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Multidisciplinary Care of Patients with Hemorrhagic and Ischemic Stroke

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Neurovascular News

Christopher S. Ogilvy, MD
DIRECTOR
Brain Aneurysm Institute

Phil Taussky, MD
CO-DIRECTOR
Brain Aneurysm Institute

Justin Granstein, MD
Attending,
Brain Aneurysm Institute

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Middle Meningeal Artery Embolization for Chronic Subdural Hematoma: Less Invasive Endovascular Treatment as an Alternative or Adjunct to Surgery

Naveen Arunachalam Sakthiyendran, Philipp Taussky, MD, Justin H. Granstein, MD, Christopher S. Ogilvy, MD,

INTRODUCTION

Subdural hematoma (SDH) is a neurosurgical disease that has been traditionally characterized by a collection of blood and fluid that develops between the brain and its outer protective covering, the dura. It often appears after head trauma such as bumps, falls, and other etiologies. With age, the brain gradually atrophies, stretching delicate bridging veins that can tear more easily. Blood then flows under the dura, starting a process that may persist for weeks or months. Given the time variable nature of the bleeding, SDH can also be characterized as a chronic disease (often called chronic subdural hematoma; cSDH).

PATHOPHYSIOLOGY

After bleeding into the subdural space, two membranes form: a thin, inactive inner layer and an outer layer that is biologically active and highly vascular. The outer membrane contains fragile, immature capillaries prone to leakage due to thin or absent basement membranes and endothelial gaps. Hematoma fluid is rich in vascular endothelial growth factor (VEGF)—often over 20× normal levels—driving abnormal vessel growth and leakiness. Inflammatory cytokines (IL-6, IL-8, TNF-α) sustain inflammation, while fibrinolytic proteins such as tissue plasminogen activator (tPA) liquefy clots, promoting further bleeding. This cycle underlies the tendency of chronic subdural hematomas to recur even after successful surgery.[1]

TRADITIONAL TREATMENTS

Burr-Hole Drainage and SEPS

The standard treatment for large or symptomatic cSDH is burr-hole drainage. This procedure involves making one or two small openings in the skull, inserting a soft drain into the subdural space, and allowing fluid to drain for 24–48 hours. The fluid drained is a thick, "crankcase oil' consistency and is dark in color as a result of blood breakdown products. Most patients improve rapidly and drain reduce recurrence rates from about 24% without a drain to roughly 9% in large, controlled trials. Nonetheless, 10–20% of cases still have fluid recur, often due to continued leakage from the outer membrane. For more medically fragile patients or those with smaller hematomas, the Subdural Evacuating Port System (SEPS) provides a less invasive alternative yet still involves creating a hole in the skull surgically. Performed at the bedside under local anesthesia through a twist-drill hole, SEPS offers continuous gravity-driven drainage over 24–48 hours, avoids the operating room, and enables good recovery in selected patients. Both burr holes and SEPS require surgery with skull drilling as shown in Figure 1.

Pharmacological Therapies

Several pharmacological approaches for cSDH aim to reduce inflammation, strengthen fragile vessels, and stabilize clots. Corticosteroids, such as dexamethasone, once showed promise; however, the landmark Dex-CSDH randomized trial found that although dexamethasone lowered reoperation

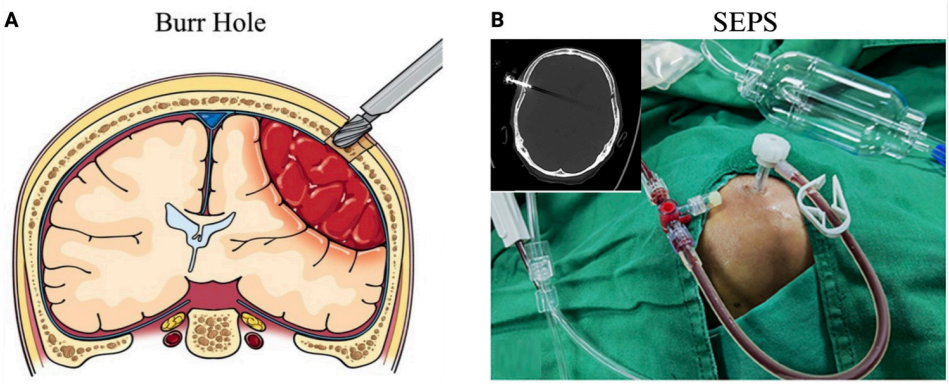

Figure 1. (A) Burr-hole craniotomy: A small circular opening is drilled in the skull to access the subdural space, allowing evacuation of hematoma fluid (B) Subdural Evacuating Port System (SEPS): A minimally invasive, bedside procedure performed under local anesthesia through a twist-drill opening. A port is connected to a closed drainage system for continuous evacuation over 24–48 hours. Rodriguez et al. Frontiers in Neurology 2023.

rates for cSDH, it led to worse six-month functional outcomes and increased complications—including infection and hyperglycemia—prompting recommendations against routine use.[2]

Tranexamic acid (TXA), an antifibrinolytic agent, helps stabilize blood clots. Observational studies and meta-analyses suggest it can lower recurrence rates without increasing thrombotic risk, but large randomized trials are still underway to confirm its safety and efficacy.[3]

Statins, particularly atorvastatin, have anti-inflammatory and vessel-stabilizing effects. In the ATOCH trial, atorvastatin therapy in patients with mildly symptomatic resulted in significant hematoma size reduction, a decreased need for surgery, and good overall tolerability.[4]

Middle Meningeal Artery Embolization: A New Paradigm in cSDH Care

A relatively recent and critical advancement in treating cSDH is middle meningeal artery embolization (MMAE). This is a minimally invasive endovascular procedure that directly targets the blood supply of the abnormal outer membrane causing the hematoma (Figure 2).

During MMAE, a thin catheter (microcatheter) is inserted through an artery in the wrist/groin and navigated up to the middle meningeal artery – the main vessel feeding the outer membrane of the dura. Then a liquid embolic agent or tiny particles are injected to block off these branches, starving the leaky vessels and effectively stopping the cycle of bleeding into the subdural space. By cutting off the blood flow to the fragile membrane, MMAE addresses the root cause of hematoma growth and recurrence.

The BIDMC Brain Aneurysm Institute has been one of the leaders nationally to adopt and carefully study the results of this technique. Our team has performed hundreds of MMAE procedures for cSDH, making us one of the most experienced centers in the country.

MMAE can be used instead of surgery for minimally symptomatic or asymptomatic patients or as an adjunct to open surgical techniques to reduce the recurrence of the SDH.

Why add MMAE to surgery?

The EMBOLISE trial found that adding MMAE to burr-hole surgery reduced the 3-month recurrence rate significantly from 11.3% to 4.1%. Similarly, the STEM trial reported that adding embolization cut the overall treatment failure rate (recurrences or need for further treatment) from 39% down to 15% at 6 months. Across multiple trials, patients who received MMAE had better outcomes and fewer serious adverse events than those who only had traditional burr hole treatment. Consistent with these findings, our own Beth Israel Deaconess team recently published a study showing that adjunctive MMAE after surgery significantly lowers recurrence. In that study, patients who received MMAE in addition to surgical evacuation had a 3–4 times lower risk of the hematoma coming back compared to surgery alone.[5]

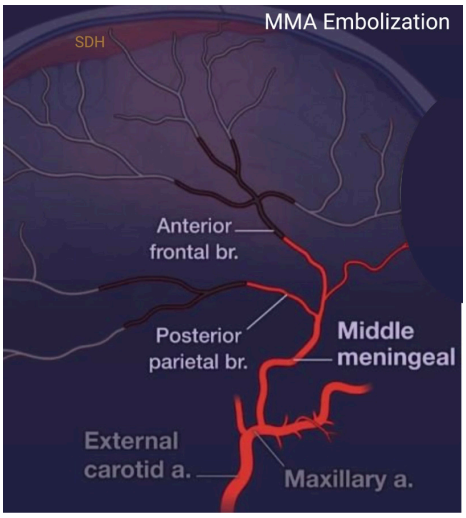

Figure 2. Blood supply to a chronic subdural hematoma (cSDH) and how MMAE works. The middle meningeal artery (MMA), a branch of the maxillary artery from the external carotid artery, has two main branches—the anterior frontal and posterior parietal—that feed the outer membrane of a cSDH. By blocking these small vessels during embolization, the blood supply to the fragile, leaky membrane is cut off, stopping further bleeding and allowing the hematoma to shrink over time.

Safety and Efficacy of MMAE

In a recent study of patients over 90 years old (nonagenarians) treated at BIDMC and one other center, 95% of those who had MMAE (mostly without any surgery) saw their hematomas resolve with no recurrence.[6] This is especially encouraging given that very elderly patients often have medical issues that make surgery risky – yet MMAE was able to treat the hematoma effectively with minimal risk. Other special groups have also been studied by our team. For instance, patients on blood thinners or with bleeding/clotting disorders tend to have a higher chance of hematoma recurrence. Our multicenter analysis of over 500 MMAE cases found that even in those on anticoagulants or antiplatelet drugs, MMAE worked well – the vast majority avoided re-bleeding – though the rate of needing a rescue surgery was slightly higher than in patients with normal clotting.

Moreover, MMAE has an excellent safety profile. Across large studies, serious complications like stroke or nerve damage have been very rare (<1%). There is no brain surgery or general anesthesia required in many cases, which helps avoid the risks of those interventions. One complication our team investigated is seizures after MMAE – since the embolization can cause the hematoma to shrink and sometimes irritate the brain's surface. In this study, about 4% of patients had a seizure in the hospital after MMAE, with the highest risk being in patients who had very large hematomas causing major brain shifts or who were already significantly impaired neurologically. It's important to note that these post-procedure seizures were still uncommon (especially relative to the seizure risk post-surgery), and we can use prophylactic medications to treat or

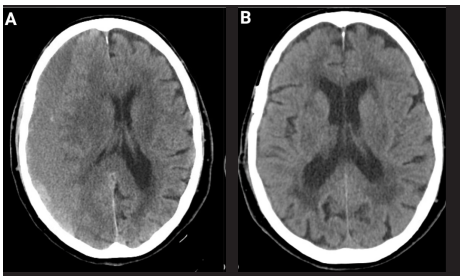

Figure 3. Resolution of cSDH post adjuvant MMAE after burr hole treatment. (A) Axial CT head scan of an 89-year-old patient at presentation demonstrates a large cSDH causing significant mass effect and midline shift. (B) Follow-up CT at 4 months after burr-hole drainage and adjunct MMAE shows complete resolution of the hematoma with restoration of normal midline anatomy and no evidence of recurrence.

prevent them when needed.

How is MMAE currently used in practice for cSDH?

Currently, in most cases, MMAE is used as an adjunct to surgery – that is, in combination with a burr-hole drainage procedure. Using MMAE as a follow-up to surgery has proven to significantly lower the recurrence risk, and adding MMAE for patients with risk factors for recurrence is often successful. Second, MMAE can sometimes serve as a stand-alone primary treatment – essentially an alternative to surgery – in patients who have more stable bleeding. In many cases the hematoma will gradually shrink over weeks to months after MMAE, avoiding an operation altogether. On the other hand, MMAE is not a solution for every case. It is not suitable for very large, acute hematomas with severe pressure or rapidly worsening symptoms, which still require an urgent surgical decompression to protect the brain. In those emergency cases, surgery is the priority. Figure 2 shows CT scans of the pre-treatment and post-burr hole and adjuvant MMAE treatment of an 89-year-old patient that was taken care of at BIDMC.

MAJOR TAKEAWAYS

- Chronic subdural hematoma (cSDH) is driven by fragile, leaky vessels in the outer membrane, sustained inflammation, and clot breakdown
- Traditional treatment: Burr-hole drainage remains highly effective but carries a 10–20% recurrence rate; the Subdural Evacuating Port System (SEPS) offers a less invasive bedside option for select patients.
- Pharmacological options like TXA and statins are promising but still under investigation; routine corticosteroid use is no longer recommended.
- Middle meningeal artery embolization (MMAE) is a minimally invasive option that targets the root cause of recurrence by blocking blood supply to the outer membrane.

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Is Less Really More in Preoperative Care for Unruptured Intracranial Aneurysm Treatment?

Naveen Arunachalam Sakthiyendran, Arissa Jokhio, Justin H. Granstein, MD, MPH, Christopher S. Ogilvy, MD

INTRODUCTION

For patients undergoing elective surgery for unruptured intracranial aneurysms (UIAs), preoperative laboratory testing is often a routine part of the process. Tests such as blood glucose panels, kidney function panels, cardiac EKGs, and platelet function assays are commonly ordered in the days leading up to or right before surgical and/or endovascular treatment. While these tests can reveal hidden risks and guide patient optimization before surgery, they can also lead to delays, unnecessary costs, and stress—especially when performed comprehensively in patients who are otherwise healthy[1].

In our research group at BIDMC, we set out to answer a fundamental preoperative question: Should all patients receive the same, detailed list of pre-op tests? Or is there a smarter, more tailored way to identify who truly benefits from specific testing?

Using a decision-analytic model and patient data from our aneurysm database, we evaluated four commonly used preoperative tests to determine which are truly cost-effective—and for whom. Our goal was to determine whether testing actually improved outcomes and justified the cost of testing.

PREOPERATIVE TESTS UNDER EVALUATION

The four tests included in our study were selected because of their frequency in preoperative UIA protocols and their potential to detect clinically relevant conditions that increase perioperative risk. These included:

12-lead Electrocardiogram (ECG): to detect silent cardiac arrhythmias or ischemia.

Blood Glucose Panel (BGP): to assess for hyperglycemia or undiagnosed diabetes.

Basic Metabolic Panel (BMP): to check renal function and electrolyte status.

Platelet Function Test (PFT): to screen for clotting abnormalities that could increase bleeding/thromboembolic risk.

METHODS: DECISION-ANALYTIC MODELING BY RISK CATEGORY

To simulate the clinical scenarios faced by UIA patients, we built a Markov decision-tree model. This allowed us to compare two strategies for each test: performing the test or not performing it. We modeled expected outcomes in terms of both cost (USD) and quality-adjusted life years (QALYs).

We stratified patients into two risk categories:

High-Risk Patients (HRM): those with comorbidities such as heart disease, diabetes, chronic kidney disease, or clotting disorders.

Normal-Risk Patients (NRM): those without these comorbidities—i.e., healthy, asymptomatic patients.

In the model, patients who underwent testing and were found to have abnormal results could receive targeted preoperative management (e.g., cardiology referral, blood sugar control, hydration for renal protection) before proceeding to aneurysm treatment.

Patients with normal test results—or who didn't receive testing—proceeded directly to surgery.

We then modeled potential postoperative complications, associated outcomes (recovery, disability, death), and long-term healthcare costs and QALYs. Each scenario was analyzed using incremental cost-effectiveness ratios (ICERs) and net monetary benefit (NMB) at a willingness-to-pay (WTP) threshold of $100,000 per QALY.

RESULTS

High-Risk Patients: Targeted Testing Improves Outcomes

Among high-risk patients, three tests—BGP, ECG, and BMP—were clearly cost-effective. All three not only improved clinical outcomes but also reduced overall lifetime healthcare costs by preventing complications.

Blood Glucose Panel (BGP): yielded 0.83 QALYs at a cost of $2,111. In patients with undiagnosed or uncontrolled diabetes, early detection enabled better infection prevention and wound healing.

Electrocardiogram (ECG): revealed arrhythmias or silent cardiac ischemia in patients with known heart disease, prompting safer surgical planning and reducing cardiac event risk.

Basic Metabolic Panel (BMP): identified renal insufficiency prior to contrast-based imaging (as in endovascular coiling), helping to avoid contrast-induced kidney injury.

Notably, the PFT did not prove cost-effective even in high-risk patients.

Average-Risk Patients: Testing Adds Cost Without Benefit

In otherwise healthy patients (average-risk cohort), most preoperative tests failed to show any meaningful benefit. The BGP was borderline cost-effective under some assumptions, but the ECG, BMP, and PFT consistently increased costs without improving outcomes.

For example, performing an ECG in a healthy patient without heart disease cost over $1,100 and provided no additional QALY gain versus not testing. Similarly, BMPs and PFTs had high costs and no difference in effectiveness.

SENSITIVITY ANALYSIS

We performed both one-way and probabilistic sensitivity analyses to test how changes in variables (e.g., complication rates, cost of complications, or test utility) affected the model's outcome. Across nearly all scenarios:

- BGP remained the most consistently cost-effective test, especially when the risk of diabetes-related infection was ≥1% or recovery from such infection carried a high quality-of-life burden.
- ECG and BMP were cost-effective primarily when complications were common (≥3–7%) or expensive to manage (e.g., >$5,000 per complication).
- PFT rarely became cost-effective, even under extreme assumptions.

DISCUSSION

Implications For Patients & Practice

Our results support what many anesthesiologists and surgeons intuitively suspect: not all patients need every test. When testing is tailored to risk factors, it can prevent life-threatening complications and save costs. But when applied indiscriminately, routine testing becomes inefficient and even harmful by causing treatment delays, triggering unnecessary additional testing, increasing patient anxiety, and driving up healthcare costs[2].

Of all the tests analyzed, BGP showed the most consistent value. Many patients with UIAs are older and may have undiagnosed diabetes or poor glycemic control. High blood sugar increases surgical-site infection risk and impairs healing—particularly in neurosurgery, where even minor infections can carry high morbidity[3]. Fortunately, glucose testing is inexpensive and simple to address, making it an easy and effective test that supports value-based care.

On the other hand, platelet function assays were considered low value, which aligns with studies from both anesthesia and neurosurgical literature, which show routine PFTs rarely change clinical decisions[3].

MAJOR TAKEAWAYS

- Pre-op testing should not be one-size-fits-all. Routine lab tests are often ordered before UIA treatment, but many of them do not provide benefit in healthy patients and may delay care.
- Risk-based testing improves value. Patients with medical comorbidities gain real benefit from targeted preoperative tests that help prevent serious complications.
- Three tests in particular were cost-effective in high-risk patients: BGPs identified patients at risk of infection and poor wound healing. ECGs helped detect silent cardiac issues that could increase surgical risk, and BMPs detected kidney dysfunction, etc.
- Unnecessary testing causes harm. Routine labs in low-risk patients can lead to:
  - Scheduling delays
  - Additional (often unneeded) workups
  - Increased anxiety and cost
  - No clinical benefit
- Potential system-wide impact is large. Avoiding even one unnecessary test per patient could save millions annually across the U.S. healthcare system[5].

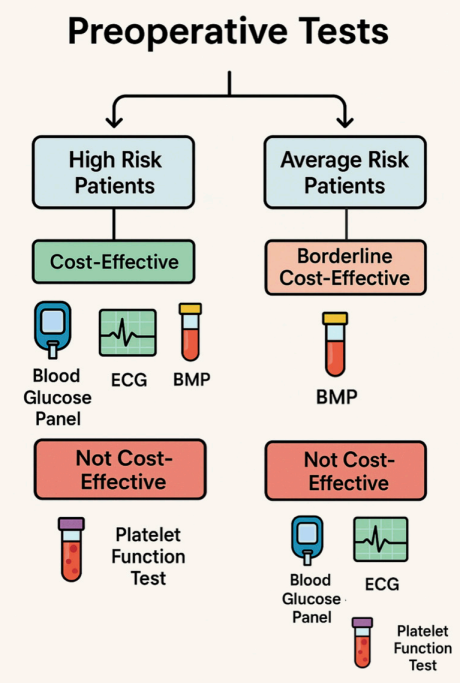

Figure 1. Preoperative Testing Framework in Patients Based on Risk

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What Are Patients Doing at the Time of Aneurysmal Subarachnoid Hemorrhage?

Anjeli Reyes Macaranas, BA, Olivia Li, Emmanuel Mensah, MD, MPH, Christopher S. Ogilvy, MD

INTRODUCTION

As we at the BIDMC Brain Aneurysm Institute have encountered patients with subarachnoid hemorrhage, we inquired what activity they were engaged in at the time of their aneurysm rupture. Although it is often held that aneurysm rupture is precipitated by vigorous activity, this may not be true in the majority of patients.

In order to study this question more comprehensively, we sought to quantify the physical intensity of activities directly preceding the onset of aneurysmal subarachnoid hemorrhage (aSAH) using an objective measure of exertion known as the metabolic equivalents of task (MET). Furthermore, we aimed to assess and compare the prevalence of nonstrenuous and strenuous activities precipitating aSAH. Understanding the acute triggers of aSAH may clarify its pathogenesis and inform clinical recommendations regarding lifestyle modifications to prevent aneurysm rupture.

STUDY SELECTION & ACTIVITY INTENSITY CLASSIFICATION

Our comprehensive review used studies from the years 2000 to 2024 and included all cases meeting the following aSAH diagnosis criteria: (1) adult patients (>18 years); (2) radiologically confirmed aSAH; (3) documented activity at time of aSAH.

In line with established MET classification guidelines[3], precipitating activities were categorized by intensity as follows: sleeping/resting (MET 1), seated activities (e.g. eating/drinking) (MET 2), light strain (e.g. standing/walking) (MET 3–4), moderate strain (e.g. sexual activity) (MET 5), and heavy strain (e.g. physical exercise) (MET ≥6) (Table 1). Activities with MET values 1–4 were grouped as "nonstrenuous," while those with MET ≥5 or involving Valsalva maneuvers were classified as "strenuous." Mental strain (unexpected emotional distress and debating) was also included.

RESULTS

Six retrospective case series were included in the systematic review and meta-analysis, with a total sample of 3,285 aSAH patients. Over 60% of patients were female, and the average age was 56.1±12.1. Overall, nonstrenuous activities preceded aSAH in 43.2% (1420/3285) of cases, while strenuous activities precipitated rupture in 23.5% (773/3285). 29.1% of cases were preceded by "other" or "unknown" activities. Using sleeping or resting (MET 1) as our reference, most activities (e.g. seated activities, light strain, and moderate-to-high strain) were associated with a reduced likelihood of aSAH.

Figure 1A illustrates the general breakdown of activity types that preceded aSAH in the total sample. Among nonstrenuous activities, 9.3% of all aSAH cases occurred during sleep or rest, 26.5% during seated activities, and 7.4% during light strain. Strenuous activities consisted of moderate strain (6.7%), heavy strain (8.9%), and Valsalva maneuvers (7.9%). Activities categorized as "other" and "unknown" accounted for 16.6% and 12.5%, respectively.

The most common seated activities (MET 2) as a proportion of all activities preceding aSAH were sitting (7.1%), working (6.8%), and watching TV/chatting/staying home (5.8%). Common light strain activities (MET 3–4) included personal hygiene (2.6%), shopping or outings (2.1%), and standing or walking (2.0%).

Strenuous activities preceded aSAH in 23.5% of all cases, comprising moderate strain (6.7%), heavy strain (8.9%), and Valsalva maneuvers (7.9%). Within the moderate strain category (MET 5), common activities included housework (3.2%), heavy labor (1.5%), and sexual activity (1.4%). Heavy strain activities (MET 6–8) were primarily sports or exercise (7.3%), followed by bicycling (0.4%), and lifting heavy loads (0.4%). Valsalva-associated triggers included defecation or micturition (7.8%) and nose blowing (0.1%). 4.1% of patients experienced mental strain prior to aSAH. Figures 1B through 1E each report separate activity distributions as a proportion of their respective MET strain category.

DISCUSSION

Seated & Light Strenuous Activities

Aneurysm rupture ultimately occurs when stress on the aneurysm wall exceeds its strength[4]. Our review showed that the largest percentage of aSAH cases (43.2%) were preceded by routine, low- exertion activities. While no clear physiological mechanism

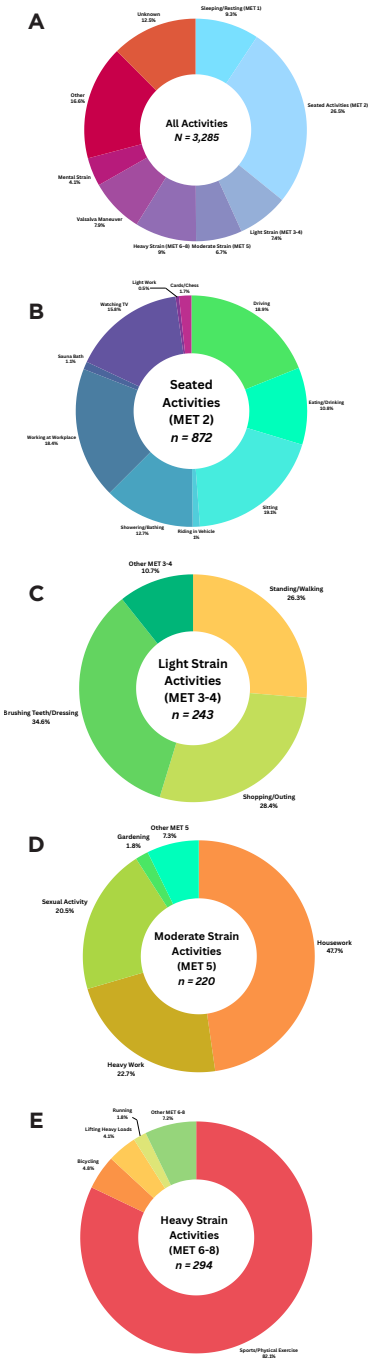

Figure 1. Distribution of All Activities Preceding aSAH. (A) Distribution of broad activity classifications preceding aSAH, (B-E) Proportional representation of activities within their respective MET categories.

links nonstrenuous activities to aSAH, fluctuations in systemic blood pressure (BP) — which is positively correlated with intra- aneurysmal BP — may contribute to rupture occurrence. Systemic BP tends to peak at around 9AM; similarly, peak rupture risk has been reported to be 6–9 AM and 6–9 PM[5]. However, the precise threshold at which increased intra-aneurysmal pressure leads to rupture remains unknown. In addition, cerebral autoregulation — a set of autonomic and myogenic mechanisms that protect

against cerebrovascular events by maintaining stable cerebral blood flow — has been found to be weakened from 6AM-12PM[6]. Thus, morning activities such as brushing teeth and bathing may coincide with this more vulnerable window for aneurysm rupture due to a combination of higher systemic BP and weakened autoregulation.

Sleeping & Resting

9.3% of aSAH cases occurred during sleep or rest. Normally, BP decreases by 10-20% during sleep which may lower intra-aneurysmal pressure and reduce rupture risk[7]. However, certain comorbidities can increase aSAH risk during sleep, particularly diabetes mellitus and antiplatelet usage, which increase nocturnal BP and decrease platelet aggregation, respectively[8].

Moderate & Heavy Strain

Our data show that strenuous activities, like sports and heavy lifting, were less common triggering events of aSAH. This is supported by computational fluid dynamics studies which show that moderate aerobic exercise does not cause the significantly altered flow patterns generally associated with aneurysm rupture and formation[9]. Additionally, hyperventilation-induced cerebral vasoconstriction has been shown to return cerebral blood flow to baseline during exercise intensities exceeding ~60% of maximal oxygen intake[10], acting as a protective measure against the up to 400% increases in BP during intense aerobic exercise and weight-lifting.

Valsalva Maneuvers, Anaerobic, and Aerobic Activity

Valsalva-like activities (e.g. defecation, nose blowing) comprised 7.9% of aSAH cases. For example, occupational physical activity, which may include weightlifting and other Valsalva-like motions, has been associated with elevated rupture risk, potentially due to significant increases in cerebral blood flow velocity[11].

In contrast to anaerobic, Valsalva-like activities, aerobic activities may reduce long-term aSAH risk by lowering systemic and vascular inflammation1. Consequently, the role of activity type (e.g. aerobic, anaerobic, or Valsalva strain) in predicting rupture risk, given potential differing effects on cerebral vasculature, warrants further study.

Mental Strain

Lastly, 4.1% of patients experienced mental strain immediately prior to aSAH. While acute emotional arousal is known to raise systemic BP[1], the relationship between emotional reactivity, BP fluctuations, and aSAH risk warrants further investigation.

Limitations

Our study had several limitations. All included studies were retrospective case series, which are subject to recall bias, data entry errors, and low generalizability. Furthermore, studies did not provide data regarding patients' baseline activity levels, aneurysm geometries, or comorbidities. Given that individuals generally spend most of the day conducting routine nonstrenuous activities, our findings of greater aSAH prevalence following such activities may simply reflect this pattern. Additionally, many cases were categorized as "unknown" or "other" by included studies, and activity descriptions sometimes did not capture variation in intensity within specific activities (i.e. bicycling, running).

CONCLUSION

Our findings indicate that aSAH more frequently occurs during nonstrenuous activities, such as seated tasks and resting, than strenuous exertion like sports or heavy lifting. This pattern suggests that circadian BP fluctuations and impaired cerebral autoregulation may be key in triggering rupture during routine, low-intensity activities, particularly in the morning and evening. Given the multifactorial nature of aneurysm rupture, further clarification of the relationship between physical activity, BP dynamics, and aSAH risk may contribute to informing lifestyle recommendations for patients with conservatively managed aneurysms.

MET value	Activity Classification	Activity Examples
1	Sleeping/resting	-
2	Seated activities	Eating, drinking, watching TV, riding in vehicle
3-4	Light strain	Standing/walking, shopping
5	Moderate strain	Heavy work, gardening, sexual activity
≥ 6	Heavy strain	Sports/physical exercise, lifting heavy loads, running
N/A	Valsalva maneuver	Defecation/micturition, nose blowing
N/A	Mental strain	Unexpected emotional distress, debating

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Comaneci-Assisted Coil Embolization of Vertebrobasilar Fenestration Aneurysm: A Compromise-Free Option

Arissa Jokhio, Evan McNeil, MD, Lorenzo Tomaselli, BA, Sandeep Muram, MD, Syed Sarmad Bukhari, MBBS, FCPS, Justin H. Granstein, MD, MPH, Christopher S. Ogilvy, MD, Philipp Taussky, MD

INTRODUCTION

Posterior fossa bifurcation aneurysms are thought to be more prone to rupture due to complex hemodynamics. Their morphology, including lack of a robust parent vessel and well-delineated neck make microsurgical clipping challenging, especially in aneurysms arising from fenestrated anatomy. Current endovascular options, including stent-assisted coiling

and flow diversion, carry their own limitations, including the requirement for postprocedural dual antiplatelet therapy, risk of jailed branch occlusion, unpredictable vessel remodeling, and reduced efficacy in non-sidewall aneurysms.[1,2] The Comaneci™ device offers a temporary, flow-preserving scaffold that avoids these drawbacks and has shown high technical success in treating wide-neck intracranial aneurysms. The device provides temporary neck support without leaving a permanent implant, offering a unique advantage over permanently implanted stents.[3]

CASE PRESENTATION

We report the case of a 61-year-old female presenting with worsening headaches and two syncopal events. Cerebral angiography revealed an 8 x 6 x 7 mm vertebrobasilar aneurysm with a 4 mm neck located within a fenestration of the proximal portion of basilar artery. Given the patient's risk factors, including age, sex, smoking, hypertension, limited geographic access to healthcare, and complex aneurysm location and aneurysm size, Comaneci-assisted coil embolization was selected for treatment of the aneurysm. Flow diversion was considered but was ultimately not favored due to the aneurysm's non-sidewall location.[2] Microsurgical clipping was considered but avoided due to unacceptable risk. In this case, the integrity of the basilar artery at the fenestration was suspect; this variant of normal anatomy can be particularly structurally weak, increasing risk of intraoperative rupture, occlusion, or dissection. Stent-assisted coiling, similarly, poses risk of damaging the paper-thin fenestrated basilar artery due to unavoidable radial force of the stent.[1] Comaneci-assisted coiling was performed, supported by evidence of its safety and efficacy in such anatomies.[3]

PROCEDURE

Right-sided radial artery and femoral artery accesses were obtained to catheterize both vertebral arteries. Through radial access, the system was navigated into the right vertebral artery (VA); through femoral access, into the left VA. A microcatheter over a microwire was navigated from the right VA across the aneurysm neck, across the fenestration, and into the contralateral basilar artery duplicate. A second microcatheter over a microwire was navigated through the left VA to gain access to the aneurysm dome. The Comaneci™ 17 Embolization Assist Device was unsheathed from the microcatheter in the left basilar duplicate into the right VA to cover the aneurysm neck. Under direct fluoroscopic visualization, the Comaneci™ was dialed up to oppose the parent vessel, protecting aneurysm neck and temporarily jailing the coiling microcatheter. Through the coiling microcatheter, four Cerenovus CerepakTM freeform microcoils (4 mm x 10 cm to 7 mm x 21 cm) and two Cerenovus CerepakTM freeform xrtasoft microcoils (3 mm x 6 cm) were deployed in a serial fashion. Intermittent angiograms confirmed proper coil placement without coil herniation. Unlike in balloon-assisted coiling, there was no interruption of parent vessel flow, and the device did not need to be serially deflated. Heparin was administered intra-procedurally to reduce thromboembolic risk. Final angiograms demonstrated excellent coil compaction with no herniation into the parent vessel, eliminating the need for postprocedural antiplatelet therapy.

OUTCOME

The patient recovered uneventfully and remained neurologically intact post-intervention. She was discharged home the following day without complications. Follow-up imaging is planned.

DISCUSSION

Endovascular management has become standard of care for wide-necked bifurcation aneurysms of the posterior fossa. Stent-assisted coiling, unlike the Comaneci-assisted coiling used in this case, can provide effective parent vessel protection but may cause vessel geometry changes and unpredictable remodeling, especially in fenestrated anatomy.[1] Flow diversion for bifurcation aneurysms has lower occlusion rates and higher complication risks.[2] The Comaneci™ device preserves branch patency, avoids permanent implants, and allows precise coil placement without deforming the parent artery, in a flow-preserving manner superior to balloon assisted coiling.[3] This case demonstrates the device's utility in managing complex fenestration aneurysms where other modalities may be less suitable.

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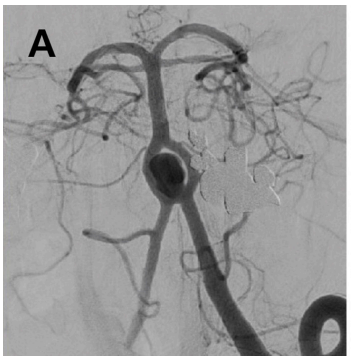


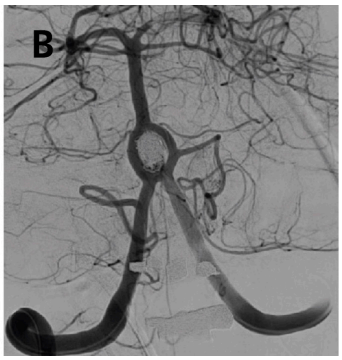
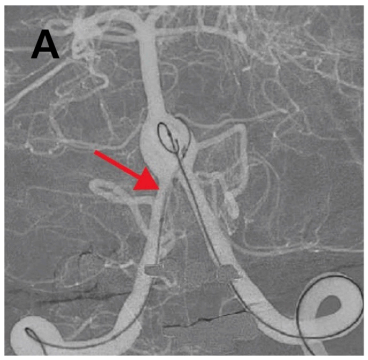


Figure 1. (A) Diagnostic cerebral angiogram in a 61-year-old female demonstrating a vertebrobasilar aneurysm arising from a fenestrated proximal basilar artery. The aneurysm measured 8 × 6 × 7 mm with a 4 mm neck. (B) Final angiogram following Comaneci-assisted coil embolization, demonstrating complete occlusion of the aneurysm with preservation of flow through the duplicated basilar artery.



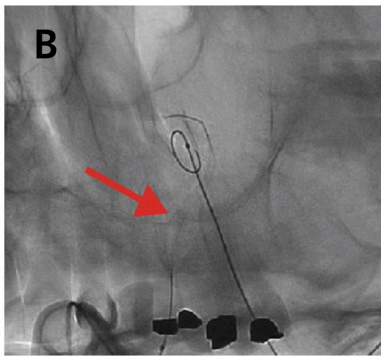


Figure 2. (A) Angiogram showing positioning of the two microcatheters, one in the aneurysm dome for coil delivery (from the left vertebral artery), and one from the right vertebral artery to the left duplicated basilar artery just prior to Comaneci™ 17 deployment. (B) Fluoroscopic image demonstrating the Comaneci™ 17 Embolization Assist Device deployed across the aneurysm neck to protect the parent vessel in preparation for coil placement.

Beth Israel Lahey Health
Beth Israel Deaconess Medical Center

Brain Aneurysm Institute
110 Francis Street, Suite 3B
Boston, MA 02215
bidmc.org/brainaneurysm

AWARDS & ACKNOWLEDGEMENTS

A special congratulations to Christoper S. Ogilvy, MD for receiving the New England Neurosurgical 2025 Lifetime Achievement Award on June 27, 2025. The award recognizes a career dedicated to advancing neurosurgery. Christopher Ogilvy, M.D. is the Director, Endovascular and Operative Neurovascular Surgery BIDMC Brain Aneurysm Institute and Professor of Neurosurgery, Harvard Medical School.

The BIDMC Brain Aneurysm Institute is proud to recognize the following awardees, all part of our collaborative group of clinicians and researchers, for their achievements and contributions over the past year.

On March 12, 2024. Honorable Mention Award, Harvard Medical School - Jean Filo "Conservative Medical Therapy is a Safe and Effective Line Treatment for External Carotid and Vertebral Pseudoaneurysms"

On June 30, 2024. New England Neurosurgical Society Meeting 2024, Scoville Award - Alejandro Enriquez Marulanda. "Defining light transmission aggregometry cutoff values for clopidogrel and aspirin resistance in flow diversion treatment of intracranial aneurysms"

On September 12, 2024 - Farhad R. Nazami. "Driven Comparison Hemodynamic Analysis and Safety Prediction for Intracranial Aneurysm Flow Diversion"

On October 1, 2024. CNS Annual Meeting, Duke Sampson Award - Felipe Ramirez Velandia. "The Dynamic Adaptability of the Circle of Willis in Response to Major Branch Artery Coverage with a Flow Diverter"

On July 1, 2025. Journal Cover - Felipe Ramirez Velandia. "Sequential Hemodynamic Analysis of Ruptured Posterior Communicating Artery Aneurysms Treated with Coil Embolization and Delayed Flow Diversion"

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