CONTENTS

The current state of standard tumor diagnostics using contrast-enhanced MRI and biopsy is assessed in this review, and the progress of proton magnetic resonance spectroscopy (MRS) over the last 15 years is discussed. We summarize MRS basics and describe a typical magnetic resonance session for noninvasive routine tumor diagnostics at 1.5 T, including two-dimensional magnetic resonance spectroscopic imaging (MRSI). The results that can be obtained from such procedures are illustrated with clinical examples. Attention is turned to cutting-edge methodologic and clinical research at 3 T, with examples using high-resolution or very short echo-time three-dimensional MRSI. The current status and limitations in proton MRSI are discussed, and we look to the potential of faster data collection and even higher field strength.

Diffusion tensor imaging (DTI) appears to offer the possibility of adding important information to aid in presurgical planning. Although experience is limited, DTI seems to provide useful local information about the structures near the tumor. In the future, DTI may provide an improved way to monitor intraoperative surgical procedures as well as their effects. Evaluation of the response to treatment with chemotherapy and radiation therapy may also become possible. Although DTI has some limitations, its active investigation and further study are clearly warranted.

Intraoperative MRI has proven to be a crucial tool in glioma surgery. Over the past decade, more than two thirds of the 871 operations done in our facility have been on gliomas. The surgical challenges related to brain shift, discernment of tumor margins, eloquent cortex, and completeness of resection are met by the unprecedented capabilities of intraoperative MRI. It allows precise localization of tumor margins and neural structures and provides updated information on the progress of surgery. The result is thorough tumor resection without critical injury to important areas of the brain. As intraoperative MRI continues to expand its presence, it is likely to become a standard of care for many glioma cases.

Compact imagers for intraoperative MRI (iMRI) designed for use in a regular neurosurgical operating room (OR) are an attractive alternative to modifying a diagnostic MRI (dMRI) suite for surgery or altering an OR to accommodate dMRI. The PoleStar N-10 iMRI system incorporates a 0.12-T magnet and was fashioned as a tool for intracranial neurosurgery. In our experience, this system proved to be a valuable aid for a wide variety of surgery, mostly for intracranial tumors. Expansion of this compact unit to a unit with a 0.15-T magnet has recently been accomplished, addressing some of the limitations of the previous device. We discuss the pros and cons of surgery with these low-field compact iMRI systems.