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**ABSTRACT
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Meningiomi

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CYBERKNIFE FOR MENINGIOMAS: NEW TREATMENT PARADIGMS

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INTRODUZIONE:

Stereotactic radiosurgery has progressively emerged as both an adjuvant treatment modality for residual tumors and an effective primary treatment of properly selected meningiomas. Frameless radiosurgery enabled the use of “multi-session” radiosurgery (2-5 fractions) and hypofractionated stereotactic radiotherapy (hFSR). This has expanded the spectrum of tumors that can be managed by high-doses, high-conformality radiotherapy treatments.

OBIETTIVI:

We reviewed our series of meningiomas treated with CyberKnife (CK) radiosurgery reporting intermediate-term results. We also propose a classification of meningiomas in the light of technical requirements, complications and clinical results using the CK SRS system.

MATERIALI E METODI:

Between July 2007 and March 2015, 238 patients with meningiomas were treated by CK at the University of Messina (Italy). All patients had either evidence of tumor growth or post-surgery residual or recurrent tumor. On the basis of technical requirements, including doses and number of fractions, risk of radio-induced complications, probability of tumor control we divided meningiomas in 6 categories: 1) perioptic meningiomas that included tumors lying <2 mm from the optic nerves and chiasm; 2) skull base meningiomas including tumors involving the anterior, middle and posterior skull base; 3) parasagittal and convexity meningiomas; 4) large meningiomas, namely tumors with a volume >50 cc; 5) malignant meningiomas including atypical and anaplastic tumors; 6) spinal meningiomas.

RISULTATI E CONCLUSIONI:

At a median follow up of 45 months, the tumor control was 94% for benign lesions; shrinkage was recorded in 35%. Six percent of patients underwent surgery because of tumor progression or symptomatic edema. Three percent of tumor progressed. Seven cases of transient trigeminal neuralgia were recorded in middle fossa or petrosal meningiomas.

1) for perioptic meningiomas we calculated, using radiobiological models, that a BED of 100 Gy was necessary to control progression and a 10% dose gradient to avoid hazardous irradiation of the optic nerve. This was possible with 5 fractions in presence of minimal distance between the tumor and the nerve; up to 15 fractions were used in other cases. No radioinduced optic neuropathy was recorded in 67 patients.

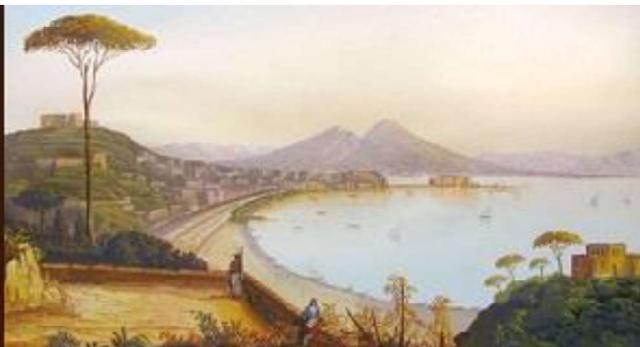
2) Skull base meningiomas (85 patients). The extra-arachnoidal localization of these

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tumors and the use of hypofractionation granted the avoidance of brain complication and injuries of the cranial nerves, even in large tumors.

3) Parasagittal and convexity meningiomas were associated to a higher risk of radio-induced symptomatic post-treatment edema (6 of 56 patients). Neither fractionation, nor staging was sufficient to avoid complications. The difference with basal meningiomas could be attributed to the absence of brain tumor arachnoid interface.

4) Large meningiomas (>50 cc) were treated using 10-15 fractions. This CK hFSR resulted in a treatment with a high BED and a relatively high conformality representing an attractive alternative to other 3D radiotherapy treatments definitely less conformal.

5) Atypical/Malignant meningiomas (21 patients) were treated with high doses (24-30 Gy in 3 fractions) for large volumes (40-70 cc). Results were unsatisfactory, with only 20% progression-free at 2 years.

6) Spinal meningiomas (4 patients): radiosurgery was used for recurrent tumors. Satisfactory results were obtained with low doses (18 Gy in 3 fractions); no radio-induced complications were recorded to date.

With fractionation, we could manage lesions not amenable to single-fraction radiosurgery, including tumors compressing or even encasing the optic nerves, brainstem and cranial nerves, very large tumors, and spinal meningiomas. The treatment of these lesions appeared possible using BED values that are not dissimilar from those of single fraction radiosurgery. Complication rates at short term were satisfactory. Finally, we used such innovative approaches to treatment to classify tumors under a radiosurgical perspective.