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Role of external radiotherapy in the treatment of Naso-sinus sarcomas

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Abstract

Naso-sinus sarcomas are uncommon and aggressive tumors with limited treatment options due to their proximity to vital structures. This retrospective study examines the effectiveness of external beam radiotherapy (EBRT), particularly intensity-modulated radiotherapy (IMRT), in managing these malignancies. Sixteen patients treated between 2013 and 2023 were analyzed, receiving radiation doses between 50 and 70 Gy. Additionally, 62.5% of patients with high-risk histologies underwent chemotherapy. Surgical resection was performed in 12.5% of cases.

Most patients tolerated treatment well, experiencing only mild to moderate toxicities. Complete response was observed in 37.5% of cases, while 31.25% achieved partial response, and 18.75% had stable disease. Disease progression occurred in 12.5% of patients. Median disease-free survival was longer for those receiving chemotherapy (20 months) compared to those who did not (15 months). The overall median survival reached 24 months.

These results underscore the importance of EBRT, particularly IMRT, in the multidisciplinary management of naso-sinus sarcomas. IMRT demonstrated improved local control with reduced toxicity. However, treatment remains complex, with potential late toxicities. Emerging radiotherapy techniques, such as proton therapy, volumetric-modulated arc therapy (VMAT), and stereotactic body radiotherapy (SBRT), may enhance outcomes. A collaborative, multidisciplinary approach is essential to optimize patient care.

Keywords: Naso-sinus sarcoma; External beam radiotherapy; Intensity-modulated radiotherapy; Head and neck cancer; Multimodal therapy; Proton therapy; Volumetric-modulated arc therapy; Stereotactic body radiotherapy

1. Introduction

Naso-sinus sarcomas are rare and aggressive malignancies originating in the nasal cavity and paranasal sinuses with limited therapeutic options.. Due to their proximity to critical structures, their management is challenging. This retrospective study aims to evaluate the efficacy of conformational external radiotherapy with intensity modulation (IMRT), either alone or in combination with surgical intervention and chemotherapy, in the treatment of these tumors.[1].

2. Methods

We included 16 patients treated in our department between 2013 and 2023. All subtypes of naso-sinus sarcomas were considered. Patients received conformational radiotherapy with intensity modulation (IMRT), with doses ranging from 50 to 70 Gy based on tumor volume and tolerance (Figure 1 , 2). Additionally, adjuvant or neoadjuvant chemotherapy was administered to 10 patients (62.5%) with high-risk histological subtypes (rhabdomyosarcomas and Ewing

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sarcomas). The agents used primarily included anthracyclines and ifosfamide in combination. Tumor locations included 6 cases in the maxillary sinus, 7 in the nasal cavities, 2 in the ethmoid sinus, and 1 in the frontal sinus.

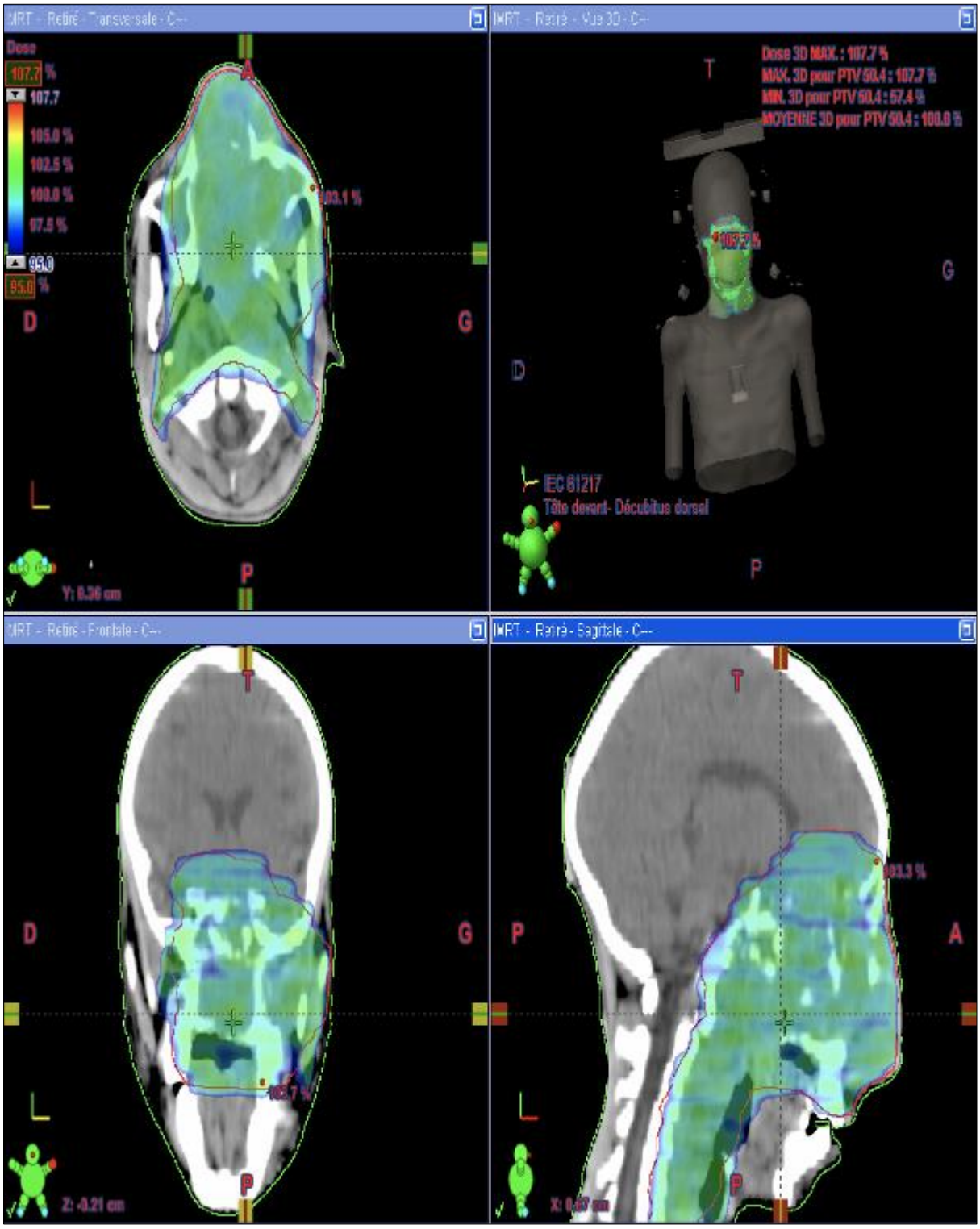

Figure 1 IMRT Treatment Plan Displaying Dose Distribution for a patient with nasosinus sarcoma

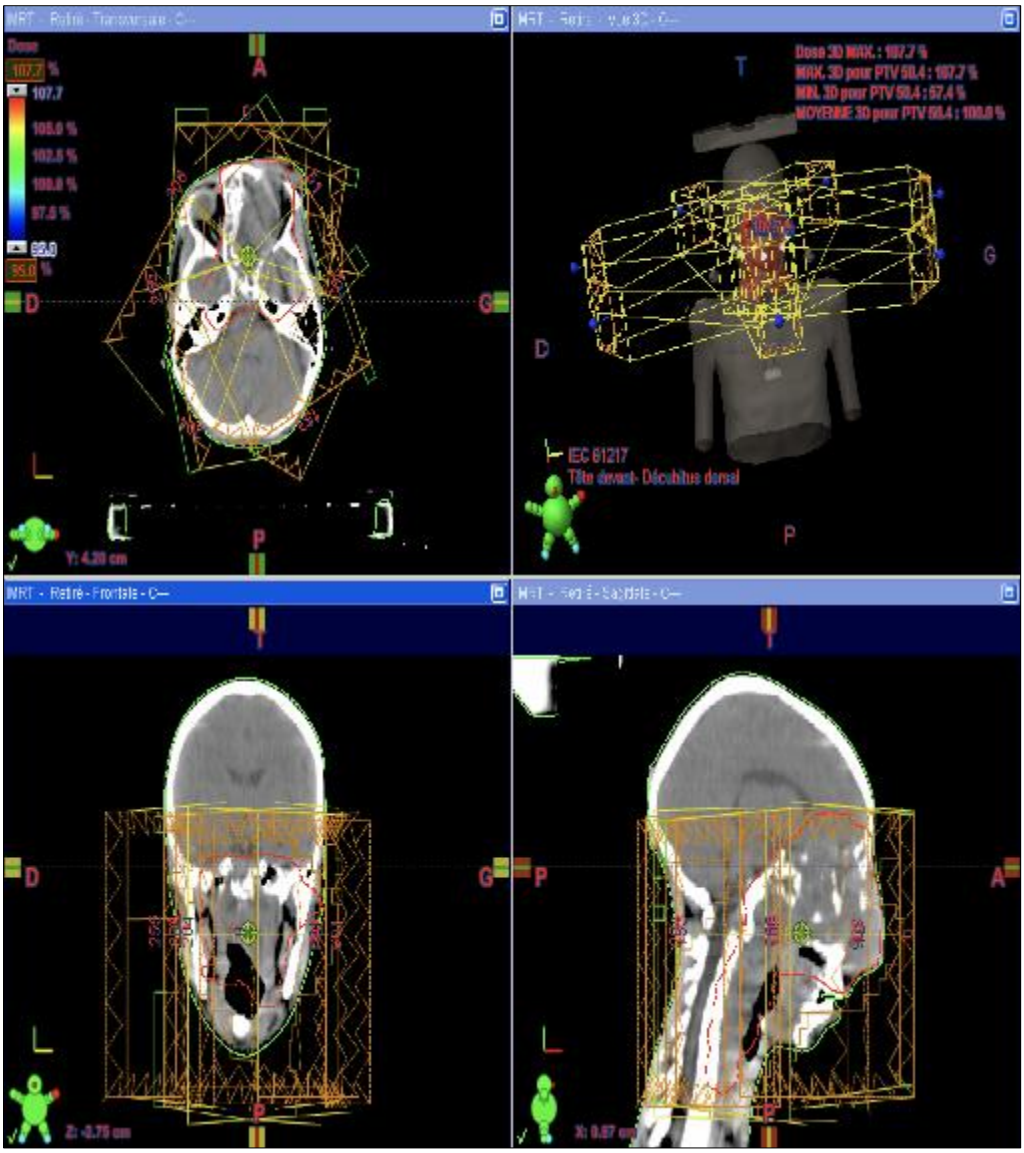

Figure 2 IMRT Treatment Plan Displaying Beam Arrangements for a patient with nasosinus sarcoma

3. Results

Histological analysis revealed 6 grade II chondrosarcomas, 5 rhabdomyosarcomas, 3 Ewing sarcomas, and 2 liposarcomas. Surgical resection was performed in 2 patients (12.5%); one had a complete resection, while the other had a subtotal resection. The treatment was generally well tolerated, with most patients experiencing only mild to moderate toxicities (grade I and II), such as mucositis and temporary dermatitis, and no grade III or higher adverse effects. Regarding clinical outcomes, 6 patients (37.5%) achieved a complete response, 5 patients (31.25%) showed a partial response, and 3 patients (18.75%) had stable disease. Disease progression occurred in only 2 patients (12.5%) despite treatment. Chemotherapy appeared to improve disease-free survival, with a median of 20 months for patients receiving chemotherapy compared to 15 months for those who did not. The median overall survival for the entire cohort was 24 months.

4. Discussion

The role of external beam radiotherapy (EBRT) in the management of naso-sinus sarcomas remains crucial, particularly given the anatomical complexity and aggressive nature of these tumors. Our retrospective analysis of 16 cases highlights the importance of EBRT as a component of multimodal therapy. EBRT is frequently used in postoperative, definitive, neoadjuvant, and palliative settings. In our cohort, postoperative adjuvant radiotherapy was employed in cases with positive or close margins, consistent with previous studies demonstrating its role in reducing local recurrence risk [2].

The efficacy of EBRT as a definitive treatment in unresectable tumors was also observed, particularly when combined with chemotherapy in radiosensitive histologies such as Ewing sarcoma and rhabdomyosarcoma . Additionally, neoadjuvant radiotherapy facilitated surgical resection by reducing tumor burden, aligning with prior findings on its role in enhancing resectability and organ preservation . Palliative EBRT effectively alleviated symptoms such as pain and obstruction in advanced cases [3,4].

Advancements in radiotherapy delivery have significantly improved outcomes while minimizing toxicity. In our study, IMRT was the most commonly used technique, providing precise dose delivery and reducing exposure to critical structures such as the optic nerve and brainstem [4]. But despite its advantages, IMRT is not without its limitations in the treatment of sinonasal sarcomas. One major challenge is the complexity and time-consuming nature of treatment planning. The precise contouring of tumor volumes and surrounding critical structures requires a multidisciplinary approach, including the expertise of radiologists, surgeons, and radiation oncologists. Additionally, the use of IMRT can be resource-intensive, requiring advanced technology and specialized equipment that may not be available in all centers. Another consideration is the potential for late toxicities, particularly in patients who require high doses of radiation due to the aggressive nature of sinonasal sarcomas. Although IMRT reduces the risk of acute toxicity, late-onset effects such as tissue fibrosis, necrosis, or secondary malignancies remain a concern, especially when treating young patients or those with long life expectancy [5].

Proton beam therapy (PBT) can be considered in selected cases, particularly for its ability to minimize radiation dose to surrounding normal tissues, an advantage previously demonstrated in pediatric and reirradiation settings . VMAT is utilized in cases requiring improved dose conformity and delivery efficiency . For patients with small or recurrent tumors, SBRT/SRS can provide effective tumor control with a reduced fractionation schedule [5, 6]. The dose and fractionation schedules in our cohort were in line with current recommendations. Patients receiving postoperative EBRT have to be treated with doses ranging from 60 to 66 Gy . For definitive treatment of unresectable tumors, doses of 66–74 Gy need to be delivered . Palliative radiotherapy is administered using hypofractionated regimens (e.g., 30–40 Gy in 10–15 fractions or 20 Gy in 5 fractions) to optimize symptom relief while minimizing treatment burden [1, 5 , 7].

Our findings in terms of treatment tolerance and clinical responses reaffirm the role of EBRT in improving local control rates, particularly in cases with high-risk features such as positive margins .The overall survival outcomes in our study were also consistent with previously reported data, highlighting the benefit of a multimodal approach integrating surgery, radiotherapy, and chemotherapy . However, despite technological advancements, treatment-related toxicities such as mucositis, xerostomia, optic neuropathy, and osteoradionecrosis remain concerns [8]. Further improvements in treatment planning and supportive care strategies are necessary to mitigate these adverse effects.

5. Conclusion

The results of our retrospective study reinforce the importance of EBRT in the management of naso-sinus sarcomas. Advances in IMRT, proton therapy, and SBRT have contributed to improved treatment precision and reduced toxicity. Given the rarity and complexity of these tumors, a multidisciplinary approach is essential to optimize outcomes. Future research should focus on refining patient selection for advanced radiotherapy techniques and exploring novel strategies to enhance therapeutic efficacy while minimizing long-term complications.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest related to this study.

Statement of ethical approval

This study was conducted in accordance with ethical standards and institutional guidelines. Given its retrospective nature, formal ethical approval was waived. Patient confidentiality was strictly maintained, and all data were anonymized to protect privacy.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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