PoleStar N20

The PoleStar N20 low-field iMRI navigation system is a promising tool for safe, minimally invasive, endonasal, transsphenoidal pituitary macroadenomas resection. It enables neurosurgeons to control the extent of tumor resection, particularly for suprasellar tumors, ensuring surgical accuracy and safety, and leading to a decreased likelihood of repeat surgeries. However, this technology is still not satisfying in estimating the amount of the parasellar residual tumor invading into cavernous sinus, given the false or uncertain images generated by low-field iMRI in this region, which are difficult to discriminate between tumor remnant and blood within the venous sinus [1].

Case series

2016

Eighteen patients with pituitary macroadenomas underwent transsphenoidal surgery during 2013-2014 under low-field intraoperative magnetic resonance imaging (iMRI) control (PoleStar N20, 0.15 T). Intrasellar balloons were used in all of them to assess the presence of tumoral remnants. Jiménez et al. compared the findings in iMRI and postoperative high-field MRI control scans and also analyzed the number of intermediate imaging controls needed during surgery using this technique.

In total, of the 18 patients, 14 underwent a complete resection. In the remaining four patients, a maximal safe resection was performed, leaving a remnant because of cavernous sinus invasion. In all cases, the balloons were a major help in distinguishing the anatomical structures from the tumoral remnants. Fewer imaging controls were required, and there were no false-positives or negative intraoperative findings. No complications related to the technique were registered.

The “intrasellar balloon technique” is a useful tool that facilitates surgeons' intraoperative decision making. It is an important contribution to overcome the limitations of low-field iMRI as it provides a precise delineation of the resection margins, reduces false-positives and -negatives, and decreases the number of intermediate imaging controls required [2].

2009

Fifty-five transsphenoidal surgeries were performed for macroadenomas (modified Hardy's Grade II-IV) resections. All of the surgical processes were guided by real-time updated contrast T1-weighted coronal and sagittal images, which were acquired with 0.15 Tesla PoleStar N20 iMRI (Medtronic Navigation, Louisville, CO). The definitive benefits as well as major drawbacks of low-field iMRI in transsphenoidal surgery were assessed with respect to intraoperative imaging, tumor resection control, comparison with early postoperative high-field magnetic resonance imaging, and follow-up outcomes.

Intraoperative imaging revealed residual tumor and guided extended tumor resection in 17 of 55 cases. As a result, the percentage of gross total removal of macroadenomas increased from 58.2% to 83.6%. The accuracy of imaging evaluation of low-field iMRI was 81.8%, compared with early postoperative high-field MRI (Correlation coefficient, 0.677; $P < 0.001$). A significantly lower accuracy was identified with low-field iMRI in 6 cases with cavernous sinus invasion (33.3%) in contrast to the 87.8% found with other sites (Fisher's exact test, $P < 0.001$).

The PoleStar N20 low-field iMRI navigation system is a promising tool for safe, minimally invasive, endonasal, transsphenoidal pituitary macroadenomas resection. It enables neurosurgeons to control the extent of tumor resection, particularly for suprasellar tumors, ensuring surgical accuracy and safety, and leading to a decreased likelihood of repeat surgeries. However, this technology is still not satisfying in estimating the amount of the parasellar residual tumor invading into cavernous sinus, given the false or uncertain images generated by low-field iMRI in this region, which are difficult to discriminate between tumor remnant and blood within the venous sinus [3].

2008

Forty patients with a pituitary macroadenoma (mean size, 26.9 +/- 9.1 mm) underwent a surgical procedure to remove the tumor. The iMRI system was implemented in a standardized microsurgical procedure (endonasal, transseptal, transsphenoidal approach) using standard microsurgical instruments. Intraoperative imaging was performed for tumor visualization/navigation and resection control. If an accessible tumor remnant was suspected, surgery was continued for reexploration and, if necessary, continued resection. Total anesthesia time and operation time were compared with a historical cohort of 100 patients who underwent a surgical procedure on pituitary neuroendocrine tumors without iMRI. Sensitivity and specificity of the iMRI to detect residual tumor tissue was assessed in 33 patients (82.5%) after comparison with standard postoperative 1.5-T MRI 3 months after the procedure. RESULTS: Preoperative tumor visualization with the ultra-low-field iMRI showed a very good congruency with the preoperative 1.5-T MRI scans. A three-dimensional reconstruction of the coronal scan enabled the surgeon to safely approach the tumor using the integrated navigation system. In seven patients (17.5%), iMRI resection control showed accessible residual tumors leading to further resection. After tumor resection, the final iMRI scan documented adequate decompression of the optic pathway in all patients. Implementation of iMRI led to a significant increase of anesthesia time (246.0 +/- 50.7 versus 163.4 +/- 41.2 min) and operation time (116.9 +/- 43.9 versus 78.2 +/- 33.0 min; $P < 0.05$, t test). Sensitivity of the iMRI was 88.9, 85.7, 93.3, and 100% for the suprasellar, intrasellar, and right and left parasellar regions, respectively, and the specificity was 90.5% in the suprasellar and 100% in the intra- and parasellar regions on both sides. In four patients, the intraoperative interpretation of iMRI was equivocal; thus, it was difficult to distinguish between very small tumor remnants and perioperative changes. CONCLUSION: Ultra-low-field 0.15-T iMRI is a safe, helpful, and feasible tool for navigation and tumor resection control in patients with pituitary macroadenomas. Total anesthesia and operation times are prolonged, but iMRI adequately documents the extent of tumor resection. In this series, the PoleStar system increased the rate of resection without disrupting the neurosurgical workflow [4]

[1], [3]
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[2]
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[4]
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