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Survival Prediction in Colorectal Liver Metastases using Radiomics

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Introduction/Background

Colorectal Liver Metastases (CRLM) signal an advanced stage of colorectal cancer. Accurate survival estimation can guide treatment decisions. We evaluate how accurate radiomics (a non-invasive method that generates numerical data from medical images) is for survival estimation in patients with CRLM and compare it with using traditional clinical information. We also examine the predictive value of radiomics features extracted from images at different quantization levels. Quantization is a process of limiting the number of distinct pixel values in an image to streamline the analysis by reducing noise and computational demands.

Methods/Intervention

This study uses the Colorectal-Liver-Metastases dataset, including preoperative CT DICOM scans with liver segmentations, and overall survival data for 197 patients post-CRLM resection. Using 'pyradiomics', 474 radiomic features were extracted at four different quantization levels (8, 32, 128, and 255). Feature extraction was performed on individual CT slices, with summary statistics computed for each patient based on slice-level data. A Random Survival Forest (RSF) was trained using the training feature set (80%) and evaluated using the censored data concordance index on the test dataset (20%). Feature selection was done using permutation importance analysis, followed by a comparison of the outcomes using concordance indexes. Moreover, we compared the predictive accuracy of just using clinical data acquired at the time of acquisition with radiomic analysis.

Results/Outcome

The most effective RSF model used the top 45 features and had a concordance index of 0.75 at the quantization level of 255. For features extracted at quantization levels 8, 32, and 128, the concordance indexes were 0.67, 0.74, and 0.73, respectively. The optimal results for these levels were obtained using the top 25, 55, and 25 features, respectively. By contrast, models employing traditional clinical data yielded a lower concordance index of 0.64.

Conclusion

Comparing radiomic features to clinical data shows a notable improvement in survival prediction accuracy. Radiomic data consistently outperforms traditional clinical data across quantization levels of 32 and above, this shows the value of quantization to streamline the analysis.

Statement of Impact

Radiomic features provide independent predictive value on top of using only clinical information when predicting survival in patients with CRLM.

Keywords

Colorectal cancer; Radiomic features; Quantization; Random Survival Forest