Deep learning differentiates small renal masses on multiphase CT

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TABLE 2: AUC and Diagnostic Performance at Optimal Cutoff Values of Output Data by CNN Models

Measure	UN	CMP	NP	EP	CMP, NP, and EP	All Phases
AUC	0.562 (0.333–0.767)	0.846 (0.584–0.955)	0.568 (0.279–0.817)	0.494 (0.215–0.777)	0.624 (0.360–0.830)	0.562 (0.263–0.822)
Sensitivity	63 (42–81)	93 (77–99)	67 (46–83)	96 (82–100)	29 (13–49)	89 (72–98)
Specificity	67 (22–96)	67 (22–96)	67 (22–96)	33 (4–78)	100 (54–100)	33 (4–78)
PPV	89 (–73 to 96)	93 (81–98)	90 (74–97)	87 (79–92)	100 (60–100)	86 (78–92)
NPV	29 (16–46)	67 (32–90)	31 (17–49)	67 (18–95)	23 (19–27)	40 (12–76)
Accuracy	64 (45–80)	88 (73–97)	67 (48–82)	85 (69–95)	41 (25–59)	79 (62–91)

Note—Except for AUC, all values are percentages. Ranges in parentheses are 95% CIs. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of convolutional neural network (CNN) models for malignancy in unenhanced (UN), corticomedullary phase (CMP), nephrogenic phase (NP), excretory phase (EP), triphasic, and all-phase CNN models were calculated at the optimal cutoff values of output data of 0.993, 0.875, 0.936, 0.996, 0.996, and 0.885, respectively.

Except for AUC, all values are percentages. Ranges in parentheses are 95% CIs. Credit: *American Journal of Roentgenology* (AJR)

A deep learning method with a convolutional neural network (CNN) can support the evaluation of small solid renal masses in dynamic CT images with acceptable diagnostic performance, according to an article published ahead-of-print in the March issue of the *American Journal of Roentgenology* (AJR).

Between 2012 and 2016, researchers at Japan's Okayama University studied 1807 image sets from 168 pathologically diagnosed small (≤ 4 cm) solid renal masses with four CT phases—unenhanced, corticomedullary, nephrogenic, and excretory—in 159 patients.

Masses were classified as malignant (n = 136) or benign (n = 32) using a 5-point scale, and this dataset was then randomly divided into five subsets.

As lead AJR author Takashi Tanaka explained, "four were used for augmentation and supervised training (48,832 images), and one was used for testing (281 images)."

Utilizing the Inception-v3 architecture CNN model, the AUC for malignancy and accuracy at optimal cutoff values of output data were evaluated in six different CNN models.

Finding no significant size difference between malignant and benign lesions, Tanaka's team did find that the AUC value of the corticomedullary phase was higher than that of other phases (corticomedullary vs excretory, p = 0.022).

Additionally, the highest accuracy (88%) was achieved in the corticomedullary phase images.

Multivariate analysis revealed that the CNN model of corticomedullary phase was a significant predictor for malignancy, "compared with other CNN models, age, sex, and lesion size," Tanaka concluded.

More information: Takashi Tanaka et al, Differentiation of Small (≤ 4 cm) Renal Masses on Multiphase Contrast-Enhanced CT by Deep Learning, *American Journal of Roentgenology* (2020). DOI: 10.2214/AJR.19.22074

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