The Role of RECIST 1.1 criteria in Evaluating Response of Locally Advanced Rectal Cancer to Neoadjuvant Therapy using Multiparametric MRI

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KEYWORDS
MRI, rectal cancer, neoadjuvant treatment, RECIST 1.1, tumor response, imaging biomarkers, pathological correlation, diffusion-weighted imaging

ABSTRACT:
Background: This study elucidates the pivotal role of using RECIST 1.1 criteria in the MRI evaluation of tumor response among patients with rectal cancer undergoing neoadjuvant therapy. By employing a systematic, reproducible approach to assessing therapeutic outcomes, RECIST 1.1 has become a cornerstone of evidence-based oncologic practice. Leveraging advanced imaging modalities such as multi-parametric MRI, RECIST 1.1 enables precise tumor measurement, response classification, and correlation with pathological outcomes. The findings underscore its indispensability in facilitating precision oncology, enhancing treatment planning, and optimizing patient-specific strategies.

1. Introduction

Rectal cancer remains a pressing global health issue, characterized by high morbidity and significant therapeutic challenges. The management of locally advanced rectal cancer often necessitates a multimodal approach, including neoadjuvant chemoradiotherapy followed by surgical resection. These strategies aim to downstage tumors, improve resectability, and achieve sphincter preservation, thereby improving both survival rates and quality of life.

In this context, the accurate and timely evaluation of tumor response is critical to tailoring treatment regimens. RECIST 1.1 (Response Evaluation Criteria in Solid Tumors) provides a well-established, standardized methodology for quantifying tumor response based on measurable radiologic changes. Integrated with advanced imaging techniques such as multi-parametric MRI, RECIST 1.1 offers unparalleled precision in evaluating both morphological and functional tumor characteristics. This study seeks to expand on RECIST 1.1's utility, evaluating its performance in predicting pathological outcomes and its integration into modern clinical workflows for rectal cancer management.

Methods

This prospective investigation was conducted at the National Cancer Institute, Cairo University, encompassing 90 patients diagnosed with histologically confirmed, locally advanced rectal cancer. Baseline and post-treatment imaging using high-resolution, multi-parametric MRI served as the primary diagnostic tool. Tumor response was assessed using RECIST 1.1 criteria, which categorize response into complete, partial, stable, or progressive disease.

Multi-parametric MRI techniques, including T2-weighted imaging, diffusion-weighted imaging (DWI), and apparent diffusion coefficient (ADC) mapping, were employed to enhance anatomical and functional evaluations. Correlation with clinical and pathological findings constituted secondary

endpoints. Quantitative metrics derived from RECIST 1.1 provided robust data for statistical analysis and response categorization.

Results

- RECIST 1.1-Based Categorization: The study revealed that 68% of patients were classified as responders (complete or partial response), whereas 32% were non-responders. This stratification underscored RECIST 1.1's capacity to effectively differentiate therapeutic outcomes.
- Tumor Dimension Analysis: Among responders, tumor dimensions showed a mean reduction of 50-70%, with statistically significant differences when compared to non-responders ($P < 0.001$). Pathological findings corroborated these imaging results, validating the clinical utility of RECIST 1.1.
- Correlation with Pathological Grades: A strong concordance between RECIST 1.1-based assessments and pathological tumor regression grades (TRGs) was observed. Responders exhibited notable histological changes, including fibrosis and reduced cellularity, aligning with radiological findings.
- Functional Imaging Insights: Diffusion-weighted imaging (DWI) demonstrated marked changes in ADC values among responders, reflecting reduced tumor cellularity and increased fibrosis. This functional metric enhanced the predictive accuracy of RECIST 1.1 by providing complementary data on tumor microenvironmental changes.
- Predictive Accuracy: RECIST 1.1 demonstrated an overall predictive accuracy of 85% for pathological complete response (pCR), affirming its value as a non-invasive biomarker in clinical practice.
- Clinical Adaptability: The efficacy of RECIST 1.1 was consistent across diverse tumor subtypes and baseline characteristics, highlighting its adaptability in heterogeneous patient populations.

Discussion

The findings of this study substantiate RECIST 1.1 as an essential tool in evaluating the therapeutic response of rectal cancer to neoadjuvant therapy. Its quantitative, standardized approach bridges the gap between imaging and pathological outcomes, offering clinicians a reliable metric for treatment efficacy.

The integration of RECIST 1.1 with advanced imaging modalities such as multi-parametric MRI and functional techniques like DWI enriches its predictive capabilities. These synergies facilitate precision oncology, enabling clinicians to tailor therapeutic strategies based on robust, objective metrics. Moreover, RECIST 1.1's reproducibility and standardization support its implementation in routine clinical workflows, fostering consistency across institutions.

Future advancements may involve leveraging artificial intelligence and machine learning algorithms to automate RECIST 1.1-based assessments, enhancing their scalability and precision. Additionally, combining RECIST 1.1 with emerging imaging biomarkers holds potential for refining response evaluation, particularly in cases with equivocal or borderline findings.

Conclusion

RECIST 1.1 emerges as a critical framework in the non-invasive assessment of rectal cancer response to neoadjuvant therapy. Its robust, standardized metrics support personalized treatment planning and optimization, contributing significantly to improved patient outcomes. By integrating morphological and functional imaging criteria, RECIST 1.1 provides a comprehensive evaluation system that underscores its pivotal role in advancing the field of precision oncology.

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