Comparaison objective de la résolution spatiale et de la détection à bas contraste en utilisant différents protocoles cliniques

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Purpose

To propose a way to objectively compare computed tomography (CT) scanner performances for three clinically relevant protocols using a task-based image quality assessment method in order to assess the potential for radiation dose reduction made possible through technological developments.

Methods

Four CT scanners from different manufacturers released between 2003 and 2008 were compared with four CT scanners from the same manufacturers released between 2012 and 2014 using ideal model observers (MO) : Prewhitening (PW) MO and channelized Hotelling (CHO) MO with Laguerre-Gauss channels for high-contrast spatial resolution and low-contrast detectability performances. High-contrast spatial resolution was assessed using a custom-made phantom enabling to compute task transfer function (TTF), and noise power spectrum (NPS). Low-contrast detectability was assessed using a commercially available anthropomorphic abdominal phantom (QRM) providing equivalent diameters of 24, 29.6, and 34.6 cm. Three protocols were reviewed : a head (trauma) and an abdominal (urinary stones) protocol were applied to assess high-contrast spatial resolution performances ; and another abdominal (focal liver lesion) protocol was applied for low-contrast detectability. The latter protocol was tested by using fixed and modulated tube currents.

Results

The use of the PW MO was not optimal for assessing high-contrast spatial resolution performances of the various CT scanners, and the TTF integral was proposed instead. Compared to older generation CT scanners, newer systems did not yield major improvements for high-contrast detectability. One recent system had even lower performances than its predecessor. The use of the CHO MO was appropriate for assessing low-contrast detectability performances and revealed that an excellent level of image quality could be obtained with newer scanners at a significantly lower dose level.

Conclusion

This study shows that MO can objectively benchmark CT scanners using a task-based image quality method, thus help to estimate the potential for further dose reductions offered by the latest systems. Such an approach may be useful for adequately comparing the clinically relevant image quality between various scanners.