

Acute visual loss after preoperative embolization of an ethmoidal metastasis

Karsten Hufendiek · Katerina Hufendiek ·
Thomas Finkenzeller · Horst Helbig ·
Carsten Framme

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Abstract An unintentional embolization of retinal arteries is rare and has been documented as a complication after embolization of arteries supplying head and neck tumors. However, occlusion of the central retinal artery with severe loss of vision has never been reported to be a complication from embolization of tumor-supplying ethmoidal branches of the ophthalmic artery. A 40 year-old male patient with a history of right

nephrectomy for renal cell carcinoma underwent preoperative radiological embolization of an ethmoidal metastasis after having experienced a life-threatening sinus bleeding. Repeated probing of the ophthalmic artery with an endovascular microcatheter for particle embolization of the tumor-supplying arteries was performed under anticoagulation with heparin. Postoperatively, a standard ophthalmological examination including extended vascular evaluation by angiography was performed. After extended probing of the ophthalmic artery a marked reduction in its blood flow occurred. Despite post-interventional imaging showing persisting perfusion of the central retinal and ciliary arteries, the patient developed complete loss of vision on this side four days later. At this time fundoscopy and fluorescein angiography revealed a recanalized central artery occlusion, while indocyanin angiography showed infarctions of the choroid. Radiological intervention via the ophthalmic artery can result in complete loss of vision, even after limited and transient obstruction of the vessel.

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K. Hufendiek · K. Hufendiek · H. Helbig · C. Framme
Department of Ophthalmology, University Medical
Center Regensburg, Regensburg, Germany

K. Hufendiek (✉)
University Eye Clinic Regensburg,
Franz-Josef-Strauss-Allee 11,
93042 Regensburg, Germany
e-mail: hufendiek@eye-regensburg.de

T. Finkenzeller
Department of Diagnostic and Interventional Radiology,
University Medical Center Regensburg,
Regensburg, Germany

T. Finkenzeller
Department of Diagnostic and Interventional Radiology,
Weiden Hospital, Weiden, Germany

C. Framme
Department of Ophthalmology, Bern University Hospital,
Bern, Switzerland

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Introduction

An unintentional embolization of retinal arteries is rare and has been documented as a complication after

embolization of arteries supplying head and neck tumors such as juvenile nasopharyngeal angiofibroma [1], meningioma [2–4], embolization of a maxillary artery [5], a thyroid artery [6] or even following cardiac catheterization [7]. In one case, a partial visual field defect occurred in the right eye after occlusion of the right upper branch of the central retinal artery [4]. A rare case of anterior ischemic optic neuropathy resulting in visual loss after craniofacial resection of a nasal lesion preceded by ophthalmic artery embolization has also been reported [8].

However, complete occlusion of the central retinal artery with severe loss of vision has never been reported to be a complication from embolization of tumor-supplying ethmoidal branches of the ophthalmic artery.

Patient and methods

A 40 year-old male who had undergone right nephrectomy for renal cell carcinoma five years earlier, experienced a life-threatening nasal bleeding. Ear, nose and throat examination revealed a mass of up to 5 cm diameter in the left nasal cavity and paranasal sinuses. Biopsy as well as 18F-fluorodesoxyglucose positron-emission-tomography computer tomography investigation confirmed an ethmoidal metastasis of the renal cell carcinoma. The patient was scheduled for pansinus surgery aiming for complete removal of the metastasis.

Radiological intervention

To minimize the risk of a second life-threatening bleeding and enable the complete resection of the metastasis, preoperative endovascular embolization using polyvinyl alcohol (PVA) particles [Contour[®] (150–250 µm); Boston Scientific, MA, USA] was selected to achieve obliteration of the tumor-supplying vessels, with respect to the risk of potential visual loss. The radiological intervention was performed under anticoagulation with heparin (5000 IU initially followed by constant infusion of 500 IU/h during intervention). During the procedure, repeated microcatheter-probing (Echelon[®] 14; MTI, MN, USA) of the mandibulovidian, the inferolateral and the ophthalmic artery became necessary to access the tumor-supplying arteries for embolization.

Ophthalmologic evaluation

A standard ophthalmological examination including testing of visual acuity (Snellen chart), slit-lamp examination and funduscopy was performed on days one and four postoperatively. For ophthalmological evaluation of retinal and/or choroidal malperfusion, standard fluorescein angiography and indocyanin green (ICG) angiography were performed on day four postoperatively. Macular assessment was performed on day four using stereo funduscopy and optical coherence tomography (OCT).

Results

Radiological intervention

Diagnostic angiography showed that the tumor was extensively supplied via the ethmoidal arteries arising from the distal portion of the ophthalmic artery (Fig. 1a). For tumor embolization a 14F microcatheter was positioned in the ophthalmic artery far distal to the origin of the central retinal artery and ciliary arteries. PVA-particle embolization was performed with repeated control of the patency of the ophthalmic artery. After prolonged positioning of the microcatheter in the lumen of the ophthalmic artery during the embolization process it was withdrawn and embolization of additional branches via the internal maxillary artery was performed. Repeated probing of the left ophthalmic artery with a new microcatheter revealed remaining blood flow to the metastasis via the posterior ethmoidal artery. Hence, a further selective embolization of this branch was performed (Fig. 1b). At the end of the intervention, the proximal ophthalmic artery including the portion harboring the central retinal artery and the posterior ciliary arteries appeared angiographically patent (Fig. 1c), with reduced blood flow in the distal ophthalmic artery.

Ophthalmologic evaluation

On the first day after the embolization procedure, visual acuity of the left eye was hand movement (bedside examination). Fundoscopy showed swelling of the optic disc. Further evaluation could not be performed due to the patient's reduced general state of health directly after the procedure.

Fig. 1 **a** Opacification of the tumor-supplying vessels via the left internal carotid artery. **b** Microcatheter tip in the distal ophthalmic artery aiming at the ethmoidal branches (*arrow*) and a larger feeder to the metastasis (*arrowhead*). **c** Opacification of the ophthalmic portion giving rise to the central retinal artery and the ciliary arteries (*arrow*) and persistent choroidal perfusion (*arrowhead*) at the end of the embolization procedure

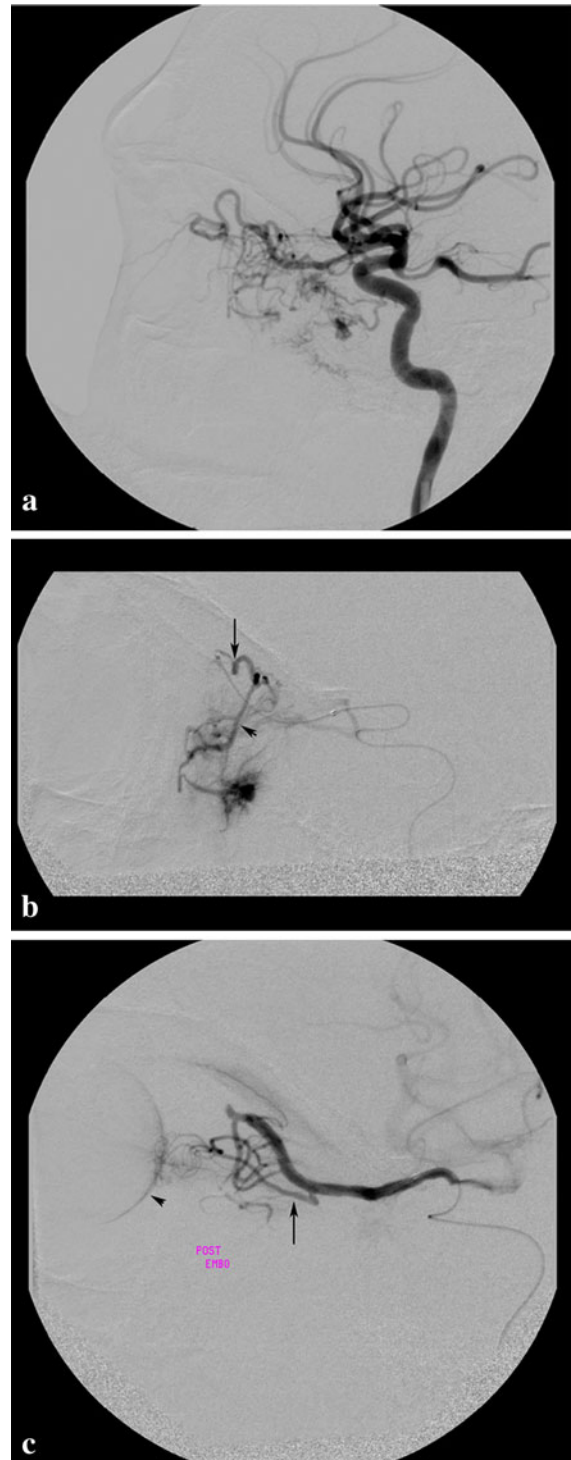
On follow-up three days later, a more pronounced loss of visual function with uncertain light perception had occurred in the left eye. Fundoscopy at this time showed features of retinal swelling (Fig. 2a). OCT showed marked retinal swelling with partial detachment of the posterior vitreous, with a faint signal in the photoreceptor outer segment/retinal pigment epithelium/inner choroidal layer complex (Fig. 2b). Fluorescein angiography showed delayed but complete filling of the retinal vessels (Fig. 2c–d), while ICG angiography showed areas of malperfusion of the choroid (Fig. 2e–f).

After discharge from the clinic, the patient was not seen in our department again, nor did he seek follow-up at a local ophthalmologist. This may be explained on the one hand by of the lack of therapeutic options and an unimpaired vision on the remaining functional eye or, on the other hand, by the patient's different perspective and priorities for his remaining lifetime.

Discussion

The central retinal artery is usually the first important intraorbital branch of the ophthalmic artery, arising in close association with the lateral and posterior ciliary arteries. During the course of the larger medial division of the ophthalmic artery, the anterior and posterior ethmoidal branches are given off, and therefore can have prominent anastomoses with the long sphenopalatine branches of the internal maxillary artery. This route along the nasal septum constitutes an anastomotic peril to the ophthalmic artery during embolization of the internal maxillary artery. A further threatening possible anastomosis between the external carotid artery and the ophthalmic artery via the internal maxillary artery, the recurrent meningeal artery and the lacrimal artery is described by Mames et al. [9].

After particle embolization of tumor-feeding vessels from the external carotid artery and branches from the cavernous segment of the internal carotid artery,



embolization was attempted directly via the ophthalmic artery, aimed at occlusion of the ethmoidal branches which represented the main arterial feeders

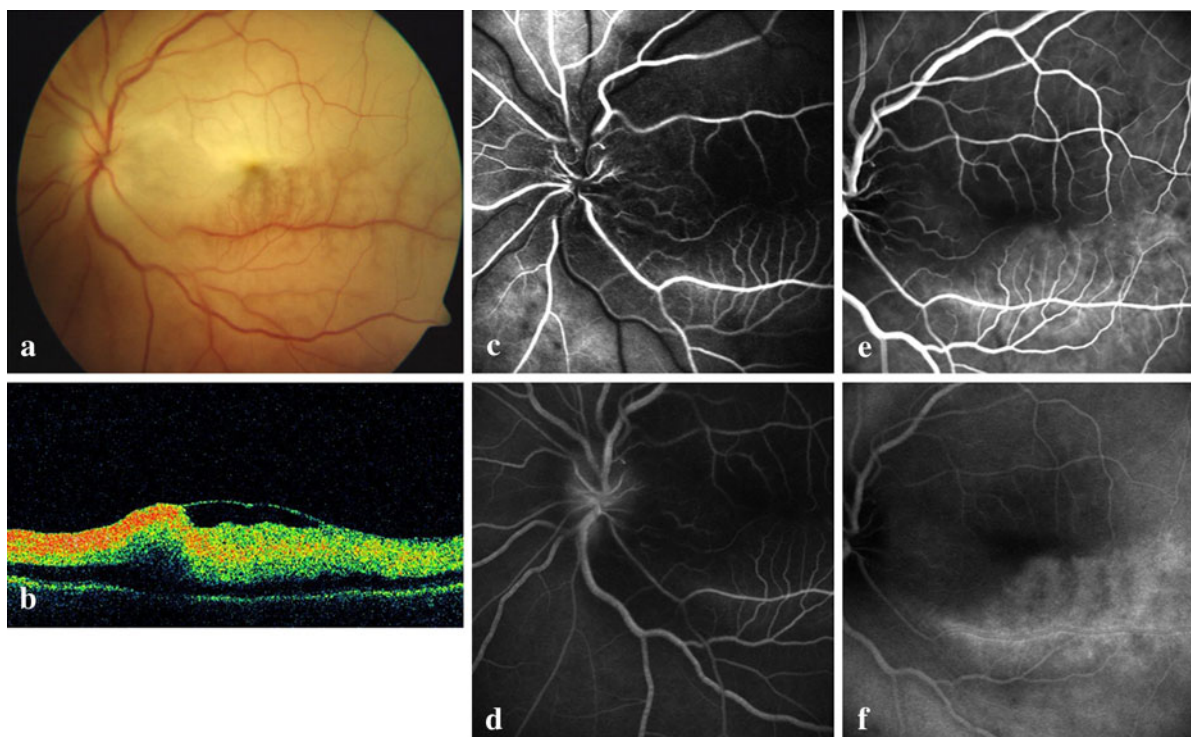


Fig. 2 **a** Photograph of the left fundus showing a faint cherry-red spot along with red-brownish halos around the vessels of the lower arcade. A milky-white edema obscures the region of the papillomacular bundle as well as the upper central arcade. **b** OCT of the left eye showing retinal swelling, partial detachment of the posterior vitreous and a reduced signal in the layer consisting of photoreceptor outer segments, retinal pigment epithelium and inner choriocapillaris. **c** Fluorescein

angiogram after 30 s with no apparent irregularities. **d** Fluorescein angiogram after 14 min with complete perfusion of the retinal vessels and slight leakage at the optic disc. **e** ICG angiogram after 58 s with patchy choroidal filling and hypofluorescence in the papillomacular bundle as well as around the upper central vessel arcade. **f** ICG angiogram after 16 min 41 s showing late staining of the area around the lower central vessel arcade

of the metastasis. At the end of the intervention, the portion harboring the central retinal artery and the posterior ciliary arteries appeared angiographically patent, although reduced blood flow in the ophthalmic artery was evident. This was attributed to the distal occlusion of the ophthalmic artery and its tumor-supplying branches.

Fluorescein angiography of the left central retinal vessels showed a delayed, but complete filling of arterial and venous vessels with some leakage. These findings are consistent with a post-occlusion status or reduced perfusion. A delayed central choroidal filling on ICG angiography might also suggest that the posterior ciliary arteries suffered from malperfusion.

Most likely this transient occlusion was caused by retrograde particle transport and consecutive embolization of the central retinal artery and ciliary arteries after the intervention. A possible alternative

mechanism is a secondary thromboembolization after the procedure as a result of altered local hemodynamics.

A central retinal artery occlusion with a visible PVA particle at the bifurcation of the central retinal artery on the optic disc has been recently reported after the embolization of a juvenile nasopharyngeal angiofibroma. The suggested mechanism was a hemodynamical alteration under the intervention with secondary filling of the ophthalmic artery by branches of the maxillary artery, which was affected by the embolization procedure through the external carotid artery [1].

In a similar situation, anterior ischemic optic neuropathy was described, resulting from migration of embolic material to the short posterior ciliary arteries as well as occlusion of the collateral blood supply to the optic nerve head through the external carotid artery [7].

Occlusion of a temporal branch of the upper central retinal artery with consecutive visual field defect has been documented after preoperative ophthalmic branch embolization of a hypervascular meningioma [4].

Fifteen percent of adults have a cilioretinal artery that feeds the macular region, and occlusions of the cilioretinal artery have been reported to be associated with systemic and ocular disorders, including central retinal artery or vein occlusions, collagen diseases, carotid artery dissection, and coronary catheterization. These occlusions can easily lead to severe visual dysfunction. On the other hand, central retinal artery occlusions with a patent cilioretinal artery result in good central visual acuity with peripheral visual field defects [2]. In our case, the loss of visual function is attributed to the temporary occlusion of both the central retinal artery and at least part of the choroidal arteries after the actual procedure. Hence it remains unclear whether the existence of a cilioretinal artery would have resulted in preservation of the central visual acuity.

Conclusion

The gravity of inadvertent occlusion of the central retinal artery usually precludes the possibility of direct embolization of the ethmoidal branches through the proximal ophthalmic artery, unless circumstances are extenuating or the eye is already blind.

In our case, preoperative embolization of the tumor-supplying vessels was considered necessary to prevent another life-threatening arterial bleeding and enable complete resection of the metastasis in this young patient. It was extensively discussed with the patient and his relatives before intervention, emphasizing the potential risk of visual loss after the procedure. The tumor responded well to the embolization procedure, and intraoperatively the anterior ethmoidal artery showed no pulsation indicating complete embolization. Tumor resection was performed without complications and without local relapse.

Hence, the patient in this case lost vision in one eye through surgery of a life-threatening metastasis but had a good quality of life for approximately 16 months afterwards, still working as a farmer for most of the time. He died in May 2009 from metastatic disease.

In vision-threatening radiotherapeutic procedures, comprehensive explanation and discussion of the procedure and its risks is mandatory.

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