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LETTER TO THE EDITOR

Review on article of preoperative prediction in chronic hepatitis B virus patients using spectral computed tomography and machine learning

Yao-Qian Yuan, Qian-Qian Chen

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Yao-Qian Yuan, Qian-Qian Chen, Department of Gastroenterology, The First Medical Center of Chinese PLA General Hospital, Beijing 100853, China

Corresponding author: Qian-Qian Chen, MD, Associate Chief Physician, Associate Professor, Department of Gastroenterology, The First Medical Center of Chinese PLA General Hospital, No. 28 Fuxing Road, Haidian District, Beijing 100853, China. qian_qian_chen@163.com

Abstract

This letter comments on the article that developed and tested a machine learning model that predicts lymphovascular invasion/perineural invasion status by combining clinical indications and spectral computed tomography characteristics accurately. We review the research content, methodology, conclusions, strengths and weaknesses of the study, and introduce follow-up research to this work.

Key Words: Gastric cancer; Spectral computed tomography; Perineural invasion; Lymphovascular invasion; Machine learning

Core Tip: Accurate preoperative assessment of gastric cancer staging and tumor aggressiveness is critical for the development of individualized treatment. Previous studies have shown that lymphovascular invasion (LVI) and perineural invasion (PNI) can predict tumor invasion and patient prognosis; therefore, preoperative LVI and PNI assessment can help oncologists identify high-risk categories of gastric cancer patients preoperatively and predict outcomes. This letter comments on a published study that showed that the accurate preoperative identification of LVI/PNI in gastric cancer can be achieved by merging clinical markers with portal venous and equilibrium phase spectral computed tomography characteristics.

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TO THE EDITOR

For gastric cancer, perineural invasion (PNI) and lymphovascular invasion (LVI) are significant prognostic variables, suggesting a higher risk of metastasis and poor prognosis. Clinical professionals can determine high-risk patients and make treatment decisions with the use of precise preoperative LVI/PNI status. Nevertheless, the accuracy of previous models that solely used computed tomography (CT) scans to predict LVI or PNI was restricted.

Spectral CT imaging, which offers a wide range of quantitative characteristics, can transition from studying macroscopic morphology to microscopic quantitative issues[1]. Prior research has shown that the prognosis, staging, lymph node metastases, and histological classification of patients with gastric cancer may all be evaluated quantitatively using spectral CT imaging[2-4]. According to Ren *et al*[5], LVI and PNI could be evaluated using energy-based spectral CT parameters, histological grading, Borrmann grading, and cancer antigen 125. Few studies have examined the efficacy of predicting preoperative LVI and PNI in gastric cancer patients using machine learning and spectral CT imaging. To better address this clinical problem, this study used a machine learning approach in which the optimal fusion of clinical markers and spectral CT parameters could more precisely anticipate preoperative LVI/PNI status in gastric cancer patients.

MACHINE LEARNING MODEL

The purpose of this letter is to comment on the machine learning model that incorporates spectral CT parameters and clinical indicators to accurately anticipate LVI/PNI status.

We read with interest the article published in *World Journal of Gastroenterology* by Ge *et al*[6]. The retrospective dataset utilized for this investigation included 257 gastric cancer patients [validation cohort (n = 85); training cohort (n = 172)]. First, quantitative spectral CT characteristics were retrieved from the delimited tumor sites, together with various clinical indicators such as cytotactin/tenascin (TN) stages, serum tumor markers, and CT-detected extramural vein invasion (CT-EMVI). Subsequently, informative clinical and spectral CT parameters were chosen by a two-step feature selection procedure within a 10-fold cross-validation loop that combined information gain ranking and correlation-based techniques. The area under the receiver operating characteristic area under the curve (AUC) was used to assess the efficacy of a nomogram model based on logistic regression (LR) that was created to predict LVI/PNI status.

A statistically significant difference was observed in the prevalence of CT-EMVI positive status (P < 0.05), CT-N positive status, and CT T3-4 stage between the LVI/PNI-positive group in both the validation and training cohorts. Following LR analysis, the training group's preoperative CT-EMVI, CT-T stage, the ratio of standardized iodine concentration of equilibrium phase (EP-NIC), and single-energy CT values of 70 keV of venous phase (VP-70 keV) were found to be independent affecting factors. CT-T and CT-EMVI had AUC of 0.793 and 0.762, respectively, the AUC of EP-NIC and VP-70 keV were 0.824 and 0.888, respectively, and were marginally higher.

This study used a machine learning system to assess CT-determined TN stage, quantitative spectral CT parameters, CT-EMVI, and blood tumor markers. Feature reduction and LR analysis showed that the histological LVI/PNI status could be independently predicted by the VP-70 keV CT value, CT-EMVI, CT-T stage, and EP-NIC.

There were some limitations to this study. First, there were differences in the number of patients in the LVI/PNI-positive and negative groups, and the sample size was small. Second, other histological tumor types were not examined; only gastric adenocarcinoma. Third, conventional clinicopathological parameters were not taken into account by this prognostic model. Fourth, the results may not be generalizable because the study was conducted at a single center. To confirm that using these predictive models more widely is clinically feasible, a multicenter study is required.

Subsequent research will rely on verifying the therapeutic utility of a noninvasive spectral-CT-based machine learning model in preoperative risk assessment through a prospective multicenter investigation. Further research may examine how this model might be incorporated into standard clinical practice to evaluate its effects on patient management, especially in terms of identifying patients who might profit from more intensive preoperative treatment plans. In the future, research on spectral CT imaging may enhance and expand its prognostic powers, which could lead to better results and more personalized treatment plans for patients with gastric cancer.

The combination of artificial intelligence (AI) and medical imaging is helpful for preoperative prediction of gastric cancer, and many novel techniques are emerging. Huang *et al*'s team used CT deep learning features and clinical data to predict malnutrition in patients with gastric cancer[7]. Fan *et al*'s team used alexander networks, extreme learning machines to optimize a new hybrid method for detecting early gastric cancer[8]. Fan *et al*'s team used positron emission CT/CT and augmented CT radiomics and clinical variables for machine learning analysis of noninvasive prediction of LVI in gastric cancer[9].

CONCLUSION

These studies demonstrate the potential of AI techniques for preoperative prediction of gastric cancer, especially in analyzing complex medical imaging data. As these technologies continue to evolve and their effectiveness and clinical applications are being validated through clinical trials and studies, more innovative methods may be developed in the future to improve the accuracy of preoperative gastric cancer prediction.

FOOTNOTES

Author contributions: Yuan YQ drafted the article; Chen QQ made critical revisions related to the important intellectual content of the manuscript; all of the authors read and approved the final version of the manuscript to be published.

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