Influence of CT Scanners on Radiomics Features in Abdominal CT: A Multicenter Phantom Study

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Abstract guidelines:

280 Word Limit

Area of Interest:

Oncology

Imaging Technique:

Quantitative CT, CT

Purpose/Learning objective:

To investigate the influence of different CT scanners on the stability and discriminative power of radiomics features using an anatomically accurate 3D-printed abdominal phantom.

Methods or Background

Based on a patient's CT scan with multiple hepatic lesions, an anatomically and texturally realistic phantom was commercially 3D-printed using potassium-iodide ink on paper. The phantom was scanned on 13 CT scanners by 4 different manufacturers at 8 institutions with 10 scan repetitions each. A harmonized clinical oncologic CT acquisition protocol was used on all scanners. Images were reconstructed using iterative reconstruction algorithms. 86 radiomics features were assessed for six different ROIs (metastasis, hemangioma, 2 cysts, 2 normal liver parenchyma regions) using principal component analyses (PCA) and Kruskal-Wallis tests.

Results or Findings

For all ROIs, PCA analyses clearly showed clustering by scanners and manufacturers, with the same scanner models overlapping. Kruskal-Wallis tests for each ROI and radiomics feature showed significant differences between scanners in 511 of 516 tests ($p<0.05$). Pairwise ROI comparison in the PCA showed both separation of the 13 different CT scanners and of the ROIs, while the separation between ROIs was stronger than between scanners.

Conclusion

In this multicenter study, radiomics features are impacted by CT scanner models in varying degrees, despite the use of matched acquisition and reconstruction parameters. When performing multicenter studies, an a priori phantom analysis and feature harmonization techniques may be ways to account for these influences and select more stable radiomics features.

Limitations

As the phantom includes 1-2 ROIs per tissue type, variability of the same tissue type was not studied and results of ROI separation may not be fully generalizable to tissue type classification. Patient motion cannot be assessed with this phantom and may aggravate inter-scanner variations.