Stent Retriever and Aspiration Catheter Biopsy of an Intraluminal Transverse Sinus Meningioma: Case Report

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BACKGROUND AND IMPORTANCE: Intracranial intraluminal mass lesions are rare and challenging to biopsy using noninvasive methods. Obtaining tissue for diagnosis is critical for guiding treatment, yet traditional approaches such as craniotomy pose significant risks. In this case report, we describe the first use of an aspiration catheter and stent retrieval system to safely and successfully perform an endovascular biopsy in a patient with an exclusively intraluminal meningioma.

CLINICAL PRESENTATION: The patient had a history of medulloblastoma, which was resected and treated with craniospinal radiation. During routine surveillance MRI, an incidental filling defect was identified in the superior sagittal sinus, suspected to be either thrombus or intraluminal meningioma. The lesion demonstrated rapid growth despite anticoagulation therapy, prompting the decision to pursue tissue sampling to guide further treatment. A combined approach using a large-bore suction thrombectomy catheter and a 6-mm Solitaire X stentriever was used through a transvenous femoral approach. Although no tissue was obtained from the suction effluent, sufficient tissue fragments were captured on the stentriever to diagnose meningioma. The patient tolerated the procedure well, with no periprocedural complications.

CONCLUSION: Obtaining intravascular tissue with a stent retrieval system, particularly for firmer sinus wall lesions such as a meningioma may offer a safe alternative technique to craniotomy for intraluminal sinus tissue diagnosis.

KEY WORDS: Biopsy, Endovascular, Meningioma, Minimally invasive

Endovascular techniques to perform intraluminal biopsy have been previously described for filling-defect lesions within the pulmonary arteries, liver, and aorta.[1-5] Exclusively, intracranial intraluminal mass lesions are rare with a consequent paucity of published techniques for safely obtaining endovascular biopsy. Various endovascular techniques have been previously described, including the use of forceps, aspiration, and stent retriever devices.[6,7] In this study, we describe the first reported successful endovascular biopsy of an intraluminal firm tumor using a stent retriever and large-bore aspiration catheter for a sinus meningioma that uses equipment and devices familiar to the neuroendovascular operator and commonly used in mechanical large vessel occlusion thrombectomy. Using these common endovascular techniques to biopsy lesions present within the intraluminal space may be a safe and effective alternative to a craniotomy as a means to acquire samples of firmer tissue not amenable to simple unassisted suction.

CLINICAL PRESENTATION

Ethics Statement

This institution does not require ethical approval for reporting individual cases or case series.

Consent Statement

Verbal information consent was obtained from the patient for their anonymized information to be published in this article. The patient provided written informed consent for all procedures described in this report.

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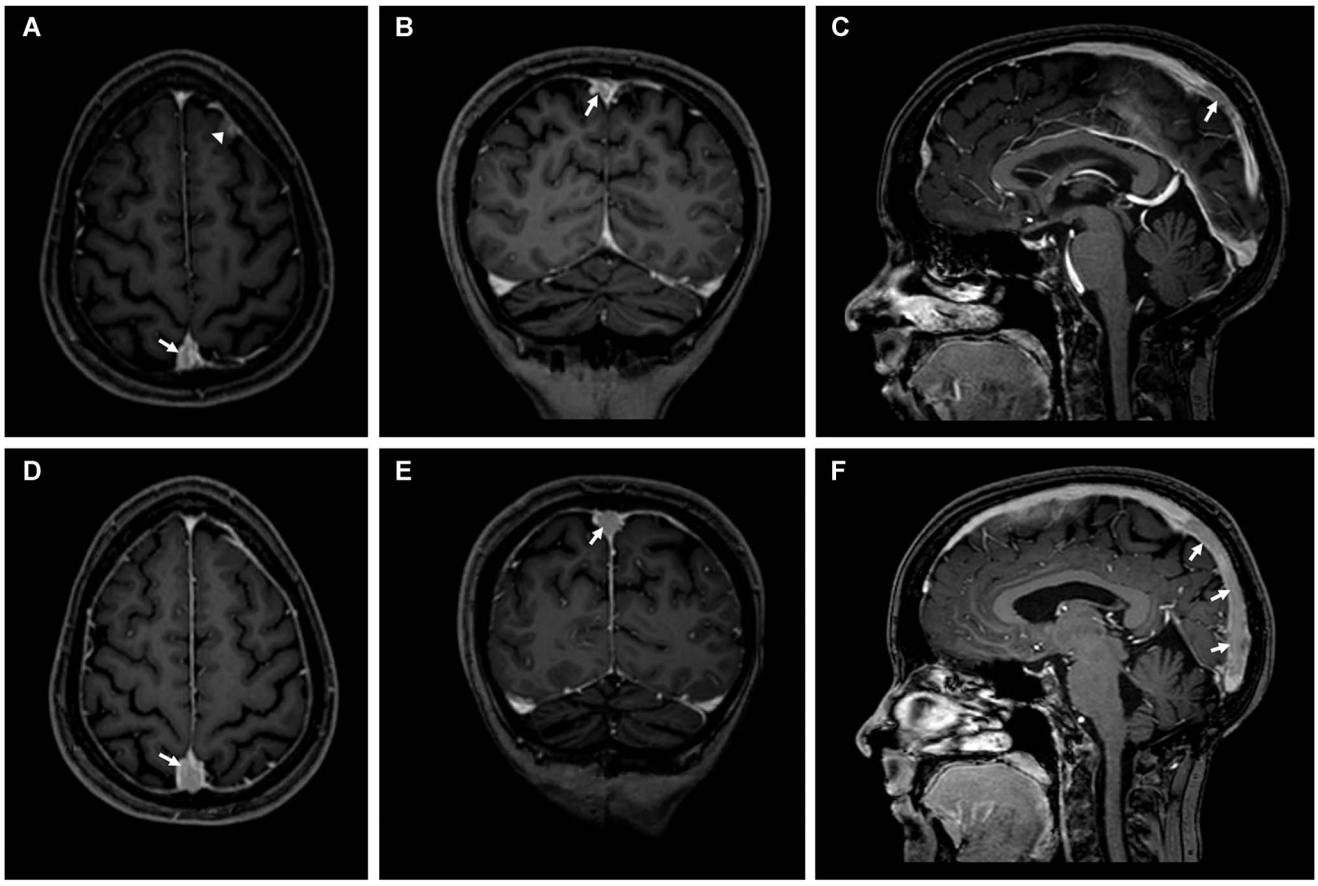


FIGURE 1. *Contrast-enhancing MRI demonstrating progression of the intraluminal lesion.* **A-C**, *Initial MRI obtained that demonstrates the incidentally found nonocclusive lesion within the posterior aspect of the superior sagittal sinus (arrow). Axial* **A**, *coronal* **B**, *and sagittal* **C** *views of the lesion. Imaging characteristics of the lesion are similar in appearance to left frontal lesion presumed to be meningioma (arrowhead,* **A**). **D-F**, *Follow-up MRI demonstrating significant progression of the lesion from the posterior aspect of the confluence of the sinuses (arrow) extending into the right transverse sinus. Axial* **D**, *coronal* **E**, *and sagittal* **E** *views of the lesion.*

Off-Label Statement

The manuscript describes using stent retriever devices to obtain a biopsy of a venous intraluminal meningioma.

The patient is an adult female who initially presented as a child with a medulloblastoma. She underwent craniotomy for tumor resection and subsequently completed a treatment course of craniospinal radiotherapy and chemotherapy. She was followed with serial MRI imaging, which identified several incidental small convexity meningiomas and an intraluminal nonocclusive tubular filling defect within the superior sagittal sinus extending to the level of the confluence of sinuses (Figure 1A-1C). The lesion measured 2.2 cm and was similar in appearance to the patient's other presumed meningiomas. However, on follow-up imaging 3 months later, the lesion grew to 5.5 cm.

The rapid interval growth raised suspicion for a venous sinus thrombus, and the patient was started on apixaban. Despite anticoagulation, a follow-up MRI scan 4 months later demonstrated continued interval growth of the intraluminal lesion, now extending into the right transverse sinus (Figure 1D-1F). We now felt a definitive tissue diagnosis was necessary to appropriately identify and treat the lesion. Given the purely intraluminal location of the mass lesion and the alternative possibility that it may still constitute a thrombus, transvenous endovascular biopsy was considered as a safer initial approach compared with a craniotomy.

A diagnostic venous-phase arteriogram and 3D cone-beam computed tomography was initially performed, revealing a filling defect in the distal third portion of the superior sagittal sinus that extended to the torcula and into the medial portion of the right transverse sinus (Figure 2). A 9-French shuttle sheath was selected for venous access, and a TracStar (Imperative Care) guide catheter was advanced and placed at the level of the jugular bulb (Figure 3). Through this, a Zoom 71 (Imperative Care) was then

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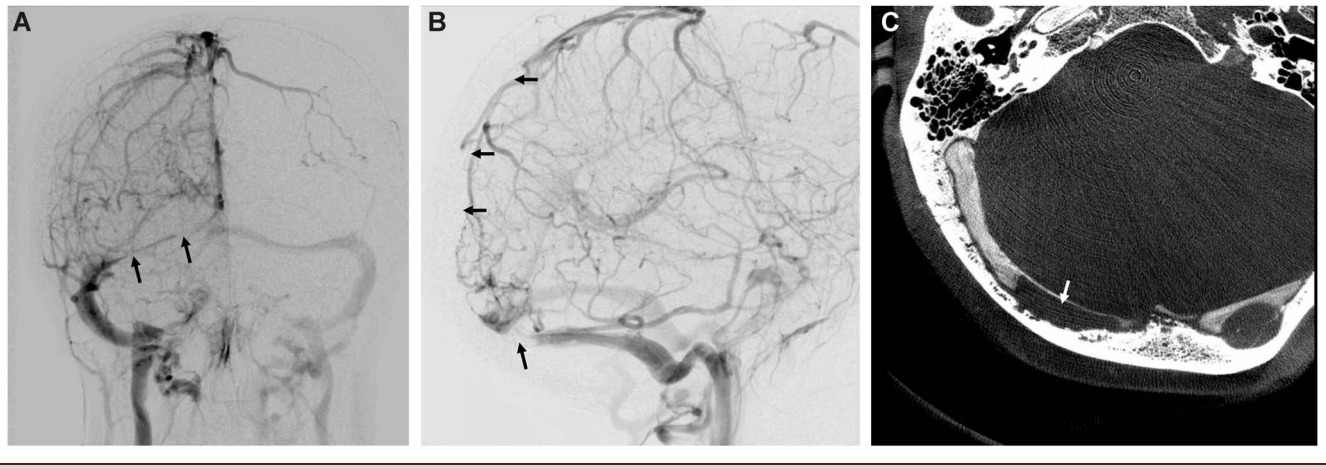


FIGURE 2. *Digital subtraction angiography of venous phase demonstrating the lesion.* **A** *and* **B**, *Large nonocclusive intraluminal lesion in AP* **A** *and sagittal* **B** *planes (black arrows). There is visible flow through the right transverse sinus into the sigmoid sinus bilaterally.* **C**, *High-resolution cone-beam dyna computed tomography scan of the lesion within the right transverse sinus causing a partial-filling defect (white arrow).*

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advanced over a Velocity Microcatheter (Penumbra Inc.) into the medial right transverse sinus and then across the torcula into the contralateral transverse sinus.

An Imperative Care Pod (Imperative Care) was connected in line with the suction tubing to a Penumbra thrombectomy vacuum pump. The vacuum pump canister was modified to include a Telfa dressing pad (Covidien) over the suction filter holes to catch any tissue that may collect through the aspiration process. Under suction, the Zoom 71 was advanced to the interface of the filling defect in the medial right transverse sinus. Aspiration only retrieved nondiagnostic tissue (Figure 4). Next, a 6 × 40 mm Solitaire X stent retriever (Medtronic) was advanced through the Velocity Microcatheter and deployed through the filling defect in the right medial transverse sinus and withdrawn back through the lesion, attempting to capture any material into the suction catheters (Figure 5A and 5B).

The stent retriever was then removed from the body and sent in formalin to pathology, as was all material from the pod. Within the stent interstices, soft yellow to brown tissue was found (Figure 5C). An angiographic run and a cone-beam computed tomography angiogram were performed with no evidence of arterial or venous injury, change in the intraluminal configuration, or contrast extravasation (Figure 6). The size and shape of the filling defect within the medial right transverse sinus was found unchanged after stent retrieval and suction aspiration, angiographically suggesting a tumor mass or organized thrombus rather than a soft thrombus or mass. The patient tolerated the procedure well without perioperative complications.

In contrast to the foamy tissue in the pod and suction pump canister, only the tissue fragments caught within the interstices of the stent retriever were diagnostic. The pathology was consistent with the World Health Organization Grade 1 meningioma (Figure 7). The patient subsequently underwent Gamma Knife radiosurgery for the meningiomas identified on MRI and the intraluminal meningioma. She was seen in clinic at 1-month follow-up and was doing well without any neurological deficits or complaints.

DISCUSSION

Intravascular filling-defect lesions may occur from multiple underlying pathologies including tumors, thrombosis, or inflammation. Given the rarity of intraluminal tumors, these lesions are often mistaken for an acute thrombus, and patients begin anticoagulation for several months before appropriately diagnosing the lesion. Indeed, the duration between symptom onset and diagnosis has been reported to be as long as 12 months because of initial misdiagnosis.[8-10] In cases of uncertainty of diagnosis, it is possible to perform a craniotomy and perform dissection through the sinus wall to obtain a biopsy.[11] However, this procedure involves risk including injury to the sinus, resulting in either postoperative hemorrhage or sinus occlusion and venous infarct. Performing a biopsy through endovascular means may provide a safer, less invasive alternative to a craniotomy.

The first described strategy to perform an intracranial intraluminal lesion biopsy was by Quan et al, describing a technique using small biopsy forceps.[7] We opted not to perform this particular technique because we felt that using forceps may cause vascular trauma and may prove difficult to navigate through the tortuous sigmoid sinus. Instead, we chose to use a technique recently described by Khatibi et al using a Zoom 71 aspiration catheter (Imperative Care) and EmboTrap stent retriever system (Cerenovus). The case describes performing an endovascular

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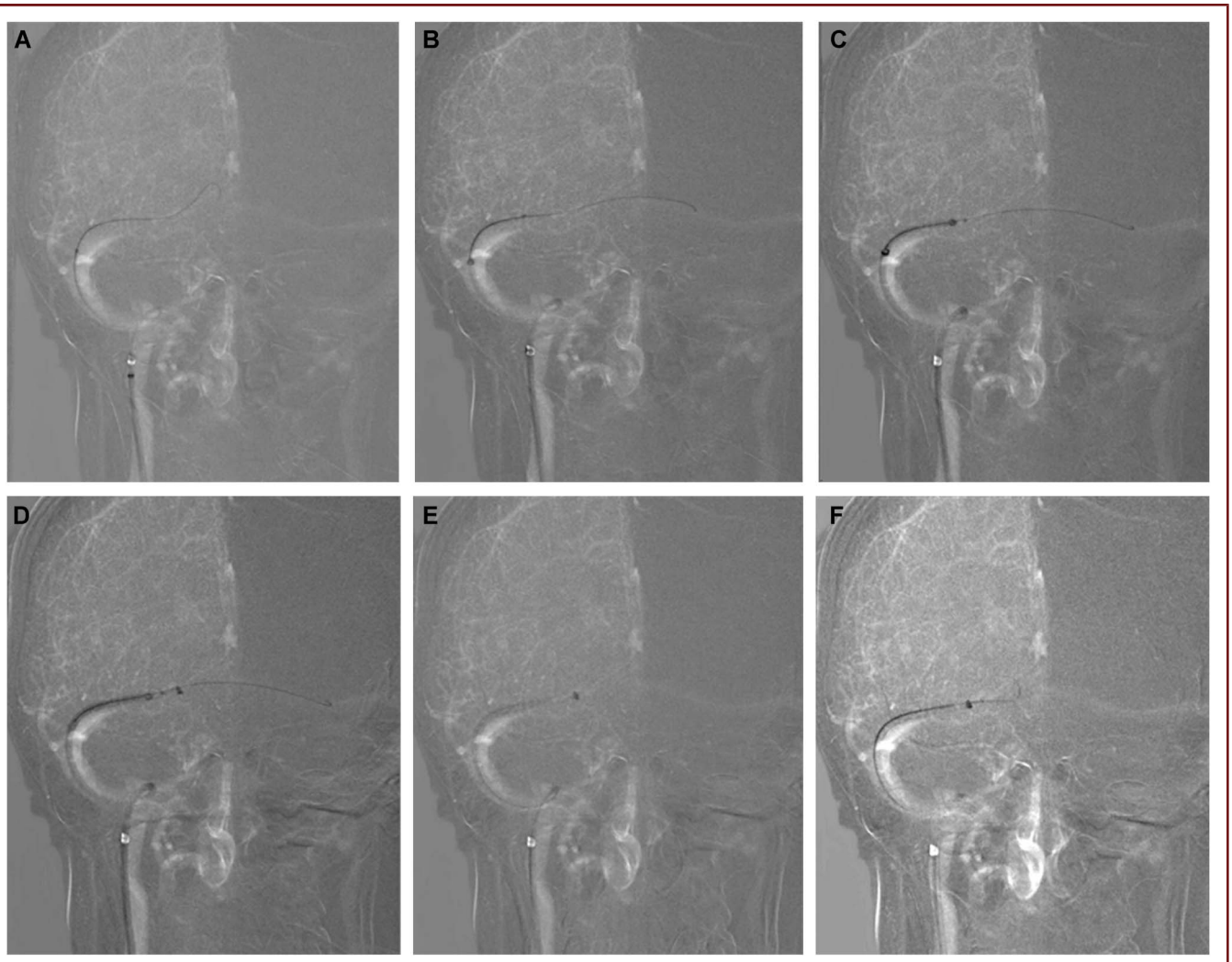


FIGURE 3. *Zoom aspiration catheter system advanced through the lesion in the right transverse sinus.* **A**, *A 9-French shuttle sheath was advanced to the right jugular bulb. The Velocity Microcatheter is advanced through the lesion in the right transverse sinus. A Zoom 71 catheter was then advanced to the right transverse sinus through a TracStar guide catheter.* **B**, *The Velocity Microcatheter was further advanced through the lesion into the contralateral transverse sinus, and the Zoom catheter construct was advanced to the lesion interface.* **C**, *The Zoom 71 catheter is advanced over the Velocity Microcatheter through the lesion.* **D**, *The TracStar is then advanced over the Zoom 71 catheter through the lesion.* **E**, *With the suction on, the Zoom 71 and microcatheter system is withdrawn to attempt suctioning of part of the lesion.* **F**, *The Zoom 71 catheter and microwire are then readvanced in preparation for a second pass.*

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FIGURE 4. *Results of aspiration catheter techniques to obtain tissue sample.* **A**, *The aspiration catheter technique did not collect any diagnostic tissue.* **B**, *The sample collected on the Telfa filter was not diagnostic of meningioma.*

biopsy of an intraluminal myeloid sarcoma, a type of soft tissue tumor consisting of extramedullary proliferation of myeloid precursor cells.[6] Myeloid sarcoma has been described as having a firm consistency with invasion into surrounding bone and soft tissue.[12,13] For this reason, we felt that a similar technique to biopsy a meningioma.

Importantly, we have expanded the applicability of this technique by successfully performing an endovascular biopsy on a meningioma, a commonly encountered neurosurgical tumor. Meningiomas can exhibit variable tissue consistency, firmness, and calcifications. Despite these challenges, we were able to safely perform the biopsy. We also provide detailed clarification of the technique using a large-bore catheter system equipped with a 6-mm diameter Solitaire X stent. The Solitaire X stent was specifically selected for its combination of closed-cell design and a longitudinal slot along its length. We theorized this design would maximize contact with the luminal tumor and enhance radial and shearing forces on the tumor itself, thereby increasing the likelihood of abrasion and tissue yield. The stent retriever was critical in obtaining sufficient tissue for a pathological diagnosis. In addition, we advise against using Telfa in future procedures to avoid the risk of nondiagnostic specimens.

CONCLUSION

In this case report, we successfully demonstrated the productive biopsy of an exclusively intraluminal lesion along the transverse sinus wall using a combination of large diameter stent retriever and large-bore aspiration catheter. To avoid open cranial surgery, a percutaneous transfemoral endovascular approach to the intracranial venous sinus can be safely performed and yield sufficient diagnostic tissue on the stentriever device provided a plurality of passes is performed to allow tissue interaction and trapping within the stent interstices.

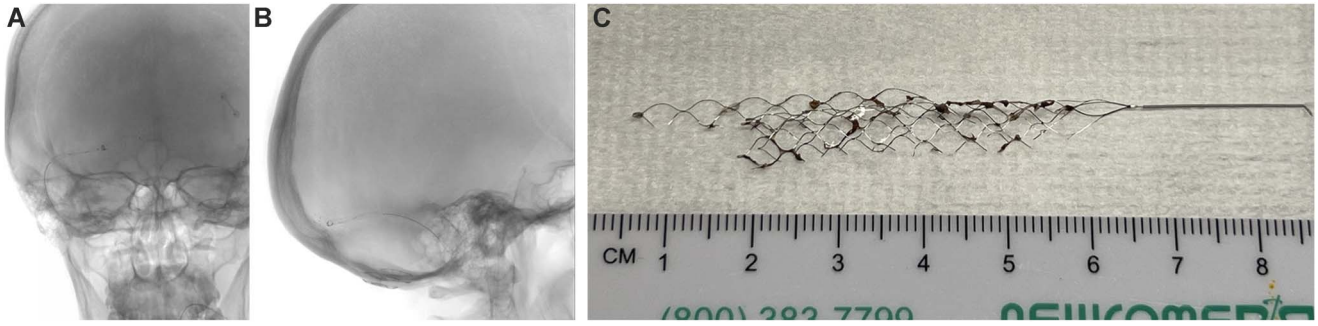


FIGURE 5. *Intraprocedural images of stent deployment through the transverse sinus lesion.* **A** *and* **B**, *A Solitaire X stent was deployed through the Zoom catheter system across the filling defect to capture any material into the aspiration catheters. The stent was then withdrawn back into the aspiration catheters.* **C**, *Solitaire X stent with what seems to be small collections of tissue surrounding the stent.*

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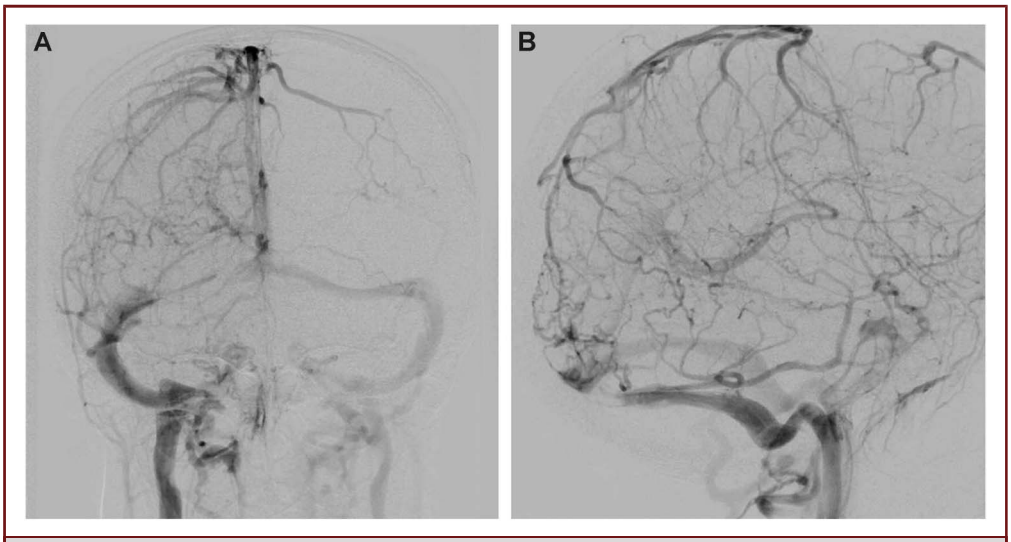


FIGURE 6. *Digital subtraction angiography of venous phase after biopsy of the lesion. AP* **A** *and sagittal* **B** *views re-demonstrating the lesion. There was no evidence of arterial or venous injury or change. There was stable appearance of the medial right transverse sinus without deterioration or further thrombosis.*

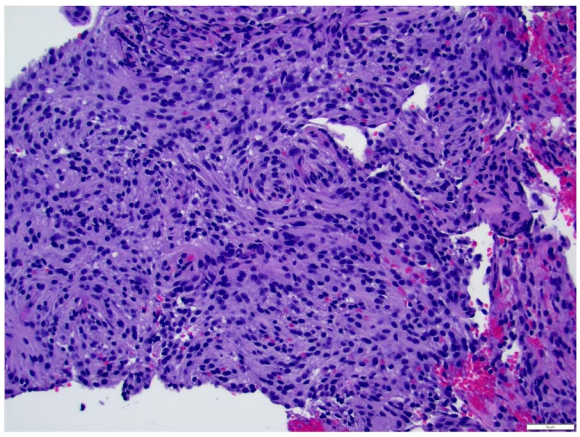


FIGURE 7. *Histological staining of the intraluminal lesion. Tissue from the stent was sufficient for the histological diagnosis of meningioma, which demonstrates classic meningothelial architecture and whorls.*

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The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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COMMENTS

The authors present a case of endovascular biopsy for an intraluminal meningioma in the transverse sinus using a stent retriever and aspiration catheter. This approach represents an important step forward in minimally invasive neurointervention, offering a viable alternative to traditional open biopsy, which carries significant risks in highly vascularized intracranial regions.[1a,2a]

One of the study's major strengths lies in its demonstration of a safe and effective method for obtaining diagnostic tissue from a challenging anatomic location. The successful use of a stent retriever to secure sufficient tissue for histopathologic evaluation highlights the adaptability of thrombectomy devices beyond their conventional applications. This technique could be particularly beneficial for patients where surgical biopsy poses excessive risk.

However, while the case is compelling, a few considerations should be acknowledged. The study does not provide a direct comparison with other endovascular biopsy methods, such as forceps, which might offer different advantages depending on lesion consistency. Additionally, while no complications were observed in this case, the long-term implications of manipulating an intraluminal tumor with a stent retriever remain unclear. Future studies assessing procedural safety, risk of tumor fragmentation, and long-term outcomes will be essential to validate this technique further.

Overall, this report is a valuable addition to the evolving field of neurointervention. It not only expands the potential applications of endovascular technology but also raises important questions that warrant further research. As neuroendovascular techniques continue to advance, refining methods for diagnosing complex intracranial lesions will be critical in optimizing patient care.

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