

Anterior ischemic optic neuropathy after transvenous coiling of dural arteriovenous fistulas: A case report

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Case report

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Abstract

Background A dural arteriovenous fistula (dAVF) is defined as an abnormal arteriovenous direct connection in the dura mater, with the cavernous sinus (CS) being one of the most common locations. Transarterial or transvenous embolization remains the first-line treatment for most dAVF, although these procedures are associated with rare sight-threatening ophthalmic complications. We report a case of nonarteritic anterior ischemic optic neuropathy (nAION) following successful treatment of dAVF with a coil embolization. **Case presentation** A 76-year-old woman complained of conjunctival hyperemia in both eyes 1 month prior to visiting our hospital. She was diagnosed with bilateral dAVF based on magnetic resonance angiography (MRA). On ophthalmic examination, her best-corrected visual acuity (BCVA) was 0.8 in the right eye and 0.7 in the left. Intraocular pressure was 27 mmHg in the right and 24 mmHg in the left. Extraocular movements were limited in all directions. Slit lamp examination disclosed red eyes with dilated corkscrew vessels. Funduscopy examination revealed normal findings in both eyes except a partial chorioretinal atrophy in the left eye. Goldmann perimetry revealed an inferior nasal defect corresponding to the chorioretinal atrophy in the left eye and normal visual field in the right eye. Transvenous coil embolization of the right CS was performed. The dAVF was completely embolized and there was no intraoperative complication. Follow-up brain MRA showed no evidence of residual dural fistula. Ten days after embolization, she developed double vision and visual disturbance in the right eye. Her right BCVA was 0.8. Fundus examination revealed pallor papilledema and splinter hemorrhages at the optic disc edge in her right eye. Fluorescein angiography showed hypofluorescence around the optic disc and a nasal lesion in the early phase. Goldman perimetry revealed lower altitudinal hemianopsia in the right eye. From these findings, nAION was diagnosed. During hospitalization, her right BCVA decreased to 0.08. Ten months later, funduscopy revealed right temporal optic disc pallor without edema, and her right visual acuity remained at 0.08. **Conclusions** We report a case of nAION after embolization of dAVF located in CS. This complication should be considered after embolization for dAVF.

Background

A dural arteriovenous fistula (dAVF) is defined as an abnormal arteriovenous direct connection in the dura mater, with the cavernous sinus (CS) being one of the most common locations [1, 2]. A dAVF may arise spontaneously or develop after craniocerebral trauma. The patients have signs and symptoms characteristic of increased CS pressure, including orbital or retro-orbital pain, pulsatile proptosis, dilated conjunctival and episcleral vessels, ocular or cranial bruit, deterioration of visual acuity, and ophthalmoplegia [1, 2]. Although transvenous embolization of a dAVF has been proven to be safe and provide complete occlusion of the fistula [3-5], ophthalmic complications including central retinal vein occlusion, posterior ischemic optic neuropathy, choroidal detachment and choroidal infarction after operation have been reported [6-9].

In this report, we present a rare case of nonarteritic anterior ischemic optic neuropathy (nAION) that developed after transvenous coil embolization.

Case Presentation

A 76-year-old Japanese woman with no previous medical and traumatic history presented with gradually worsening conjunctival congestion in both eyes from 2 weeks prior to visiting our hospital. She had been diagnosed with conjunctivitis and prescribed antibacterial eye drops in a local ophthalmology clinic. While undergoing therapy, she developed double vision and headache. She visited a private neurosurgery clinic and was diagnosed with dAVF. She was then referred to the department of neurosurgery in our hospital for further investigation and treatment. Magnetic resonance imaging (MRI) angiography identified a high-intensity signal in the CS (Fig. 1). Digital subtraction angiography (DSA) revealed dAVFs with a shunting point mainly in the right CS. Bilateral external carotid arteries were involved as feeders from middle meningeal arteries (MMAs), and the shunted blood flow drained into the right superior ophthalmic vein (SOV) and uncal vein. The shunted blood flow also entered the left CS via the intercarvernous sinus and drained into the left SOV and left inferior petrosal sinus (Fig. 2).

On ophthalmic examination, her best-corrected visual acuity (BCVA) was 0.8 in the right eye and 0.7 in the left. Intraocular pressure was 27 mmHg in the right and 24 mmHg in the left. Extraocular movements were limited in all directions of gaze in both eyes. Hess charting confirmed underaction of the right inferior rectus. There was no obvious proptosis and pulsatile bruit. Slit lamp examination disclosed red eyes with dilated corkscrew vessels, but no evidence of angle closure or other causes of increased intraocular pressure. Funduscopy examination revealed chorioretinal atrophy in the inferior quadrant of the left eye. Goldmann perimetry revealed an inferior nasal defect in her left eye, corresponding to the chorioretinal atrophy observed in funduscopy examination. A normal visual field was demonstrated in her right eye.

Transvenous coiling embolization of the right CS under general anesthesia was performed 16 days after the first visit. The dAVF was successfully embolized and there was no intraoperative complication. Following embolization, her symptoms including headache and diplopia, conjunctival erythema and ocular movement improved. Follow-up brain MRI and MRA one day after embolization showed no evidence of residual dural fistula (Fig. 3).

Ten days after embolization, she developed double vision and visual disturbance in her right eye. The BCVA was 0.8 in the right eye and 0.9 in the left. Intraocular pressure was 13 mmHg in the right and left eyes. Fundus examination revealed pallor papilledema and splinter hemorrhages at the optic disc edge in her right eye (Fig. 4). Fluorescein angiography showed hypofluorescence of a lesion nasal to the optic disc in the early phase due to delayed filling without apparent retinal vascular occlusions. Goldman perimetry revealed lower altitudinal hemianopsia in her right eye (Fig. 5). These findings led to a diagnosis of nAION. Kallidinogenase and vitamin B12 were prescribed. During hospitalization, her right visual acuity worsened to 0.08. After 8 months, funduscopy revealed right temporal optic disc pallor without edema, and her right visual acuity remained at 0.08.

Discussion And Conclusions

Endovascular therapy has been the first-line treatment for dAVF. Few cases of ophthalmic complications associated with endovascular therapy have been reported [6-9]. This is the first report of a case of nAION that developed after transvenous coiling in a patient with dAVF.

Although the exact pathogenesis of nAION remains unclear, nAION is essentially caused by transient hypoperfusion or nonperfusion of the posterior ciliary arteries (PCAs) supplying the optic nerve head, and usually not by occlusion of the PCAs.¹⁰ Short PCAs that arise from the medial branching of the ophthalmic artery are the major vessels supplying blood to the optic nerve head. In this case, preoperative DSA demonstrated many branches from MMAs. Dilenge and Ascherl [11] reported variations of the ophthalmic artery and MMAs, including ophthalmic artery arising from MMA and/or MMA arising from ophthalmic artery. Although angiographic findings do not provide the complete picture, surgeons and ophthalmologists should consider the possibility of onset of nAION after the dramatic hemodynamic changes involving the ciliary circulation caused by abrupt closure of the arterio-venous shunt.

Another possible cause of nAION is that the coil material induces a sequence of chemical thrombogenic events in the vessels, resulting in acute allergic inflammation followed by vasculitis. Although thrombogenic events due to other factors may be involved, visualization of these events is difficult.

To date, there is no high-grade evidence for an effective treatment of nAION. Because of the poor visual prognosis of nAION, this complication should be taken into consideration after embolization for dAVF and patients should be informed of the existence of a small but unpredictable risk of vision loss.

Abbreviations

dAVF: dural arteriovenous fistula

CS: cavernous sinus

nAION: nonarteritic anterior ischemic optic neuropathy

MMAs: middle meningeal arteries

BCVA: best corrected visual acuity

MRI: magnetic resonance imaging

DSA: digital subtraction angiography

PCAs: posterior ciliary arteries

Declarations

Ethics approval and consent to participate

This study followed the tenets of the Declaration of Helsinki. Ethics approval was not applicable. The written informed consent was obtained from the patient.

Consent for publish

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Availability of data and materials

All data generated and analyzed during this study are included in this article.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

KF, KM and SM clinically assessed, analyzed and interpreted the patient data regarding the ocular manifestations. KF and KM drafted the article, SM and MK provided critical revision and correction of the manuscript. All authors read and approved the final manuscript.

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Not applicable

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Figures

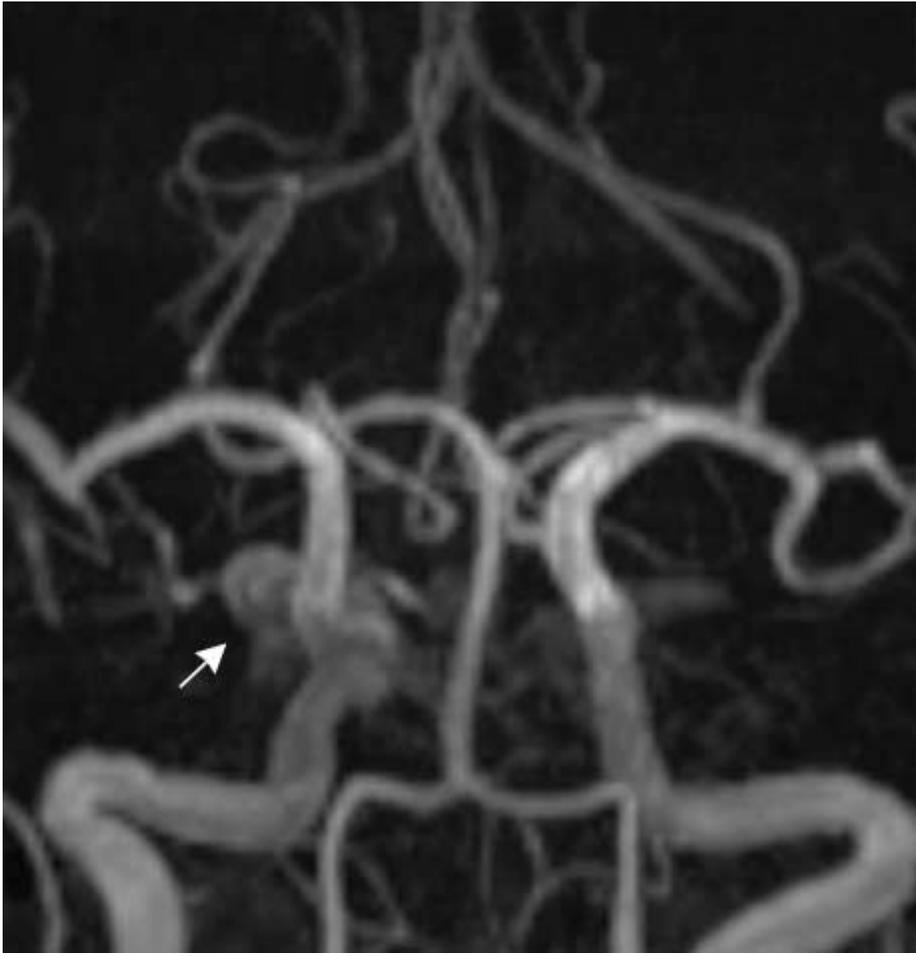


Figure 1

MRI angiography shows abnormal high intensity signal (arrow).

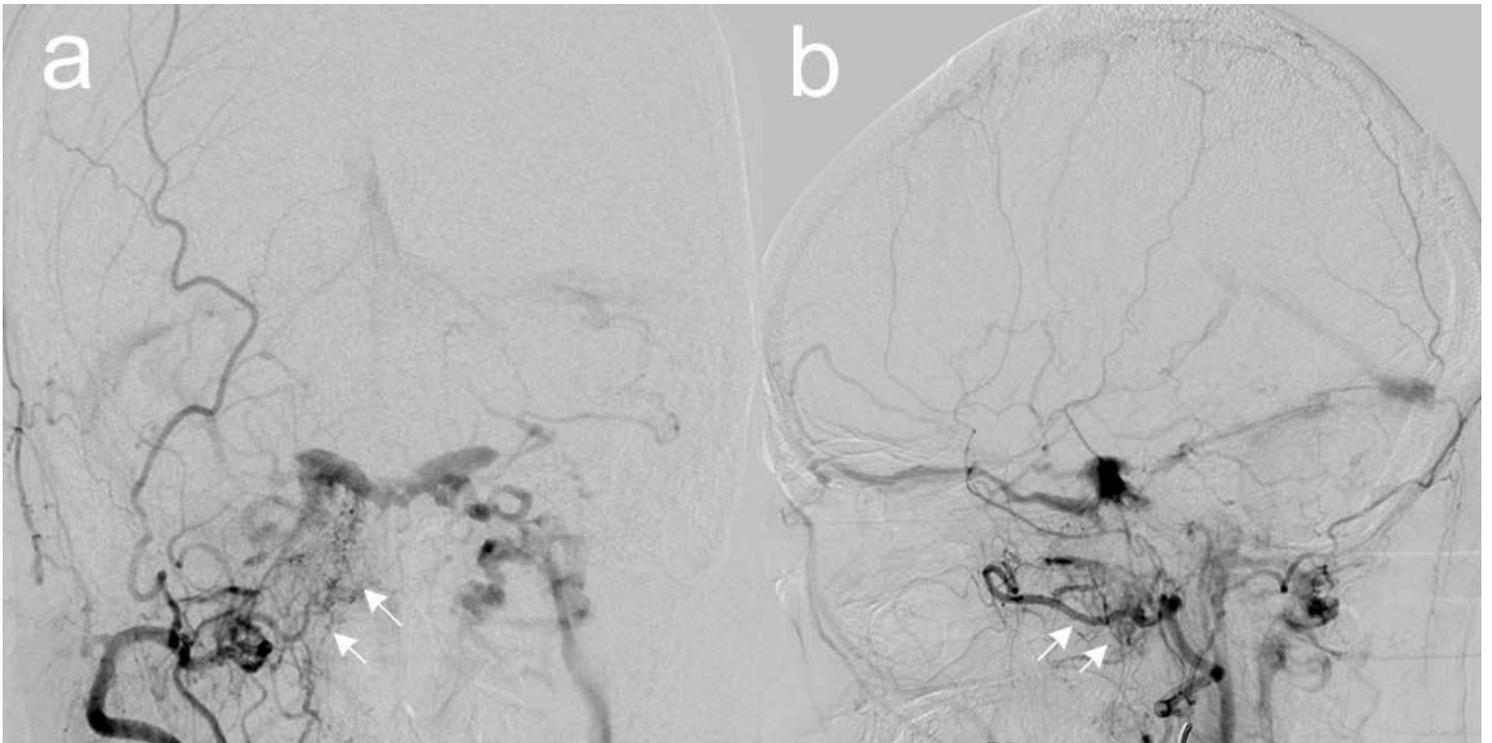


Figure 2

Right external carotid angiograms: (a) anterior-posterior view and (b) lateral view. Right external carotid angiogram shows dural arteriovenous fistula at the cavernous sinus (arrows).

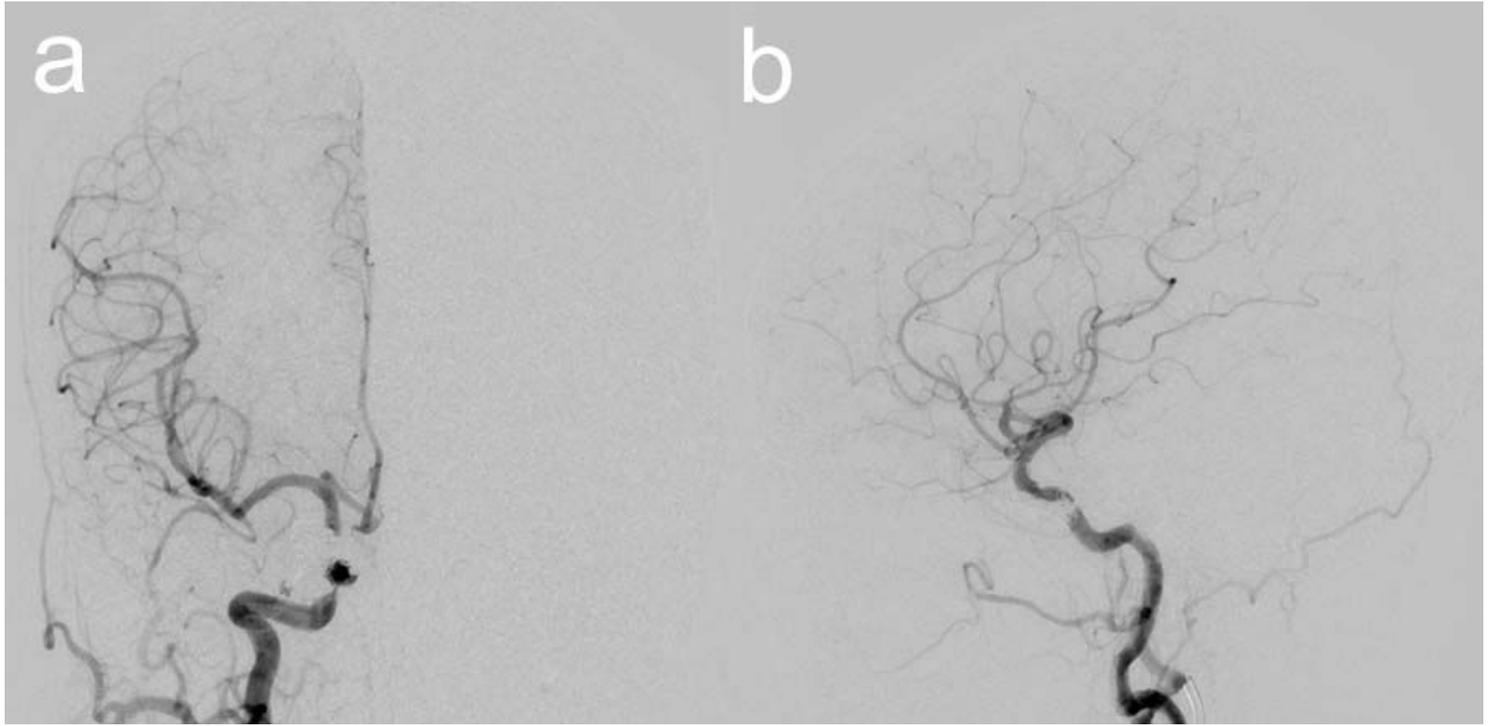


Figure 3

Postoperative common carotid angiogram: (a) anterior-posterior view and (b) lateral view. Postoperative common carotid angiogram shows disappearance of the dural arteriovenous fistula.

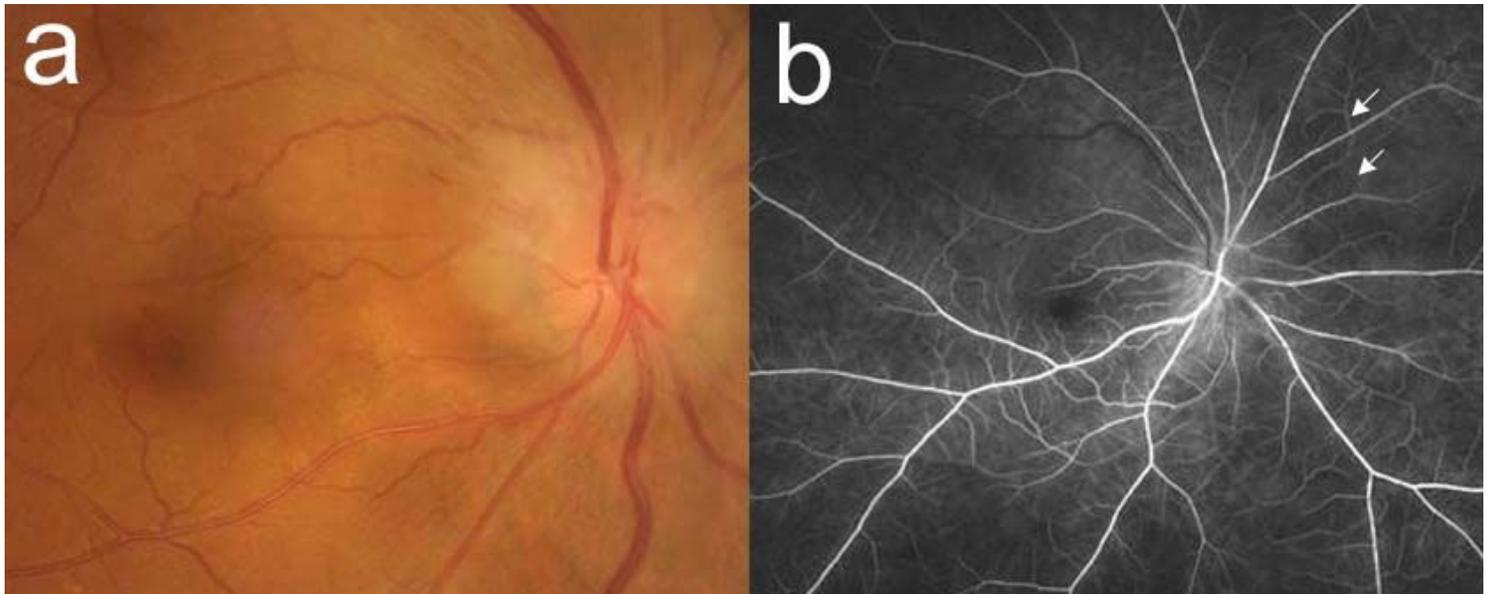


Figure 4

a) Fundus photograph of the right eye 10 days after embolization shows pallor papilledema and splinter hemorrhages at the optic disc edge. (b) Fluorescein angiography shows hypofluorescence of a lesion nasal to the optic disc in the early phase (arrows).

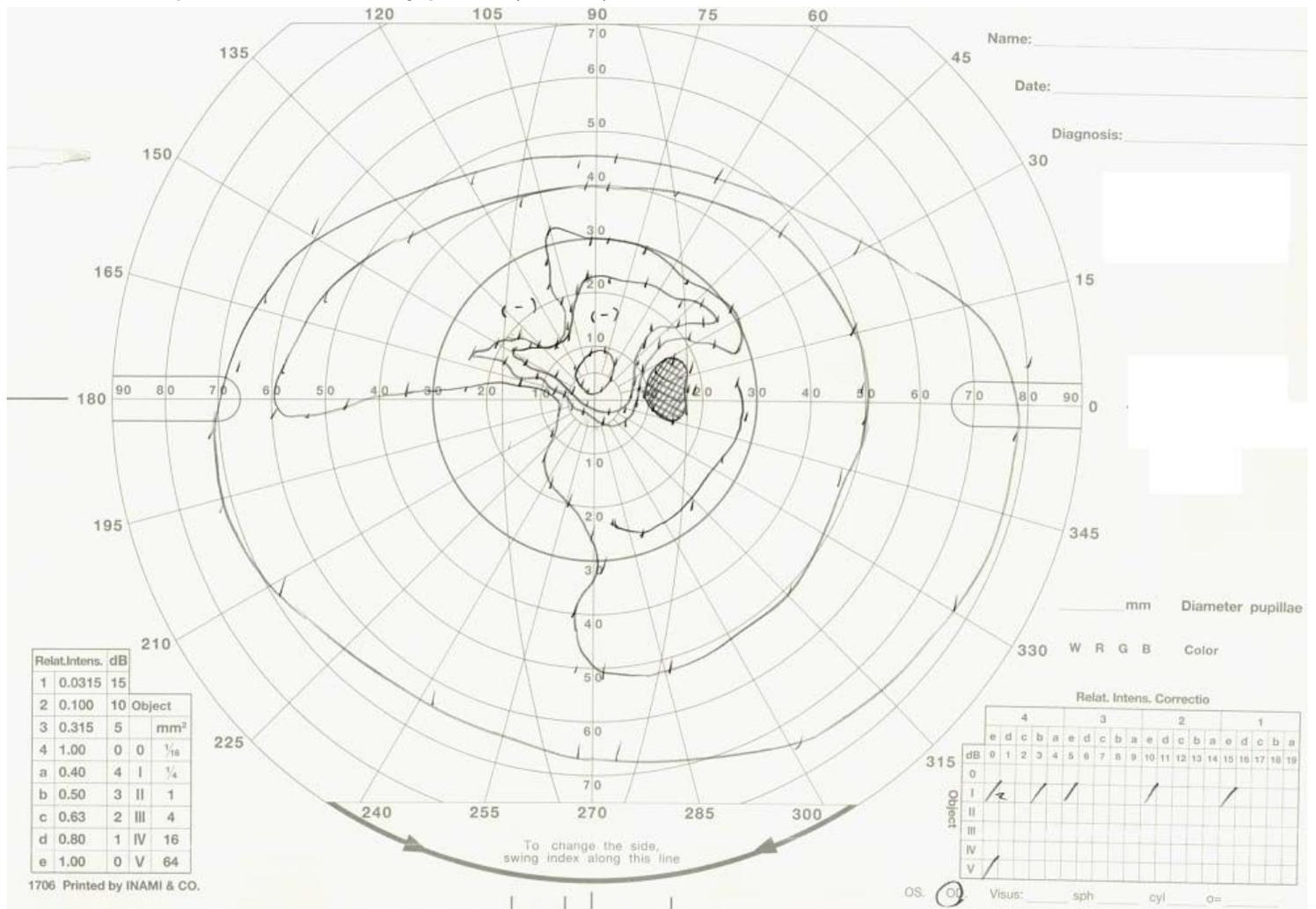


Figure 5

Goldmann perimetry shows lower altitudinal hemianopia in the right eye.

Supplementary Files

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