COMPLEX MULTIPLE RUPTURED ANEURYSMS TREATED WITH EMBOLIZATION IN A SINGLE SESSION: CASE REPORT

Aneurismas rotos múltiples complejos tratados con embolización en una sesión única: reporte de caso

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ABSTRACT

Introduction: Multiple aneurysms are responsible for 15 to 35% of spontaneous subarachnoid hemorrhages, some of them being complex aneurysms. These are characterized by their large size, difficult location, wide neck, weak wall structure, giving rise to branches from the aneurysm, presenting calcifications, or due to ineffective previous treatment. Its management is difficult due to the variation in the anatomical distribution and the difficulty of determining which aneurysm is the ruptured one. The complex aneurysm needs special techniques for its management. Embolization has an acceptable complication rate compared to clipping, with the additional benefit of being a minimally invasive technique with a short hospital stay.
Clinical case: A 50-year-old female patient who presented headache, nausea, vomiting, and sensory disorder, being diagnosed with subarachnoid hemorrhage due to a ruptured aneurysm of the bifurcation of the right internal carotid artery. In addition, 3 other aneurysms were found (left carotid bifurcation, top of the basilar, and communicating segment of the left carotid). We proceeded to embolize the two aneurysms of the carotid bifurcation with coils using the remodeling technique, as well as the one at the top of the basilar with coils assisted with a double "Y" stent. The clinical evolution was good, and the patient was discharged without neurological sequelae.
Conclusion: The embolization of multiple aneurysms in a single session is an effective and safe technique. If the aneurysms are complex, the use of "remodeling" techniques or stent assistance is required to achieve a successful outcome.

Keywords: *Aneurysm, Ruptured, Subarachnoid Hemorrhage, Embolization, Therapeutic, Stents. (Source: MeSH NLM)*

RESUMEN

Introducción: Los aneurismas múltiples son causantes del 15 al 35% de las hemorragias subaracnoideas espontáneas, siendo algunos de ellos, aneurismas complejos. Estos se caracterizan por su tamaño grande, localización difícil, cuello ancho, estructura débil de la pared, dar origen a ramas desde el aneurisma, presentar calcificaciones o por tratamiento previo no efectivo. Su manejo es difícil debido a la variación en la distribución anatómica y la dificultad de determinar que aneurisma es el roto. El aneurisma complejo necesita de técnicas especiales para su manejo. La embolización tiene una tasa aceptable de complicaciones comparado con el clipaje, con el beneficio adicional de ser una técnica mínimamente invasiva y de estancia hospitalaria corta.
Caso Clínico: Paciente mujer de 50 años que presentó cefalea, náuseas, vómitos y trastorno de sensorio, siendo diagnosticada de hemorragia subaracnoidea por aneurisma roto de la bifurcación de la arteria carótida interna derecha. Se encontró, además, otros 3 aneurismas (bifurcación carotídea izquierda, top de la basilar y segmento comunicante de carótida izquierda). Se procedió a embolizar los dos aneurismas de la bifurcación carotídea con coils con la técnica de remodeling, y también el del top de la basilar con coils asistida con doble stent "Y". La evolución clínica fue buena y la paciente salió de alta sin secuela neurológica.
Conclusión: La embolización de aneurismas múltiples en una sola sesión es una técnica eficaz y segura. Si los aneurismas son complejos, se requiere del uso de técnicas de "remodeling" o asistencia con stent para lograr un resultado exitoso.

Palabras Clave*: Aneurisma Roto, Hemorragia Subaracnoidea, Embolización Terapéutica, Stents. (Fuente: DeCS Bireme)*

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The detection rate for multiple aneurysms has increased due to recent advances in imaging techniques. From 15% to 35% of patients with subarachnoid hemorrhage present multiple intracranial aneurysms.[1] The presence of multiple aneurysms represents a high risk because it is associated with higher morbidity and mortality compared to patients with single aneurysms.[2] The etiology of multiple intracranial aneurysms is little known and studies indicate that congenital causes and acquired degeneration of the arterial wall as the main causes.[3] Its treatment is difficult due to the variety of its anatomical location and the difficulty to determine the ruptured aneurysm. [1]

Complex aneurysms are a heterogeneous group of cerebral vascular malformations, characterized by their large size, difficult location, wide neck, giving rise to branches from the aneurysm, weak structure of its wall, presence of calcifications, intraluminal thrombus, or by previous treatment no cash. Due to this complexity, the neurosurgeon must use more complex endovascular treatment techniques to decrease the rate of recanalization. [5]

We present the case of a patient with multiple and complex aneurysms of the anterior and posterior circulation who was successfully treated in our Hospital, using advanced endovascular techniques.

CLNICAL CASE

History and examination: A 50-year-old female patient with a history of right peripheral facial paralysis was transferred from another hospital due to severe headache, blurred vision, and sensory disorder. A cerebral tomography (CT) showed a pancisternal subarachnoid hemorrhage predominantly in the left Silvio valley, with ventricular breakthrough and level hydrocephalus (*Figure 1*).

A CT angiography (AngioCT) showed the presence of multiple aneurysms in the bilateral carotid bifurcation and top of the basilar. On physical examination: Patient awake, oriented, Glasgow scale: 15, without motor or sensory deficits, neck stiffness + / +++, isochoric and photoreactive pupils, sequelae of right cranial nerve VII, central vertigo level.

A cerebral Panangiography showed a 4.77 x 3.47mm right carotid bifurcation aneurysm with a 3.19mm neck, dysplastic, and a pseudoaneurysm that originated at the base of the large aneurysm and was directed posterolaterally. A second aneurysm in the left carotid bifurcation measuring 5.32 x 5.16mm with a neck of 3.06mm, saccular, without deformation in the wall of it. A third aneurysm of the top of the bilobed basilar artery measuring 6.6 x 6.01mm with a neck of 6.15mm, dysplastic. Finally, a fourth aneurysm in the communicating segment of the left internal carotid artery close to the origin of the anterior choroid artery measuring 1.71 x 1.56mm with a neck of 1.84mm (*Figure 2*).

Endovascular treatment: First, the left internal carotid artery (ICA) aneurysm was embolized, for this, a Headway 17 ® microcatheter assisted with Traxcess 14 ® microguide was used to reach the dome of the aneurysm, and then using In the remodeling technique by using a 5 x 30mm Transform C ® balloon, the aneurysm was embolized with 2 coils (first an Axium Prime ® 4mmx8cm and a Microplex 10 ® 1.5mmx4cm) achieving adequate compaction (Raymond Roy IIIA), without showing protrusion of coils towards the parental vessel after removal of the balloon (*Figure 3: A and B*).

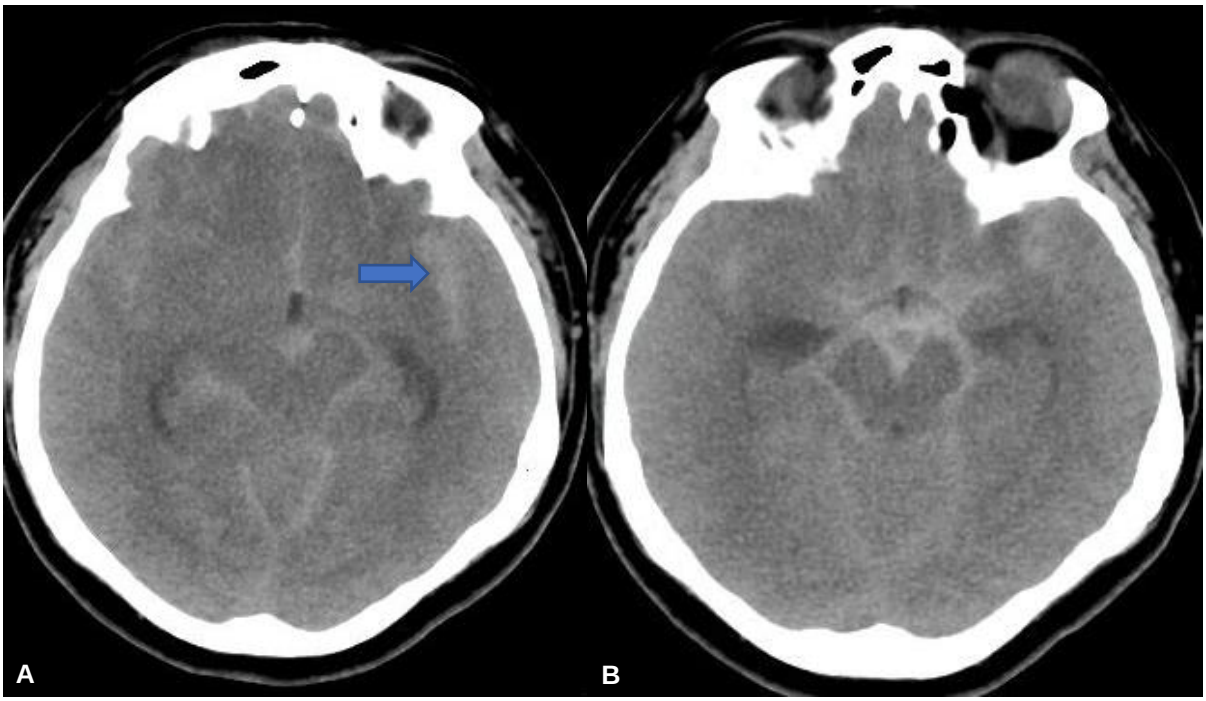

Fig 1. (A) Brain CT without contrast in axial section, showing diffuse subarachnoid hemorrhage predominantly in the left Silvio valley (arrow). **(B)** Brain CT without contrast in axial section, showing diffuse subarachnoid hemorrhage in basal cisterns.

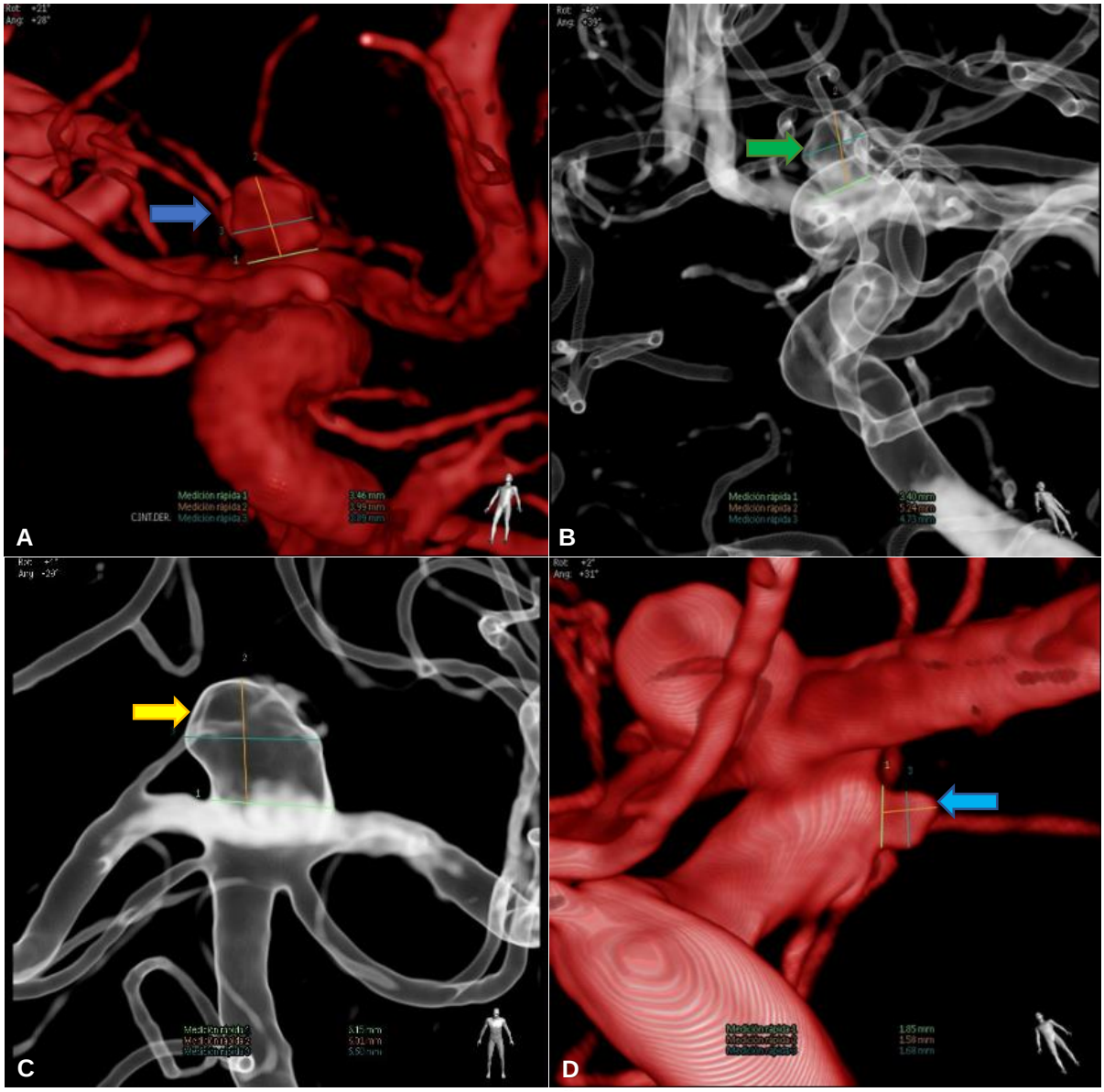

Fig 2. (A) 3D digital angiography of the right internal carotid artery (ICA), showing a dysplastic aneurysm of the carotid bifurcation with indirect signs of rupture (blue arrow). (B) 3D digital angiography of the left ICA, showing a bifurcation aneurysm, without deformation of its wall (green arrow). (C) 3D digital angiography of the basilar artery, showing a bilobed dysplastic aneurysm of the top of the basilar artery (yellow arrow). (D) 3D digital angiography of the left internal carotid artery, showing a small aneurysm of the communicating segment, close to the origin of the left anterior choroidal artery (light blue arrow).

This was followed by embolization of the aneurysm of the upper part of the basilar artery, in which the assisted coiling technique with a double "Y" stent was used; for which 360mg of Ticagrelor and 4000IU of Heparin Sodium were previously administered intravenously. First, using a microcatheter (Headway 17 ®) assisted with a microguide (Transend 10 ®), the left vertebral artery was navigated until reaching the left P2 segment, to give stability to the stent (LVIS JR ® 3.5x18mm) which was finally left from left P1 to the middle third of the basilar artery. Next, another stent (LEO BABY ® 3x18mm) was placed from right P1 to the middle third of the basilar artery. Then, the microcatheter was placed in the dome of the aneurysm and it was embolized with 3 coils (first an Axium Prime ® 9mmx20cm, followed by an Axium Prime ® 7mmx30cm and finally an Axium Prime ® 4mmx12cm) achieving adequate compaction of the coils (Raymond Roy II) (*Figure 3: C and D*).

Finally, the right internal carotid artery (ICA) aneurysm was embolized, for which a Headway 17 ® microcatheter assisted with Hybrid 1214D ® microguide was used, navigating to the dome of the aneurysm, and using the remodeling technique (with the same balloon used previously), a coil was placed (Axium Prime ® 4mm x 10cm) achieving adequate coil compaction (Raymond Roy IIIA) without coil protrusion when removing the balloon (*Figure 3: E and F*).

Clinical evolution: In the postoperative period the patient did not present neurological deficit. He had a persistent headache, vertigo, and nausea that were treated with some

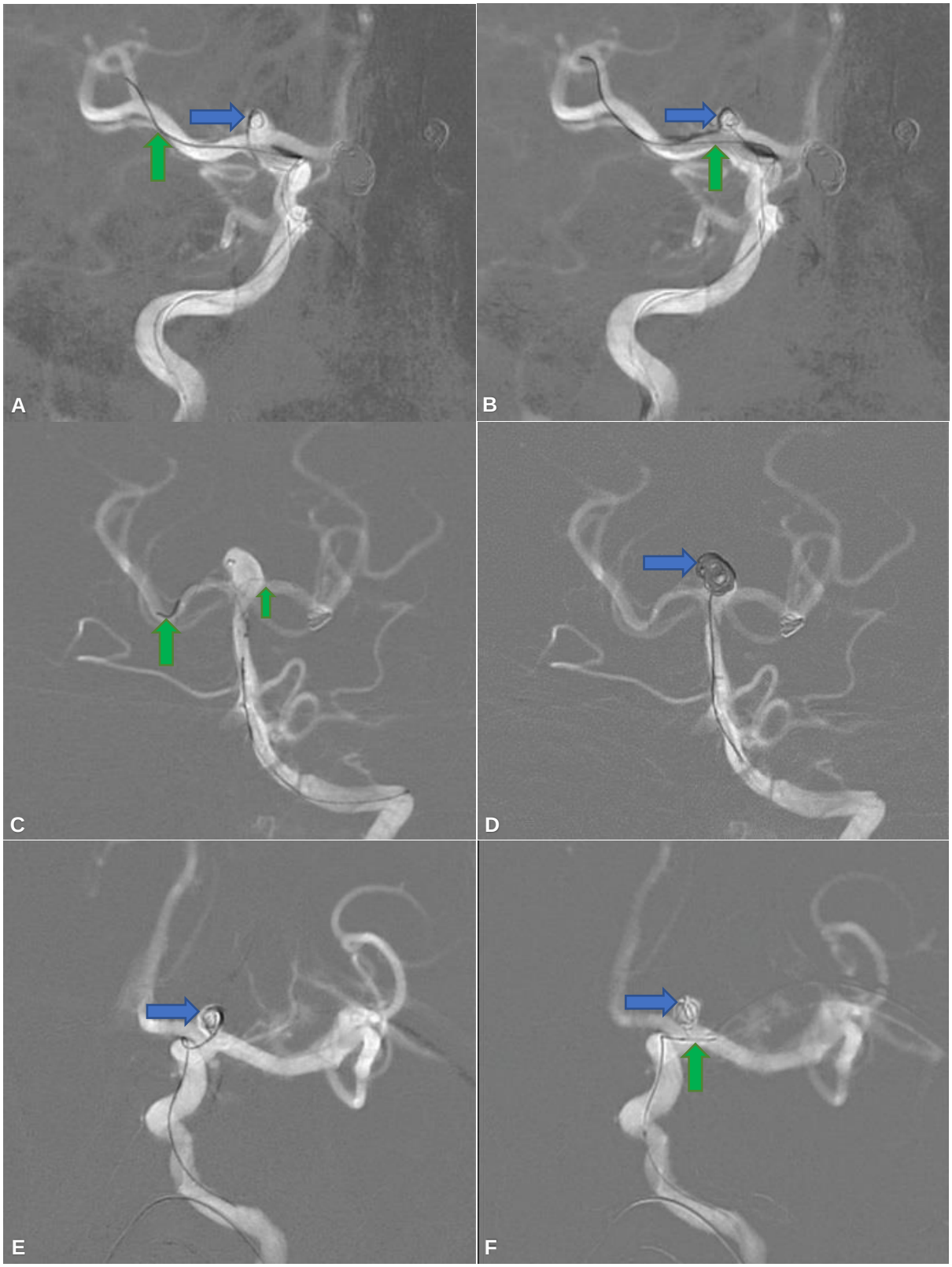

Fig 3. (A) Roadmap of the left internal carotid artery (ICA), where embolization of the bifurcation aneurysm is evidenced. The non-inflated balloon catheter can be seen that reaches M1 post-bifurcation in its upper branch (green arrow), as well as initial coiling within the aneurysm (blue arrow). **(B)** Roadmap of left ICA, showing final embolization of the bifurcation aneurysm (blue arrow) and the balloon catheter inflated at the base of the aneurysm (green arrow). **(C)** Roadmap of the basilar artery, in which the 2nd stent is detaching towards the right P1 segment (green arrow). Note the left stent already in place (small green arrow). **(D)** Basilar artery roadmap, which shows embolization in its final phase with coils inside the aneurysm of the top of the basilar (blue arrow). **(E)** Right internal carotid artery (ICA) roadmap, showing the insertion of the coil to embolize the bifurcation aneurysm (blue arrow). **(F)** Right ICA roadmap, where an uninflated balloon catheter is evidenced at the base of the aneurysm (green arrow) compacting the coil used inside the bifurcation aneurysm (blue arrow)

symptomatic medication up to the 5th postoperative day. A brain CT without contrast showed no hemorrhage, infarction, hydrocephalus, or other complications (*Figure 4*). The patient was discharged on the 6th postoperative day with good clinical evolution, with a Modified Rankin scale of 1 point and with a control AngioCT (*Figure 5*). The patient returned to her normal daily activities.

DISCUSION

The management of patients with multiple aneurysms is complex, due to the variation in the anatomical distribution and the difficulty in determining which aneurysm is ruptured.[1] The fatal outcome due to bleeding from an untreated aneurysm is reduced when treating all aneurysms, since it will be easier to treat vasospasm with hypertensive therapy by reducing the risk of the rest of the aneurysms rupturing. [3]

The microsurgical approach in a single session would involve making several incisions, both in the case of bilateral aneurysms and in the case of a combination of anterior and posterior circulation aneurysms. Given this, the endovascular alternative is a better, more effective, and safer option as it is a minimal invasive route.[1]

Dong et al found that embolization has an acceptable rate of complications compared to clipping, but if the minimally invasive effect and short hospital stay are added to this, endovascular management is better than clipping in the management of multiple aneurysms. [3]

In the medical literature, there are only 2 small studies, case series, where multiple aneurysms are coiled in a single session, one of them being by Solander et al. who, in a study of 38 patients with 93 aneurysms, reported no permanent morbidity related to the treatment. Also, Xavier et al. treated 6 patients with 13 aneurysms, in a single session, and found no complications related to the procedure. [4]

On the other hand, Jeon et al. mention that clipping multiple aneurysms in a single session resulted in a poor outcome compared to just treating one aneurysm. This is due to excessive manipulation of the cerebral arteries and brain tissue. Furthermore, it is always difficult to determine which aneurysm is the ruptured one in a patient with multiple aneurysms, and it is necessary to treat all of them to manage postoperative complications such as hypertensive therapy. [4]

Dong et al. refer that there are always difficulties in deciding which aneurysm to treat, in addition to whether it will be in 1 session or in 2 sessions. Because treating all aneurysms simultaneously during the acute rupture phase would require more time and could involve greater complications. However, treatment of the ruptured aneurysm is indispensable when aggressive treatment for vasospasm is needed. Therefore, one of the options is to treat the ruptured aneurysm in the first session, and the unruptured aneurysms in the second session. There is the possibility of treating all aneurysms in a single session if the time used in treating the ruptured aneurysm is not too long. [3]

In the present case, it was a patient who had a short surgical time, and in which complex endovascular techniques were used, such as remodeling and the double "Y" stent, all of which was part of meticulous endovascular planning from the beginning.

This planning avoided improvisation during the surgical procedure, so the operative time was reduced, which translated into good clinical-radiological results.

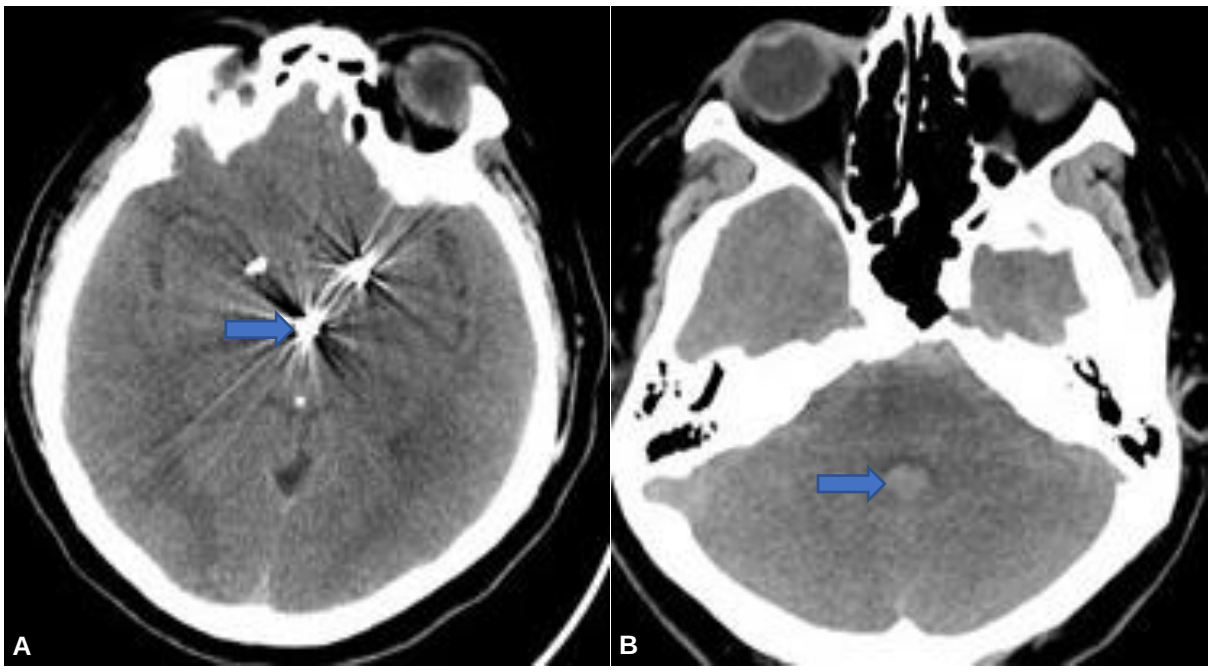

Fig 4. (A) Brain CT without contrast in axial section in the immediate postoperative period at the level of the polygon of Willis, where reabsorption of the subarachnoid hemorrhage is evidenced, without acute complications, with refringence of the coils (blue arrow). **(B)** Non-contrast cerebral CT in axial section at the level of the IV ventricle, where intraventricular hemorrhage is still observed in resorption (blue arrow).

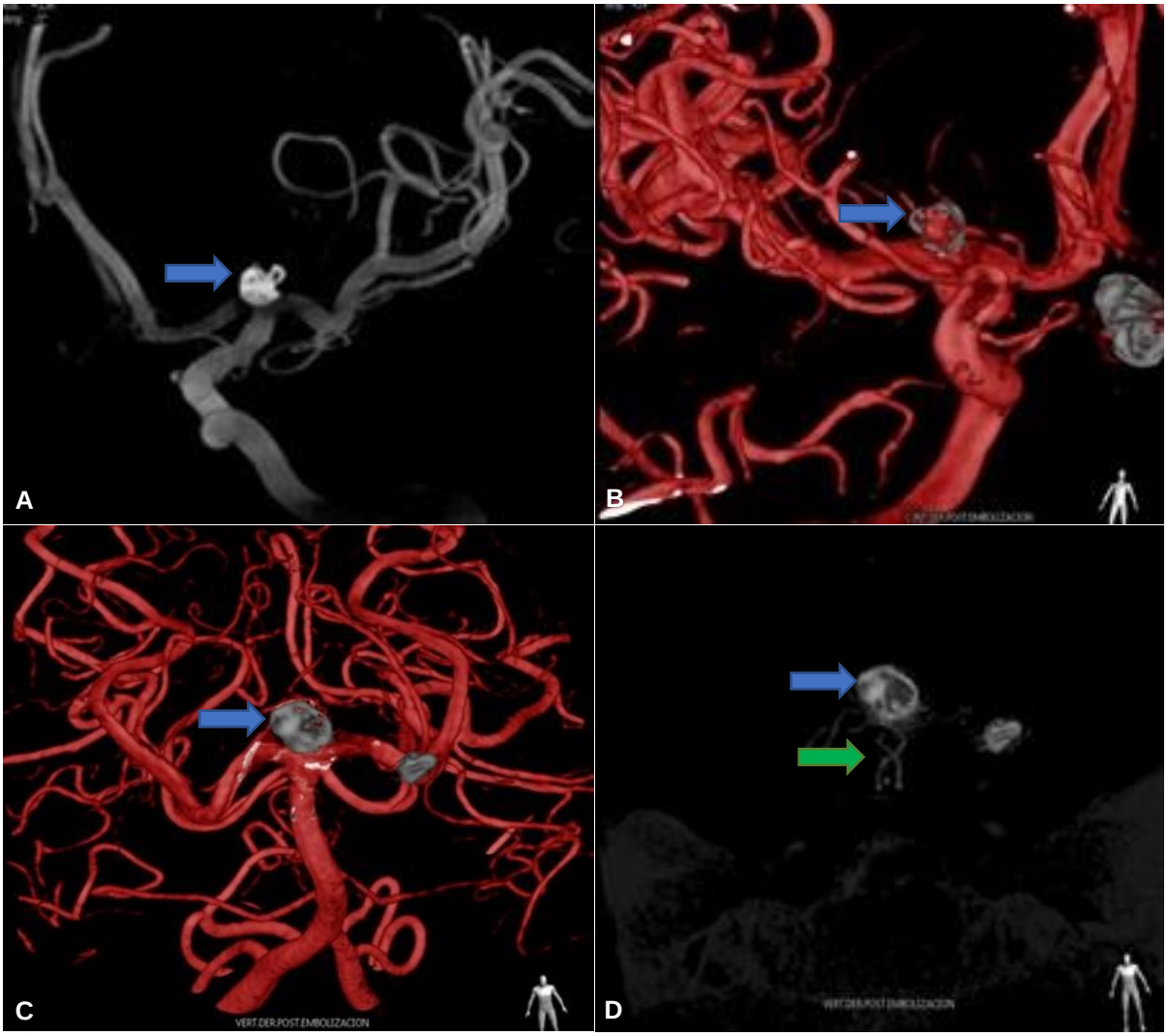

Fig 5. (A) 3D digital angiography of the left internal carotid artery, showing coils (blue arrow) with adequate compaction in the carotid bifurcation aneurysm, without a residual neck. **(B)** 3D digital angiography of the right internal carotid artery, showing adequate compaction of the coils of an embolized bifurcation aneurysm (blue arrow), without a residual neck. **(C)** 3D digital angiography of the basilar artery, showing adequate compaction of coils in the aneurysm of the top of the basilar (blue arrow). **(D)** Digital angiography with arterial subtraction, showing 2 stents in a "Y" (green arrow), in addition to the mass of coils of the top basilar aneurysm (blue arrow).

CONCLUSION

Embolization of multiple aneurysms in a single session is feasible to be performed efficiently and safely. The occlusion of all aneurysms in a single session is essential since it allows better treatment of complications associated with subarachnoid hemorrhage, especially vasospasm, in that an increase in blood pressure is necessary to maintain cerebral perfusion.

The embolization of complex multiple aneurysms requires the use of advanced techniques such as remodeling or stent assistance since simple coiling has a high failure rate. The minimally invasive effect and short hospital stay make endovascular management better than clipping in the management of multiple aneurysms.

REFERENCES

1. Oh K, Lim YC. Single-session coil embolization of multiple intracranial aneurysms. **J Cerebrovasc Endovasc Neurosurg. 2013**; 15(3):184-190.
2. Shen X, Xu T, Ding X, Wang W, Liu Z, Qin H. Multiple intracranial aneurysms: endovascular treatment and complications. **Interv Neuroradiol. 2014**; 20 (4): 442-447.
3. Dong QL, Gao BL, Cheng ZR, He YY, Zhang XJ, Fan QY, et al. Comparison of surgical and endovascular approaches in the management of multiple intracranial aneurysms**. Int J Surg. 2016**; 32:129-135.
4. Jeon P, Kim BM, Kim DJ, Suh SH. Treatment of multiple intracranial aneurysms with 1-stage coiling. **Am J Neuroradiol. 2014**; 35(6): 1170-1173.
5. Hofman M, Jamróz T, Jakutowicz I, Jarski P, Masarczyk W, Niedbala M, et al. Endovascular treatment of complex

intracranial aneurysms. **Pol J Radiol. 2018**; 83: e109-e114.
6. Wiebers DO, Whisnant JP, Huston J. International study of unruptured intracranial aneurysms investigators. Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. **Lancet. 2003**; 362:103-110.
7. Yang K, Ahn JS, Park JC, et al. The efficacy of bypass surgery using a short interposition graft for the treatment of intracranial complex aneurysm. **World Neurosurg. 2015**; 83:197-202.
8. Ha SW, Jang SJ. Clinical analysis of giant intracranial aneurysms with endovascular embolization. **J Cerebrovasc Endovasc Neurosurg. 2012**; 14:22-28.
9. Nieuwkamp DJ, Setz LE, Algra A, et al. Changes in case fatality of aneurysmal subarachnoid hemorrhage over time, according to age, sex, and region: a meta-analysis. **Lancet Neurol 2009**; 8:635-642.
10. Xavier AR, Rayes M, Pandey P, et al. The safety and efficacy of coiling multiple aneurysms in the same session. **J Neurointerv Surg. 2012**; 4:27-30.
11. Sfyroeras GS, Dalainas I, Giannakopoulos TG, et al. Flow-diverting stents for the treatment of arterial aneurysms. **J Vasc Surg. 2012**; 56(3):839-846.
12. Withers K, Carolan-Rees G, Dale M. Pipeline embolization device for the treatment of complex intracranial aneurysms: a nice medical technology guidance. **Appl Health Econ. 2013**; 11(1): 5-13.
13. Oh SY, Kim MJ, Shin YS. Treatment for giant fusiform aneurysm located in the cavernous segment of the internal carotid artery using the pipeline embolization device. **J Korean Neurosurg Soc. 2014**; 55(1):32-35.
14. Vendrell JF, Costalat V, Brunel H, et al. Stent-assisted coiling of complex middle cerebral artery aneurysms: initial and midterm results. **Am J Neuroradiol. 2011**; 32(2): 259-263.
15. Chung J, Shin YS. Multiple intracranial aneurysms treated by multiple treatment modalities. **Neurosurgery. 2011**; 69(4): e1030-e1032.

Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Authors Contributions

Conception and design: All authors. *Drafting the article:* Vargas. Critically revising the article: Rodriguez. *Reviewed submitted version of manuscript:* Vargas. *Approved the final version of the manuscript on behalf of all authors:* Vargas.

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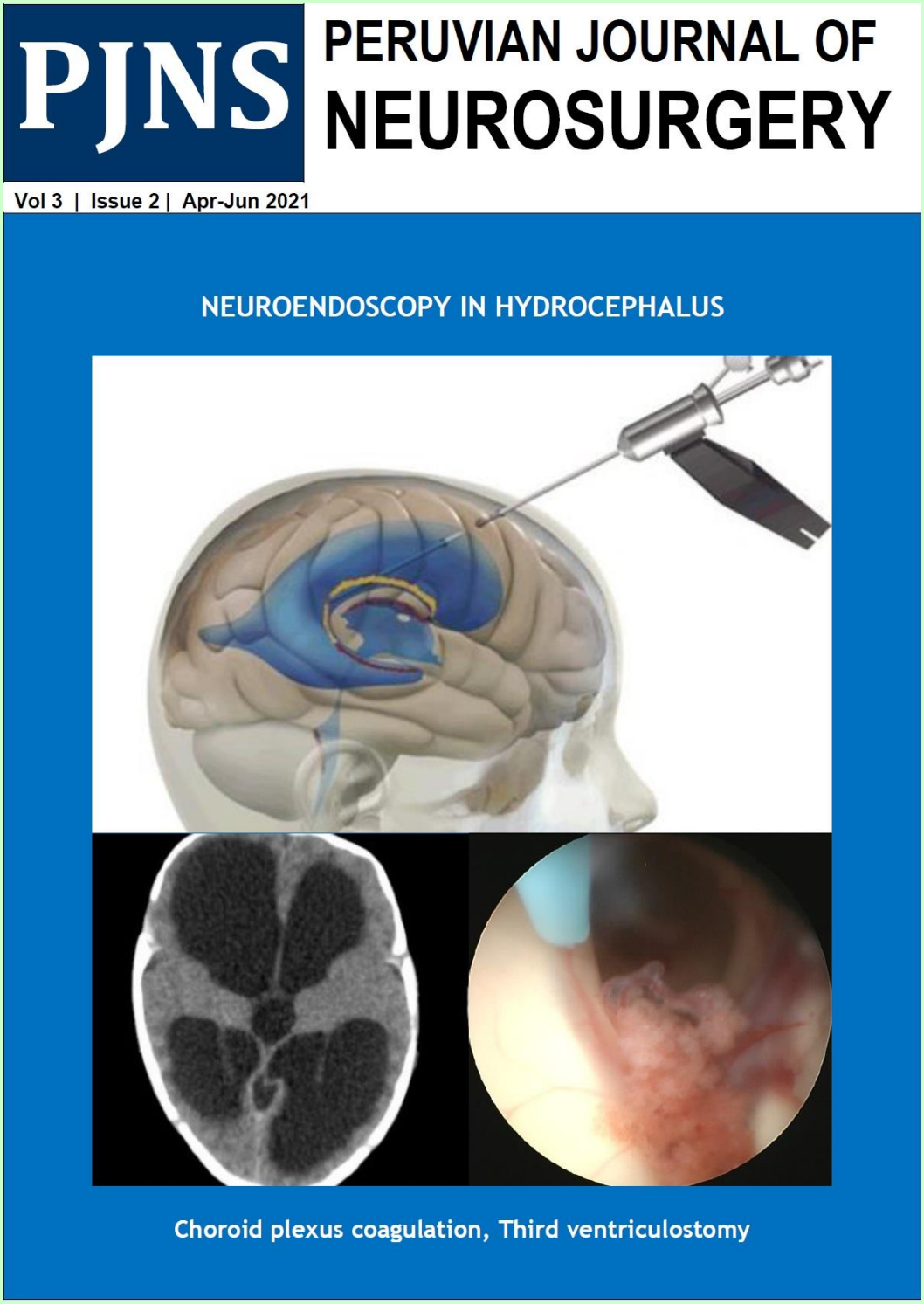
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