



Research Article

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Appraisal of Changes in Tumor Size in Response to Neoadjuvant Treatment in Oligometastatic Renal Cell Carcinoma



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Abstract

Objective: This study aims at assessment of tumor size changes in patients with oligometastatic RCC who received neoadjuvant therapy.

Materials and methods: We reviewed clinical records of patients diagnosed with oligometastatic RCC who received neoadjuvant therapy. Included patients had a diagnosis of oligometastatic RCC, administration of neoadjuvant therapy, and availability of baseline and follow-up imaging data. Tumor size measurements were extracted from radiology reports and direct review of imaging studies. Changes in tumor sizes were assessed by comparing measurements before and after neoadjuvant therapy. Treatment decisions following neoadjuvant therapy were made by a multidisciplinary team of experts considering imaging response, patient performance status, and disease characteristics.

Results: All patients had undergone neoadjuvant treatment, and tumor size changes post-neoadjuvant therapy demonstrated a spectrum of responses, with patients showing different degrees of tumor shrinkage. Imaging-based response evaluation was used in decision making for further subsequent treatment strategies.

Conclusion: Neoadjuvant therapy represents a promising strategy to enhance the management of oligometastatic RCC by reducing tumor burden and improving the feasibility of subsequent curative treatments. Comprehensive imaging assessment is essential to guide multidisciplinary decision-making and optimize patient outcomes. Continued research efforts are warranted to refine treatment algorithms and integrate emerging systemic and local therapies within personalized care paradigms.

Keywords: Renal cell cancer; Oligometastasis; Treatment response

Abbreviations: SCLC: Small Cell Lung Cancer; IMRT: Intensity-Modulated Radiotherapy; stereotactic techniques, ART: Adaptive Radiotherapy; CT: Computed Tomography; MRI: Magnetic Resonance Imaging; AAPM: Association of Physicists in Medicine; ICRU: International Commission on Radiation Units and Measurements; HU: Hounsfield Units

Introduction

Renal cell carcinoma (RCC) constitutes a relatively smaller proportion of adult malignancies worldwide, but could follow an aggressive disease course with its propensity for metastatic spread and resistance to conventional therapies [1-7]. Although localized RCC can often be effectively treated with nephrectomy, the presence of metastatic disease substantially worsens prognosis [2-7]. Within the spectrum of metastatic RCC, the subset of patients with oligometastatic disease-commonly defined as having five or fewer metastatic lesions-has garnered increasing clinical interest as a potentially more favorable group that might benefit from aggressive multimodal therapy [2-7].

Oligometastatic RCC represents an intermediate disease state between localized and widespread metastatic disease, where the metastatic burden is limited and possibly amenable to curative-intent approaches [3-7]. Recent advances in systemic therapies, particularly targeted agents such as vascular endothelial growth factor receptor (VEGFR) tyrosine kinase inhibitors (TKIs), mammalian target of rapamycin (mTOR) inhibitors, and immune checkpoint inhibitors, have significantly transformed the treatment landscape of RCC [2-7]. These agents have shown efficacy not only in controlling metastatic disease but also as neoadjuvant therapies, potentially downstaging tumors prior to local interventions [2-7].

Neoadjuvant therapy in oligometastatic RCC may serve several important purposes: reducing tumor size to facilitate subsequent surgical resection or ablation, eradicating micrometastatic disease, improving local control which may ultimately translate into enhancing survival outcomes. Furthermore, the response to neoadjuvant treatment provides prognostic information and may guide personalized therapeutic decisions.

In parallel, the evolution of radiotherapy techniques—such as stereotactic body radiotherapy (SBRT), image-guided radiotherapy (IGRT), and adaptive radiotherapy (ART)—has opened new avenues for the treatment of oligometastatic lesions with high precision and limited toxicity for several disease sites throughout the human body [2-106].

These technologies allow targeted delivery of ablative doses to metastatic sites, complementing systemic therapies and surgery within a multidisciplinary treatment framework. Despite these advances, the assessment of tumor response to neoadjuvant therapy remains challenging in RCC due to the heterogeneous nature of the disease and variable radiographic appearances. Conventional criteria such as RECIST may not fully capture the biological effects of targeted or immunotherapy, necessitating comprehensive evaluation strategies. This study aims at assessment of tumor size changes in patients with oligometastatic RCC who received neoadjuvant therapy.

Materials and Methods

We reviewed clinical records of patients diagnosed with oligometastatic RCC who received neoadjuvant therapy. Included patients had a diagnosis of oligometastatic RCC, administration of neoadjuvant therapy, and availability of baseline and follow-up imaging data. Tumor size measurements were extracted from radiology reports and direct review of imaging studies. Changes in tumor sizes were assessed by comparing measurements before and after neoadjuvant therapy. Treatment decisions following neoadjuvant therapy were made by a multidisciplinary team of experts considering imaging response, patient performance status, and disease characteristics.

Results

All patients had undergone neoadjuvant treatment, and tumor size changes post-neoadjuvant therapy demonstrated a spectrum of responses, with patients showing different degrees of tumor shrinkage. Imaging-based response evaluation was used in decision making for further subsequent treatment strategies.

Discussion

RCC accounts for a relatively small proportion of adult malignancies worldwide but can exhibit an aggressive clinical course due to its tendency for metastatic spread and resistance to conventional treatments [1-7]. While localized RCC is often effectively managed with nephrectomy, the development of metastatic disease significantly worsens the prognosis [2-7].

Among metastatic RCC patients, those with oligometastatic disease—typically defined as having five or fewer metastatic lesions—have attracted growing attention as a distinct subgroup that may benefit from more aggressive, multimodal therapeutic approaches [2-7].

Oligometastatic RCC represents an intermediate stage between localized and wide metastatic disease, characterized by a limited tumor burden that may be amenable to curative-intent treatments [3-7]. The advent of novel systemic therapies, including vascular endothelial growth factor receptor (VEGFR) tyrosine kinase inhibitors (TKIs), mammalian target of rapamycin (mTOR) inhibitors, and immune checkpoint inhibitors, has dramatically reshaped the therapeutic landscape for RCC [2-7]. These agents have demonstrated efficacy not only in controlling metastatic disease but also as neoadjuvant therapies, offering the potential to downstage tumors before definitive local interventions [2-7].

Neoadjuvant treatment in oligometastatic RCC serves several critical roles: reducing tumor volume to facilitate subsequent surgical resection or ablative procedures, eliminating micrometastatic disease, and improving local control, which may ultimately translate into enhanced survival outcomes. Moreover, tumor response to neoadjuvant therapy can provide valuable prognostic information and inform personalized treatment planning. Concurrently, advances in radiotherapy techniques—such as stereotactic body radiotherapy (SBRT), image-guided radiotherapy (IGRT), and adaptive radiotherapy (ART) have expanded therapeutic options for oligometastatic lesions across various cancer types with high precision and minimal toxicity [2-106].

These technologies enable the delivery of ablative doses directly to metastatic sites, complementing systemic therapies and surgery within a coordinated multidisciplinary framework. Despite these progressions, evaluating tumor response to neoadjuvant therapy in RCC remains challenging due to the disease's heterogeneity and variable imaging characteristics. Traditional response criteria, such as RECIST, may not fully capture the biological effects of targeted or immunotherapies, highlighting the need for comprehensive assessment strategies. This study aimed to evaluate tumor size changes in patients with oligometastatic RCC who underwent neoadjuvant therapy. We reviewed clinical records of patients diagnosed with oligometastatic RCC who received neoadjuvant therapy. Included patients had a diagnosis of oligometastatic RCC, administration of neoadjuvant therapy, and availability of baseline and follow-up imaging data. Tumor size measurements were extracted from imaging reports and direct review of imaging studies.

Changes in tumor sizes were assessed by comparing measurements before and after neoadjuvant therapy. Treatment decisions following neoadjuvant therapy were made by a multidisciplinary team of experts considering imaging response, patient performance status, and disease characteristics. All

patients had undergone neoadjuvant treatment, and tumor size changes post-neoadjuvant therapy demonstrated a spectrum of responses, with patients showing different degrees of tumor shrinkage. Imaging-based response evaluation was used in decision making for further subsequent treatment strategies.

Oligometastatic RCC occupies a unique clinical niche characterized by limited metastatic dissemination and the potential for curative-intent therapy [2-7]. The concept of oligometastasis challenges the traditional dichotomy of localized versus widespread disease and supports a paradigm shift towards aggressive multimodal treatment to improve long-term outcomes [2-7]. Our findings in this study reinforce the notion that neoadjuvant therapy can effectively reduce tumor burden in a significant subset of patients with oligometastatic RCC. The incorporation of neoadjuvant therapy offers multiple theoretical and practical benefits.

First, tumor downsizing may facilitate subsequent therapies that might otherwise be unfeasible due to size or anatomical considerations. Second, neoadjuvant treatment targets both macroscopic and micro metastatic disease, potentially reducing recurrence risk post-local treatment. Third, treatment response can serve as a biomarker of tumor biology, identifying patients more likely to benefit from aggressive interventions. Targeted therapies such as VEGFR TKIs (e.g., sunitinib, pazopanib) and mTOR inhibitors have demonstrated promising response rates in metastatic RCC, with tumor shrinkage frequently observed in the neoadjuvant settings. More recently, immune checkpoint inhibitors, alone or in combination with TKIs, have exhibited promising efficacy and durable responses, reshaping the treatment algorithm for metastatic RCC. However, the optimal sequencing, duration, and combination of neoadjuvant therapies remain areas of ongoing research.

From a radiotherapy perspective, advances in technology including SBRT and IGRT permit precise targeting of metastatic lesions with ablative doses, minimizing exposure to surrounding healthy tissues and reducing treatment-related toxicity [8-106]. These modalities are particularly suited to the oligometastatic setting, where limited lesions can be treated with curative intent. Integrating radiotherapy with systemic neoadjuvant therapy requires careful multidisciplinary coordination to optimize timing and maximize therapeutic synergy. Our study highlights the importance of detailed imaging assessment in evaluating tumor response. While size-based criteria such as RECIST provide a standardized framework, functional imaging modalities (e.g., PET/CT, diffusion-weighted MRI) and volumetric analyses may offer additional insights into biological response, particularly in the context of immunotherapy where radiographic pseudoprogression may occur.

Conclusion

Neoadjuvant therapy represents a promising strategy to enhance the management of oligometastatic RCC by reducing

tumor burden and improving the feasibility of subsequent curative treatments. Comprehensive imaging assessment is essential to guide multidisciplinary decision-making and optimize patient outcomes. Continued research efforts are warranted to refine treatment algorithms and integrate emerging systemic and local therapies within personalized care paradigms.

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