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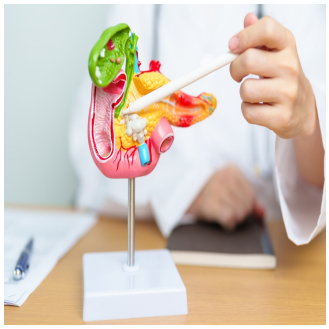
CT Radiomics and Clinical Data for Predicting Acute Pancreatitis



Acute pancreatitis (AP) is a common gastrointestinal disorder marked by inflammation of the pancreas, often resulting in both local and systemic complications. While the majority of cases present mild symptoms and resolve without significant intervention, around 20% of patients develop moderate to severe pancreatitis, potentially leading to necrosis, organ failure and mortality rates between 13% and 40%. Severe cases can result in multiple organ complications, significantly impacting patient outcomes. Early and accurate prognosis prediction is essential to guide clinical decisions and improve patient management, particularly for those at risk of developing critical complications.

Traditional approaches to assessing AP severity involve laboratory markers such as white blood cell counts and C-reactive protein levels, along with imaging through contrast-enhanced computed tomography (CT). However, these methods can be limited in their ability to detect early pancreatic necrosis and subtle morphological changes. Radiomics, a data-driven imaging analysis technique, has emerged as a powerful tool for enhancing diagnostic precision by extracting a large number of quantitative features from medical images. A study recently published in *Insights into Imaging* explores the integration of CT-based radiomics with clinical data to improve the accuracy of AP prognosis prediction.

Radiomics Analysis and Predictive Modelling

Radiomics involves the extraction of complex quantitative imaging features from standard medical scans, allowing for the identification of subtle patterns and textural changes not visible to the human eye. In the study, CT radiomics data were collected from both the pancreatic and peripancreatic regions in a cohort of 344 patients diagnosed with AP. These patients were divided into training, validation and test sets to ensure a balanced evaluation of the models developed.

Over 2,000 radiomics features were initially extracted, with a focus on pancreatic and peripancreatic tissues. A rigorous feature selection process was applied using statistical techniques such as the least absolute shrinkage and selection operator (LASSO) algorithm, reducing the dataset to 14 key radiomics features that were most predictive of AP prognosis. These features were used to construct multiple predictive models, including a clinical model, a pancreatic radiomics model, a peripancreatic radiomics model and a combined model integrating both radiomics and clinical data.

The combined model, which incorporated both radiomics features and clinical variables, demonstrated superior predictive performance compared to individual models. In the training set, it achieved an area under the receiver operating characteristic curve (AUC) of 0.899, significantly outperforming both the radiomics-only and clinical models. This trend persisted in the validation set, where the combined model achieved an AUC of 0.877, underscoring its robustness and potential clinical utility.

Clinical Integration and Model Validation

A key strength of the combined model was its integration of both radiomics data and critical clinical markers such as white blood cell (WBC) count, C-reactive protein (CRP) levels and the presence of peripancreatic effusion and extrapancreatic complications. These clinical features were selected based on their established association with poor AP prognosis. Elevated CRP and WBC levels often signal a heightened inflammatory response, while peripancreatic effusion and extrapancreatic complications can indicate more severe disease progression.

The validation process involved randomly splitting the patient cohort, with data from different sets used to train, validate and test the models. This approach helped ensure the reliability and generalisability of the findings. Across all datasets, the combined model consistently outperformed both the standalone radiomics models and the clinical model in terms of sensitivity, specificity and overall accuracy.

Decision curve analysis (DCA) was further employed to assess the clinical applicability of the combined model. DCA evaluates the net benefit of a predictive model across different probability thresholds for intervention. The combined model demonstrated superior net benefit across a range of clinical scenarios, further supporting its potential for improving decision-making in AP management.

Advantages and Limitations of the Combined Approach

Integrating CT radiomics with clinical data offers several advantages in the context of AP prognosis prediction. By capturing microscopic structural changes in the pancreas and peripancreatic regions, radiomics can reveal early indicators of disease severity that may not be evident through conventional imaging. The inclusion of clinical markers adds another layer of predictive power, resulting in a more comprehensive assessment of patient risk.

However, there are limitations to this approach. The study was conducted retrospectively at a single medical centre, which could limit the generalisability of the findings to broader populations. Additionally, CT imaging quality and segmentation accuracy can vary between institutions, potentially affecting model performance. Manual image segmentation, as used in this study, can introduce variability and may not be practical for widespread clinical use without further automation. Future research should aim for multi-centre validation and the standardisation of image acquisition and processing techniques.

Another limitation involves the exclusion of certain patient groups, such as those with chronic pancreatitis or those without follow-up imaging. The reliance on contrast-enhanced CT also restricts its use in patients with contraindications to contrast agents.

The integration of CT radiomics with clinical features represents a significant advancement in predicting the prognosis of acute pancreatitis. By combining detailed imaging data with established clinical markers, this approach offers a more accurate and comprehensive risk assessment compared to traditional models. The combined model developed in the study consistently demonstrated superior predictive performance, making it a promising tool for guiding clinical decision-making and personalised treatment strategies for patients with AP.

Further validation through multi-centre trials and the incorporation of automated segmentation techniques could enhance the practical implementation of this model. If widely adopted, such integrated approaches could help clinicians identify high-risk patients earlier, allowing for timely interventions and improved patient outcomes in acute pancreatitis care.

Source: **Insights into Imaging**

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