

## Title: Neutrophil-to-Lymphocyte Ratio Changes in Meningiomas after Radiotherapy

Authors: Mishra S, Kroymann T, Pandey S, Golden L, Sando N, Song CW, Lawrence J, Puri S, Kleinberg LR, Yuan J, Neil E, Venteicher A, Moore JA, Terezakis SA, Sloan L

**Purpose:** Neutrophil-to-lymphocyte ratio (NLR), a systemic inflammation marker, is linked to progression and recurrence in meningiomas. Radiotherapy (RT)--either conventional fractionated radiotherapy (CFRT) or stereotactic radiosurgery (SRS)--is used for unresectable or recurrent tumors; however, its impact on NLR remains unclear. We evaluated NLR changes in patients with meningioma treated with CFRT or SRS, hypothesizing that both would elevate NLR--with a greater rise after SRS due to enhanced antigen release and immune activation.

**Methods:** In this IRB-approved study, adult patients with meningioma treated with CFRT or SRS (2009–2023) were included if they had  $\geq 2$  complete blood counts (CBCs) within 2 years of RT consultation. Of 72 patients, 29 were excluded for missing CBC data ( $n = 20$ ) or inaccurate ICD-10 codes ( $n = 9$ ), leaving 43 patients. CBCs were obtained at baseline,  $\sim 3$  months, and  $\sim 12$  months post-RT; changes in NLR, white blood cell count, hemoglobin, and platelets were analyzed using paired t-tests ( $p < 0.05$ ).

**Results:** Among 43 patients (12 males, 31 females; mean age  $62.1 \pm 15.3$  years), 21 underwent SRS and 22 CFRT. SRS delivered a median dose of 13 Gy in 1 fraction (range: 12.5–25 Gy over 1–5 fractions) versus a median CFRT dose of 51.3 Gy in 28 fractions (range: 46.8–60 Gy in 26–30 fractions). In the SRS group, 3 tumors were grade 1 and 18 unbiopsied; in the CFRT group, 5 were grade 1, 7 grade 2, 1 grade 3, and 9 unbiopsied. Overall, mean NLR increased significantly from  $2.51 \pm 1.68$  at baseline to  $3.49 \pm 2.76$  at 3 months ( $n = 31$ ,  $p = 0.029$ ), with no significant changes in hemoglobin, platelets, or white blood cell counts. At 1 year, mean NLR was  $2.97 \pm 1.72$  versus  $2.56 \pm 1.49$  at baseline ( $n = 30$ ,  $p = 0.141$ ), while white blood cell counts decreased significantly ( $7.25 \pm 2.79$  vs.  $6.46 \pm 1.81$ ,  $p = 0.036$ ). For CFRT, NLR increased from  $2.33 \pm 1.03$  to  $3.40 \pm 3.14$  ( $p = 0.082$ ), and for SRS from  $2.72 \pm 2.20$  to  $3.61 \pm 2.31$  ( $p = 0.110$ ) at 3 months.

**Conclusion:** RT in patients with meningioma is associated with a transient, significant NLR increase at 3 months that trends toward baseline by 1 year, suggesting an acute radiation-induced immune response. Although both CFRT and SRS trended toward increased NLR, the differences were not statistically significant. Further studies are needed to elucidate the immunologic effects of RT in meningioma.