Simultaneous resolution of arachnoid cyst and chronic subdural hematoma after middle meningeal artery embolization: illustrative case

Ryan W. Sindewald, BS,1 Michael G. Brandel, MD, MAS,1 Arvin R. Wali, MD, MAS,1 Alexander A. Khalessi, MD, MBA,1 and David R. Santiago-Dieppa, MD1,2

Departments of 1Neurosurgery and 2Materials Science and Engineering, University of California, San Diego, California

BACKGROUND  Arachnoid cysts are cerebrospinal fluid–filled spaces that are typically congenital and treated conservatively or with fenestration when symptomatic. Chronic subdural hematomas (cSDHs) can arise in the presence of arachnoid cysts due to fragile leptomeningeal vessels or veins within the cyst wall or cyst lumen, leading to bleeding and subsequent hematoma formation. Middle meningeal artery (MMA) embolization is regularly used for the treatment of cSDH as an alternative to craniotomy and evacuation.

OBSERVATIONS  Here, the authors present the first known report of the simultaneous resolution of an arachnoid cyst and cSDH following MMA embolization in an adult. A 24-year-old male presented to the emergency department with 1 month of worsening headaches. Imaging revealed the presence of a cSDH and ipsilateral arachnoid cyst. The cSDH was treated with MMA embolization using coils exclusively. Follow-up imaging 4 months after embolization demonstrated simultaneous resolution of both the hematoma and the arachnoid cyst.

LESSONS  MMA embolization has been used for the treatment of cSDH. In cases in which the hematoma is related to an arachnoid cyst, MMA embolization can also lead to the concurrent resolution of both pathologies.

https://thejns.org/doi/abs/10.3171/CASE24192

KEYWORDS  arachnoid cyst; coiling; embolization; endovascular; middle meningeal artery; subdural hematoma

Chronic subdural hematomas (cSDHs) are a common neurosurgical pathology, particularly among older individuals, and can occur as sequelae of trauma, an underlying coagulopathy, or antithrombotic medications.1 The leaky outer neomembrane of a cSDH is supplied by the middle meningeal artery (MMA), leading to blood accumulation in the subdural space.2 As the subdural hematoma (SDH) increases in size within the fixed volume of the cranial cavity, this can lead to midline shift and symptoms such as focal neurological deficits, headache, and altered mental status, and seizures can occur.3 Chronic SDHs can be managed expectantly with discontinuation of any antiplatelet or anticoagulant agents or correction of an underlying coagulopathy.4 Many cSDHs resolve spontaneously. For large hematomas exerting mass effect and causing midline shift, craniotomy for evacuation may be necessary.4 In recent years, MMA embolization has grown as a minimally invasive method to prevent expansion of cSDHs and encourage their resolution. We have previously demonstrated that coils make unique strategies possible in MMA embolization for the treatment of cSDH.2

Arachnoid cysts are congenital lesions that are frequently found incidentally on imaging.5 Bony erosion has been reported for intracranial arachnoid cysts and in some cases has caused bony defects exposing the intracranial cavity to the frontal sinus.

Arachnoid cysts are rarely treated, but when treatment is necessary, it can be surgically performed, establishing a connection between the cyst lumen and normal cerebrospinal fluid (CSF) spaces.6 A known potential complication of arachnoid cysts is cSDH, hypothesized to be attributable to decreased cushioning of the brain given the cyst’s presence. Sources of bleeding that explain the hematoma’s association with an arachnoid cyst are veins within the cyst itself, veins within the cyst walls, and potentially leptomeningeal vessels.7 It has previously been reported that MMA embolization for recurrent SDH incidentally led to the resolution of an arachnoid cyst in a pediatric patient.8

Currently, no report of the simultaneous treatment of an arachnoid cyst and SDH in an adult using MMA embolization exists in

ABBREVIATIONS  cSDH = chronic subdural hematoma; CSF = cerebrospinal fluid; CT = computed tomography; MMA = middle meningeal artery; MRI = magnetic resonance imaging; SDH = subdural hematoma.

INCLUDE WHEN CITING  Published July 29, 2024; DOI: 10.3171/CASE24192.

SUBMITTED  March 17, 2024. ACCEPTED  April 15, 2024.

© 2024 The authors, CC BY-NC-ND 4.0 (http://creativecommons.org/licenses/by-nc-nd/4.0/)
the literature. Here, we report the case of a patient presenting with SDH and arachnoid cyst, both of which resolved following MMA embolization.

**Illustrative Case**

A 24-year-old male presented to the emergency department at an outside hospital with 1 month of worsening headaches. Computed tomography (CT) revealed a right frontal convexity cSDH and a hyperdense mass with calvarial remodeling just posterior to it (Fig. 1). The mass did not enhance with contrast on CT scanning. The hyperdense mass was confirmed to be an arachnoid cyst with intracystic hemorrhage on magnetic resonance imaging (MRI). The patient denied any history of head trauma or antithrombotic medications, and there was no evidence of coagulopathy. The right-sided temporal hyperdense nonenhancing mass demonstrated on CT was most consistent with an arachnoid cyst given the presence of bone remodeling around the mass and adjacent SDH. After a discussion of the risks and benefits, the patient was offered MMA embolization for management of the cSDH.

MMA embolization was performed with the patient under moderate sedation. Vascular access was achieved via the right common femoral artery. The right external carotid artery was catheterized, and an angiogram was used to characterize the MMA target. A microcatheter angiogram demonstrated perfusion of the subdural membranes. A series of coils with no liquid or particle embolisates were used to embolize the MMA and a follow-up angiogram demonstrated complete occlusion of the vessel. All catheters and wires were removed, and the femoral access site was closed. Angiograms demonstrating the MMA target prior to embolization and a follow-up angiogram postembolization are featured in Fig. 2.

There were no complications. The patient endorsed significant improvement in headaches and was discharged with a steroid taper on postoperative day 1. The patient followed up in clinic 1 month postprocedure and endorsed minor infrequent headaches but no other neurological symptoms. Follow-up CT 4 months postprocedure demonstrated complete resolution of both the cSDH and the arachnoid cyst (Fig. 3).
Patient Informed Consent

The necessary patient informed consent was obtained in this study.

Discussion

Observations

Here, we present the first known report of the simultaneous resolution of an arachnoid cyst and SDH following MMA embolization in an adult. Arachnoid cysts are collections of CSF encapsulated within an arachnoid capsule and are typically congenital. In adults, arachnoid cysts typically do not change in size. SDHs are known sequelae of arachnoid cysts, often times with a history of head trauma, and are hypothesized to originate from bleeding of the leptomeningeal vessels, veins within the cyst wall, or veins within the cyst itself. Both cysts and SDHs are space-occupying intracranial lesions and can lead to symptoms due to mass effect or increased intracranial pressure. In our patient, the etiology of the cSDH was likely the arachnoid cyst given the lack of other risk factors in this healthy young patient.

There are limitations to the case presented. The absence of a tissue sample for pathological diagnosis required that diagnosis of an arachnoid cyst be made radiographically. Head CT with contrast prior to MMA embolization demonstrated a nonenhancing cyst, with no evidence of a nodular mass, making a cystic tumor extremely unlikely. Additionally, the presence of bony erosion with concurrent intracystic hemorrhage or SDH has been suggested to be diagnostic of arachnoid cysts.

While many arachnoid cysts contain fluid with the same MRI signal as CSF, the presence of intracystic hemorrhage can change the MRI signal because of the presence of extracellular methemoglobin. The cyst in our case contained a slightly hyperintense signal relative to CSF because of the presence of intracystic hemorrhage. Resolution of the arachnoid cyst was discovered on follow-up noncontrast CT; thus, follow-up MRI was not needed.

Despite these limitations, arachnoid cyst remains the most likely etiology for the hyperdense mass considering the overlying bony erosion on CT, which has previously been suggested to be diagnostic of an arachnoid cyst. This is further supported by the otherwise unexplained SDH, making arachnoid cyst the most likely diagnosis considering the entire clinical picture. Typically, arachnoid cysts and SDHs have different surgical management, with symptomatic arachnoid cysts requiring craniotomy. The risk profile of MMA embolization is favorable, and a minimally invasive operation for the resolution of both pathologies can decrease overall risk. More investigation and reports of similar cases are required to determine if MMA embolization can be considered for the treatment of an arachnoid cyst in the absence of an accompanying cSDH.

Lessons

MMA embolization has been used for the treatment of cSDH. In cases in which the hematoma is related to an arachnoid cyst, MMA embolization can also lead to the concurrent resolution of both pathologies.

References


Disclosures

Dr. Khaledi reported personal fees from Medtronic, Ospitek, Route 92/SUMMIT MAX, Neuroventis, and XENSE and stock options from Aseyena outside of the submitted work. Dr. Santiago-Dieppa reported personal fees from Balt, Stryker, and Medtronic outside the submitted work.

Author Contributions

Conception and design: Wali, Santiago-Dieppa. Acquisition of data: Sindewald, Wali, Santiago-Dieppa. Analysis and interpretation of data: all authors. Drafting the article: Sindewald, Brandel, Wali, Santiago-Dieppa. Critically revising the article: Sindewald, Brandel, Santiago-Dieppa. Reviewed submitted version of manuscript: Sindewald, Brandel, Khaledi, Santiago-Dieppa. Approved the final version of the manuscript on behalf of all authors: Sindewald. Administrative/technical/material support: Santiago-Dieppa. Study supervision: Khaledi, Santiago-Dieppa.

Correspondence

Ryan W. Sindewald: University of California, San Diego, CA. rsindewald@health.ucsd.edu.