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CASE REPORT

Bridging the Diagnostic Gap between Emergency Medicine and Neuro-Ophthalmic Disorders with Technology and Telehealth

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ABSTRACT

Patients presenting with neuro-ophthalmic disorders pose a diagnostic challenge when they present to community hospital emergency departments (ED) where expertise in neuro-ophthalmology is often limited. Many have no ophthalmology coverage or have a call group composed of general ophthalmologists who are not comfortable managing neuro-ophthalmic disorders. The limited familiarity with neuro-ophthalmology and the lack of essential equipment, such as a fundus camera or optical coherence tomography (OCT), contribute to a substantial gap in accurate and timely diagnosis and treatment. This deficiency results in patients making multiple visits to the emergency department, where they receive limited or no treatment, and this overall increases the risk of disease progression and potentially blindness.

Advocating for standardized protocols and integrating technological advancements will aid non-ophthalmologist physicians and mid-level physician extenders in the initial assessment and management of patients with acute visual issues. Additionally, improving the accessibility of neuro-ophthalmological services through telehealth, and diagnostic aids (such as smartphone-based fundus cameras) in emergency department settings is essential to avoid overlooked or misdiagnosed neuro-ophthalmological disorders.

We describe two common scenarios that illustrate the diagnostic journey of patients. One is a young patient presenting with headache and vague visual symptoms and the other is an elderly patient with unilateral visual loss and vague headaches. We will focus on the crucial role of the fundus camera/OCT in identifying disc edema but also discuss the key questions that help guide diagnosis.

Introduction:

When patients present with acute visual loss, double vision, or other neuro-ophthalmic disorders, it often poses a diagnostic and management challenge for community hospital emergency departments (EDs). Neuro-ophthalmology falls outside the typical expertise of most ED physicians, tele-neurologists, ophthalmologists, and radiologists. Gathering crucial patient history, conducting eye examinations, and capturing fundus or gaze images are essential steps to guide the initial assessment in the ED and facilitate communication with tele-neurologists and on-call ophthalmologists. Failure to perform the necessary laboratory tests, imaging, and diagnostic procedures in the ED can lead to permanent vision loss or even life-threatening outcomes[1].

While a lack of training and limited experience are key factors contributing to this unease, non-neuro-ophthalmologists are also constrained by the lack of visualization of the optic nerve and retina that is essential to accurate diagnosis[2]. Addressing this discrepancy involves establishing standardized protocols, utilizing recent advancements in ocular imaging, and telehealth tools which can enhance the confidence of medical professionals when treating patients with acute visual loss, double vision, or other neuro-ophthalmic disorders[2].

Seeing the back of the eye – known as the fundus- is essential in the evaluation of patients with headaches and visual symptoms including stroke.

The fundus camera is particularly useful in the diagnosis and management of a wide range of conditions affecting the posterior segments of the eye and other ocular diseases. It has also been instrumental for patient education, counseling, ongoing monitoring, and the prediction of various chronic ophthalmic conditions, including diabetic retinopathy, age-related macular degeneration, retinal vascular disorders, retinopathy of prematurity, and glaucoma[3].

Fundus cameras are non-invasive and can be performed without dilating the patients' pupils. There is a brief flash of light that may be uncomfortable for patients who are sensitive to light (photophobic). Capturing the images can be performed by a wide variety of physician extenders including medical assistants, nurses, or physician assistants[3]. In ophthalmology practices, these images are easily captured by ophthalmic technicians without specific certifications.

Optical coherence tomography (OCT) is another type of optical imaging that possesses even more power as a diagnostic agent, providing both a fundus photo but also assessment of the retina and optic nerve in comparison to a normative cohort that is age matched. Through the measurement of backscattered or back-reflected light, OCT conducts detailed, cross-sectional tomographic imaging of the internal microstructure within materials and biological systems[4]. Similar to the fundus camera, this type of ocular imaging is noninvasive but offers further insight into the morphologic features of the human retina such as the fovea and optic disc in addition to potential abnormalities of the anterior eye[5].

Optical coherence tomography can be conducted both *in situ* and in real-time. It can capture images up to 2 to 3 mm deep in most

tissues which offers quantitative insights into retinal and optic nerve pathology. Overall, it serves as a valuable tool for assessing disease presence in acute settings and for diagnosing and monitoring the progression of chronic diseases such as glaucoma or macular edema associated with diabetic retinopathy.

Papilledema due to Increased Intracranial Pressure

A 30-year-old woman with a BMI of 38 complained of early morning headaches that woke her from sleep and were not improved with over-the-counter headache medications. She was evaluated in the ED on several occasions and was noted to have a normal CT scan of the brain. Finally, when her vision started to impact her tasks of daily living, she was seen by an optometrist and found to have severe bilateral optic disc edema and was subsequently referred to a Neuro-ophthalmology specialist for further evaluation. She reported experiencing brief eye discomfort and blurred vision in her left eye. This unilateral blurred vision was described as looking through a fog. She denied diplopia, any transient obscurations of vision, or pulsatile tinnitus. However, she did report worsening headaches over the last several months that presented as pressure behind the eyes. She had denied a history of steroid use, tetracycline use, Vitamin A use, or oral contraceptive use, but a history of COVID-19 infection in August, ~2 months prior to the initial presentation. Upon evaluation, her pupils were equal, briskly reactive, and she had a left afferent pupillary defect. Her sensorimotor exam was also normal, and an intraocular pressure of 13 OU was recorded. However, a dilated fundus exam showed bilateral Friesen grade 3 disc edema with 360 blurred disc margins, and obscuration of blood vessels as they leave the disc hyperemia with dilated capillaries, but no hemorrhages. Her visual fields showed peripheral constriction on the right and diffuse visual field defect on the left. Her OCT showed severe optic nerve elevation. See Figure 1.

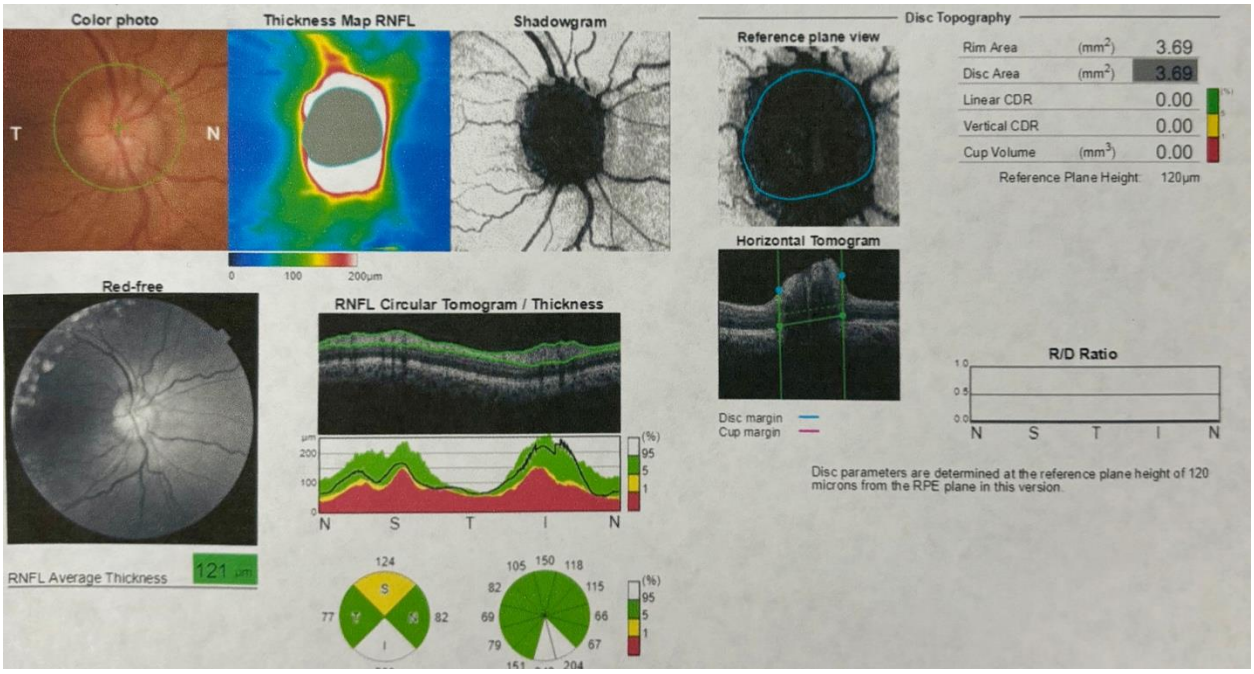

Figure 1: Picture of Pallid Edema and OCT with disc edema

MRI/MRV of the brain was normal but a lumbar puncture done in lateral decubitus was noted to have opening pressure of 30 mm water (normal is less than 20 mm water). She was started on Acetazolamide 500 mg BID with resolution of her papilledema over one month and normalization of her visual field on the right and improvement but incomplete resolution of her left visual field defect. Missed papilledema is one of the most common ophthalmic diagnoses that results in lawsuits for ED physicians.

Arteritic Ischemic Optic Neuropathy

A 75-year-old frail woman presents with acute visual loss in her right eye. Tele-neuro was consulted, and a stroke work-up initiated. Her visual acuity was hand motion only in the right eye and 20/30 in the left eye. A non-contrast CT scan of the head was performed that is noted to be normal. The ophthalmology on call doctor was consulted and asked whether the patient should be admitted for the stroke protocol. Without a fundus examination, this question cannot be answered. If a fundus photo or OCT imaging could be sent to the EyeMD, the workup and treatment could proceed appropriately.

On additional questioning, the patient reported fatigue, weight loss, and temporal tenderness. She denied jaw claudication, eye pain, ear pain or double vision. She did note abdominal discomfort. On examination, she had a right afferent pupillary defect and pale disc edema consistent with giant cell arteritis related ischemic optic neuritis also known as arteritic ischemic optic neuropathy. Her ESR and CRP were elevated, and IV corticosteroids were initiated to prevent vision (one gram over one hour). Admitting the_patient for stroke treatment would have been wrong and potentially resulted in harm. The patient had a temporal artery ultrasound that was diagnostic and was discharged on 60 mg of Prednisone and then transitioned to Actemra infusions monthly.

Discussion:

Ophthalmology stopped being a required rotation in medical school two decades ago. Being able to fully evaluate a patient with headaches, visual loss and double vision requires the ability to see the back of the eye. While many ED physicians feel comfortable with checking vision, pressure, examining the front of the eye with a slit lamp and even performing an ultrasound to identify a retinal detachment, most cannot view the back of the eye.

Early morning headaches or ones that wake a patient from sleep are suggestive of increased brain pressure. Other symptoms include transient loss of vision especially when going from laying down to standing, pulsatile tinnitus and horizontal double vision that is worse at far (sixth nerve palsy). The findings of bilateral disc edema, along with blurred disc margins, obscuration of blood vessels, hyperemia with dilated capillaries, and the absence of hemorrhages upon dilated fundus examination strongly suggest the presence of papilledema. Papilledema is characterized by the swelling of the optic disc due to elevated intracranial pressure (ICP), potentially caused by conditions like intracranial hypertension or space-occupying lesions[6]. The absence of hemorrhages distinguishes it from other optic disc conditions. The fundus camera or OCT can play a key diagnostic role by capturing detailed images of the optic disc and

surrounding structures, allowing for the observation of these characteristic features. This imaging helps in the timely identification of papilledema, enabling further investigations and appropriate management to relieve increased ICP and protect the patient's vision.

A new headache in an elderly patient warrants neuroimaging but also should prompt laboratory testing for evidence of vasculitis (anemia, thrombocytosis, and elevation of inflammatory markers including sedimentation rate and c reactive protein). Other symptoms may include eye, ear, abdominal or jaw pain. Weight loss, fatigue and diffuse polymyalgia are also common.

The findings of unilateral disc edema that is pale – pallid disc edema – is very characteristic of arteritic ischemic optic neuropathy. Acute visual loss in patients in their 70's or 80's should also prompt questioning about the associated symptoms of Giant cell arteritis. While this disorder is more common in Caucasian women, it can occur in men and other ethnicities. Tele-neuro services are more widely available than ophthalmology coverage for community-based hospitals and pursuing a stroke evaluation and treatment can result in bilateral blindness when the patient is not diagnosed and treated with high dose corticosteroids.

Conclusions:

Examination of the fundus appearance is crucial in patients with neuro-ophthalmic disorders.

Despite their obvious clinical value, neither the fundus camera nor OCT are available in the majority of community hospital EDs. In addition to commercially available fundus cameras and OCT, smartphone-based fundus attachments have been developed for patient assessments.

Integration of these technologies into ED settings will prove invaluable for non-ophthalmologist physicians in the recognition and assessment of neuro-ophthalmic disorders. In addition to the advancements in fundus cameras, the ability to confidently read and interpret their findings through the use of AI will help bridge the gap between neuro-ophthalmology and emergency medicine. Embracing these advancements represents a crucial step toward collaborative and efficient healthcare in diverse clinical environments.

Conflict of Interest:

None

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