EMBOLIZATION OF RUPTURED GIANT ANEURYSM OF THE MEDIUM CEREBRAL ARTERY FOLLOWED BY SURGICAL EVACUATION OF INTRACEREBRAL HEMATOMA

Embolización de aneurisma gigante roto de la arteria cerebral media seguido de evacuación quirúrgica de hematoma intracerebral

JOSÉ LUIS URQUIZO R.[1a], RODOLFO RODRÍGUEZ V.[1b], WALTER DURAND C.[1b], RICARDO VALLEJOS T.[1b], DANTE VALER G.[1b], JESÚS FLORES Q.[1b], GIANCARLO SAAL Z.[1b]

[1] Department of Neurosurgery, Service of Neuroradiology of the Guillermo Almenara National Hospital, Lima, Perú.
[a] Resident of Neurosurgery, [b] Endovascular Neurosurgeon

ABSTRACT

Introduction: Early endovascular therapy of a ruptured giant aneurysm associated with intracerebral hematoma avoids the need for clipping of the aneurysm, thereby avoiding the need for greater brain retraction, edema, transient clipping, as well as the possibility of intraoperative rupture, thus achieving timely and adequate management of this pathology.
Clinical case: We present the case of a 48-year-old woman with subarachnoid hemorrhage (SAH) and intracerebral hematoma (ICH) due to dysplastic giant aneurysm of the right middle cerebral artery bifurcation (MCA) who was treated by coils embolization followed by microsurgical evacuation of the hematoma achieving a good result and a favorable clinical outcome.
Conclusion: The combined treatment by embolization with coils of a giant ruptured aneurysm of the MCA followed by the microsurgical evacuation of the ICH during the acute phase is an effective and safe alternative to single surgical management.

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

RESUMEN

Introducción: La terapia endovascular precoz de un aneurisma gigante roto asociado a hematoma intracerebral evita la necesidad del clipaje del aneurisma evitando con ello la necesidad de mayor retracción cerebral, edema, clipaje transitorio, así como la posibilidad de ruptura intraoperatoria, logrando de esta forma un manejo oportuno y adecuado de esta patología.
Caso clínico: Se presenta el caso de una mujer de 48 años con hemorragia subaracnoidea (HSA) y hematoma intracerebral (HIC) por aneurisma gigante displásico de la bifurcación de la arteria cerebral media (ACM) derecha que fue tratado por embolización con coils seguido de evacuación microquirúrgica del hematoma logrando un buen resultado y una evolución clínica favorable.
Conclusión: El tratamiento combinado mediante embolización con coils de un aneurisma gigante roto de la ACM seguido de la evacuación microquirúrgica del HIC durante la fase aguda es una alternativa eficaz y segura de manejo quirúrgico único.

Palabras Clave*: Aneurisma roto, Hemorragia Subaracnoidea, Hematoma, Embolización Terapéutica (Fuente: DeCS Bireme)*

Peru J Neurosurg 2020, 2 (2): 54-59

Subarachnoid hemorrhage (SAH) can present with intracerebral hematoma (ICH) in 4 to 42.6% with a mortality rate between 21-100%.[1] ICH associated with SAH by aneurysm presents with poor degrees of Hunt Hess overshadowing the forecast [5,8,9]. If the HSA generally has a 30-day mortality of 33 to 50%, the HIC due to aneurysm increases it to 80 to 100%. [13]

It is important to exclude the ruptured aneurysm as soon as possible to avoid rebleeding, however clipping in the acute phase represents a technical challenge due to the presence of hematoma and severe cerebral edema, [2, 5] which leads to the need for parenchymal retraction. and the risk of iatrogenic injury; In this context, endovascular therapy is a good management alternative in the acute phase of a ruptured aneurysm, as demonstrated in the ISAT (International Subarachnoid Aneurysm Trial). [3]

Submitted *: March 20, 2020*
Accepted *: April 17, 2020*
HOW TO CITE THIS ARTICLE*:* Urquizo J, Rodríguez R, Durand W, Vallejos R, Valer D, Flores-Q J, Saal-Zapata G. Embolization of ruptured giant aneurysm of the medium cerebral artery followed by surgical evacuation of intracerebral hematoma. *Peru J Neurosurg 2020; 2(2): 54-59*

Studies on the technical and clinical efficacy of endovascular therapy prior to surgical evacuation of ICH have been reported, which despite having a small population show that the percentage of independent patients at one month of treatment exceeds 50%, with mortality Relatively low compared to other surgical series and similarly to the results of series of patients in poor clinical condition without ICH [24]

CLINICAL CASE

History and examination: A 48-year-old female patient from Huancavelica, with a surgical history of cholecystectomy and cesarean section on 2 occasions, with a clinical picture of sudden-onset severe headache, transient consciousness disorder and left hemiparesis. A brain computed tomography (CT) was performed, which showed SAH Fisher IV with ICH (volume: 34cc) at the level of the right Silvio valley, so it was transferred to the Guillermo Almenara National Hospital 24 hours after the bleeding, due to the distance from the place of residence of the patient who lived in Huancavelica, 427 km from the city of Lima (06 hours approx. transfer by road).

On neurological examination: Glasgow Coma Scale (GCS) of 12, left hemiparesis 4/5, with stiff neck (Hunt Hess grade III). An angiotomography and cerebral panangiography were performed, showing a ruptured dysplastic saccular aneurysm in a bifurcation of the right MCA, of 25.7 mm x 19.5 mm and a neck width of 5.1 mm.

Endovascular treatment: Endovascular treatment was immediately performed using the Philips Allura 3D biplanar angiograph. Under general anesthesia, the PX SLIMTM microcatheter and Traxcess 14 microguide were navigated

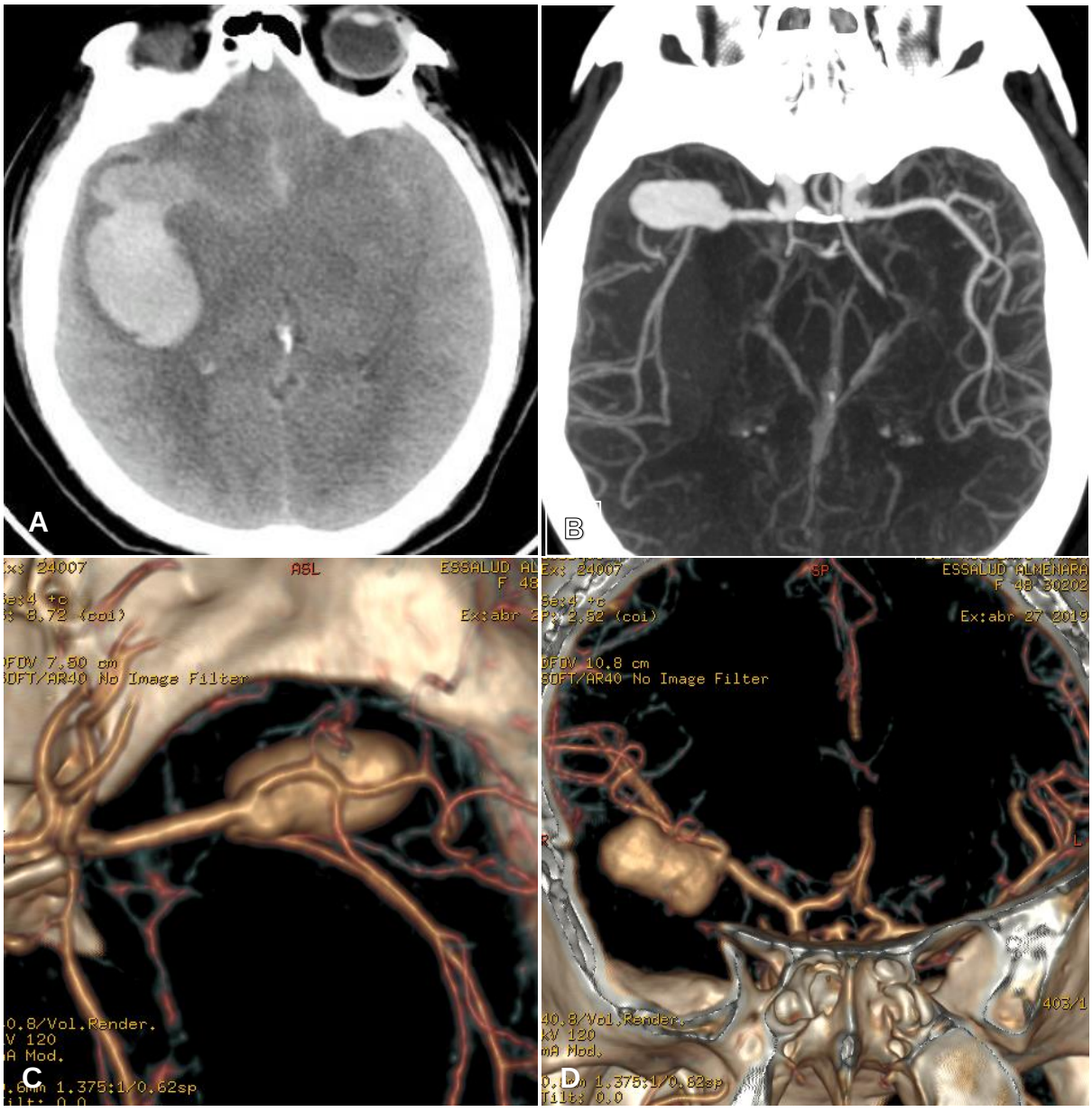

Fig 1. (A) Brain CT without contrast showing SAH with extensive intraparenchymal and Silvio Valley hematoma. **(B)** 3D reconstruction with maximum intensity projection of cerebral AngioCT demonstrating the presence of **(C, D)** aneurysm in the bifurcation of the multilobed ACM with incorporation of its branches in the aneurysmal neck.

together with the HyperForm occlusion balloon to the aneurysm sac with Coils Penumbra 400TM deployment: 16 mm x 60 cm, 14 mm x 50 cm, 12 mm x 35 cm and 13 mm x 48 cm, reaching a total obliteration of the dome with a residual neck (Raymond Roy II), without complications.

Clinical evolution: At the end of the embolization procedure, the patient was transferred to the emergency surgery room for microsurgical treatment, performing a right frontotemporal craniotomy and a subtotal evacuation of the ICH by means of a transcortical approach performed by the same neurosurgical medical team, and was subsequently transferred to a neurocritical care unit

In the following days, the patient had a good clinical evolution (15 points on the GCS), with improvement of the neurological deficit (modified Rankin scale II) and a hospital stay of 13 days. Control brain CT showed complete resolution of the hematoma without showing signs of infarction or cerebral bleeding.

DISCUSSION

The incidence of ICH associated with SAH is 42 to 84% of cases.[12] The functional prognosis of these patients will be worse if at hospital admission they present a poor clinical state, ICH associated with signs of intracranial hypertension (ICH). Thus, only 30% become independent after 30 days, [24] with a mortality rate of up to 50% with surgical treatment. [22]

The most frequent location of HSA-associated ICH is at the frontal or temporal level in Silvio's fissure due to the anatomical location of an anterior and middle cerebral artery aneurysm. [8] Middle cerebral artery aneurysms (MCA) are susceptible to treatment with clipping, its evolution being favorable. Conversely, endovascular therapy of an aneurysm at this location is challenging since they are frequently dysplastic, have a wide neck or segmental branches incorporated into or very adjacent to their dome. There are studies that support this claim, such as the ISUIA (International Study of Unruptured Intracranial

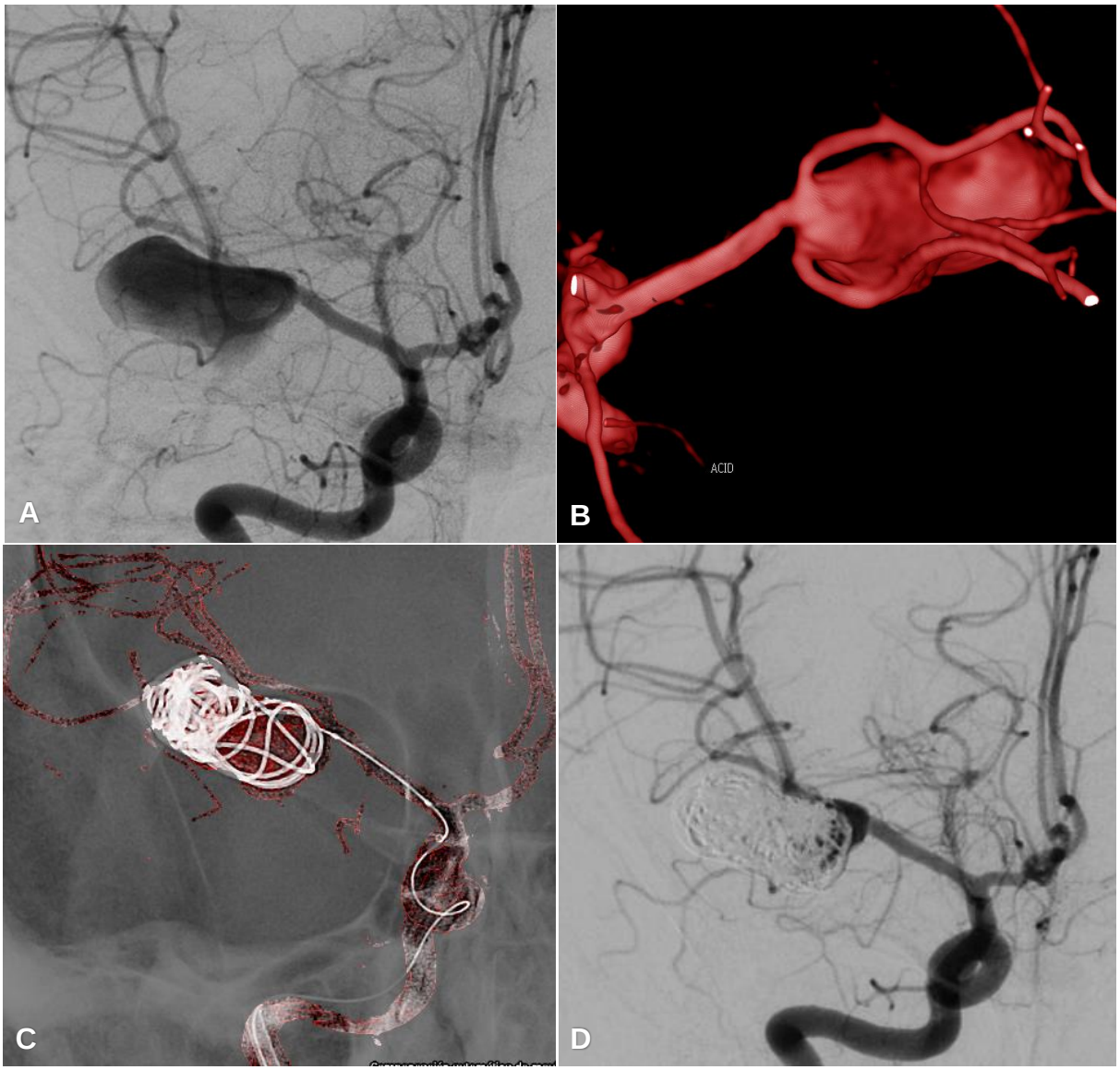

Fig 2. (A) Digital subtraction angiography of the right internal carotid artery (ICA) with 3D reconstruction showing **(B)** dysplastic saccular aneurysm in bifurcation of the ruptured giant right MCA. **(C)** Embolization with balloon-assisted coils with angiographic control **(D)** showing subtotal obliteration, with adjacent patent vessels.

Aneurysms) with 704 MCA aneurysms treated, in which 92.3% were by clipping; [17] the BRAT (Barrow Ruptured Aneurysm Trial) where 67% of the MCA aneurysms initially assigned for embolization had to be clipped; [18] the guidelines of the American Heart Association / American Stroke Association 2012 that recommend clipping for MCA aneurysms with ICH greater than 50 cc.[19]

According to Shimoda et al., precipitating factors for brain injury such as ICH, acute hydrocephalus, and seizures could be the cause of the neurological deficit on admission, being potentially reversible.[10] Heiskanen et al. described a mortality rate of 80% in patients who only underwent evacuation of the ICH compared to 27% in whom the aneurysm was also clipped; therefore, aneurysmal exclusion is recommended during the same procedure. However, in a surgical setting with large cerebral edema due to acute hemorrhage, ICH, and impaired self-regulation, where dissection and proximal arterial control can be challenging, the need for cortical retraction can cause parenchymal injury, significant cerebral edema, and ischemia,[2] as reported by Shimoda et al., who found 48% of post-clip bruises. [10]

In recent years, endovascular technology is being integrated into microsurgical treatment for these vascular lesions.[4] Lawton et al. described that the management of complex aneurysms requires a combined strategy [11] integrating endovascular diagnosis and therapy with surgery.

That is why, the embolization of the aneurysm avoids the surgical need for a clip, thus avoiding the dissection,

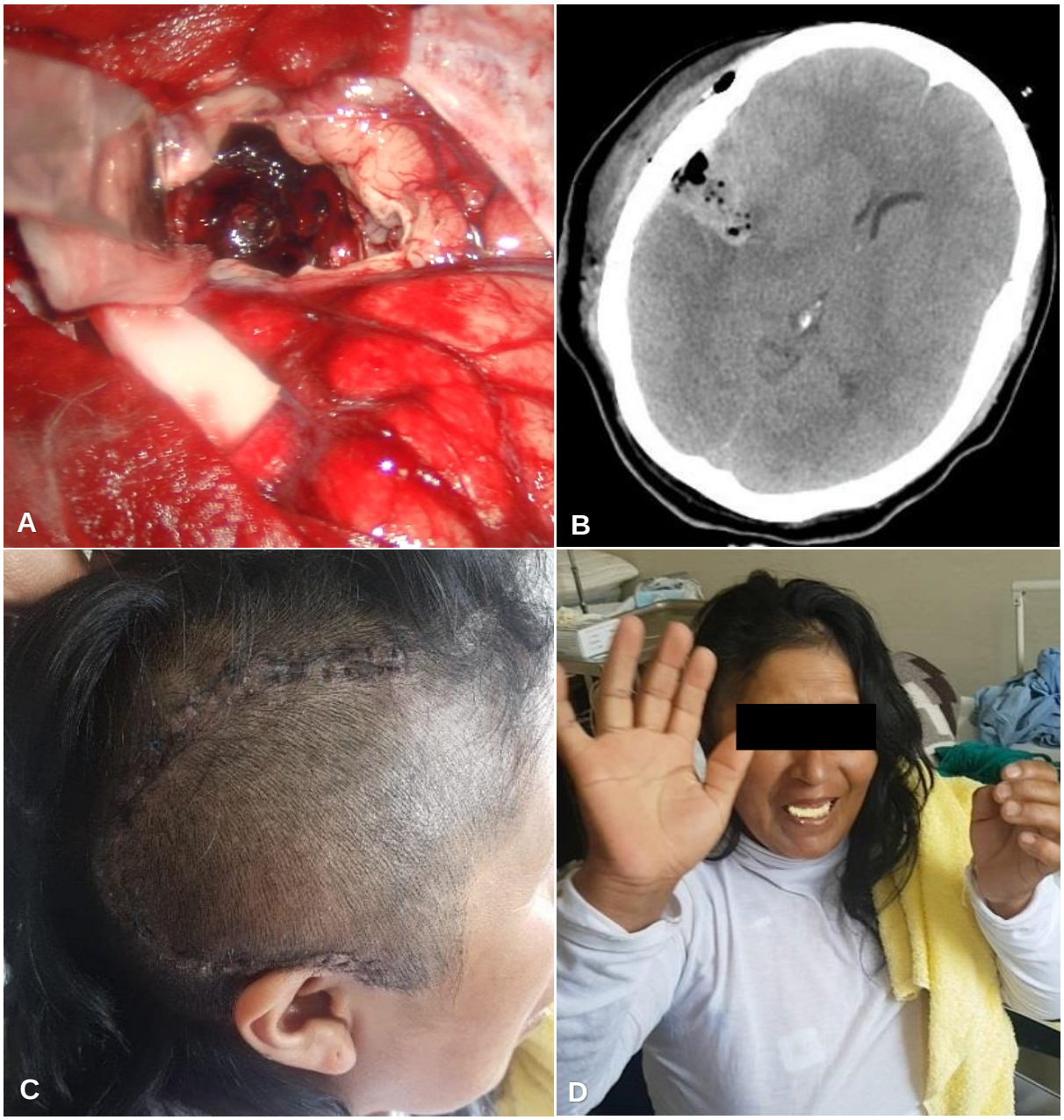

Fig 3. (A) Microsurgical evacuation of intraparenchymal hematoma and the right Silvio valley, with cerebral tomographic control without contrast **(B)** subtotal evacuation of hemorrhage. **(C, D)** It presented good clinical evolution with improvement of the neurological deficit.

retraction, transient clipping and eliminating the risk of intraoperative rupture of the aneurysm, a severe complication that can lead to death, achieving a procedure simpler, safer and faster surgical procedure. According to Houkin et al., 12.5% of intraoperative ruptures were caused by evacuation of the hematoma with acute decompression and 16.7% only by brain retraction.[16]

Stapleton C. et al. described that of a total of 49 patients with MCA aneurysm and extensive intraparenchymal or Silvio Valley ICH who underwent clipping, 28.6% had intraoperative rupture. [20] This is because the ICH surrounds the aneurysm, making arachnoid dissection difficult. around the neck of the aneurysm for the control of the main artery and clipping, causing rebleeding during the evacuation of the ICH.[23] The difficulty of the surgical technique can prolong the time of surgery and increase the rate of complications (infection, pneumonia, pulmonary edema or heart failure), worsening prognosis. [24]

Rebleeding is the most preventable cause of mortality and poor functional outcome, therefore, it is significant to establish a treatment strategy that leads to faster obliteration of the aneurysm without greater risks, since the rupture rate is three times higher in presence of ICH.[15] In a series of 50 patients, the exclusion of the aneurysm within 6 hours of the clinical presentation was the most significant predictor of a favorable outcome ($p < 0.025$), regardless of the treatment modality. [15]

De los Reyes et al. demonstrated that patients embolized before ICH evacuation achieved aneurysm obliteration faster than those operated on by clipping (299 vs 885 min, $p < 0.001$), which implies less time for general anesthesia, an additional benefit for elderly patients. advanced or with poor preoperative clinical conditions. Furthermore, no significant differences were found in terms of complications, hospital stay, functional outcome, and costs; [14] Unless there is difficult vascular access due to unfavorable anatomy, surgery is preferred. It is worth mentioning that an embolized patient presented a complication due to the use of aspirin and heparin that was used to avoid the formation of thrombi due to the fact that a coil was projected towards the lumen of the main vessel, developing expansion of the HIC (23 cc to 50 cc) ; For this reason, a total packaging in a ruptured aneurysm is not recommended to achieve a good clinical result, as in the case presented, where Penumbra® coils (thicker than conventional ones) were used, which offer more effective and faster packaging, especially in giant aneurysms.[6,7] Tawk et al. 30 patients who underwent aneurysm embolization followed by evacuation of the ICH were studied, achieving 61% with good recovery after 18 months of follow-up. [2]

Turner R. et al. described a novel technique with a suction device, called the Penumbra Apollo system, for minimally invasive evacuation of ICH after embolization and that can be performed in the same neurointerventional room, saving valuable time of transfer to another surgery room [21] However, if ICH has a significant mass effect, inducing herniation of the brain with ease, as in this case, craniotomy is the best option. To avoid moving the patient from one room to another, it is necessary to incorporate hybrid operating rooms where the two pathologies can be treated in a single moment.

With the presentation of this case, the viability and safety of endovascular therapy before immediate microsurgical evacuation is demonstrated, emphasizing the creation of hybrid operating rooms since there is a clear benefit of combined management in complex aneurysms.

CONCLUSION

The efficacy of combined emergency treatment is demonstrated by embolization with coils of a giant ruptured aneurysm of the MCA, followed by microsurgical evacuation of the associated HIC during the acute phase. This case demonstrates that this treatment is a feasible and safe alternative to joint endovascular and microsurgical surgical management.

REFERENCES

1. Jeong JH, Koh JS, Kim EJ: A less invasive approach for ruptured aneurysm with intracranial hematoma: coil embolization followed by clot evacuation. **Korean J Radiol 8**:2-8, 2007.
2. Rabih G. T, Aditya P, Elad L: Coiling of Ruptured Aneurysms Followed by Evacuation of Hematoma. **World Neurosurg. 74**, 6:626-631, 2010.
3. Molyneux AJ, Kerr RS, Yu LM, Clarke M, Sneade M, Yarnold JA, Sandercock P: International subarachnoid aneurysm trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomi zed comparison of effects on survival, dependency, seizures, rebleeding, subgroups, and aneurysm occlusion. **Lancet 366**:809-17, 2005.
4. Dehdashti AR, Thines L, Da Costa LB, terBrugge KG, Willinsky RA, Wallace MC, Tymianski M: Intraoperative biplanar rotational angiography during neurovascular surgery. **J Neurosurg 111**:188-92, 2009.
5. Niemann DB, Wills AD, Maartens NF, Kerr RS, Byrne JV, Molyneux AJ: Treatment of intracerebral hematomas caused by aneurysm rupture: coil placement followed by clot evacuation**. J Neurosurg 99**:843-7, 2003.
6. Villwock MR, Singla A, Padalino DJ, Deshaies EM. The penumbra coil 400 system for treatment of wide-necked intracranial aneurysms: initial single-center experience. **Acta Neurochir Suppl 120**:191-5, 2015.
7. Woo H, Fiorello D, Han P. Preliminary results with a new volumetric-filling platinum coil, the Penumbra coil 400. **J Neurointervent Surg; 3**: A20, 2011.
8. Abbed KM, Ogilvy CS: Intracerebral hematoma from aneurysm rupture. **Neurosurg Focus 15**: E4, 2003.
9. Nowak G, Schwachenwald D, Schwachenwald R, Kehler U, Muller H, Arnold H: Intracerebral hematomas caused by aneurysm rupture: experience with 67 cases. **Neurosurg Rev 21**:5-9, 1998.
10. Shimoda M, Oda S, Mamata Y, Tsugane R, Sato O: Surgical indications in patients with an intracerebral hemorrhage due to ruptured middle cerebral artery aneurysm. **J Neurosurg 87**:170-5, 1997.
11. Lawton MT, Quinones-Hinojosa A, Sanai N, Malek JY, Dowd CF: Combined microsurgical and endovascular management of complex intracranial aneurysms. **Neurosurgery 52**:263-75, 2003.
12. Hauerberg J, Eskesen V, Rosenorn J. The prognostic significance of intracerebral haematoma as shown on CT scanning after aneurysmal subarachnoid haemorrhage. **Br J Neurosurg 1994; 8**:333e9.
13. Cross DT 3rd, Tirschwell DL, Clark MA, et al. Mortality rates after subarachnoid hemorrhage: variations according to hospital case volume in 18 states. **J Neurosurg 2003; 99** :810e17.

14. De los Reyes K, Patel A, Bederson J. Management of subarachnoid hemorrhage with intracerebral hematoma: clipping and clot evacuation versus coil embolization followed by clot evacuation. **J NeuroIntervent Surg 2013**; 5:99–103.
15. Guresir E, Beck J, Vatter H, et al. Subarachnoid hemorrhage, and intracerebral hematoma: incidence, prognostic factors, and outcome. **Neurosurgery 2008**; 63:1088e93.
16. Houkin K, Kuroda S, Takahashi A, et al. Intra-operative premature rupture of the cerebral aneurysms. Analysis of the causes and management. **Acta Neurochir (Wien) 1999**; 141:1255e63.
17. Wiebers DO, Whisnant JP, Huston J III, et al. Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. **Lancet. 2003;362**(9378):103-110.
18. Spetzler RF, McDougall CG, Albuquerque FC, et al. The Barrow ruptured aneurysm trial: 3-year results. **J Neurosurg. 2013**;119(1):146-157.
19. Connolly ES Jr, Rabinstein AA, Carhuapoma JR, et al. Guidelines for the management of aneurysmal subarachnoid hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. **Stroke. 2012;43** (6):1711-1737.
20. Stapleton C, Walcott B, Fusco M. Surgical Management of Ruptured Middle Cerebral Artery Aneurysms with Large Intraparenchymal or Sylvian Fissure Hematomas. **Neurosurgery 76**:258–264, 2015.
21. Turner R, Vargas J, Turk A. Novel Device and Technique for Minimally Invasive Intracerebral Hematoma Evacuation in the Same Setting of a Ruptured Intracranial Aneurysm: Combined Treatment in the Neurointerventional Angiography Suite. Operative **Neurosurgery 11**:43–51, 2015.
22. Otani N, Nawashiro H, Wada K, Nagatani K, Takeuchi S, Koba-yashi H, et al. Surgical results after primary decompressivecraniectomy in poor-grade aneurysmal subarachnoid hemorr-hage. **Acta Neurochir Suppl. 2013**; 118:269.72.
23. Steiner T, Juvela S, Unterberg A, Jung C, Forsting M, RinkelG. European Stroke Organization guidelines for the manage-ment of intracranial aneurysms and subarachnoid haemorrhage. **Cerebrovasc Dis. 2013; 35**: 93-112.10.
24. Quintana E, Garcia A, Vega P. Tratamiento combinado, mediante embolización y cirugía, de los aneurismas cerebrales rotos con hematoma cerebral e hipertensión intracraneal: Análisis retrospectivo y revisión de la bibliografía. **Radiología. 2019;61**(1):42-50.

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:* Urquizo. Critically revising the article: Rodriguez. *Reviewed submitted version of manuscript:* Urquizo. *Approved the final version of the manuscript on behalf of all authors:* Urquizo.

Correspondence
José Luis Urquizo R. Department of Neurosurgery. Guillermo Almenara National Hospital. 800 Grau Avenue. La Victoria. Lima 13, Perú. *E-mail: jose_luisur@hotmail.com*

PROXIMO NUMERO