

Anesthesia for Intraoperative MRI

Keith J Ruskin, MD

Yale University School of Medicine, New Haven, Connecticut, USA

Intraoperative magnetic resonance imaging (IMRI) provides substantial benefits for patients undergoing surgical management of intracranial pathology. IMRI is most commonly used to locate a target for a brain biopsy or to guide resection of brain tumors. It allows the surgeon to accurately determine whether additional resection is needed while the patient is still in the operating room, or to determine whether the surgical approach will impinge upon a critical area of the brain. One study found that 96% of patients with a glioma in whom IMRI was used to guide the surgery had a complete tumor resection as opposed to 68% of the controls.¹ In several studies, gross total resection is significantly related with the patient survival.² In a recent study, survival was increased from 60 weeks to 88 weeks ($p = 0.07$) if IMRI was used to guide surgery.³ Although this technique improves surgical outcome, it does expose the patient and surgical personnel to significant hazards.

The MR operating room (MROR) is a hybrid environment in which the MRI coexists with ferromagnetic surgical instruments and anesthesia equipment. Although magnet safety underlies all aspects of patient care, the MROR presents unique hazards that fundamentally affect anesthesia care. The anesthesiologist is confronted with unfamiliar equipment and limited access to the patient during much of the procedure. Bringing the scanner into the room presents multiple distractions, and problems (e.g., hypotension or a disconnected endotracheal tube) may go unrecognized. During the scan, the room is dark and noisy, which makes it difficult to hear alarms, communicate with other personnel, or troubleshoot problems.

A comprehensive training program includes a tutorial on how to use the MRI safe monitors and infusion pumps. Anesthesia personnel who will work in the room are taught about the changes in workflow imposed by the equipment and safety procedures. Lastly, all personnel are given a demonstration of the magnet's strength using small, ferromagnetic objects. Team training is essential to maintain communication and ensure that all team members are empowered to intervene when the scanner is brought into the OR. The MROR impacts all aspects of anesthesia care, but following safety procedures, constant training, and an understanding of the physics and physiology of strong magnetic fields can mitigate the hazards of working in this unique environment.

References

1. Senft C, Bink A, Franz K, Vatter H, Gasser T, Seifert V. Intraoperative MRI guidance and extent of resection in glioma surgery: A randomised, controlled trial. *Lancet Oncol* 2011;12:997-1003.

2. Kubben PL, terMeulen KJ, Schijns OE, terLaak-Poort MP, van Overbeeke JJ, van Santbrink H. Intraoperative MRI-guided resection of glioblastoma multiforme: A systematic review. *Lancet Oncol* 2011;12:1062-70.
3. Senft C, Franz K, Blasel S, Oszvald A, Rathert J, Seifert V, Gasser T. Influence of iMRI-guidance on the extent of resection and survival of patients with glioblastoma multiforme. *Technol Cancer Res Treat* 2010;9:339-46.