



Cognitive Trajectory After Preoperative Embolization for Skull Base Meningiomas



Hithardhi Duggireddy, MS; Rommi Kashlan, BS; Thomas McCaffery, BS; J. Manuel Revuelta-Barbero, MD, PhD; Karen Salmeron-Moreno, MD; Karthik Papisetty, BA; Gustavo Pradilla, MD; Tomas Garzon-Muvdi, MD, MSc
Department of Neurosurgery, Emory University School of Medicine

EMORY
UNIVERSITY
SCHOOL OF
MEDICINE

INTRODUCTION

Cognitive dysfunction represents a significant source of morbidity in patients with skull base tumors, affecting quality of life and functional independence. These tumors, by virtue of their proximity to eloquent cortex, deep gray matter structures, and critical white matter tracts, frequently present with cognitive deficits including memory impairment, executive dysfunction, and personality changes. Preoperative embolization has emerged as a valuable adjunct in the management of hypervascular skull base lesions, reducing intraoperative blood loss and potentially facilitating safer resection. However, the impact of embolization on cognitive outcomes remains poorly characterized, with theoretical concerns regarding embolic particle migration, inadvertent occlusion of perforating vessels supplying eloquent structures, and periprocedural ischemic events. Furthermore, the relationship between tumor burden, as reflected by tumor volume, and the prevalence of cognitive symptoms in this population has not been systematically evaluated. Defining the cognitive safety profile of preoperative embolization and identifying predictors of cognitive outcomes are essential for informed patient counseling and treatment planning.

AIMS

This study aimed to characterize the prevalence, trajectory, and predictors of cognitive symptoms in patients undergoing preoperative embolization for skull base tumors, with particular focus on the relationship between tumor volume, embolization variables, and cognitive outcomes.

METHODS

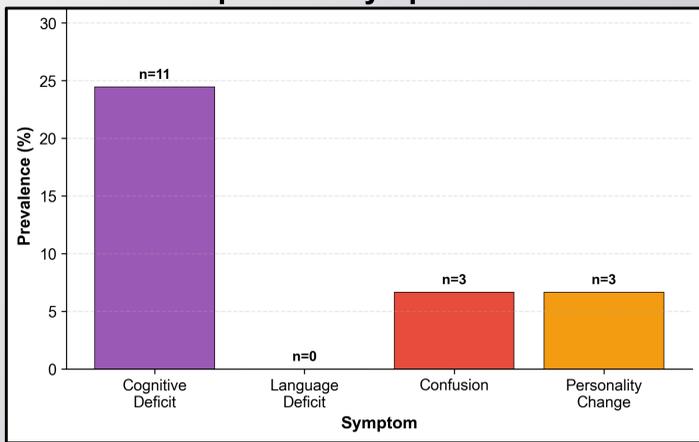
A retrospective cohort analysis was conducted on 45 consecutive patients undergoing preoperative embolization followed by surgical resection of skull base tumors, assessing cognitive symptoms (cognitive deficit, language deficit, confusion, personality change) at baseline, 3, 6, and 12 months postoperatively, with univariate analyses evaluating associations between cognitive outcomes and tumor volume, embolization extent, embolic agent, procedure timing, and tumor location.

CONCLUSION

Preoperative embolization demonstrates a favorable cognitive safety profile in skull base tumor patients, with high symptom resolution rates (88%) and low rates of cognitive worsening (6.7%), though larger tumor volumes are significantly associated with pre-operative cognitive deficits ($p=0.029$), and anterior skull base location may confer increased risk warranting targeted cognitive monitoring.

RESULTS

Pre-Operative Symptom Prevalence



Cognitive Symptom Prevalence Over Time

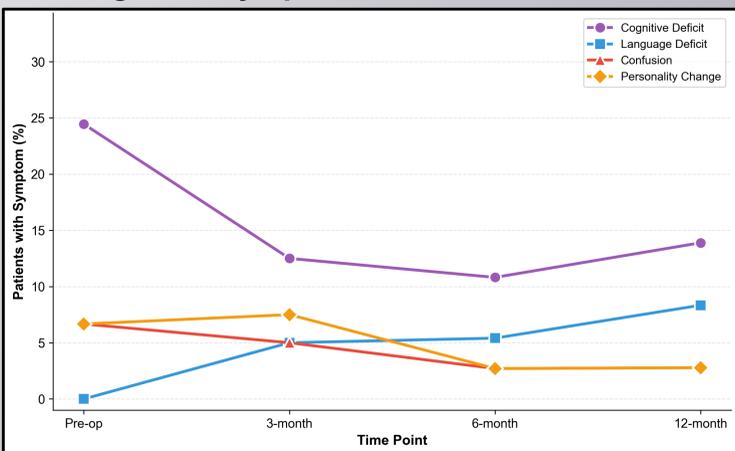


Figure 2. Cognitive symptom prevalence over time. Longitudinal trends in cognitive deficit, language dysfunction, confusion, and personality change assessed preoperatively and at 3-, 6-, and 12-month follow-up. Overall cognitive symptom burden decreased after treatment, with sustained improvement through 12 months.

Cognitive Symptom Resolution Over Time

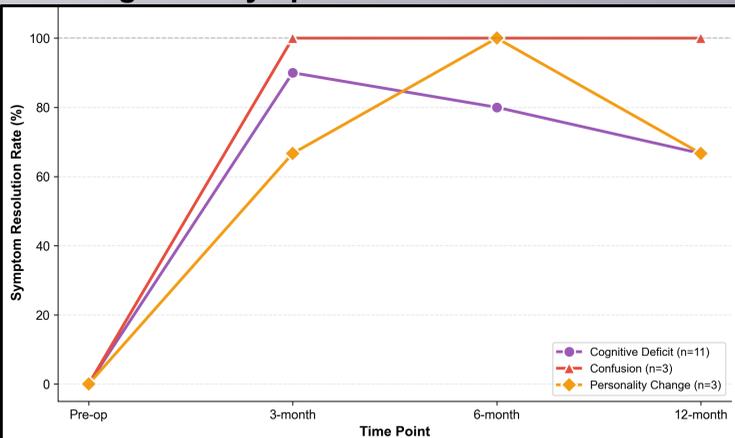


Figure 4. Cognitive symptom resolution over time. Rates of symptom resolution for cognitive deficit, confusion, and personality change across postoperative follow-up. Most patients demonstrated rapid improvement by 3 months, with high rates of sustained resolution at later time points.

Embolization Variables

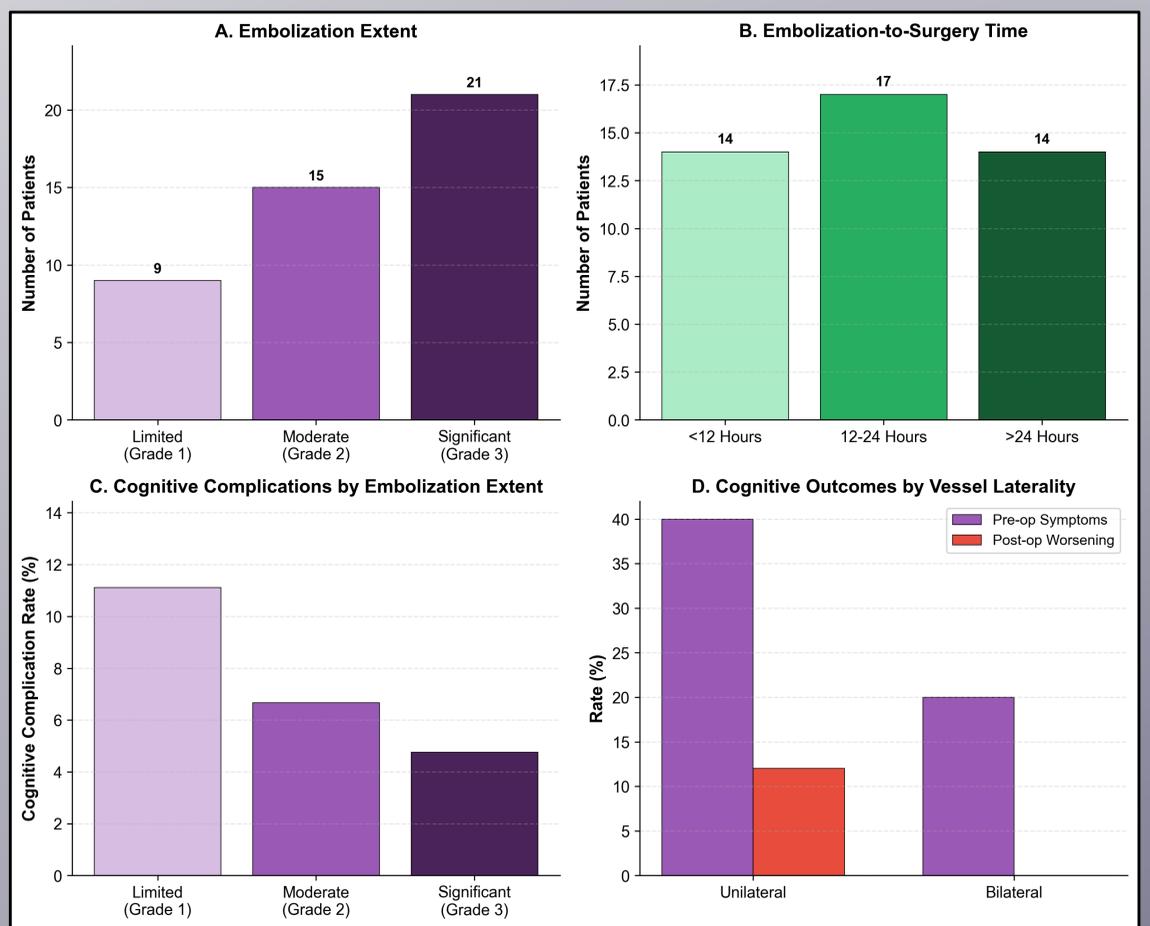


Figure 3. Embolization variables. Distribution of embolization characteristics including (A) extent of embolization, (B) embolization-to-surgery interval, (C) cognitive complication rates stratified by embolization extent, and (D) cognitive outcomes by vessel laterality. Greater embolization extent was not associated with increased cognitive complication rates.

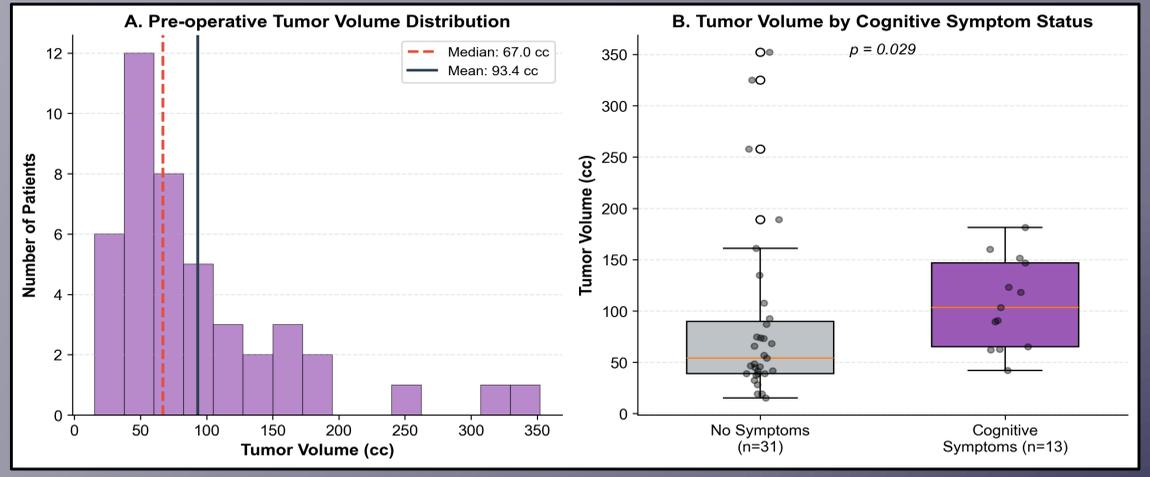


Figure 5. Preoperative tumor volume distribution and Tumor volume by cognitive symptom status. Histogram illustrating the distribution of preoperative tumor volumes across the cohort. Median and mean tumor volumes are indicated by dashed and solid reference lines, respectively, demonstrating a right-skewed distribution. Box-and-scatter plot comparing preoperative tumor volume between patients with and without cognitive symptoms. Patients with cognitive symptoms had significantly larger tumors on univariate analysis ($p = 0.029$).

