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Single-Stage Clipping of Triple Intracranial Aneurysms in the Anterior Circulation Through Unilateral Pterional Approach in a 42-Year-Old Female: A Case Report

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Multiple intracranial aneurysms are not uncommon in patients with cerebral aneurysms, however, studies relating to its natural history, symptomatology and management have not been extensively explored especially in the local setting. The case presented is that of a 42-year-old hypertensive female with a three-day history of sudden severe throbbing headache. The patient had three intracranial saccular aneurysms, two on the middle cerebral artery and one on the anterior cerebral artery. The three intracranial aneurysms were clipped through a right pterional approach in one operative procedure. The surgical and postoperative courses were unremarkable. The patient recovered well with no neurologic deficits and was subsequently discharged after three weeks. Single-stage clipping can be performed in the presence of multiple intracranial aneurysms.

Key words: Hypertensive, multiple intracranial aneurysms, pterional approach, clipping, case report

Multiple intracranial aneurysms are found in approximately 15 to 35% of all aneurysm patients, and are relatively uncommon especially in the absence of predisposing conditions.[1,2] In the Philippines, there are currently no readily available published data on the natural history and simultaneous clipping of multiple intracranial ruptured aneurysms using a single-stage setup. The risk for subarachnoid hemorrhage with these aneurysms is at least 2% per year. They have a greater propensity for rupture than the solitary aneurysm.[1]

Intracranial aneurysms are basically abnormal outpouchings or localized dilations of cerebral arteries. Research using radiographic imaging and postmortem examinations found that around 3.2% of the general population have intracranial saccular aneurysms.[3]

Single and multiple intracranial aneurysms may have similar risk factors. Hypertension, cigarette smoking and connective tissue diseases likely contribute to the development of aneurysms. However, these are only secondary causes that trigger the aneurysm formation process.[3]

The treatment of patients with multiple intracranial aneurysms may involve simultaneous or staged surgical clipping, endovascular coiling, or a combination of both surgical clipping and endovascular coiling.[2]

In this report, the author presents a case of a 42-year-old female with multiple intracranial aneurysms treated successfully with surgical clipping in a single-stage procedure. This study helps incorporate insights from multiple specialties, encouraging collaboration and broadening understanding across fields. It also illustrates the nuances of patient-specific management, which can promote more tailored approaches to care. Lastly, it may reveal new insights into disease processes, mechanisms, or therapeutic responses.

The Case

This is a case of a 42-year-old hypertensive female admitted to the hospital with a three-day history of sudden severe throbbing headache (VAS: 10/10). The patient had been experiencing nausea and vomiting, and had a sudden decrease in sensorium. At the private medical institution where she was taken, she had a Glasgow Coma Score (GCS) of 8. She was subsequently intubated. A non-contrast CT scan showed an acute intraparenchymal

bleed in the right temporal region measuring 4.9 cm x 3.6 cm x 3.9 cm with an estimated volume of 34.40 cm^3 with subarachnoid hemorrhage (Figure 1).

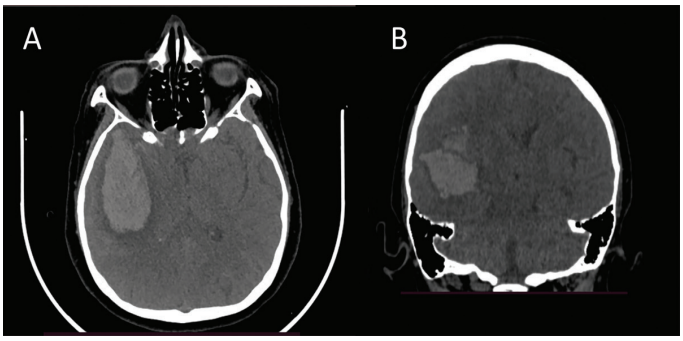

Figure 1. Preoperative cranial CT scan showing the acute parenchymal hemorrhage in the right temporal lobe with acute subarachnoid hemorrhage; (A) axial view at the level of the orbits, and (B) coronal view.

The patient was managed medically, her condition clinically improved and she was transferred to this institution 24 hours post ictus. At the Emergency Department, the patient had a GCS of 15. Her physical examination revealed a blood pressure of 140/90 mm Hg, a heart rate of 92, pupils were 3.0 mm, reactive to light. There was nuchal rigidity but Kernig's sign was absent. She demonstrated muscle strength of 5 over all limbs, there was no Babinski reflex elicited. She had a Hunt and Hess Grade 2, World Federation of Neurosurgical Surgeons score of 1, and Modified Fisher Scale of 3. The patient was a known hypertensive with maintenance oral anti-hypertensive medications.

A Cranial Computed Tomography Angiography (CTA) revealed three saccular aneurysms in the anterior circulation of the circle of Willis. Of these aneurysms, two were located at the right middle cerebral artery and one at the right anterior cerebral artery (Figure 2A). The saccular aneurysm on the proximal A1 segment of the right anterior cerebral artery had a 3 mm neck and 3.9 mm high dome. Of the Middle Cerebral Artery (MCA) aneurysms, one was on the M1 segment and had a 2.6 mm neck and 2.2 mm high dome. The second aneurysm was on the M2 segment and had a 2.0 mm neck and 1.6 mm high dome with a visible secondary sacculation (Figures 2B, 3).

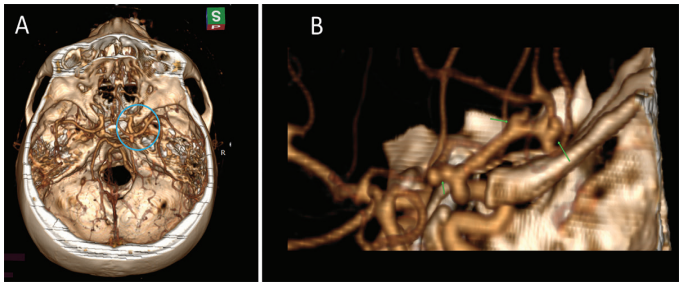

Figure 2. A 3D reconstructed cranial CTA. (A) Axial view, the location of the 3 aneurysms indicated by the circle. (B) Right oblique view, green arrows showing the aneurysms at A1, M1 and M2, respectively.

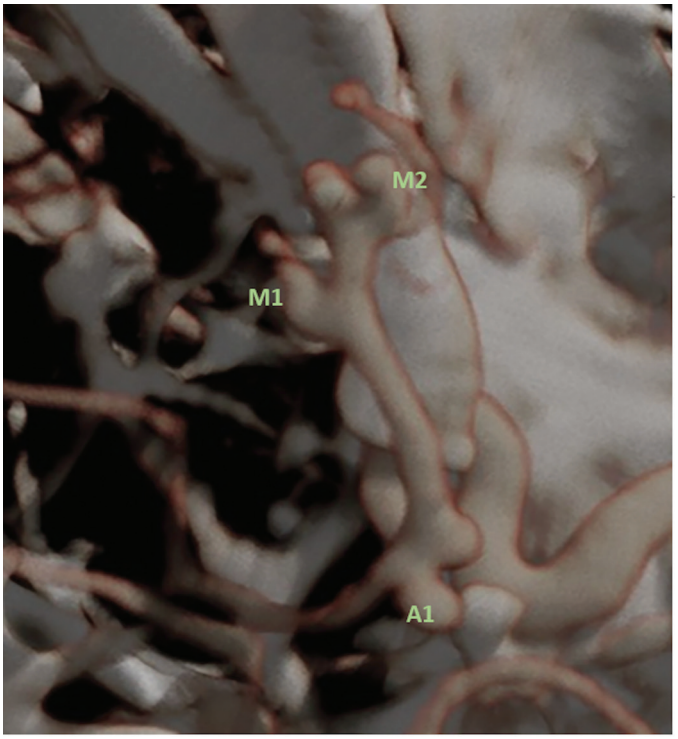

Figure 3. Three-dimensional reconstructed CTA magnified axial view showing the three aneurysms at the A1, M1 and M2 segments.

Since the temporal profile and CTA exhibited straightforward indications of vascular lesion, the team immediately prepared and planned for the appropriate treatment on the patient.

The team decided to clip the aneurysms through a right pterional craniotomy. The cardio-pulmonary risk was evaluated, packed red blood cells were requested, and the necessary surgical materials were secured, the patient underwent emergent surgery.

The patient was positioned supine under general anesthesia with the head, secured using three-point fixation, rotated 15°–30° away from the side of aneurysms. A curvilinear skin incision was made 1 cm anterior to the tragus and around 1.5 cm inferior to the zygoma, followed by soft tissue and submuscular dissection. The temporalis muscle was reflected anteriorly and inferiorly, with towel clips anchoring it in place. Four burr holes were performed and connected using a craniotome. The bone flap was lifted and detached from the underlying dura. The temporal bone and sphenoid wing were further trimmed to increase exposure. The dura was opened in stellate fashion. The dural flaps were pulled against pterion and transfixed with stitches. The sylvian fissure was split carefully using micro scissors, careful to avoid injury to the superficial sylvian veins.

After temporarily reflecting the superficial veins to the side and opening the superficial sylvian cistern, the deep sylvian veins emerged overlying the M1 segment. Distal-to-proximal dissection proceeded sequentially and inside-out dissection began to reach deep arterial trunks.

Initial dissection began at the neck of the right M1 aneurysm. The dome was seen to be embedded against the medial right temporal lobe. After completion arachnoid dissection surrounding the M1 aneurysm neck, a straight 5-mm mini clip (Rebstock™; Tuttlingen Germany) was placed (Figure 4). Following dissection of the whole caliber of the right proximal M1, the M2 segment aneurysm neck was exposed and successfully clipped using a straight 4-mm mini clip (Rebstock™; Tuttlingen Germany) (Figure 5). Premature rupture of the A1 segment aneurysm had been encountered upon dissection of the neck and mobilization of the medial frontal gyrus. The bleeding was controlled with the application of a temporary aneurysm clip at the proximal A1 segment and the use of oxidized regenerated cellulose fabric (Surgicel™, Ethicon, USA) and cottonoid patties. Eventual permanent clipping of the aneurysm neck was done using 90°-angled, non-fenestrated mini clip with a diameter of 5 mm (Rebstock™, Tuttlingen Germany) (Figure 6). There was no premature rupture of the right M1 and M2 aneurysms. The aneurysms were successfully clipped in one sitting and the rest of the intraoperative course was unremarkable.

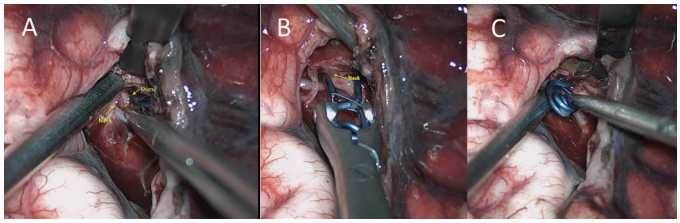

Figure 4. Operating microscope view of the clipping of the M1 segment aneurysm. (A) Exposure of the neck and dome of the M1 segment aneurysm and (B, C) successful application of the clip at the aneurysm neck.

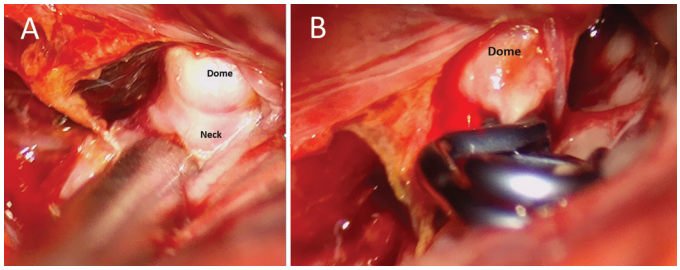

Figure 5. Operating microscope view of the clipping of the M2 segment aneurysm. (A) Exposure of the neck and proximal dome of the aneurysm and (B) successful clipping of the aneurysm neck.

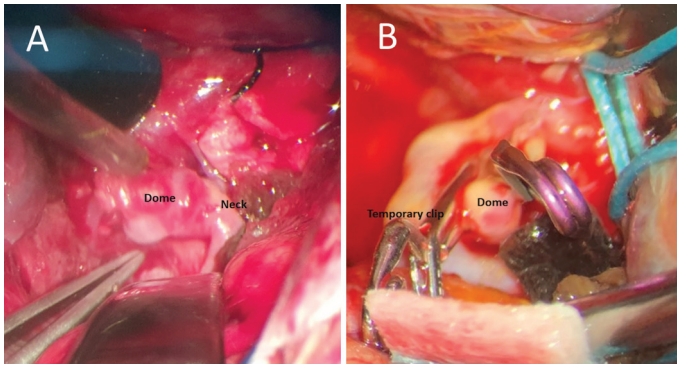

Figure 6. Operating microscope view of the clipping of A1 segment aneurysm. (A) Exposure of the neck of the aneurysm as well as the proximal dome. (B) Successful clipping of the aneurysm neck with a temporary clip applied to aid in neck dissection and aneurysm mobilization.

Overall, three different permanent clips were used. The patient was maintained clinically euvolemic and treated with permissive hypertension after the operation. She was admitted to the surgical intensive care unit for her recovery.

During her first postoperative day, the patient was awake and coherent. She could follow commands. General liquids progressed to a soft diet as well. The patient gradually recovered over the next seven days. By then, she could already tolerate a regular diet. She presented with no neurologic deficits. Metabolic workup was unremarkable. Her vital signs were stable.

A follow-up cranial CTA was done on the 13th day post operation. The CTA results showed an interval regression in the size of the temporal intracerebral hemorrhage and a complete obliteration of all three aneurysms (Figure 7). There were no residual aneurysms found.

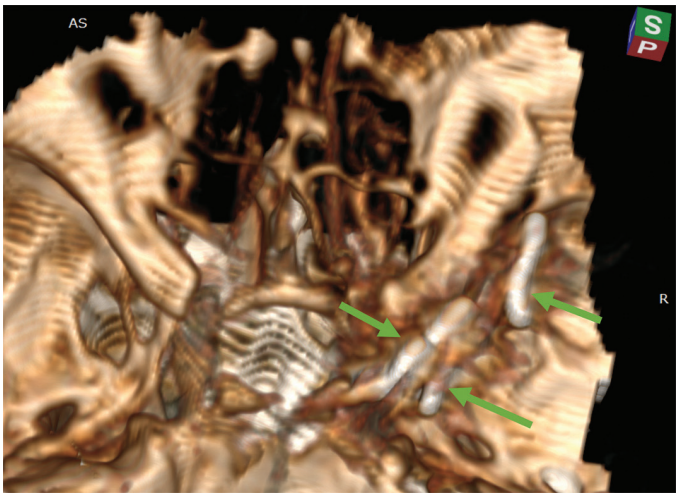

Figure 7. Postoperative cranial CT angiogram. Axial 3D reconstructed view showing the three aneurysms, A1, M1, and M2 clipped successfully (green arrows).

After 24 days of hospitalization, she was discharged without any neurologic sequelae. She had her follow-up consultation one week after hospital discharge.

During her follow-up consultation in the outpatient clinic, the patient had no subjective complaints. There were no new neurologic deficits encountered, and the postoperative wound was healing well with no signs of infection. Proper wound care advised, and she was counselled to continue her maintenance medications.

Discussion

Managing patients with multiple intracranial aneurysms presents unique, case-specific challenges. Treatment is often complex and carries an increased risk of complications related to both aneurysm rupture and treatment compared to cases involving a single aneurysm.[4] A multidisciplinary approach, including collaboration with an endovascular neurosurgeon, may be beneficial for optimal clinical management.

In this case report, the author presented the successful management of multiple intracranial aneurysms in a 42-year-old hypertensive female. As mentioned, the three aneurysms located in anterior circulation were successfully clipped in a single-stage procedure.

Intracranial aneurysms typically occur at the branching points where the primary arteries traverse the subarachnoid space at the base of the brain. They are often asymptomatic until the time of rupture. Subarachnoid hemorrhage resulting from the rupture of an intracranial aneurysm is a severe occurrence linked with significant rates of illness and death.[1]

A combination of clinical and radiological characteristics can identify the ruptured aneurysm with high reliability, achieving a 97.5% accuracy rate in patients. Key indicators to predict the source of bleeding include: (1) ruling out extradural aneurysms; (2) identifying localized subarachnoid hemorrhage; (3) detecting focal vasospasm or mass effects on angiography; (4) noting larger or irregularly shaped aneurysms; (5) evaluating focal neurological symptoms; (6) determining the aneurysm with the highest likelihood of rupture, such as an anterior communicating artery aneurysm; and (7) considering follow-up angiography to detect any new signs or changes in an aneurysm over time.[5]

In this case, the location and pattern of the intraparenchymal and the subarachnoid hemorrhages were consistent with a rupture of MCA aneurysms at M1 and M2 segments. These two MCA segments demonstrated irregular morphology on the CTA, and visible ruptures were confirmed during the operation.

Selecting the optimal treatment method for cases involving multiple intracranial aneurysms is essential. A 2015 case report described a multidisciplinary approach in managing a patient with seven intracranial aneurysms. The initial treatment involved endovascular stent-assisted coiling of two posteriorly located aneurysms, followed two months later by microsurgical clipping of the

remaining five anteriorly located aneurysms. This case demonstrated that a staged multidisciplinary approach, combining coiling and clipping, can be an effective option for complex cases like this.[6]

In a study by Chung, et al.,[7] both open surgery and endovascular procedures were found to be viable treatment options. A subset of patients was treated using a combined approach, though newer techniques, such as balloon- and stent-assisted coiling, were shown to be more effective and safer than microsurgical clipping alone.

In this case study, although endovascular coiling could be an option considering it to be safe and effective treatment with low morbidity and mortality,[8] the primary surgeon selected microsurgical clipping as the treatment method because the three aneurysms were located near the anterior circulation on the same side and were close to one another, with cost-effectiveness also favoring this approach. Given the risk of re-rupture, the surgeon opted to clip the unruptured aneurysm on the A1 segment due to its accessibility and angioarchitecture, which was favorable for clipping. This configuration increased the likelihood of achieving successful single-stage clipping.

Conclusion

Numerous reports discuss patients with multiple intracranial aneurysms, highlighting the importance of treatment decisions regarding which aneurysms have ruptured, which require intervention, and the best treatment modality to use. Treatment options include endovascular coiling and surgical clipping, with clipping often preferred for aneurysms at high risk of rupture. Developing tailored treatment plans is essential to improve outcomes in these high-risk cases, taking into account factors such as aneurysm characteristics and patient health. In this case study, surgical clipping was chosen as the definitive treatment due to the location and angioarchitecture of the aneurysms.

Consent

The informed consent for this case report was obtained directly from the patient by the author and was signed by both the patient and a witness.

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References

1. Winn HR, Britz GW, Schaller K. The natural history of cerebral aneurysms. In: Winn R, ed. Youmans and Winn Neurological Surgery, 8th ed. Philadelphia: Elsevier, 2023;3401-19.
2. Xu K, Huo K, Xu B, Guo Y, Yu J. Single-stage clipping of seven intracranial aneurysms in the anterior circulation via unilateral pterional approach: A case report and literature review. J Neurol Surg A Cent Eur Neurosurg 2020, 81(3):271–8. doi. org/10.1055/s-0039-1698381
3. Vlak MH, Algra A, Brandenburg R, Rinkel GJ. Prevalence of unruptured intracranial aneurysms, with emphasis on sex, age, comorbidity, country, and time period: a systematic review and meta-analysis. Lancet Neurol 2011 Jul;10(7):626-36. doi: 10.1016/S1474-4422(11)70109-0
4. Dong QL, Gao BL, Cheng ZR, He YY, Zhang XJ, Fan QY, Li CH, Yang ST, Xiang C. Comparison of surgical and endovascular approaches in the management of multiple intracranial aneurysms. Int J Surg 2016 Aug; 32:129-35. doi: 10.1016/j.ijsu.2016.07.004
5. Nehls DG, Flom RA, Carter LP, Spetzler RF. Multiple intracranial aneurysms: determining the site of rupture. J Neurosurg 1985 Sep;63(3):342-8. doi: 10.3171/jns.1985.63.3.0342
6. Ahmed O, Kalakoti P, Hefner M, Cuellar H, Guthikonda B. Seven intracranial aneurysms in one patient: Treatment and review of literature. J Cerebr Endovasc Neurosurg 2015 Jun;17(2):113-9. doi: 10.7461/jcen.2015.17.2.113
7. Chung J, Shin YS. Multiple intracranial aneurysms treated by multiple treatment modalities. Neurosurgery 2011 Oct;69(4): E1030-2. doi: 10.1227/NEU.0b013e31822a5280
8. Jeon P, Kim BM, Kim DJ, Kim DI, Suh SH. Treatment of multiple intracranial aneurysms with 1-stage coiling. Am J Neuroradiol 2014 Jun;35(6):1170-3. doi: 10.3174/ajnr. A3821