



# Impact of Polyvinyl Alcohol Particle Size on Outcomes of Preoperative Embolization for Skull Base Meningiomas



Rommi Kashlan, BS; Hithardhi Duggireddy, MS; 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

Preoperative embolization is often employed in the management of skull base meningiomas to reduce intraoperative blood loss and facilitate safe tumor resection. Polyvinyl alcohol (PVA) particles are widely used embolic agents, yet the influence of particle size on surgical outcomes remains poorly defined. Smaller particles may allow deeper intratumoral penetration and more complete angiographic devascularization, whereas larger particles may provide safer occlusion of proximal feeders with less risk of ischemic complications.

## METHODS

We performed a retrospective analysis of patients with skull base meningiomas who underwent preoperative embolization with PVA particles. Patients were stratified into two cohorts based on embolic particle size: small (150–250  $\mu\text{m}$ ) and large (250–355  $\mu\text{m}$ ). Demographics, tumor volume, procedural parameters, and clinical outcomes were assessed. Primary endpoints included perioperative complications, angiographic blush reduction, percent blood supply embolized, procedure duration, ICU stay, and modified Rankin Scale (mRS) scores at discharge. Secondary endpoints included discharge disposition and change in functional status from pre-embolization baseline.

## AIMS

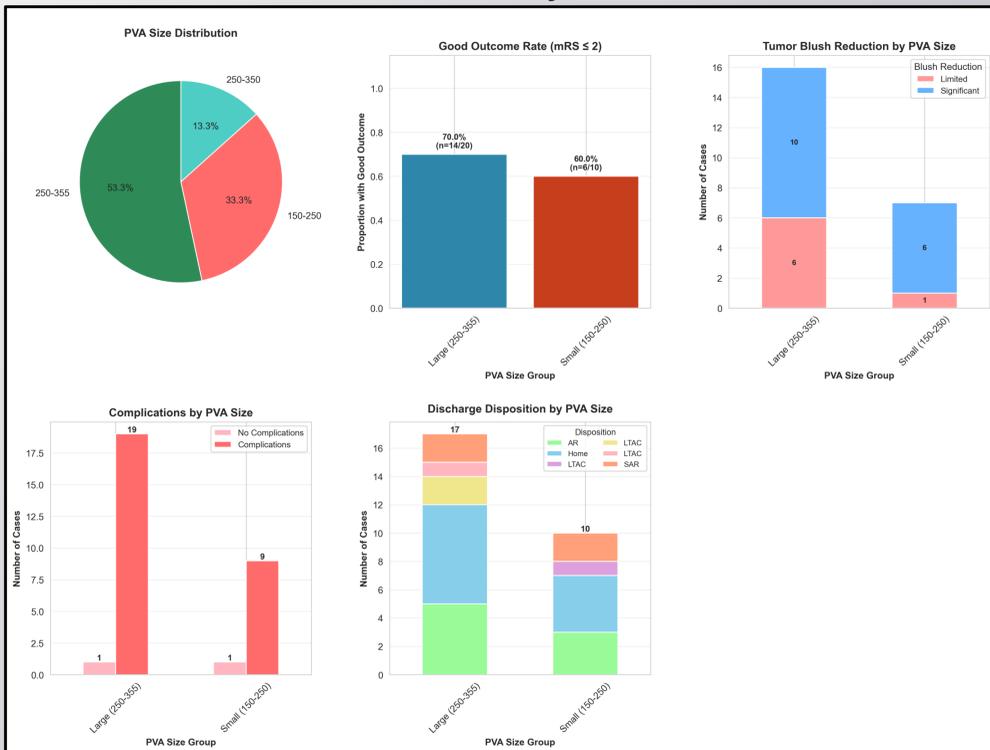
This study aimed to clarify the clinical impact of PVA particle size to optimize embolization strategies for these complex tumors.

## CONCLUSION

PVA particle size influences procedural and perioperative dynamics in the embolization of skull base meningiomas but does not appear to substantially affect overall complication rates or short-term functional outcomes. Smaller particles produced greater angiographic devascularization, yet this did not translate into improved functional recovery. Larger particles were associated with shorter operative times and more favorable discharge dispositions despite treating larger tumors. These findings suggest that large PVA particles may provide a safe and efficient balance in preoperative embolization, while the theoretical advantage of deeper penetration with small particles may not confer clinical benefit.

## RESULTS

### PVA Size Analysis



**Figure 1. Distribution of Embolization Particle Size**  
Proportion of patients embolized with small (150–250  $\mu\text{m}$ ) versus large (250–355  $\mu\text{m}$ ) polyvinyl alcohol particles.

**Figure 2. Good Functional Outcome by PVA Particle Size**  
Percentage of patients achieving a good postoperative outcome, defined as discharge modified Rankin Scale (mRS) score  $\leq 2$ , stratified by embolic particle size.

**Figure 3. Tumor Blush Reduction by PVA Particle Size**  
Reduction in angiographic tumor blush following embolization comparing small and large particle cohorts, reflecting degree of devascularization.

**Figure 4. Procedural Complication Rates Stratified by PVA Size**  
Incidence of procedural or perioperative complications stratified by embolic particle size.

**Figure 5. Discharge Disposition by PVA Particle Size**  
Clinical discharge outcome categories — home, acute rehab, skilled nursing facility, or death — stratified by embolization particle size.

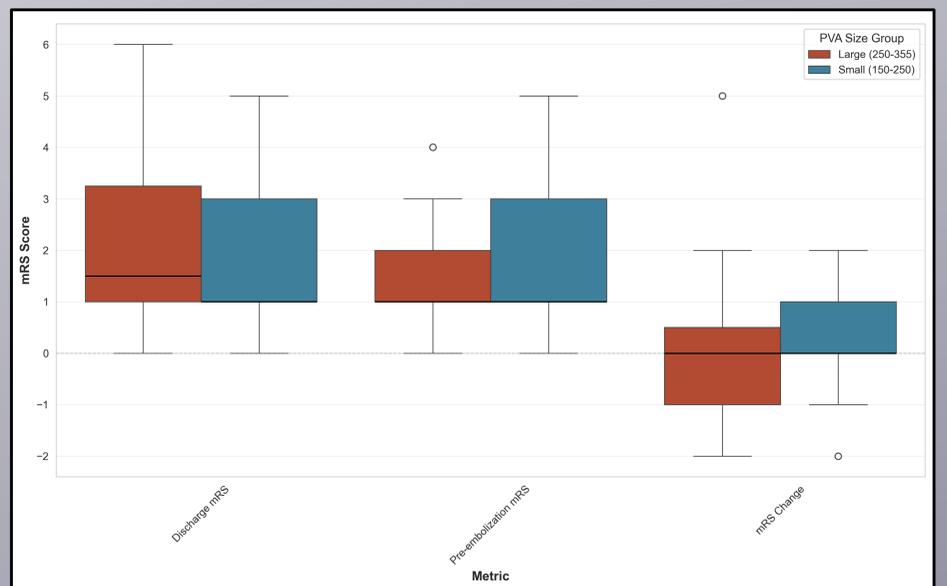
**Figure 6. Surgical Blood Loss by PVA Size**  
Estimated intraoperative blood loss during tumor resection in patients treated with small versus large embolization particles.

**Figure 7. ICU Length of Stay by PVA Particle Size**  
Postoperative intensive care unit stay duration comparing patients treated with small versus large particles.

**Figure 8. Tumor Volume by PVA Group**  
Preoperative tumor volume distribution in patients treated with different embolization particle sizes.

**Figure 9. Procedure Duration by PVA Particle Size**  
Total embolization procedure duration (minutes) comparing small and large particle cohorts.

### mRS Metrics



**Figure 6. Discharge mRS Metrics by PVA Size**  
Distribution of preoperative and discharge modified Rankin Scale scores in patients treated with small versus large particles, including shifts in functional status.

### Other Correlates

