THE VALUE OF RADIOMICS BASED CT IMAGING MODEL IN DISTINGUISHING BENIGN AND MALIGNANT THYROID NODULES

Turgunov Boburjon Shavkatovich

Yang Ming Xia.
Supervisor, Assistant Professor

Abstract

Objective to investigate the value of CT radiomics mode in differential diagnosis of benign and malignant thyroid nodules. Methods The clinical and imaging data of 179 patients with thyroid nodules confirmed by pathology from May 2017 to August 2018 were retrospectively analyzed in the Affiliated Huaian First People′s Hospital of Nanjing Medical University. Among the patients, 89 cases were benign nodules and 90 cases were malignant nodules. All patients underwent unenhanced and enhanced CT scan before operation. The stratified random sampling method was used to divide patients into a training group (143 cases) and a testing group (36 cases) according to a ratio of 8∶2. The A.K software was used to extract 378 imaging omics

features based on preoperative CT images, and then Spearman correlation analysis and least absolute shrinkage and selection operator regression analysis were used for feature selection and model construction. The receiver operating characteristic (ROC) curve was used to verify the model in the training group and the testing group, and the efficacy of imaging omics features to predict benign and malignant thyroid nodules was evaluated.

Results After feature screening, 16 radiomics features were used to construct an identification model between benign and malignant thyroid nodules. In the training group, the area under the ROC curve (AUC) was 0.92 [95% confidence interval (CI): 0.88-0.97], the sensitivity and specificity were 88.7%, 82.0%, and the diagnostic accuracy of the model was 91.1%. In the testing group, AUC was 0.90 (95%CI: 0.81-0.98), sensitivity and specificity were 88.5%, 84.6%, and the diagnostic accuracy of the model was 88.2%. Conclusion The CT radiomics mode has a good diagnostic performance in the identification of benign and malignant thyroid nodules.

Materials and Methods

A retrospective collection of patients with thyroid nodules confirmed by surgery and pathology from the Huaian First Hospital affiliated to Nanjing Medical University from May 2017 to August 2018. Inclusion criteria: (1) Receive unenhanced CT scan and enhanced examination of thyroid before operation, and the interval between examination and operation is 1~15 days; (2) No history of other tumors; (3) Preoperative ultrasound examination thyroid imagingreporting and data system (thyroid imagingreporting and data system, TI-RADS) graded as Ⅱ~Ⅳ; (4) lesion diameter> cm; (5) The newly diagnosed patient has no puncture, radiotherapy or chemotherapy.

2. CT inspection method

Using Germany Siemens Definition dualsource 64-slice CT scanner, tube voltage 120 kV, tube current 250 mAs, layer thickness 3 mm, layer The spacing is 3 mm. In contrast, ioverol (containing 320 mg/ml of iodine) was injected via the median cubital vein on the enhanced scan, the injection flow rate was 3.0 ml/s, the dose was 1.5 ml/kg, and the arterial phase and intravenous phase were collected 35 s and 65 s after the injection. Pulse phase enhancement image. Before the scan, train the patient to breathe and hold their breath. During the scan, ask the patient to lie on their back, with the neck raised, and the shoulders to sink as much as possible, and swallowing is prohibited. The scan range is from the andible to the base of the neck. When the thyroid extends behind the sternum, the scan range is expanded to cover all of it. Three, image segmentation and feature extraction Using stratified random sampling method, patients were divided into training group and test group at a ratio of 8:2. The data of the training group was used for feature screening and model construction.

Three, image segmentation and feature extraction.

Using stratified random sampling method, patients were divided into training group and test group at a ratio of 8:2. The data of the training group was used for feature screening and model construction. 1. ROI segmentation: 2 experienced imaging physicians (A doctor Teacher, Doctor B) use ITK-SNAP (www.itksnap.org) software to delineate the edge of the target lesion layer by layer on CT plain scan, arterial phase and venous phase images, and synthesize a three-dimensional region of interest (ROI). A. The doctor will draw the outline again after 3~6 days.

2. Feature selection: Using the Artificial Intelligence Kit (A. K) software (Version: 3.2.0.R, GE healthcare, USA), first standardize the three-phase CT images of the patient, and then perform feature extraction respectively. A total of 378 features are extracted Parameters, including histogram There are three categories: map feature, geometric form feature and texture feature.

Result

A total of 179 patients were enrolled, including 59 males and 120 females, aged 25 to 64 (40±11) years old. 89 cases of benign nodules, including 53 cases of thyroid adenoma (25 cases of follicular adenoma, 17 cases of eosinophilic adenoma, atypical gland 10 cases, 1 case of hyaline variable beam tumor), nodular goiter There were 32 cases, 2 cases of granulomatous thyroiditis and 2 cases of hemangioma. 90 cases of malignant nodules, including 56 cases of papillary thyroid carcinoma, 21 cases of follicular carcinoma, There were 7 cases of medullary carcinoma, 1 case of undifferentiated cancer, 4 cases of metastasis, and 1 case of lymphoma. According to TI-RADS classification, 9 cases were grade II, 113 cases were grade III, and 57 cases were grade IV. After stratified random sampling and grouping, there were 143 cases in the training group, including 43 males and 100 females, aged from 25 to 64 (40±10) years old, the largest dimension of the lesion was 1.4-3.0 (2.4±0.6) cm, and 75 cases were malignant 68 cases were benign; 36 cases were in the test group, 16 males and 20 females, aged 27-61 (38±13) years old, the largest lesion diameter was 1.2-3.8 (2.9±0.9) cm, 15 cases were malignant, and 20 were benign. 21 cases. Gender (χ^2=2.689, P=0.101), ratio of benign and malignant lesions (χ^2=1.337, P=0.248), age (t=1.185, P=0.272), maximum diameter of lesions (t=2.386, P= 0.362) The differences were not statistically significant. 2. Imaging Features

At the same time, the three phase images of the patient are extracted, and the image of each patient is obtained 378 imageomics features, through the LASSO model for high-dimensional data Perform dimensionality reduction and screen out 16 imageomics features. 3 geometric features, including surface volume ratio (surface volume ratio), compactness (compactness1), and sphericity; 2 histogram features, including relative deviation (relative deviation), area percentage (zone percentage); texture 11 class features, including 2 full-angle gray-level co-occurrence matrices (GLCMEntropy-AllDirection-offset1/4), 2 full-angle correlations (correlation- AllDirection-offset1/4), 2 full-angle diagonal correlations (haralick correclation-AllDiretion-offset1 / 7) and full-angle Inertia (inertia-AllDirection), short run emphasis-AllDirection, 0 degree long run advantage (lung run emphasis-angle0), fullangle cluster shade-AllDirection, full-angle cluster shade (cluster shade) AllDirection). The weight of each feature is shown in Figure 1. Will The 16 features were selected to establish a model for predicting benign and malignant thyroid nodules, and cross-validation was used to select the optimal model parameter λ to obtain the most The λ value is 0.047 1, logλ=-3.053 7 (Figure 2), and the characteristic coefficient varies with The curve of λ change is shown in Figure 3.

3. The efficacy of imaging omics model in identifying benign and malignant thyroid nodules. The results of the omics model predicting the benign and malignant thyroid nodules in the training group and the test group are consistent with the pathological results, as shown in Figure 6 and 7. The two lines have a high degree of coincidence, indicating that the predicted results are consistent with the pathological results Good, strong predictive ability. The histogram of the accuracy of the model for predicting benign and malignant nodules is shown in Figure 8. The overall prediction effect is better, and the model has high clinical value.

In this study, a total of 16 feature parameters with high value in 3 categories were extracted, namely geometric features (3), histogram features (2), and texture features (11).