

Differentiating Benign from Malignant Cystic Renal Masses using CT Texture–based Machine Learning Algorithms

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Take-Away Points

- **Major Focus:** To assess the feasibility of CT texture–based machine learning algorithms in differentiating benign from malignant cystic renal masses (CRMs).
- **Key Results:** All three models (random forest, logistic regression, and support vector machine) demonstrated a similar high accuracy in differentiating benign from malignant CRMs.
- **Impact:** CT texture–based machine learning algorithms show promise in detecting malignant CRMs and can help overcome the diagnostic uncertainty and interreader variability associated with using Bosniak classification.

CRMs, which have less than ~25% enhancing tissue, often are identified incidentally at abdominal CT. The Bosniak classification system is used commonly to stratify CRMs based on likelihood of malignancy. However, this classification is subject to interobserver variability, particularly for Bosniak IIF and III masses that are often indeterminate, and frequently requires multiphase imaging. CT texture analysis is an objective method that may help differentiate benign and malignant CRMs.

This retrospective study used machine learning algorithms based on CT texture analysis to assess the likelihood of malignancy in CRMs independent of Bosniak class. The study included 144 CRMs with 93 and 51 benign lesions and renal cell carcinomas, respectively. Miskin and colleagues extracted six first-order radiomics features (mean, standard deviation, mean value of positive pixels, entropy, skewness, and kurtosis) from a single

axial image demonstrating the most complex morphologic feature of the mass. To classify each mass as benign or malignant, the authors tested three CT texture–based machine learning models, namely random forest, logistic regression, and support vector machine, applied with 10-fold cross validation.

Among the texture features, entropy demonstrated the highest discriminatory ability, yielding a sensitivity, specificity, and training area under the receiver operating characteristic curve (AUC) of 0.73, 0.82, and 0.82, respectively. For detection of malignancy, the three machine learning algorithms demonstrated a similar high accuracy. Sensitivity, specificity, positive predictive value, negative predictive value, and AUC values were 0.61, 0.87, 0.72, 0.80, and 0.79 for the random forest model; 0.59, 0.87, 0.71, 0.79, and 0.80 for the logistic regression model; and 0.55, 0.86, 0.68, 0.78, and 0.76 for the support vector machine model.

CT texture–based machine learning algorithms demonstrated good performance in distinguishing benign from malignant CRMs. Once validated with larger, prospective studies, these parameters could help improve assessment and management of CRM.

—ANUPAMA RAMACHANDRAN

Highlighted Article

Miskin N, Qin L, Silverman SG, Shinagare AB. Differentiating Benign From Malignant Cystic Renal Masses: A Feasibility Study of Computed Tomography Texture-Based Machine Learning Algorithms. *J Comput Assist Tomogr* 2023;47(3):376-381. doi: 10.1097/RCT.0000000000001433