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CT-derived radiomics analysis of diabetic nephropathy by machine learning models

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Objectives: Kidney radiomics has been used to develop more accurate diagnostic tools of renal tumor and predict outcomes. However, radiomics studies for diabetic kidney disease (DKD) remain few. In this light, we hypothesized that computed tomography (CT) radiomics features could differentiate DKD from normal kidneys and assess the severity of DKD.

Methods: This retrospective study included 343 subjects with type 2 diabetes mellitus (T2DM) (male 65.5%, mean age 63.6±14.8) and 90 healthy controls (HC) (male 34.4%, mean age 41.9±8.5) who underwent abdominal CT. Whole volumetric CT data of both kidneys were automatically extracted using a deep-learning based model and radiomics features were extracted. T2DM was categorized into three groups according to eGFR (mL/min/1.73m^2) (group 1, eGFR > 60; group 2, 15 ≤ eGFR ≤ 60; and group 3, eGFR <15). The capability of CT radiomics features to distinguish not only DKD from HC but also various DKD groups based on eGFR, was evaluated using machine learning models.

Results: A total of 1,723 radiomics features were extracted from the volumetric CT data of both kidneys. A combination of LASSO filter and random forest showed best performance in differentiating between HC and DKD, with an area under curve (AUC) of 0.98 and accuracy of 95.7%. It also showed an excellent performance in differentiating between HC and DKD group 1 with AUC of 0.97 and accuracy of 91.7%, and also it was able to differentiate between DKD groups (AUCs > 0.78). CT radiomics features and eGFR had a moderate degree of correlation (R=-0.50 to R=0.63, all P<.00).

Conclusions: CT-derived radiomics analysis of kidneys using machine learning models can be useful in differentiating DKD from normal kidneys as well as assessing the severity of DKD.