

Case Report

Lateral supraorbital approach to ipsilateral PCA-P1 and ICA-PCoA aneurysms

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Abstract

Background: Aneurysms of the posterior cerebral artery (PCA) are rare and often associated with anterior circulation aneurysms. The lateral supraorbital approach allows for a very fast and safe approach to the ipsilateral lesions Circle of Willis. A technical note on the successful clip occlusion of two aneurysms in the anterior and posterior Circle of Willis via this less invasive approach has not been published before. The objective of this technical note is to describe the simultaneous microsurgical clip occlusion of an ipsilateral PCA-P1 and an internal carotid artery - posterior communicating artery (ICA-PCoA) aneurysm via the lateral supraorbital approach.

Case Description: The authors present a technical report of successful clip occlusions of ipsilateral located PCA-P1 and ICA-PCoA aneurysms. A 59-year-old female patient was diagnosed with a PCA-P1 and an ipsilateral ICA-PCoA aneurysm by computed tomography angiography (CTA) after an ischemic stroke secondary to a contralateral ICA dissection. The patient underwent microsurgical clipping after a lateral supraorbital craniotomy. The intraoperative indocyanine green (ICG) videoangiography and the postoperative CTA showed a complete occlusion of both aneurysms; the parent vessels (ICA and PCA) were patent. The patient presents postoperative no new neurologic deficit.

Conclusion: The lateral supraorbital approach is suitable for the simultaneous microsurgical treatment of proximal anterior circulation and ipsilateral proximal PCA aneurysms. Compared to endovascular treatment, direct visual control of brainstem perforators is possible.

Key Words: Aneurysm, internal carotid artery, lateral supraorbital approach, posterior cerebral artery, posterior communicating artery

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INTRODUCTION

Aneurysms of the posterior cerebral artery (PCA) are rare; less than 2% of all cerebral aneurysms involve the PCA.^[2,9,10] PCA aneurysms are often associated with anterior circulation aneurysms.^[2,4]

Several surgical approaches, such as the pterional,^[15,18] orbitozygomatic,^[3] and anterior/pretemporal approach^[5,8] are described for treating vascular lesions at both locations. However, the classic pterional approach is the golden standard for the microsurgical treatment of aneurysms located on the ipsilateral Circle of Willis.^[2,18,19] During the past three decades, the lateral supraorbital approach, which is more anteriorly and subfrontally located than the pterional approach, was established in our institution.^[6,7]

The objective of this technical report is to present the lateral supraorbital approach for the microsurgical clip occlusion of ipsilateral internal carotid artery - posterior communicating artery (ICA-PCoA) and PCA-P1 aneurysms under direct visual control of the crucial perforating branches originating from the P1 segment of PCA.

Illustrative case

History and examination

A 59-year-old female patient developed symptoms of a left hemiparesis and a neglect to the left by a right cerebral infarction secondary to an idiopathic right carotid artery dissection. Therefore a cervical and intracranial computed tomography angiography (CTA) was performed. The CTA showed an occlusion of the right carotid artery and two intracranial aneurysms [Figure 1]: A left ICA-PCoA (saccular, neck 4 mm, width 6 mm, length 8 mm) aneurysm and a left-sided PCA-P1 (saccular, neck 2 mm, width 3 mm, length 6 mm) aneurysm.

Indication

The presented patient had multiple risk factors for intracranial aneurysm rupture (female gender, hypertension, smoker) and an occlusion of the

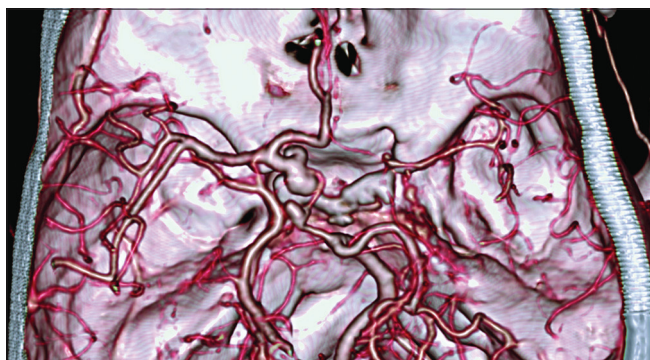


Figure 1: Preoperative computed tomography angiography reveal a right side carotid occlusion and a left side internal carotid artery PCoA segment aneurysm and a posterior cerebral artery P1 segment aneurysm

contralateral ICA, which leads to an increasing flow through the affected vessels, ICA, and PCA. Therefore, the indication for an active treatment was given. The operative treatment was performed 6 month after the ischemic stroke.

Positioning and craniotomy

The patient was placed in the supine position with the head rotated 30° to the left using a Sugita clamp. The head was slightly elevated above the heart level. A fast one-layer skin-muscle flap followed by a left sided lateral supraorbital craniotomy was performed [Figure 2].

Intracranial dissection

A schematic overview of the angioarchitecture in the surgical field is given in [Figure 3]. First the proximal portion of the sylvian fissure was carefully dissected. Thereby the C7 segment of the left ICA and the left ICA-PCoA aneurysm became visible [Figure 4]. The oculomotor nerve, the PCoA and the proximal portion with the PCA-P1 aneurysm were visible in the carotid-oculomotor-triangle [Figure 5]. Under direct visual control, the perforator and the anterior choroidal artery were detached from the left PCA-P1 aneurysm.

Clip occlusion

Under direct visual control, a pilot clip was placed on the PCA-P1 aneurysm and the aneurysm was shrunken with bipolar forceps. The attached perforating branches to the aneurysm dome were mobilized. For the placement of the final clip, a temporary clip was placed on the PCA and the aneurysm could be safely clipped using a straight (nontitanium) Yasargil mini-clip [Figure 6].

The ICA-PCoA aneurysm was dissected next. For the exposure of the whole affected ICA segment, arachnoid fibers between the proximal ICA and the optic nerve were cut. An anterior clinoidectomy was not necessary, but the overlying dura was coagulated down to obtain enough space. The whole ICA-PCoA aneurysm became

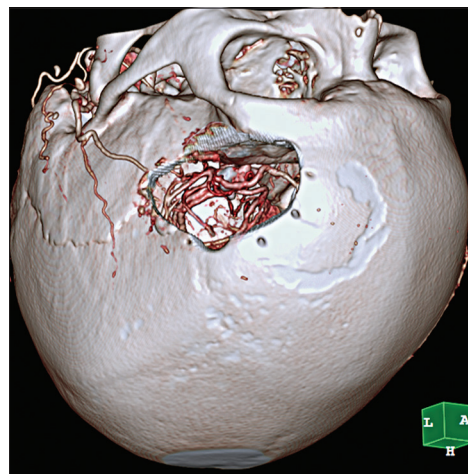


Figure 2: Postoperative 3D reconstruction image of the left lateral supraorbital craniotomy

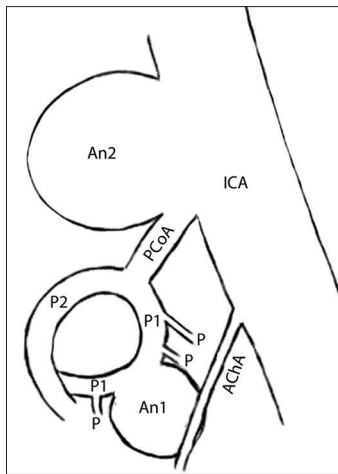


Figure 3: Schematic drawing of the PCoA complex, showing the angioarchitecture and the ICA-PCoA and PCA-P1 aneurysms. AChA – anterior choroidal artery, An1 - posterior cerebral artery P1 segment aneurysm, An2 – internal carotid artery - PCoA segment aneurysm, ICA – internal carotid artery, M1 - middle cerebral artery, P – midbrain perforating branches, P1 – posterior cerebral artery P1 segment, P2 – posterior cerebral artery P2 segment, PCoA – posterior communicating artery

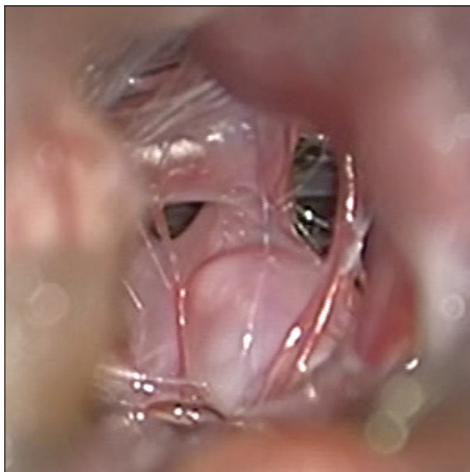


Figure 5: Intraoperative view of the left posterior cerebral artery P1 segment aneurysm

visible. A temporary clip was placed on the ICA and the aneurysm was electro-thermally shrunken; the origin of PCoA became visible. Finally, the ICA-PCoA aneurysm could be occluded with a straight (nontitanium) Yasargil standard-clip [Figure 7].

Intraoperative indocyanine green videoangiography

Postclip occlusion intraoperative indocyanine green (ICG) videoangiography provided real time images of the blood flow inside the ICA-C7 [Figure 8a] and PCA-P1 segment [Figure 8b]. All midbrain-perforating branches were preserved. The aneurysms were occluded.

Operation time

The skin to skin operation time was 55 min. The following times for temporary clipping were used:



Figure 4: Intraoperative view of the left side internal carotid artery PCoA segment aneurysm



Figure 6: Clip occlusion of the left posterior cerebral artery P1 segment aneurysm

65 s of the PCA (PCA-P1 aneurysm) and 70 s of the ICA (ICA-PCoA aneurysm).

Postoperative course

The patient was woken just after the surgery. The postoperative CTA show a reconstructed angioarchitecture without occlusion of the parent vessels or neck remnants [Figure 9]. The patient was discharged 6 days after the surgery with the same neurological state as preoperative (mRS of 2), caused by the preexisting right cerebral infarction secondary to an idiopathic right carotid artery dissection.

DISCUSSION

PCA aneurysms are often associated with anterior circulation aneurysms,^[2,4] which are well treatable by microsurgical means. Nevertheless, open microsurgical treatment of upper posterior circulation aneurysms is a challenging surgical procedure.^[18] The surgical field has to be approached through a deep, narrowed corridor

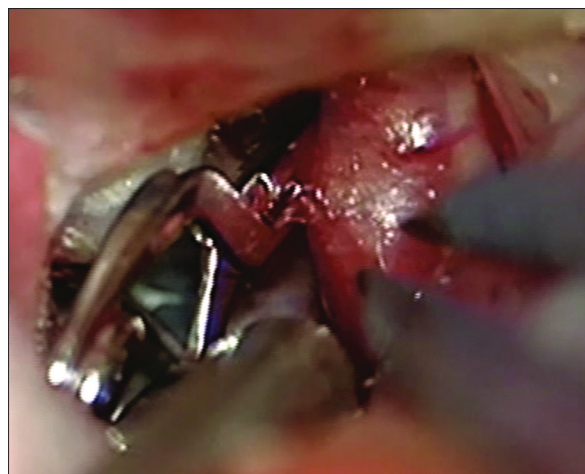


Figure 7: Clip occlusion of the left side internal carotid artery PCoA segment aneurysm

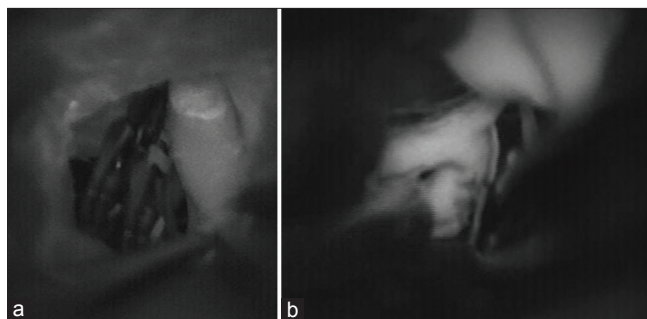


Figure 8: ICG videoangiography shows the occlusion of the ICA-PCoA aneurysm (a) and the PCA-PI segment aneurysm (b)

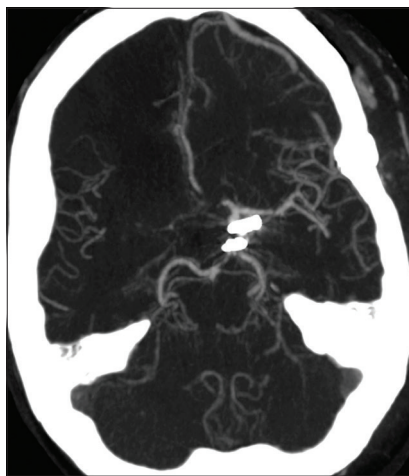


Figure 9: Postoperative CTA show the patency of the parent vessels (ICA and PCA)

surrounded by several sensitive structures.^[17] However, the microsurgical intracranial dissection is performed through the subarachnoid space, almost without affecting the neural tissue.

Frontotemporal approaches, in different modifications, are suitable for the treatment of aneurysms located

on the ipsilateral side, inside the circle of Willis.^[3,8,15,18] Compared to pterional or orbitozygomatic approaches, the lateral supraorbital approach is less invasive.^[7,14,16] The short one-layer skin muscle flap reduces the risk for facial nerve injuries and temporal muscle atrophy. The risk for cerebrospinal fluid (CSF) leakage, infections and epidural hematomas is decreased by the smaller craniotomy and dura opening. The distance to the ipsilateral ICA and PCA is much shorter compared with the small supraorbital key-hole craniotomy.^[13] The craniotomy is placed more anterior and subfrontal than the pterional approach and more lateral than the supraorbital key-hole craniotomy [Figure 2]. Thereby the lateral supraorbital approach provides sufficient workspace for fine instrument movements without intense brain tissue retraction.^[12] For the treatment of proximal PCA aneurysms, the preservation of all midbrain and brainstem perforating branches is especially crucial.^[2] For the intraoperative evaluation of the microsurgical procedure, the ICG videoangiography provides real time images of the parent vessels, the perforating branches, and the occluded aneurysm.^[1,11,12]

As a result, in our case, both aneurysms were occluded by microsurgical clipping, without constriction of parent vessel lumen or other technical problems and no perioperative complications were observed. Due to modern microsurgical techniques, the lateral supraorbital approach has become a relatively safe procedure in experienced hands.

CONCLUSION

A safe microsurgical treatment of ipsilateral aneurysms inside the circle of Willis is feasible by the lateral supraorbital approach. Compared to endovascular treatment, the important perforating branches can be preserved under direct visual control. However, a critical preoperative decision-making process is needed based on various factors such as estimated vessel occlusion time, anatomical features of the aneurysm, the angioarchitecture and the microsurgical skills.

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