REVASCULARIZATION WITH FIRST GENERATION BYPASS PLUS CAROTID RECONSTRUCTION WITH TANDEM CLIPPING OF COMPLEX PARACLINOID ANEURYSM.FIRST CASE IN THE DOS DE MAYO NATIONAL HOSPITAL, LIMA PERU

Revascularización con bypass de primera generación más reconstrucción de carótida con clipaje en tandem de aneurisma paraclinoideo complejo. Primer caso en el Hospital Nacional Dos de Mayo de Lima - Perú.

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ABSTRAC

Introduction: Cerebral aneurysms are formed due to a weakness in the arterial wall, this cause a dilation and the subsequent risk of rupture, conditioning subarachnoid hemorrhage, being one of the causes of cerebrovascular disease with higher risk of morbidity or death. We presented the first brain revascularization microsurgery for the treatment of a complex cerebral aneurysm performed at the Dos de Mayo National Hospital.
Clinical case: Woman with a ruptured left paraclinoid giant aneurysm, from Piura, who underwent revascularization by means of an extra-intracranial first generation bypass, between superficial temporal artery and silvian branch of M2, using a mini-interfascial approach, sphenoid wing drilling, anterior extradural clinoidectomy, opening of the canal, distal dural ring and tandem clipping for reconstruction of the carotid artery, excluding the complex aneurysm, was the surgical strategy chosen.
Conclusion: Post-surgical evolution was favorable, with radiological evidence of complete tandem clipping and permeability of the internal carotid and bypass.

Keywords: *Intracranial Aneurysm, Cerebral Revascularization, Carotid Arteries, Microsurgery. (source: MeSH NLM)*

RESUMEN

Introducción: Los aneurismas cerebrales se forman debido a una debilidad en la pared arterial, ello condiciona una dilatación y el posterior riesgo de ruptura, condicionando hemorragia subaracnoidea, siendo una de las causas de enfermedad cerebrovascular con más alto riesgo de morbilidad o muerte. Se presenta la primera microcirugía de revascularización cerebral para tratamiento de un aneurisma cerebral complejo en el Hospital Nacional Dos de Mayo.
Caso Clínico: Mujer con un aneurisma gigante paraclinoideo izquierdo roto, procedente de Piura, a la cual se le realiza revascularización mediante un bypass extra - intracraneal de primera generación, entre arteria temporal superficial y rama silviana de M2, mediante abordaje interfascial minipterional, drilado del ala esfenoidal, clinoidectomía anterior extradural, apertura del canal, del anillo dural distal y clipaje en tándem para reconstrucción de la arteria carótida, excluyendo el aneurisma complejo, fue la estrategia quirúrgica elegida.
Conclusión: La evolución post quirúrgica fue favorable, con evidencia radiológica del clipaje completo en tándem, permeabilidad de la carótida interna y del bypass.

Palabras clave*: Aneurisma intracraneal, Revascularización cerebral, Arterias Carótidas, Microcirugía (fuente: DeCS Bireme)*

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Cerebral aneurysms are formed due to weakness in the arterial wall, this determines a dilation and risk of rupture with subarachnoid hemorrhage, being one of the causes of cerebrovascular disease with a higher risk of morbidity and mortality [1].

Revascularization is an option for complex lesions, extracranial-intracranial bypass (EC-IC), allows to increase or replace the blood supply, in complex aneurysms or tumors of the skull base [2,3].

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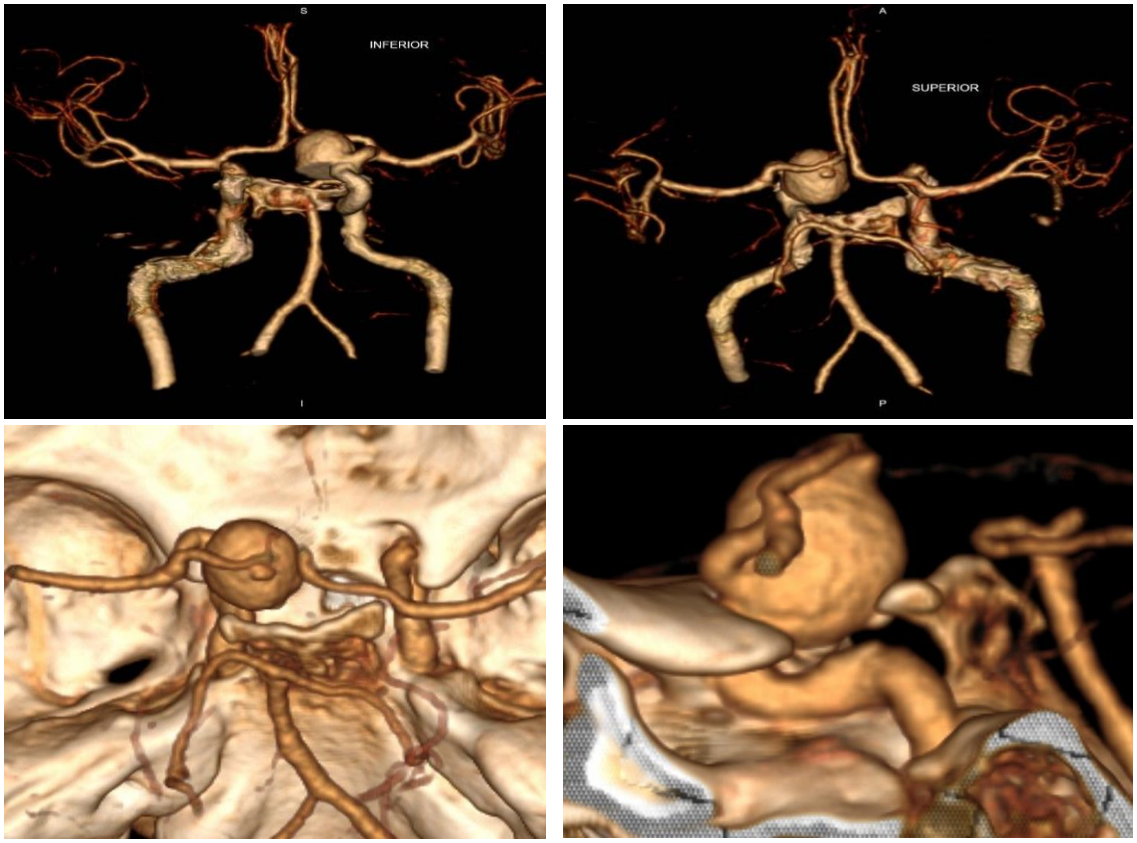

Fig. 1. Angiotomography shows giant left paraclinoid aneurysm with dome on medial direction

Prophylactic bypass is an indication in young patients with suspected late ischemia, being performed with the superficial temporal artery (STA) or with the radial artery (RA) [4].

The donor's choice is based on the size of the recipient vessel, the desired amount of flow and the revascularization site. It can be classified as low flow (STA 15–25 ml / minute), medium flow (RA 40–70 ml / minute) and high flow (saphenous vein 70–140 ml / minute) [5]. The Superficial Temporal Artery-Medial Cerebral Artery (STA-MCA) is also called as first generation bypass; the Carotid External Artery- Medial Cerebral Artery (CEA-MCA) bypass with graft is called as second generation and, intracranial-intracranial (IC-IC) artery as third generation bypass. When a "medium flow" bypass is required, the choice is the RA graft and the recipient vessel is the CEA. When a "low flow" bypass is required and the STA is not available, the donor upper thyroid artery has been used, combined with an RA graft.[6]

CLINICAL CASE

History and Examination: A 61-year-old female patient, from Piura, with a history of sudden and intense headache, associated with loss of consciousness and vomiting, taken by relatives to Regional Hospital where she has a brain scan and evidences subarachnoid hemorrhage, so a cerebral angiotomography is performed, showing a large ruptured left para-clinoid aneurysm (*Figure 1*).

Reference is made for specialized management to the Dos de Mayo National Hospital, with 16 days of subarachnoid hemorrhage. In emergency it is confused, disoriented in time and space, Glasgow 14, reactive isochoric pupils and without motor deficit. A definitive surgical treatment is planned and then it goes to the Neurocritical Intensive Care Unit for post-surgical management.

Treatment: The first stage consists of exposing the common, external and internal carotid at the cervical level, for the proximal control, the angle of the jaw is identified, which allows us to locate the carotid bifurcation, an incision of 5 cm is made in the anterior edge of the sternocleidomastoid muscle, using blunt dissection, the digastric muscle and hypoglossal nerve that cross the carotid are identified obtaining exposure of about 3cm of the Common Internal and External Carotid Artery, which are individualized with rubber bands [18]. (*Figure 2*)

Then, the microscopic exposure of the STA is carried out, keeping it as a donor vessel for the bypass (*Figure 3*).

A mini-pterional interfascial approach is performed, respecting the frontal branch of the facial nerve. The position of the head is rotated to the opposite side and extended. In this position, opening of the Silvian cistern, the M1 segment acquires a perpendicular position with the view of the neurosurgeon (*Figure 4 A-D*).

An extradural clinoidectomy is performed as well as the decompression of the canal and optic hole, section of the orbito-temporal meningeal band and milling of the minor wing of the sphenoid, exposing the superior orbital fissure. The basal partial dribbling of the orbital roof and the lateral wall of the orbit respecting the peri-orbital fat allows to visualize the distal intracanalicular portion of the optic nerve, releasing the anterior clinoids. The oculomotor

carotid membrane is dissected and a “mini peeling” or restricted peeling allows the aneurysm release. (*Figure 4E*).

After the dural opening, the frontal, temporal and the Silvian valley are exposed, the dissection of the arachnoid is continued exposing the M1 segment [19], as well as the bifurcation and the proximal portion of the M2 segment, exhibiting the site for anastomosis [16] (*Figure 4F*).

After isolating the M2 branch, the recipient vessel is prepared, the graft is cut in the form of a "fish mouth" to increase the area of anastomosis, suturing the M2 branch (recipient vessel) with the donor vessel (STA) (*Figure 5 A and B*). It is important to guarantee the flow, corroborated by intraoperative Doppler.

Then, the arachnoid dissection of the internal carotid is performed, exposing the aneurysm neck, venous bleeding due to the opening of the cavernous sinus occurred which is controlled with hemostatic. Once the neck is released, temporal clipping of cervical carotid is decided, decreasing blood flow and proceeding to clipping the paraclinoid aneurysm with fenestrated clips in tandem and a straight clip in the dome, which total control is achieved and good carotid flow is corroborated by intraoperative Doppler. (*Figure 5 C-F*)

Hemostasis and Dural closure are performed with repair for the passage of the STA-M2 bypass, once the graft is covered by the temporal muscle, the risk of graft injury at the point of entry into the skull is low. [16]

Evolution: There were no intra-operative complications, the patient was managed in the post-operative in the Neurocritical Intensive Care unit, where she is maintained with sedoanalgesia until a angiotomography was performed. Evidence of complete aneurysm occlusion and permeability of extra-intracranial anastomosis was showed on angioCT, showing perisylvian hipoflow zones which improved with intensive medical treatment. (*Figure 6*).

The patient had pneumonia and nosocomial urinary tract infection, CSF fistula contained after the third day after surgery. On the fourth day after surgery, severe right hemiparesis was evidenced, which correlates with perisylvian hipoflow foci and left basal nuclei isquemia which intensive management. After overcome all her complications, she was transferred in good conditions to the general care section of Neurosurgery, in awake state, Glasgow 14, with mild right brachiocrural hemiparesis 4/5. She completed antibiotic treatment for nosocomial infections and presenting a good neurological evolution therefore she was discharge from hospital after some days, with a modified Ranking scale of 2.

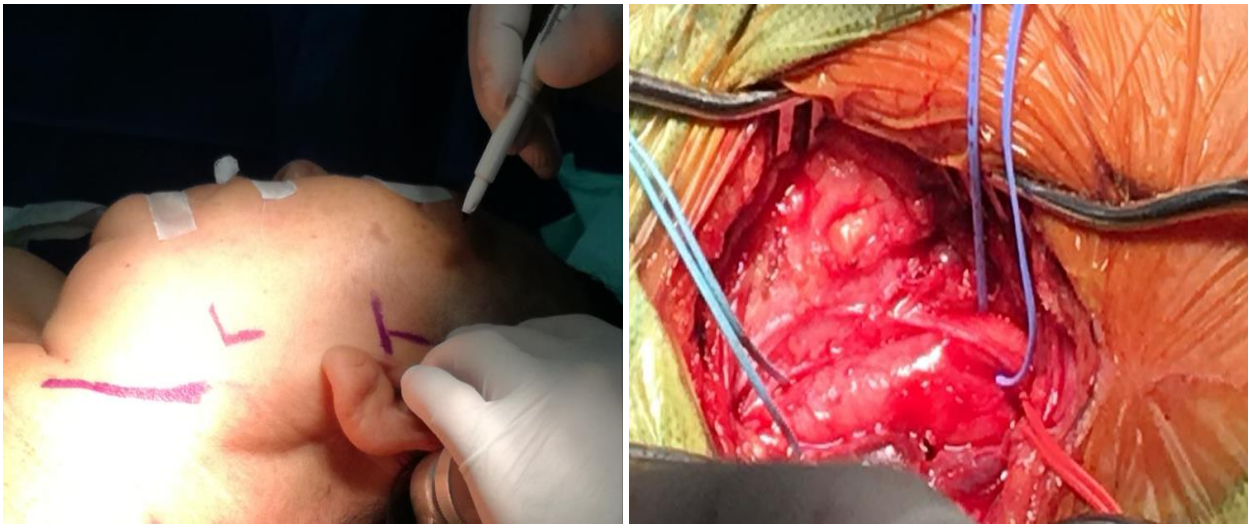

Fig. 2. Cervical exposure of the common external and internal carotid artery (ICA) for proximal control.

Fig. 3. Microsurgical exposure of the Superficial Temporal Artery (STA).

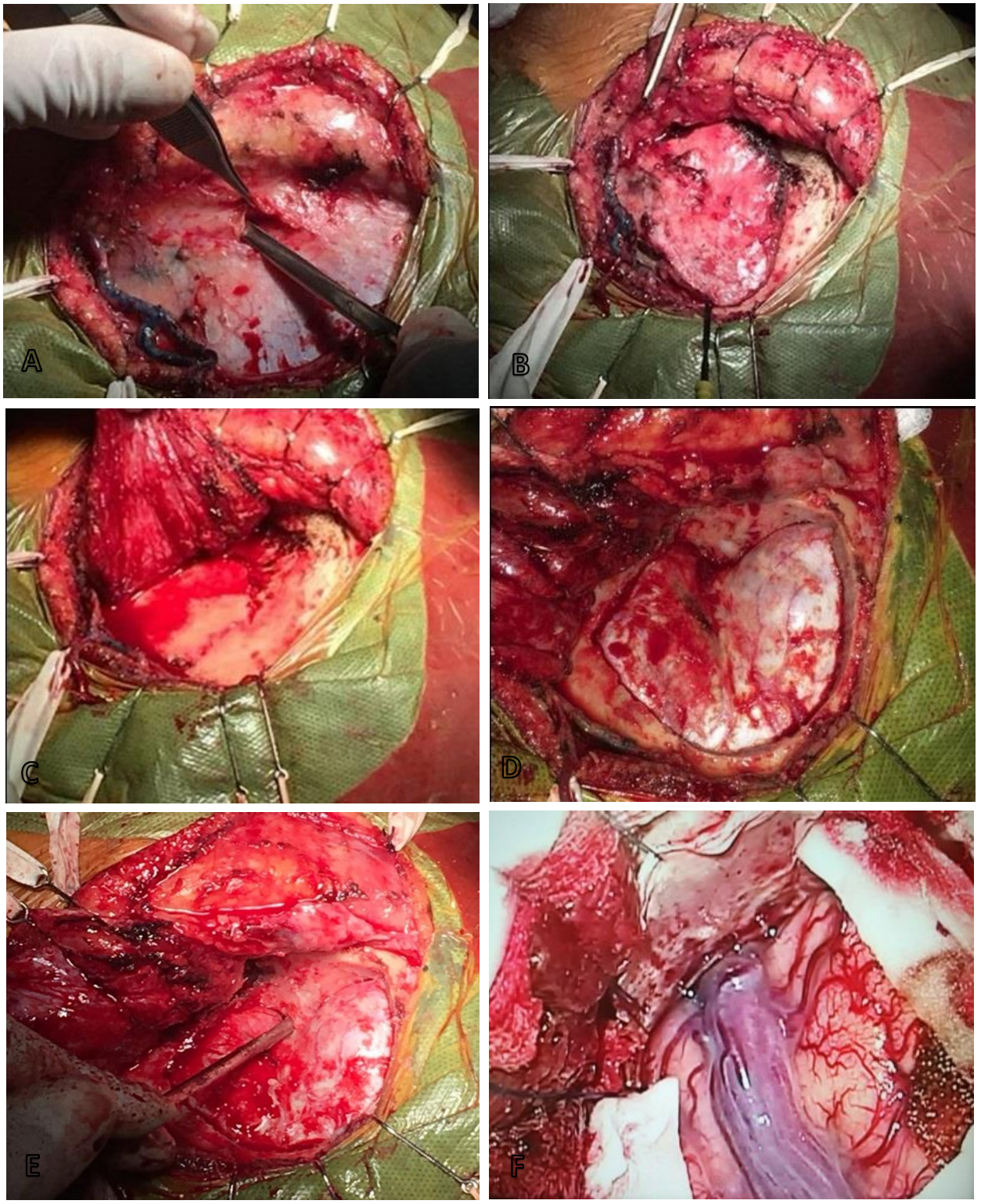

Fig. 4. **(A and B)** Interfascial approach. **(C)** Temporary muscle retraction. **(D)** Minipterional craniotomy and exposed dura. **(E)** Complete release of the anterior clinoid by dissection of the carotid-oculomotor membrane and the "mini peeling". **(F)** The durotomy and exposure of the Silvian Valley is performed, presenting the middle cerebral artery and the M2 receptor segment for the bypass.

DISCUSSION

In the "Situation Analysis in Peru" of 2010, cerebrovascular disease is in fifth place, among the ten main causes of mortality, with 31.4 / 100 000 inhabitants, with a tendency to increase, between 2003-2007, the morbidity rate was 8 to 9.1 / 10 000 inhabitants [9]. Paraclinoid aneurysms represent 5-11% of the total, its complex anatomy means a challenge in knowledge and skills at the time of surgery, and they are generally larger or giant in proportion to those of other locations [10].

Fig. 5. (**A**) Anastomosis between M2 and superficial temporal artery (STA). **(B)** Vascular Doppler. **(C)** Arachnoid dissection. **(D)** Exposure of the aneurysmal neck. **(E)** Definitive tandem clipping with fenestrated clips and straight clip in aneurysm dome for complete closure of the aneurysmal sac. **(F)** 3D angiotomography showing clips and total aneurysm exclusion.

These are born in the proximal part of the internal carotid, between the proximal dural ring (oculomotor membrane) and the origin of the posterior communicant [11 12 13]. Due to its complex relationship with bone, neural and vascular structures, surgical occlusion at this location. It is a challenge, even with endovascular techniques, incomplete occlusions or recurrence due to neck amplitude can be performed [14]. (Figure 11)

The cerebral bypass is not something recent; already in 1969 Yasargil described a bypass between the superficial temporal artery (STA) and the middle cerebral artery (MCA)[15]. In 1971 Lougheed, performed the first bypass using a venous graft between the common carotid and the internal carotid [16]. Spetzler in 1974 described a bypass between the occipital artery and the MCA and in 1978 made a bypass using the saphenous vein, between the common carotid and a cortical branch of ACM, that same year described a bypass from the external carotid artery (ECA) to the MCA using a polytetrafluoroethylene tube.

In 1979, Miller published a bypass between the middle meningeal artery and the MCA and in 1980 Spetzler described a bypass between the subclavian and MCA using the saphenous vein [17]. That same year Gelber published the treatment of intracavernous or giant aneurysms of the internal carotid (ICA) with carotid ligation combined with the use of the ATS bypass [18]. Fisch in 1980 described a bypass between the cervical and the petrosal ICA. In 1990 Spetzler performed a bypass between petrosal and supraclinoid ICA and Serbinenko associated endovascular occlusion with venous bypass for intracavernous or non-clipable giant aneurysms of ICA [19].

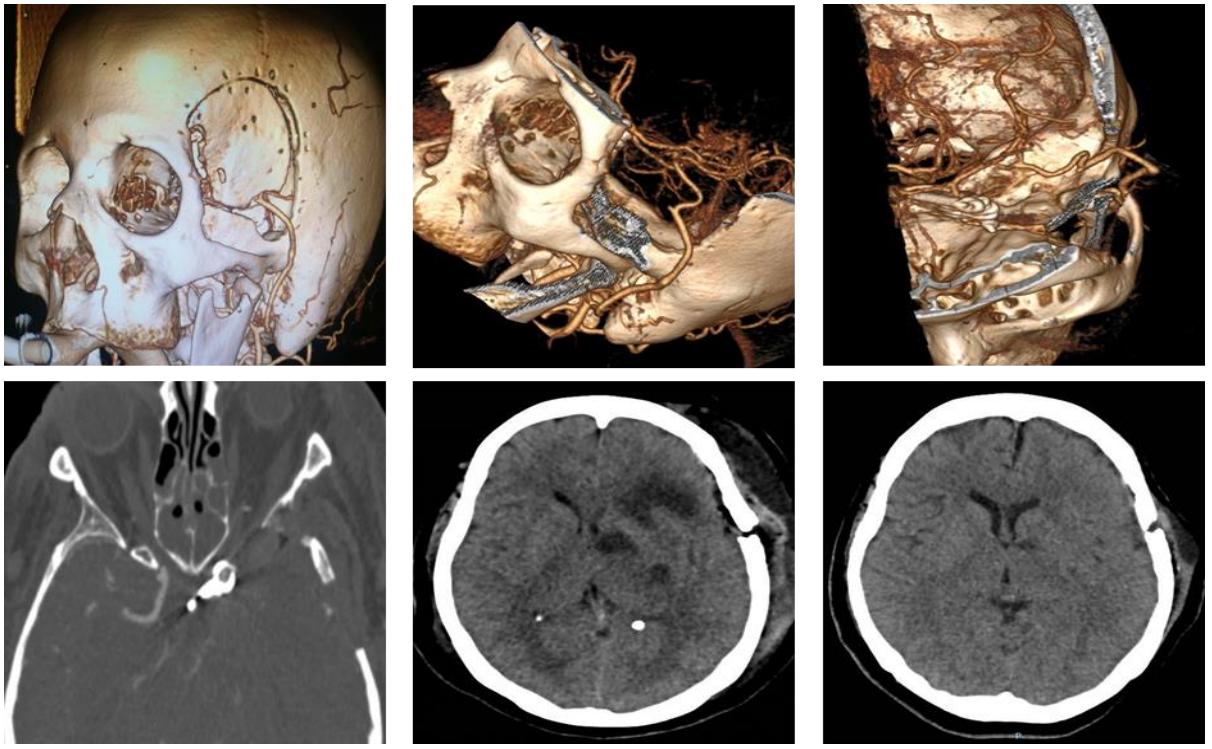

Fig. 6. Post-surgical radiological images showing the complete clipping of the cerebral aneurysm and the permeability of the bypass. Initial evolution with hypoflux with evident improvement in following days as shown in the last control tomography.

In the Department of Neurosurgery of the Dos de Mayo National Hospital, cerebral revascularization treatments had not yet been performed for complex paraclinoid aneurysms. Currently these surgical techniques are performed in different specialized centers around the world to ensure blood supply, avoiding ischemia, used in atherosclerotic disease, tumors, Moyamoya and complex aneurysms that cannot be directly clipated. [20,21,22] Aneurysms of the C5 clinoid segment and the C6 ophthalmic are complex, to achieve a successful surgery requires knowledge of the region and aneurysm [23]. The clinoids have medial, lateral and anterior varieties and the paraclinoids have medial, posterior varieties and anterior, or depending on the artery of origin in the ophthalmic, superior, pituitary and posterior paraclinoid aneurysms [24]. In our case it was decided to perform a first-generation bypass to preserve an adequate cerebral flow of the middle cerebral, which allows us to clipping of the carotid aneurysm and preventing possible ischemic complications [25].

We consider that the direct surgical approach or endovascular techniques could not be performed, due to atherosclerotic disease, calcification of the base, the wide neck leads us to the decision to opt for revascularization and then complete exclusion. In other circumstances the neck, the exit arteries incorporated in the base, the blister, fusiform and dolicoectatic form of the sac, the radiological poor visualization of the aneurysm and its adjacent branches are causes of microsurgical failure as endovascular 26. Without treatment, patients with complex aneurysms they usually have an unfavorable prognosis [27].

CONCLUSION

The surgery of complex paraclinoid aneurysms involves risks, the main one is ischemia and cerebral infarction; therefore it is necessary to apply revascularization techniques in order to minimize the risk. Our result shows that the combined treatment of revascularization with first-generation bypass followed by clipping and aneurysm exclusion provides a curative possibility. Because our hospital is a national reference for complex pathologies, and aware that training and improvement in current techniques should be applied, we decided to carry out this intervention. After the case was successfully resolved, we conclude that it is possible to be able to perform surgeries of the highest complexity with multi-disciplinary participation.

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Disclosures

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Author Contributions

Conception and design: All the authorsa. *Drafting the article:* Acha. Critically revising the article: Acha, Yaya-Loo, Soto. *Reviewed submitted version of manuscript:* Acha. *Approved the final version of the manuscript on behalf of all authors:* Acha.

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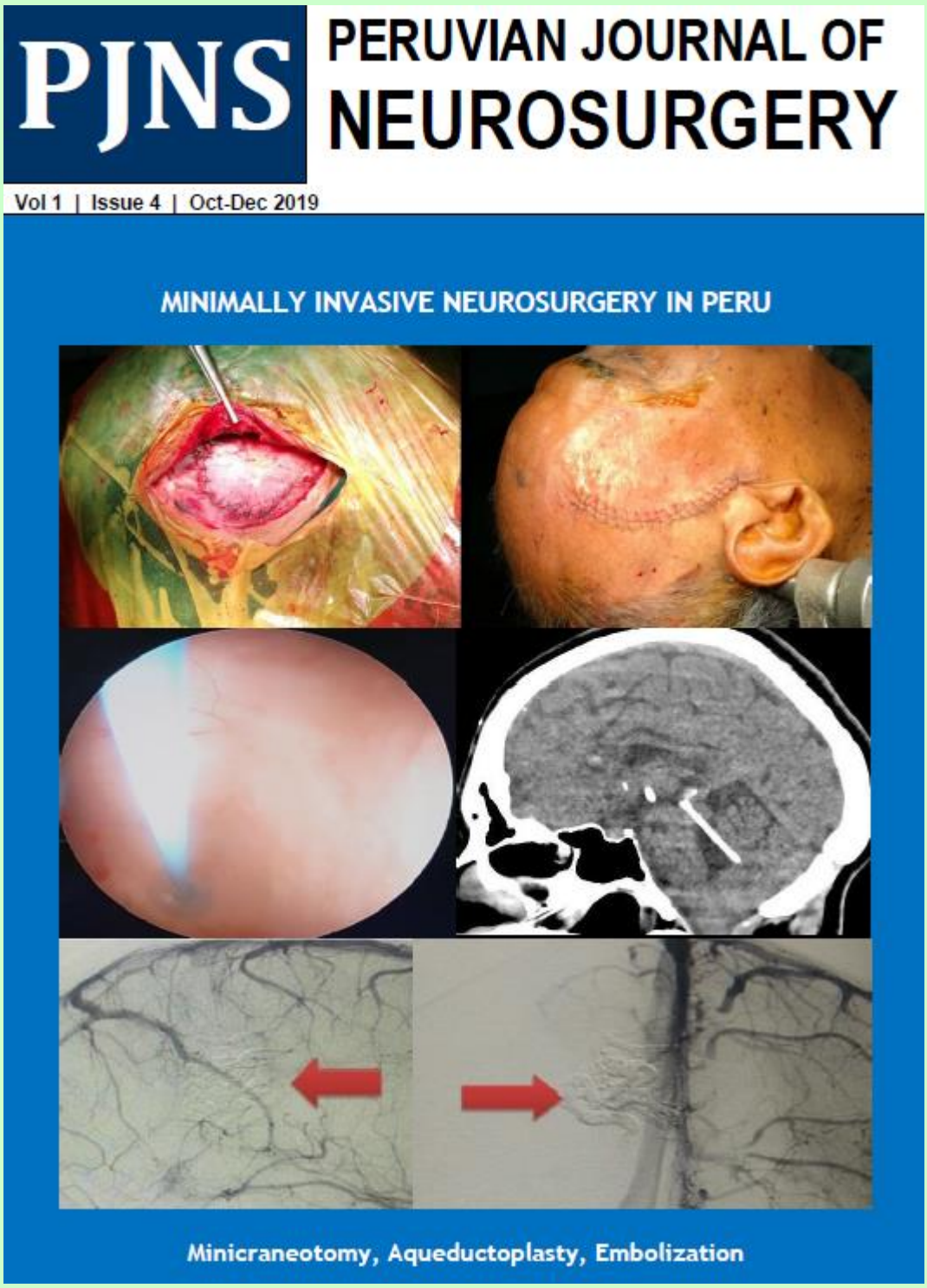
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