Radiation that is used to treat meningiomas and other diseases can also cause meningiomas, and radiation-induced meningiomas (RIMs) can sometimes be successfully treated by radiation. This interesting phenomenon is analyzed by Umansky and colleagues in this issue of Neurosurgical Focus.

Radiation-induced meningiomas are the most common brain neoplasm to be induced by ionizing radiation. With the increasing use of radiological investigations and therapeutic irradiation during the last decade, we can imagine the future. We may well be at the beginning of a massive increase in iatrogenic RIMs.

Umansky et al. make the points that RIMs are more aggressive than sporadic lesions, that their management is complicated by previous radiation damage to the tissues, and that, paradoxically, radiation is useful for curbing the radiation-induced tumors. In contrast to radiation-induced tumors such as papillary thyroid cancer, induction by radiation actually worsens prognosis in meningiomas. The growth-rate, MIB-1 indices, invasiveness, multicentricity, and recurrence rates are higher. It is thus fundamental to provide an initial strategy for long-term cure. Maximally radical surgery and immediate adjuvant treatment for any residual tumor that cannot be removed safely should be the standard.

In our experience, unfortunately, all radiation modalities are not helpful. We have not seen any major benefit to fractionated radiotherapy, which is frequently recommended in cases with residual or aggressive tumors. Fractionated radiotherapy may delay recurrences of aggressive meningiomas, but actual cures have been shown to be very rare and complication rates high. The patients we have referred for stereotactic fractionated radiotherapy of large cranial base tumors have generally fared poorly, and the results obtained in these cases do not corroborate the excellent results by Debus et al. Radiosurgery, on the other hand, may provide tumor control. It is probably important to administer it as an immediate stage of combined micro- and radiosurgery. We have recently submitted a manuscript with findings of poor radiosurgical control of meningiomas with increased MIB-1 indices and much worse results for recurrent/progressive tumors than for microsurgically tailored residual lesions that were treated as part of the initial management. These findings are probably relevant for RIMs that grow more rapidly and invasively than spontaneous tumors.

The handling of radiation-damaged tissues is complex and may vascularize flaps and tissue transplants. The healing can also be improved by increased oxygen tension in the tissues. Patients typically benefit from hyperbaric oxygen therapy. We have experience in several cases involving wound complications due to scarred, hypoxic, irradiated tissues; in these cases the patients have made excellent recoveries while receiving hyperbaric oxygen. Prophylactic hyperbaric therapy is useful when the risk of wound complications is high.

The crux of the study by Umansky et al., however, is that even doses as low as 1–2 Gy are sufficient to cause a 10-fold increase of meningiomas after several years. In my practice, I regularly see patients who receive higher doses than that as part of their neurosurgical treatment. Typical radiosurgery patients may receive 1–4 Gy to the brain outside of the target. After intervention for complex neurovascular problems, alopecia or erythema is regularly seen; such complications indicate a 3–6-Gy exposure. Also, the increased use of computed tomography scanning for vascular investigations and trauma screening, as well as the increasing number of children who underwent salvage therapy from childhood cancers by aggressive radiation treatment, needs to be considered. Radiation appears to create a relative increase in the risk for tumors, a relative increase that increases the spontaneous risk. Subsequently, the number of radiation-induced tumors will continue to increase with the patient’s age.

The review by Umansky and colleagues certainly serves as a reminder that we should be more cautious before making unnecessary use of beneficial treatments and investigations that may, paradoxically, lead to an enormous backlash in the future.

References
2. Al-Mefty O, Topsakal C, Pravdenkova S, Sawyer JR, Harrison
When considering the benefits of radiosurgery, some authors believe it is important to keep in mind that the duration of follow-up in current studies is still not adequate to fully determine the risk of secondary neoplasms developing in the irradiated field or at its periphery. The authors of several articles reviewing cases of meningioma induced by high-dose radiation have reported an average latency period of 10.8–24 years.1,3,6 Radiation dose, age at radiotherapy, and tumor grade are related to the latency period in most reports. It is notable that the latency period is even longer in patients with meningiomas induced by exposure to low-dose radiation. The mean latency period in the Israeli tinea capitis cohort (mean dose to the brain 1.5 Gy) was 36.7 years.5 Whereas our focus in this article was meningioma, the literature also includes many cases of other secondary neoplasms resulting from radiotherapy. The century following Roentgen’s discovery of this powerful form of energy was marked by great progress in both the diagnosis and management of many challenging medical conditions. However, a thorough review of that same period in history also reveals many instances in which physicians and scientists, working with the best interests of their patients in mind, underestimated the long-term risks of radiation exposure. Based on our extensive experience in the management of RIMs, we caution against the indiscriminate use of ionizing radiation, particularly in children, adolescents, and young adults.

Response: We read with interest Dr. Mathiesen’s editorial, and we share his concerns about the long-term risks associated with the use of radiotherapy of the brain. We agree that radiotherapy of recurrent/progressive meningiomas is not always helpful. Moreover, like Dr. Mathiesen, we have found that, paradoxically, radiotherapy may play a role in the treatment of some RIMs. Our policy in the treatment of de novo RIMs is radical resection when feasible. In patients with World Health Organization Grade I and II (atypical) tumors, in whom we are able to achieve gross-total resection (convexity meningiomas), we conduct close follow-up after surgery. If the tumor recurs, we reoperate, and we may consider early adjuvant radiotherapy at this stage. However, when even an aggressive surgical procedure is unlikely to achieve gross-total resection of the de novo tumor (such as in skull base meningiomas), we must be satisfied with subtotal removal and early postoperative radiotherapy. Several articles in the recent neurosurgical literature have stressed the safety and efficacy of radiotherapy in the treatment of meningiomas.2,4 When considering the benefits of radiosurgery, some authors believe it is important to keep in mind that the duration of follow-up in current studies is still not adequate to fully determine the

References

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