CASE REPORT

Ophthalmology

Point-of-care ultrasound in the detection of central retinal artery occlusion in a patient with recent COVID-19

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Received: 21 April 2022  |  Revised: 29 September 2022  |  Accepted: 30 September 2022

DOI: 10.1002/emp2.12842

Abstract

Ocular emergencies are a frequent occurrence in the emergency setting. Fortunately, point-of-care ultrasound (POCUS) lends itself exceptionally well to ocular evaluation. Here, we present a unique case of central retinal artery occlusion rapidly diagnosed with POCUS in a patient with a recent COVID-19 diagnosis.

KEYWORDS

central retinal artery occlusion, COVID-19, CRAO, emergency medicine, POCUS

1  |  INTRODUCTION

We briefly report a case of central retinal artery occlusion (CRAO) in the context of subacute coronavirus disease 2019 (COVID-19) infection detected by color flow point-of-care ultrasound (POCUS) in the emergency department. COVID-19-associated coagulopathies have gained increased recognition in recent literature. There are also several reports regarding the ophthalmic manifestations of COVID-19 as well as case reports of bilateral CRAO in COVID patients. Regardless of the underlying etiology, early detection of this time-sensitive disease process is of paramount importance. Bedside emergency sonography serves as a powerful tool to that end; it is a valuable addition to the armamentarium of any modern practicing emergency physician. When performed by a trained practitioner, sonography of the eye can be helpful in diagnosing several conditions. Indications such as retinal and vitreous detachment, vitreous hemorrhage, and increased intracranial pressure are well studied and described in the literature and are easily utilized by the emergency physician. Other uses such as foreign body and lens dislocation, which have high sensitivity and specificity in smaller studies, may be less familiar to the average emergency physician. Few case reports have described the use of point-of-care ultrasonography in vascular ocular emergencies such as CRAO and central retinal vein occlusion (CRVO). This represents the first case of CRAO associated with COVID-19 diagnosed with color Doppler-assisted POCUS.

2  |  CASE REPORT

A 66-year-old male with a past medical history of hypertension, hyperlipidemia, coronary artery disease, myocardial infarction, and congestive heart failure presented to the emergency department complaining of acute onset, left-sided, and painless vision loss. He reported intermittent and brief episodes of unilateral vision loss over the course of 2 weeks. At the time of presentation, his monocular vision loss had been ongoing for more than 6 hours and had come on abruptly in the setting of paroxysmal and forceful cough. On review of his records, he was diagnosed with COVID-19 2 weeks prior to the presentation but did not require hospitalization. He had near complete resolution of pulmonary symptoms except for the persistent dry cough. On physical examination, he demonstrated complete vision loss to the left eye with a total lack of light and form perception. He had evidence of a relative afferent pupillary defect to the left eye, failing
to constrict with direct light application in the affected eye although constricting consensually when the light was directly shone onto the unaffected eye. The inspection did not reveal any evidence of trauma, conjunctival injection, proptosis, chemosis, hyphema, or hypopyon. Extraocular movements were intact bilaterally. Fluorescein staining did not show evidence of corneal abrasions. Intraocular pressures were normal bilaterally.

Several differential diagnoses were considered in this presentation of acute and painless vision loss, including but not limited to: central retinal artery occlusion, central retinal vein occlusion, giant cell arteritis, retinal detachment, vitreous hemorrhage, optic neuritis, vessel dissection, and stroke.

Bedside ultrasound was quickly performed using a standard, high-frequency, and 10-MHz linear array ultrasound probe. Ultrasound transmission gel was applied directly to the patient’s closed eye without additional barriers such as tegaderm. This method was chosen to avoid complications such as air bubbles that occasionally hinder image transmission when using eye barriers. Ultrasound evaluation did not demonstrate a freely moving membrane or find evidence of echogenic opacities within the vitreous body. Given the high sensitivities observed with POCUS, this essentially ruled out retinal detachment or vitreous hemorrhage as possible etiologies for the patient’s vision loss.11 Next, we identified the vasculature posterior to the eye, specifically the central retinal artery and vein. This is best completed by placing a color flow Doppler on the rim of the posterior orbit, within the area of the optic nerve.17 Typically, ocular ultrasonography is preset to a high gain to ensure visualization of all echogenic structures such as retinal detachments. In this case, the color gradient and gain may need to be adjusted to decrease erroneous signals. After clearly and easily identifying the central retinal vein, we noted a complete absence of arterial flow on color-flow Doppler—highly suggestive of CRAO given this clinical context (Figure 1; Video S1). In comparison, the unaffected eye demonstrated both arterial and venous flow on color-flow Doppler (Video S2). It should also be noted that pulsed wave Doppler can be used to differentiate venous from arterial flow if there is a question of identifying vessels.18 We did not use this method in our patient because the venous flow was clearly visualized on Doppler in our patient.

Given the additional concern for potential stroke, the patient also underwent computed tomography angiography of the head and neck that demonstrated heavy calcified and non-calcified plaques at the left carotid bifurcation, resulting in 50% stenosis of the left carotid bulb. However, magnetic resonance imaging of the brain showed no acute intracranial findings. Additionally, transthoracic echocardiography showed no significant disease to suggest a cardiogenic embolic source. Serology did reveal an elevated inflammatory marker, an erythrocyte sedimentation rate (ESR) of 54 mm/h. However, giant cell arteritis seemed less likely given the absence of corroborating symptoms such as headache, scalp tenderness, or jaw claudication. We felt the ESR was likely an elevated acute phase reactant in the setting of the recent COVID-19 infection.

Ophthalmology was emergently consulted and performed bedside fundoscopic examination that demonstrated a “cherry red” macula surrounded by a pale retina—confirming the diagnosis of CRAO. Unfortunately, his vision loss was deemed permanent and not amenable to revascularization techniques given the prolonged and irreversible damage sustained.

There is a paucity of data for evidence-based treatment of CRAO. Much of the treatment is based on observational data. In general, systemic alteplase (TPA) has empirically been considered for CRAO in the same time frame as other cerebrovascular accidents, 4.5 hours from last known well, and our patient first arrived 6 hours into his vision loss. There are limited data regarding intra-arterial, directed TPA, but the only randomized control trial available (EAGLE) was stopped early due to the failure of the treatment group to outperform the conservative control group.19 Last, hyperbaric oxygen has been postulated as a method to treat CRAO and salvage retinal tissue; with case series showing that hyperbaric oxygen improves visual outcomes.20,21 This treatment was not considered for our patient given our lack of access to hyperbaric oxygen therapy at our institution and limited evidence as to its benefit weighed against its cost and availability. The patient was admitted to the medical floor for further medical optimization and ultimately discharged after interventions in modifiable stroke-related risk factors.

3 | DISCUSSION

Point-of-care emergency sonography has well established use across a myriad of clinical scenarios in the emergency setting and ocular emergencies may be counted among them.3 As an accessible organ...
that is fluid-filled and possesses easily identifiable hyperechoic structures, the eye lends itself exceptionally well to ultrasound evaluation. Unfortunately, prompt recognition of CRAO via point-of-care sonography did not ultimately impact our patient’s poor outcome. However, in select patient populations who present in time frames more proximal to the onset of injury, rapid detection may quite possibly change management and outcomes.2 We used a novel approach to the diagnosis of CRAO with POCUS by using color Doppler to evaluate blood flow. When considering the limitations of this approach, although not well described in the literature, we postulate that there could be other reasons for this finding of absent arterial flow on color Doppler sonography including severe CRVO, giant cell arteritis, vascular spasm, proximal occlusion of the ophthalmic or carotid artery, or possibly too much pressure from the ultrasound probe. For these reasons, it is important to use ultrasound findings in the context of the clinical scenario, history, and other diagnostic findings.

Previously, there have been reports discussing the “spot sign,” which is defined as a hyperechoic, sharply delineated structure (thought to be the embolus) located centrally within the optic nerve, disc, or retina.22 This test was found to have a sensitivity of roughly 70% in patients with CRAO, but perhaps more interestingly, was absent in all patients with giant cell arteritis. Although a small study, the presence of the spot sign may be a helpful data point with a high negative predictive value for giant cell arthritis to add to the Doppler evaluation described in this paper. Although the test characteristics have not yet been defined regarding color flow Doppler for CRAO, we would suspect that the lack of blood flow would be a more predictable finding in CRAO; whereas the spot sign relies on the embolus to be directly visualized and therefore be close to the retina within the field of view. Further studies are needed to define the test characteristics of color Doppler POCUS for CRAO. Additionally, it should be mentioned that the final diagnosis of CRAO required a funduscopic exam, which is also within the emergency physician’s scope of practice. However, it would seem that emergency physicians have become more facile with ultrasound than the ophthalmoscope and this may be a reasonable first step when proper visualization with an ophthalmoscope cannot be obtained due to user familiarity or patient tolerance of the exam.

Many reports have recently surfaced describing the hypercoagulable state associated with COVID-19 and its relationship with developing vascular-related thrombi.23 The exact pathogenesis of COVID-19-associated coagulopathy (CAC), as described by some authors, remains to be fully elucidated. An alarming aspect of CAC is the unusually wide spectrum of described thromboembolic presentations. Reports have included findings of deep vein thrombosis, pulmonary embolism, limb ischemia, stroke, and even microvascular thrombosis.24,25 This known association begged the question as to whether our patient’s recently confirmed COVID-19 infection played any contributing role in the development of his CRAO. A paucity of literature exists to address this specific question. However, known risk factors implicated in the development of CAC, shared almost entirely by our patient (with the exception of his ethnicity), have been detailed to include: age over 55, body mass index greater than 28, male sex, Hispanic background, history of myocardial infarction, and history of coronary artery disease.5 It seems that there are increasingly more case reports of COVID-19-associated CRAO in the literature, and as emergency physicians, we should work to increase our diagnostic ability to detect this time-sensitive injury as early as possible.26–30 Additional research is necessary to expand on the body of knowledge as it pertains to COVID-19-associated vascular insult and potential therapeutics.

ACKNOWLEDGMENTS

We would like to thank the faculty and residents of the Denver Health Residency in Emergency Medicine for their continued support.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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How to cite this article: Galust H, Banks S, Riscinti M. Point-of-care ultrasound in the detection of central retinal artery occlusion in a patient with recent COVID-19. JACEP Open. 2022;3:e12842. https://doi.org/10.1002/emp2.12842