Dosimetric comparison of VMAT and Tomotherapy techniques for the treatment of medulloblastoma / Comparaison dosimétrique des techniques VMAT et Tomothérapie pour le traitement des médulloblastomes

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Résumé

Introduction: Craniospinal irradiation (CSI) is a standard radiation therapy technique for treating medulloblastoma. Due to the large target volume, CSI is commonly delivered using helical tomotherapy (HT), which enables continuous 360◦ irradiation with simultaneous couch translation. Alternatively, C-arm linear accelerators can be used with a multi-isocentric volumetric modulated arc therapy (VMAT) technique incorporating field junctions. This study aims to compare these two treatment delivery techniques.
Material and Methods: A cohort of 14 patients treated with HT between April 2023 and April 2026 was retrospectively included and analyzed. All patients received a prescription dose of 36 Gy delivered in 20 fractions (1.8 Gy per fraction). Treatment plans were generated using Precision (v3.5.0.3, Accuray) treatment planning system (TPS). For a subset of five patients, additional plans were created on a C-arm linear accelerator using a multi-isocentric VMAT technique with Monaco TPS (v6.2.3.0, Elekta). Dosimetric evaluation included target coverage and homogeneity metrics, namely D95% and V110% of the global planning target volume (PTV), as well as mean doses to organs at risk (OARs), including the heart, kidneys and lungs (1). Treatment plans were compared with ProKnowTM software (v2.0.7.4, Elekta) using scorecards.

Results: The distribution of VMAT plans relative to the tomotherapy reference cohort was evaluated. Target coverage (D95%) was comparable between both techniques for evaluated cases. However, VMAT plans showed a slight increase in high-dose regions (V110%) and reduced dose homogeneity compared to tomotherapy. Mean doses to OARs were overall similar between the two techniques and remained within clinically accepted limits (2), despite slightly higher variability observed with VMAT (Figure 1).

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Conclusion: Multi-isocenter VMAT for CSI is feasible, providing comparable target coverage with OAR doses within recommended limits. Ongoing analysis of the full cohort, including patients treated with 23.4 Gy in 13 fractions, will further validate these findings. Future work will focus on the development and optimization of VMAT planning templates to improve robustness, reduce uncertainties, and ensure treatment continuity in clinical practice.

References

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Mots-Clés: Craniospinal irradiation, helical tomotherapy, multi isocentric VMAT