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Abstract

Radiomic: Prediction of Acoustic Neuroma Response to the Cyberknife Treatment

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Abstract

Objective(s): The aim of the study was to use a radiomic approach to evaluate the possibility to predict the response of an acoustic neuroma to Cyberknife® radiotherapy analyzing pre-treatment MR images.

Methods: 38 patients presenting an acoustic neuroma treated with Cyberknife® at our institute were selected. Comparing the pre and post-radiotherapy images, acquired after at least 2 years, the radiotherapist divided the patients according to the volumetric treatment outcome (stability, reduction, increasement). This classification was used by the machine learning algorithm as a reference value. All images were acquired on two 1.5T machines with contrast enhanced T1-weighted sequences in axial plane. Semi-automatic tumor segmentation was carried out by a radiotherapist on MR images using the level tracing effect of the 3DSlicer image analysis software. After the segmentation a resampling step was done to harmonize the images acquired on the scanners. Sequentially, 1135 shape-based, intensity-based and texture-based features were extracted using IBEX, an open software infrastructure platform. An evolutionary machine learning algorithm (a TWIST system based on KNN algorithm) was used to subdivide the dataset into training and test set and select features yielding the maximal amount of information. After the features extraction, a predictive model based on a training-testing crossover procedure was developed. The best neural network obtained was a 2-layers feed forward back propagation algorithm with 37 input variables containing the maximal amount of information.

Results: The neural network was used twice inverting the training/testing set. In the first analysis the sensitivity was 71.43%, while the specificity was 100%, with a global accuracy of 85.71%. In the second analysis the sensitivity was 83.33% and the specificity 88.24%, with a global accuracy of 85.78%. The mean value of the global accuracy was 85.75%.

Conclusion(s): The obtained results show that Machine Learning coupled with Radiomics has a great potential in distinguishing, before radiosurgery, patients with volume reduction from patients without.

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