Resection of Deep-seated Intrinsic Brain Tumors Using a Novel Combination of a Minimally Invasive Tubular Brain Retraction System, High Resolution Exoscope Visualization, and High Field Intraoperative Magnetic Resonance Imaging (iMRI)

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Learning Objectives

Explore the feasibility and safety of combining minimally invasive tubular brain retraction system (Nico Brain PathTM), high-resolution exoscope visualization and high-field intraoperative magnetic resonance imaging (iMRI) to maximize safe resection of deep-seated intrinsic brain tumors.

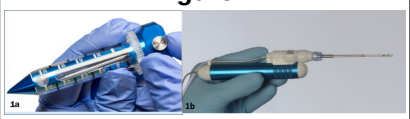
Introduction

Assessment of feasibility of combining minimally invasive tubular brain retraction system (Nico Brain PathTM), high-resolution exoscope visualization mounted on a pneumatic arm (Mitaka), a novel tissue aspirator (Nico Myriad), and high-field intraoperative magnetic resonance imaging (iMRI, IMRIS) to maximize safe resection of deep-seated tumors while minimizing injury to intervening healthy tissue (Fig 1 and 2). An exoscope is an endoscope-like device positioned above the operative field that enables visualization on high resolution monitors (Fig 3).

Methods

The prospective IRB-approved multicenter database (IMRIS iMRI Neurosurgery Database, I-MiND) was used to identify patients with tumor resections performed with MRI-compatible Brain PathTM system placed via small navigated craniotomies with high-resolution exoscope visualization, for which high -field iMRI was used to assess extent of resection. Safety and feasibility of this novel technique and impact upon extent of resection and outcomes were assessed.

Figure 1



1A: BrainPath device; 1B: Novel tissue aspirator

Figure 2

Stereotactic placement of BrainPath port

Figure 3

Surgeon working with BrainPath visualization

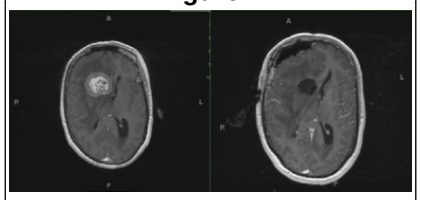
Results

7 patients with deep seated intrinsic brain tumors underwent resection using combination of a tubular retractor, exoscope, and iMRI. Mean age was 51.2 years (range: 37-61, 6 males/1 female). Lesions included 5 gliomas (3 newly diagnosed glioblastomas, 1 recurrent anaplastic astrocytoma, and 1 WHO grade I angiocentric glioma), and 2 brain metastases (1 renal cell, 1 breast). Mean tumor diameter was 2.95 cm (range: 1.2-4.4). iMRI demonstrated complete resection in 3/7 cases (43%). Additional resection was performed after iMRI in 3/7 cases (43%) leading to complete resection in 6/7 cases. In select cases the tubular retraction system was left in place during iMRI acquisition without image distortion. There were no intraoperative complications. Immediately post-op neurological function was stable in 5 cases (71%) and improved in 2 (28%) cases. Median length of stay was 2 days (range: 1-4).

Case Illustration 1

61-year-old F with mental status change and large R mass on MRI (Figure 4). Small craniotomy and dural opening facilitated placement of the BrainPath device and resection of the lesion with the novel tumor aspirator. iMRI confirmed GTR, and postoperatively the patient improved neurologically.

Figure 4

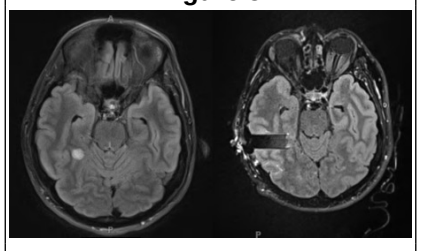


(L) Preop MRI R Frontal Metastasis (R) IMRI post resection

Case Illustration 2

36-year-old M with incidental 1.2 x 1.1 cm gadolinium enhancing posteromedial R temporal lesion (Figure 5) A surgical trajectory with entry posterior-superior to the right ear was selected using preoperative DTI imaging with tractography predicted a safe trajectory beneath the optic radiations. A small craniotomy & 12-15 mm cruciate dural incision were made over a sulcus through which the BrainPath system was passed to the depth of the lesion. The BrainPath inner cannula was removed and using the a pneumatic arm mounted exoscope for visualization,
the lesion was removed with the tissue aspirator. iMRI suggested GTR, the BrainPath was removed, and the patient recovered without event.

Figure 5



(L) Preop T2 FLAIR MRI (R) Intraop T2 MRI showing GTR with BrainPath device in place

Conclusions

Combining a minimally invasive tubular brain retraction system, pneumatic arm mounted exoscope visualization, a unique tumor aspirator, and iMRI as a novel strategy to facilitate resection of deep-seated intrinsic brain tumors is feasible, may decrease morbidity, and merits further investigation.

References

Labib MA et al: The safety and feasibilty of image guided BrainPath-mediated transulcal hematoma evacuation: a multicenter study. Neurosurgery ahead of print. DOI: 10.1227/NEU.0000000000001316

Acknowledgements

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