Introduction to Intraoperative Imaging Technology

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Modern neurosurgery has become increasingly dependent on radiological evaluation for lesion localization and resection control. In 1919, Walter Dandy introduced intraoperative pneumoencephalography as a method to determine lesion localization as it relates to ventricular displacement. In the early 1960s, investigators began using intraoperative post-contrast angiography to elucidate the completeness of aneurysm obliteration or arteriovenous malformation resection. In 1982, Lundsford first reported on the use of intraoperative computerized tomography (CT) brain scanning, and in the mid-1990s several investigators introduced magnetic resonance (MR) imaging technologies into the neurosurgical operating room. Concurrent with these developments was the evolution of surgical navigation based on preoperatively acquired CT or MR images and the use of intraoperative ultrasonography for localization of both cranial and spinal lesions. Although these technologies have been focused on lesion localization and resection, they could equally be applied to studies designed to determine the effect of surgery on the brain. In this issue of Neurosurgical Focus, several of these technologies are highlighted.

Dr. Maher and colleagues use stereotactic coordinates based on preoperatively acquired CT or MR images to achieve optimum entry into the ventricles of patients with idiopathic intracranial hypertension. The paper is an example of using a three-dimensional (3D) dataset to access a small intracranial target. Dr. Kim and colleagues apply frameless stereotaxy to study cadaveric and clinical thoracic pedicle screw placement. Although this technology was initially developed for cranial navigation, its application in the placement of spinal instrumentation has exploded in recent years. The results of intraoperative low-field MR imaging and 3D ultrasonography are compared by Dr. Tronnier and colleagues. These technologies possibly optimize lesion resection by reducing brain shift–related inaccuracies introduced during surgery. The report by Dr. Kaibara and colleagues underscores the value of high-field intraoperative MR imaging in guiding and evaluating resection. The issue concludes with a clinical pearl in which Dr. Iacopino and colleagues describe the use of intraoperative microvascular Doppler monitoring to localize a spinal dural arteriovenous fistula and determine the effect of draining vein obliteration on residual flow. All of the advances in image processing and display described in this issue have been directly related to improvements in computer system technology.

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