.1 ± 6.8; P<0.01).

***Conclusions:** PCCT yields significantly lower absolute CT attenuation errors for abdominal organs and cystic renal lesions in VNC images, compared to two dual-source dual-energy EID systems. Our results were corroborated in a subset of obese patients and small (<1 cm) renal lesions.

***Clinical Relevance/Application:** Reliable CT attenuation values of virtual non-contrast imaging are necessary to replace true non-contrast acquisitions. This can be achieved with photon-counting CT with important implications in radiation dose reduction.

Category (Complete): Genitourinary Imaging -> GUKOTH - Kidney: Other

Format Preference (Complete): Oral Paper

Questions (Complete):

Trainee Research Prize: Resident/Physics Trainee

Disclosure of "Off-Label" usage: No, I do not intend to discuss off-label uses

IRB / IACUC Response: Human subject, and received IRB approval

Has this work been previously presented or published?: No

2nd Format Opportunity: No, I am not interested in presenting in a second format.

Attached Files: EXAMPLES OF MEASUREMENTS ON CYSTIC RENAL LESIONS (PDF, 263762 bytes)

Status: Complete

Feedback