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Abstract: Phantom-based (synchronous and asynchronous) and phantomless (internal tissue calibration based) assessment of bone mineral density (BMD) in routine MDCT (multidetector computed tomography) examinations potentially allows for diagnosis of osteoporosis. Although recent studies investigated the effects of contrast-medium application on phantom-calibrated BMD measurements, it remains uncertain to what extent internal tissue-calibrated BMD measurements are also susceptible to contrast-medium associated density variation. The present study is the first to systemically evaluate BMD variations related to contrast application comparing different calibration techniques. To compare predicative performance of different calibration techniques for BMD measurements obtained from triphasic contrast-enhanced MDCT. Bone mineral density was measured on nonenhanced (NE), arterial (AR) and portal-venous (PV) contrast phase MDCT images of 46 patients using synchronous (SYNC) and asynchronous (ASYNC) phantom calibration as well as internal calibration (IC). Quantitative computed tomography (QCT) served as criterion standard. Density variations were analyzed for each contrast phase and calibration technique, and respective linear fitting was performed. Both asynchronous calibration-derived BMD values (NE-ASYNC) and values
estimated using IC (NE-IC) on NE MDCT images did reasonably well in predicting QCT BMD (root-mean-square deviation, 8.0% and 7.8%, respectively). Average NE-IC BMD was 2.7% lower when compared with QCT (P = 0.017), whereas no difference could be found for NE-ASYNC (P = 0.957). All average BMD estimates derived from contrast-enhanced scans differed significantly from QCT BMD (all P 6.0 mg/mL). All regression fits revealed a consistent linear dependency (R range, 0.861-0.963). Overall accuracy and goodness of fit tended to decrease from AR to PV contrast phase. Highest precision and best linear fit could be reached using a synchronously scanned phantom (root-mean-square deviation, 9.4% for AR and 14.4% for PV). Both ASYNC and IC estimations performed comparably accurate and precise. Our data suggest that internal calibration driven BMD measurements derived from contrast-enhanced MDCT need the same amount of post hoc contrast-effect adjustment as measurements using phantom calibration. Adjustment using linear correction equations can correct for systematic bias of bone density variations related to contrast application, irrespective of the calibration technique used.

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