Abstract:
Papilledema is a key diagnostic factor in the management of several neurological conditions. Papilledema has a variety of causes related to increased intracranial pressure (ICP), several of which require prompt surgical or medical intervention due to potential vision or life-threatening consequences. Magnetic resonance imaging (MRI) of the brain is key to making the correct diagnosis and management decisions. This case report illustrates acute onset papilledema in a young Caucasian male due to acquired hydrocephalus from a rare condition, idiopathic stenosis of the foramen of Monro. An MRI performed following the eye examination prompted a referral to neurology and neurosurgery for urgent intervention, leading to eventual good visual outcome for the patient. The important role of eye care providers in diagnosis, referral, and post-surgical management is emphasized.

Introduction
Papilledema, by definition, is bilateral optic disc edema secondary to increased intracranial pressure (ICP), though the edema may be asymmetric in its presentation. Thus, the cause of papilledema is directly related to the cause of increased ICP. According to the Monro-Kellie doctrine, intracranial pressure is determined by the composition of blood volume, cerebrospinal fluid (CSF) volume, and brain volume. Causes of increased ICP can include space-occupying lesions, cerebral edema, hydrocephalus or blockage of cerebrospinal fluid (CSF) flow or resorption, or idiopathic. Hydrocephalus is an impairment in CSF flow categorized as communicating (non-obstructive) or obstructive. Communicating hydrocephalus results from an impairment in CSF absorption or overproduction of CSF. Obstructive hydrocephalus is caused by impeded CSF flow within the ventricles of the brain.

Pertinent ocular history included refractive error. His most recent eye examination was 3 years prior while on active duty. The presence of papilledema is often a significant neurological finding and an important clinical factor in determining the course and success of treatment in a variety of cases. For instance, in the setting of idiopathic intracranial hypertension (IIH), visual loss is a key morbidity of the condition and considered a main outcome measure in determining success of treatment. Papilledema has also been listed as a poor prognostic factor in cerebral venous sinus thrombosis (CVST).

This case report illustrates papilledema due to acquired hydrocephalus from stenosis of the foramen of Monro which had eventual good visual outcome following appropriate referral and surgical treatment of the underlying condition. While hydrocephalus may be due to a variety of causes, stenosis of the Foramen of Monro is a rare condition reported in the literature.

Case Report
A 29-year-old Caucasian male presented to the optometry clinic at the Veterans Affairs hospital with an initial complaint of intermittent loss of peripheral vision in both eyes over the last two months. He described a white light obscuring part of his vision, lasting 30-45 seconds at a time, and occurring intermittently throughout the day with no apparent triggers and were not specific to postural changes. He also noted a few isolated occurrences of self-resolving intermittent horizontal binocular diplopia over the last 2 weeks. The veteran also complained of tension headaches over the past several months.

The veteran had a history of multiple traumatic brain injuries (TBI) with loss of consciousness. Additional medical history included essential hypertension, lumbar radiculopathy, tobacco use disorder, anxiety, chronic low back pain, neck pain, and epidermoid cyst of the skin. Current medications included chlorthalidone, cyclobenzaprine, and duloxetine with known allergy to gabapentin.

Pertinent ocular history included refractive error. His most recent eye examination was 3 years prior while on active duty. The patient was oriented to person, place and time, and had normal mood and affect. External observation revealed normal and symmetrical facial appearance.

Entering distance visual acuity was 20/25 in the right and left eye with moderate myopic astigmatic correction. Pupils were equal, round, and reactive to light with no afferent pupillary defect (APD) in either eye. Extraocular motility was full and...
Papilledema Due to Bilateral Stenosis of the Foramen of Monro

Differential diagnoses at this time included papilledema, idiopathic intracranial hypertension, pseudopapilledema secondary to optic disc drusen, and Leber Hereditary Optic Neuropathy (LHON). IIH is unlikely due to the patient’s sex, and pseudopapilledema is unlikely due to the moderate degree of disc edema in both eyes. LHON was a lower-tier differential because this condition presents asymmetrically and with acute vision loss. Additional causes of bilateral disc edema can include diabetic papillopathy and severe hypertensive retinopathy, which were not listed as differentials due to the patient’s most recent blood glucose levels and blood pressure.

Therefore, the patient was diagnosed with papilledema and was sent for STAT magnetic resonance imaging (MRI) of the brain and orbits with contrast to determine the presence of intracranial pathology. Blood work including complete blood count (CBC) with differential and erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels was ordered to rule out atypical causes of bilateral disc edema.

The CBC results showed mild elevation of the white blood cell count (WBC) with all others being essentially normal. Both ESR and CRP were normal for the patient’s age and gender. The MRI results were as follows: “Orbits: flattening of posterior globe, consistent with intracranial hypertension. No obstructive lesions noted, no vascular abnormalities. Ventricles: Lateral ventricles are symmetrically enlarged. Third and fourth ventricles are normal in size and position. Foramen of Monroe appears patent. No evidence of colloid cyst. (1) Compensated mild lateral ventricular hydrocephalus with third ventricular sparing. No colloid cyst or mass lesion compressing the foramen of Monro. Findings are suggestive of idiopathic foramen of Monro atresia/stenosis. (2) Findings compatible with intracranial hypertension. There is narrowing of the posterior superior sagittal sinus and bilateral distal transverse sinuses. Findings may be related to venous compression and mass effect on the dural venous sinuses versus chronic stricture/narrowing” (Figure 3).

Following the MRI results, neurology and neurosurgery were both consulted regarding the findings for continuation of the patient’s care. Due to concern for permanent loss of smooth in both eyes, with reported mild diplopia in extreme right and left gazes. He did not report any pain with eye movement. Cover test with correction revealed orthophoria in primary gaze at distance and near. Red cap testing demonstrated 85% saturation in the right eye compared to full saturation in the left eye.

Anterior segment examination with slit lamp was unremarkable in both eyes. Goldmann applanation tonometry measured 20 mmHg in the right eye and 19 mmHg in the left eye.

Dilated fundus examination revealed Grade 3 (Frisén scale) optic disc edema in both eyes (Figure 1). Maculae were flat and intact without hard exudates, vitreous was clear without cells, retinal vasculature had normal course and caliber, and retinal periphery was intact 360 degrees without holes or tears in both eyes.

Humphrey Visual Field 30-2 SITA Standard testing (Humphrey Field Analyzer 3, Carl Zeiss Meditec, Inc., Version 3.2.0.4329) demonstrated superior arcuate edge defect with mild inferior scotoma in the right eye and an enlarged blind spot with scattered nasal defects in the left eye (Figure 2).

In-office blood pressure measurement was 144/96, pulse rate 77 bpm at 11:30 am. The patient denied history of autoimmune conditions including multiple sclerosis, recent infections or illnesses, and cancer. The patient’s most recent lab work per records review demonstrated normal HbA1c and blood glucose with elevated cholesterol, triglycerides, and low-density lipoprotein (LDL).
vision related to the high intracranial pressure, neurosurgery recommended the patient be referred to the local university hospital in order to receive prompt surgical intervention.

The patient was admitted to the university hospital following confirmatory exam and MRI. A review of previous cervical spine MRI showed no Chiari malformation of the hindbrain. The veteran denied any previous history for meningitis which ruled out scar tissue at the foramen of Monro causing obstructive hydrocephalus. The neurosurgeon recommended surgery for endoscopic fenestration of the septum pellucidum (to establish communication between the lateral ventricles) followed by placement of a ventriculoperitoneal (VP) shunt. The following day a right frontal septostomy and placement of the ventriculoperitoneal shunt was successfully performed. The patient was followed closely post-surgery with neurosurgery at the VA to monitor ventricular size and patency of the shunt (Figure 4).

The patient returned 9 months after his initial exam to the optometry clinic for follow-up. He reported that his vision had returned to normal with full resolution of his prior transient visual obscurations (TVO). There was no change to the patient's medical history, except for new medications: meloxicam (NSAID) and nicotine polacrilex lozenge. Best-corrected visual acuity was 20/20 in the right and left eye. Pupils were equal, round, and reactive to light with no APD in either eye. Ocular alignment was normal and extraocular motility was full and smooth in both eyes. Anterior segment examination was unremarkable in both eyes, and Goldmann applanation tonometry measured at 14 mmHg in both eyes. Dilated fundus examination revealed full resolution of disc edema in both eyes, with distinct optic disc margins and pink rim tissue in both eyes (Figure 5). Posterior segment was unremarkable in both eyes. Repeat threshold visual field testing demonstrated full improvement of visual field loss in both eyes (Figure 6).

**Discussion**

Papilledema is a key diagnostic factor in the management of several neurologic conditions. It is well-known that the most common neurologic symptoms in patients with papilledema are headaches (reported in 85-90% of cases), nausea, and pulsatile tinnitus. Less common symptoms may include behavioral changes, fatigue, hemiparesis, seizures, or increased head size in children. Transient visual obscurations (TVO) is the most common visual symptom reported, and is classified as episodic visual disturbances which last seconds to minutes and can often be related to postural changes. TVO is reported in up to 50-70% of papilledema cases, with additional vision symptoms including blur, diplopia, visual field loss, or photophobia. Diplopia is caused by abducens nerve palsy (cranial nerve VI), which is the only cranial nerve deficit expected in the presence of papilledema. At initial clinical presentation, it is very common to have normal visual acuity, pupillary function, and color vision in both eyes with visual field defects as the only abnormal examination finding in addition to disc edema. Grading of papilledema is based on the modified Frisén scale, which clearly illustrates a progression of edema from the nasal rim, then superior and inferior poles, and finally involving the temporal rim. Grade 0 is defined as a normal optic disc, with prominence of the retinal nerve fiber layer (RNFL) at the nasal, superior, and inferior poles. Grade 1 (minimal edema) describes a C-shaped halo sparing the temporal rim. Grade 2 (low edema) involves the entire disc margin without major vessel obscuration. Grade 3 (moderate edema) involves obscuration of one or more segments of major blood vessels leaving the disc in addition to a circumferential halo. Grade 4 (marked edema) describes total obscuration of a segment of a major blood vessel, complete border obscuration, and elevation of the entire nerve head including the cup. Grade 5 (severe edema), sometimes nicknamed “champagne-cork” edema, is defined as obscuration of all vessels on the disc and leaving the disc.

Proper evaluation and management of papilledema includes dilated retinal examination, threshold visual field testing, optical coherence tomography (OCT) of the optic discs, optic nerve head photography, and thorough case history including additional neurologic symptoms. Threshold visual field and OCT are important measures in tracking progression or improvement of disc swelling. Pertinent neurologic symptoms can be a key diagnostic factor, guiding radiologic studies of the brain, orbits, or spinal cord. Initial workup should include magnetic resonance imaging (MRI) of the brain and orbits, with and without contrast. Co-management with a team of neurologists and radiologists is suggested in order to continue with further workup following the MRI results. In this case report, MRI results led to referral to neurosurgery for prompt surgical management of hydrocephalus.

Papilledema can be due to a variety of conditions resulting in increased ICP, which is broadly divided into four causes:
Hydrocephalus is an impairment in normal CSF flow within the cranium, and may be caused by over-production of CSF or blockage of CSF resorption. Hydrocephalus may be acquired or congenital. Congenital hydrocephalus is distinguished by increased head size due to open fontanelles. Hydrocephalus is categorized as communicating (non-obstructive) or obstructive. Communicating hydrocephalus is caused by impaired CSF absorption into the venous drainage, such as meningitis, subarachnoid hemorrhage (SAH), or spinal cord neoplasms. Obstructive hydrocephalus is due to impeded CSF flow and results in enlargement of the ventricles on neuroimaging. Obstruction of the ventricles or foramen may be caused by neoplasms, meningitis, cerebral hemorrhage, or congenital aqueductal stenosis. The foramen of Monro is a rare condition in adults, and may be unilateral or bilateral, due to true stenosis or membrane occlusion.

Stenosis of the foramen of Monro is treated surgically with a neuro-endoscopic approach as the preferred method. There is some debate in the literature regarding shunt placement or endoscopic third ventriculostomy (ETV) in regards to efficacy and surgical outcomes. Surgical success for hydrocephalus can be measured by neurologic status, ventricle sizes on neuroimaging, resolution of papilledema, and optic nerve sheath diameter. However, several researchers suggest that ventricle size is not a reliable indicator of clinical outcome, nor is it reliable when determining surgical success. Recurrence of papilledema is likely more indicative of surgical failure, especially in ETV.

**Conclusion**

Papilledema is a key neurologic finding in the detection and prompt treatment of otherwise asymptomatic neurologic conditions. Eye care providers should be familiar with the importance of proper diagnosis and co-management with neurologists and neurosurgeons. Regular threshold visual field and RNFL OCT are also important measures in determining resolution of papilledema following medical or surgical treatment.

**References**


**Figure 6.** Follow up Humphrey Visual Field 30-2 SITA Standard testing of both eyes.

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