Purpose:

To investigate the tradeoffs between radiation dose and diagnostic performance in CT for a challenging clinical task (diagnosis of appendicitis).

Methods:

This IRB approved study utilized data for 20 patients undergoing clinical CT exams for indications of appendicitis. Medical records were reviewed to establish true diagnosis and identified 10 positive and 10 negative cases. Original (100%) and simulated reduced dose levels (70%, 50%, 30%, 20% of original) were created with a validated software tool using raw projection data from each scan. An observer study was performed with 6 radiologists (of different training and cross-sectional reading experience) reviewing each case at each dose level in stratified random order over several sessions. Readers assessed image quality and provided confidence in their diagnosis of appendicitis, each on a 5 point scale. Receiver Operating Characteristics (ROC) curves were generated for each dose level using all rating levels and from the resulting ROC curves, the AUC (Area under curve) was calculated for each dose level. This analysis was repeated for groups of readers with different experience levels.

Results:

The ROC curves averaged over all 6 observers and corresponding AUC values showed indifferent performances for all the dose levels. For the 2 non-abdominal trained, occasional CT readers, the performance did not decrease until 30% dose level. For the 2 non-abdominal trained, routine CT readers, the performance did not decrease until 20% dose level. For the 2 abdominal trained, routine CT readers, the performance is consistent across all the dose levels.

Conclusions:

This preliminary study demonstrated the tradeoffs between radiation dose and diagnostic performance and indicated that: (a) There is essentially no difference between diagnostic performance of 100%, 70%, and 50% dose level for all 6 observers. (b) For abdominal CT specialists, the diagnostic difference is not substantially compromised even at 20% dose levels. (c) For non-abdominal trained CT readers, the performance declines at 30% and 20% dose levels.

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