Introduction

Meningiomas

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Meningiomas are among the most common primary brain tumors in adults. This issue of *Neurosurgical Focus* is dedicated to the modernization of management therapeutics by reviewing the latest contributions in tumor biology, surgical tactics, and adjuvant management schemes.

Although the treatment of some meningiomas is relatively straightforward, in some locations complete resection can be challenging or unfeasible, and in these cases an understanding of the basic biology of these lesions becomes important in developing a comprehensive approach to treatment.

For example, the consistency of tumors is well known to affect the ease and extent of resection. In this issue, Zada and colleagues have proposed a grading scale in which meningioma consistency can be standardized as groundwork for future studies relating to surgical outcomes, predictability of consistency and vascularity using neuroimaging techniques, and effectiveness of various surgical instruments.

Peritumoral edema can occur to a varying extent in certain meningiomas, and can affect pre- and postoperative care. Hou et al. discuss the role of the VEGF-A pathway; its modulators may hold the key to development of novel effective therapeutic approaches, beyond just steroid administration, for treating peritumoral brain edema associated with meningiomas.

Finally, although meningiomas are typically benign, roughly 2%–5% display malignant pathological features. The key molecular pathways involved in malignant transformation remain to be determined, but in this issue, Chang et al. show how genomic and transcriptomic analysis of meningiomas can provide novel insights into the molecular pathways involved in malignant transfor-

mation of these lesions, with implications for both molecular heterogeneity and the development of specific targeted therapeutics. Furthermore, De la Garza-Ramos and colleagues provide a review of the current standing and future frontiers for gene therapy for meningiomas, while He and colleagues review the epigenetic and gene expression alterations associated with meningiomas.

This issue is further enriched by the contributions of some of our more notable practitioners of the surgical techniques for various complex tumor locations. Kulwin et al. highlight their technique for endoscopic extended transsphenoidal resection of tuberculum sellae tumors. Ideal candidates include tumors that are smaller, are midline in location, and have preserved arachnoidal planes. Nanda and his coauthors demonstrate encouraging statistics for improvement of vision for patients with tumors of the tuberculum and diaphragma sellae. Klinger et al. emphasize the need for a team approach to cavernous sinus tumors, employing a combination of surgical cytorreduction and adjuvant stereotactic radiosurgery (SRS). According to Mazur et al., meticulous preoperative vascular imaging is necessary to predict the potential for venous outflow insufficiency when resecting tumors of the transverse and sigmoid sinuses. The reports of Agarwal et al. and Xu et al. reflect a movement away from the more radical combined cranial base approaches to a more judicious approach of the retrosigmoid trajectory for petroclival lesions. Maybe the most optimal approach to one of the more treacherous locations for a meningioma is the subject of the contribution of Flores et al. on the far-lateral approach to foramen magnum meningiomas. Gratifying outcomes and gross-total resection rates make this one of the most valuable strategies in cranial base surgery. Finally, a technical note on extracranial ligation of ethmoid arteries for devascularization of anterior and large tumors is provided by Manjila et al.

While meningioma remains primarily a surgical disease, adjuvant treatments play an increasingly important role in the overall management scheme, particularly in cases of atypical and malignant meningioma (WHO Grades II and III). In selected cases, these treatments can replace surgery, but they are primarily used to make resection safer or allow a more limited resection in order to avoid permanent neurological deficit. Three articles in this issue address the role of radiation in the treatment of meningioma both as a primary treatment and in the postoperative set-

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ting. Kuhn et al. present 279 cases in which patients were treated with SRS over a 12-year period with a variety of doses. These authors are the first to publish the finding that dose de-escalation to 12 Gy at the tumor margin will control tumor growth. Previously, higher doses of 16 Gy or more have been used. This is a significant finding that should change how we use SRS for these tumors. Articles by Lee et al. and Ding et al. address radiation treatment of Grade II and III meningiomas. Lee and colleagues review the use of fractionated radiation therapy in 90 patients with atypical meningiomas and find that it is effective in significantly reducing the 5-year recurrence rate from 91% to 20% in patients who undergo subtotal resection. However, in patients who undergo gross-total resection, the use of radiation does not significantly reduce the recurrence rate. Ding and colleagues review the literature on SRS for atypical meningiomas and find that SRS is effective in the short term at reducing recurrence, but the literature is marred by low-powered retrospective studies.

The paper by Singla et al. documents a single-institution experience with preoperative embolization and reviews the current literature. At present there is little agreement on nearly all aspects of this surgical adjuvant, and surgeon and interventionalist preference plays the dominant role in determining how it is used. For example, using smaller particles is more effective in occluding the tumor but has a higher risk of causing neurological deficit. Finally, the paper by Moazzam et al. describes the current thought in chemotherapy for meningioma. The authors have provided an excellent description of the molecular pathways important for meningioma growth and some of the biological therapies that exploit our new scientific discoveries.

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Disclosure

Dr. Selman reports ownership in Osteoplastics II and direct stock ownership in Surgical Theater.