Purpose: To assess the effect of obese patient's body mass index (BMI) on organ doses from CT and PET exams.
Methods: A set of 5 computational phantoms with different BMIs were created for PET and CT dose calculations using the Monte Carlo N-Particle Extended (MCNPX) code. The phantoms represent patients having a BMI ranging from 23 (normal weight) to 44 (morbidly obese) with increasing amounts of subcutaneous and visceral fat. The external CT dose calculations assumed a whole-body, diagnostic scan with a GE LightSpeed 16 scanner operating at a tube voltage of 120 kVp. The internal PET dose was based on S-values for F-18 and the ICRP-106 FDG biokinetic model.
Results: For the same tube current, ratios of the morbidly obese phantom CT organ doses compared to the normal weight phantom ranged from 0.46~1 with an average of 0.7 because of shielding by the extra fat. This effect was greatest for deep organs in the abdomen (e.g. colon, lungs, stomach, liver, urinary bladder). For the same injected radioactivity, the average PET organ dose ratios were 0.95 and 0.65 for source organs (e.g. brain, heart, liver, urinary bladder) and organs in the remainder, respectively (e.g. colon, stomach, spleen, etc.). These PET dose differences are due primarily to the obese phantom's smaller remainder source S-values which arise from the addition of the extra fat to the remainder compartment.
Conclusions: After adjusting for the increased tube current and tube voltage, the results suggest that obese patients can receive higher absorbed dose to some organs, depending on the protocols. This work, as part of the VirtualDose software development, demonstrates the ability to improve the estimate of organ doses from PET and CT scans for obese patients and will be useful to on-going efforts to optimize image quality and imaging doses.