CASE REPORT

Ophthalmology

Endophthalmitis diagnosis supported by bedside ultrasound

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Abstract

Endophthalmitis is a bacterial or fungal infection in the deep spaces of the eye. The diagnosis of endophthalmitis has traditionally been made by vitreous humor culture and is commonly missed on initial presentation. In this case report, we emphasize the role of ocular point-of-care ultrasound (POCUS) in revealing endophthalmitis as a primary differential diagnosis for a patient presenting with unilateral eye pain and significant swelling that limited physical examination of the eye. Here, the patient’s initial clinical examination was more suggestive of an alternative diagnosis, orbital cellulitis, which could have delayed the highly morbid and time-sensitive diagnosis of endophthalmitis. Although POCUS is traditionally enlisted for other posterior ophthalmic pathologies, including retinal detachment, vitreous detachment, vitreous hemorrhage, and papilledema, this rare case of endophthalmitis secondary to hepatic abscess demonstrates the utility of bedside ocular ultrasound as a tool to distinguish endophthalmitis from mimicking differentials when physical examination is unable to do so.

KEYWORDS

case report, ophthalmology, ultrasound

1 | INTRODUCTION

Endophthalmitis is a deep space infection of the vitreous or aqueous humor of the eye. The intraocular fluid is an optimal medium for infections to brew insidiously, as it is minimally inhabited by inflammatory cells and cytokines that typically respond to infection. If diagnosis is delayed, the infection can spread rapidly, causing irreversible damage to structures, such as the retina and choroid, ultimately resulting in loss of vision.

There are 2 distinct pathways by which microorganisms are introduced to the inner eye: exogenous and endogenous spread. Exogenous endophthalmitis occurs when direct inoculation of microorganisms to the eye occurs from a source outside the body, and it is the more common of the two. Among these cases, 40%–80% present as postocular procedural complications.1 Other causes include direct blunt or penetrating trauma with or without the presence of ocular foreign bodies.

Endogenous endophthalmitis is defined as infection from hematogenous spread of infection to the eye, and accounts for up to 20% of all cases. Among these, half are reported to be bacterial, whereas the remaining half is fungal. These endogenous infections spread hematogenously as the pathogen travels via the bloodstream, invades the choroid, disseminates to the retina, and ultimately into vitreous humor.2 In patients who have no history of ocular trauma or surgery, primary infectious sources for endogenous endophthalmitis have been reported to include meningitis, indwelling catheters, sinus infections, endocarditis, and liver abscesses.2
2 | CASE PRESENTATION

The patient is a 71-year-old female with no known past medical history who presented to the emergency department (ED) with atraumatic left eye pain and swelling for 4 days. She could no longer open her affected eye due to progressive swelling and thick yellow discharge. The eye pain was preceded by 2 weeks of general malaise. She denied blurry vision, flashers, floaters, or changes in visual acuity; however, she could not see out of her left eye secondary to swelling. The ED is an urban level I academic trauma center with over 120,000 patient visits annually, home to an emergency medicine residency and ultrasound fellowship. The hospital has no 24/7 in-house ophthalmology but is affiliated with a larger academic quaternary care center whose ophthalmology residents are available for consultation and can be on site within 1–2 hours.

The physical examination revealed significant periorbital edema and erythema involving both the upper and lower eyelids. There was active mucopurulent discharge draining from the left eye. Opening the eye required manual assistance and upon opening, the exam was notable for proptosis and significant chemosis. The patient was unable to tolerate full visual acuity testing due to tenderness and swelling but reported blurry vision in her left eye compared to the right. Topical tetracaine drops were administered in bilateral eyes for comfort during intraocular pressures, which were measured bilaterally and elevated in the left eye to 35 mm Hg whereas right eye pressure was 15 mm Hg. Fundoscopy was attempted, however, due to severe chemosis and swelling, findings were extremely limited and unhelpful in diagnosis of endophthalmitis.

As a result of the decreased visual acuity, discharge, and chemosis greatly limiting direct physical examination of the eye, a bedside ocular ultrasound was performed to assess for intraocular extension of the infection as well as retinal or vitreous detachment. The point-of-care ultrasound (POCUS) study was conducted by a non-ultrasound fellowship trained emergency medicine attending. Their training at an Accreditation Council for Graduate Medical Education-accredited emergency medicine residency included bedside ultrasound as a core competency.

With the patient supine, a tegaderm was applied over the closed eye for protection, and ultrasound gel was applied over the tegaderm. A Mindray TE 7 portable ultrasound’s L14-6Ns linear transducer was used in the transverse and sagittal views to acquire the ultrasound images.

POCUS study was notable for extensive, well demarcated, hyperechoic, mobile debris within the posterior chamber. Additional hyperechoic debris were also present in the lens of the eye (Figure 1). Based on these findings, an intraocular infection involving the globe was highly suspected. Furthermore, laboratory testing was notable for leukocytosis to 16,000 with 85% neutrophils.

Two images (Figures 1A and 1B) illustrate the globe view of the affected eye in multiple planes. Transverse ocular ultrasound using the linear probe at bedside demonstrates significant complex hyperechoic debris within the posterior chamber’s vitreous humor (red arrows). Hyperechoic debris was noted in lens (yellow stars). Figure 1C (bottom) shows healthy eye ultrasound for comparison. Note the anterior chamber (AC), lens (L), anechoic vitreous (V) humor of the posterior chamber, and hypoechoic optic nerve (ON) sheath in the far-field.

Computed tomography (CT) orbits demonstrated a rim enhancing collection that extended along the anterior left globe and an abscess (Figure 2). The left orbit exhibited proptosis with significant fat stranding and edema, consistent with orbital cellulitis. These CT findings

Various ultrasound findings have been reported in patients with endophthalmitis, including heterogeneous debris in the vitreous humor (see Figure 1), choroidal thickening, posterior membrane detachment, choroidal detachment, and retinal detachment. The ability to interpret these findings on ultrasound greatly facilitates care and early treatment, and thus, has the potential to minimize adverse sequelae. Given the difference in treatment between orbital cellulitis, which only requires parenteral antibiotics, and endophthalmitis, which requires intravitreal injection of antibiotics, these findings on ultrasound have the potential to both change and expedite management. In this case report, we share our initial bedside ultrasound findings that were obtained by the primary emergency medicine provider given the limited physical examination and directly led to the diagnosis and accelerated ocular interventions.
FIGURE 2  Computed tomography scan demonstrating left proptosis, retrobulbar fat stranding, periorbital edema, and intraocular abscess. (A) Left proptosis, retrobulbar stranding, and periorbital edema (red arrow) consistent with left orbital cellulitis. (B) Fat stranding along the orbital rim in the left anterior aspect of the left globe and laterally along the extraconal space consistent with an abscess (star). Red arrow indicates periorbital edema.

suggested the presence of orbital cellulitis but did not offer clear evidence of vitreous involvement.

Images shown demonstrate 2 axial views. Figure 2A portrays the left proptosis and retrobulbar stranding and periorbital edema (red arrow) consistent with left orbital cellulitis. Note the fat-stranding along orbital rim in Figure 2B along the left anterior aspect of the left globe and laterally along the extraconal space consistent with an abscess (star).

Based on the findings of orbital cellulitis on CT and sonographic evidence of vitreous debris suggestive of endophthalmitis, the patient was empirically started on broad-spectrum antibiotic coverage. Ophthalmology was consulted for orbital cellulitis and endophthalmitis and evaluated the patient in the ED. A combination of ophthalmic drops was initiated to decrease intraocular pressure. As a direct result of the POCUS findings, it was recognized early in the workup that the patient would likely require intravitreal antibiotics for endophthalmitis in addition to intravenous antibiotics. Because intravitreal antibiotics were not available at the presenting facility, the patient was expeditiously transferred to the affiliated quaternary care center for further management. This is not the procedure for patients with solely orbital cellulitis, as those patients can be managed at the initial presenting facility.

Inpatient ophthalmology workup and management of the endophthalmitis was initiated at the academic quaternary care center. Aspiration of vitreous fluid was cultured and grew Klebsiella pneumoniae. She received intravitreal vancomycin, ceftazidime, and voriconazole for coverage. Abdominal ultrasound and subsequent magnetic resonance imaging showed a 6-cm multiloculated liver abscess. Hematogenous spread from the collection was the presumed source for her endophthalmitis. The patient received intravitreal antibiotics and intravenous antibiotics for 7 days. The left eye underwent vitrectomy for debulking procedure, lensectomy, retinectomy, and the patient was discharged several days later on outpatient intravenous antibiotics. At the time of discharge, her visual acuity in the left eye had improved from “light perception” to “hand motion.”

3  DISCUSSION

In this case, evidence of posterior globe involvement with vitreous humor debris on ultrasound raised significant concern for endophthalmitis and accelerated the diagnosis and definitive management for this sight-threatening disease. Endophthalmitis is a clinical diagnosis based on physical exam findings and confirmed with cultures of aqueous or vitreous humor. However, in this patient with marked swelling from orbital cellulitis preventing fundoscopic examination, the diagnosis of endophthalmitis was suspected based on bedside ultrasound findings.

There have been prior efforts to delineate ultrasound findings associated with endophthalmitis. Maneschg et al4 conducted a retrospective analysis of 81 patients who developed endophthalmitis following cataract surgery from 2000 to 2005 and searched for sonographic characteristics predictive of developing a future ocular infection. The investigators found 2 traits shared among the patients who developed endophthalmitis on ultrasound: vitreous opacifications and detachment of the posterior vitreous membrane. Kohanim et al5 in 2012 found that mobile echogenic material, vitreous membranes, and thickening of the retina and choroid were the most common findings on ultrasound evaluation of patients with infectious endophthalmitis. Although these findings were highly suggestive of infectious endophthalmitis, they noted that ultrasound alone is still insufficient to include or exclude the diagnosis.

Ultrasound findings appear to have prognostic value in endophthalmitis, as well. Rachitskaya et al6 found in 2013 that dense vitreous opacities, marked vitreous membranes, retinal detachment and choroidal detachments demonstrated a statistically significant association with worse visual acuity.

Lahham et al7 published a prospective study on the sensitivity (SN) and specificity (SP) of POCUS in relation to diagnosing 3 ocular pathologies: retinal detachment, vitreous hemorrhage, and vitreal detachment. Although POCUS was found to be highly sensitive and specific for identifying retinal detachment (SN, 97%; SP, 96%),
sensitivity was fair for vitreous hemorrhage (SN, 81.9%) and was poor for vitreous detachment (SN, 42.5%). However, POCUS for vitreous detachment had specificity of 96%. These findings suggest that although POCUS may function as another tool for the evaluation of eye complaints and may show decent specificity for posterior ocular abnormalities, it cannot be relied on to independently rule out specific diagnoses.

Exogenous endophthalmitis due to intraocular procedures typically provides an obvious source of infection; however, endogenous endophthalmitis requires further investigation for a primary infection. In 2003, Jackson et al⁸ found that a majority of endogenous bacterial endophthalmitis cases were initially misdiagnosed and the diagnosis established by blood cultures. Additionally, the prognosis of endophthalmitis is poor, with most cases resulting in blindness of the affected eye. Eleven years later in 2014, Jackson et al⁹ again found that 26% of these cases experienced a diagnostic delay. The rate of exacerbation or enculnation was 24%. These studies confirm the diagnostic difficulty of this disease that carries high morbidity and a poor prognosis.

Interestingly, our patient’s nidus was a liver abscess that eventually grew out Klebsiella pneumoniae, but she did not present with abdominal pain nor elevation in the liver function panel. Although gram-negative organisms such as Klebsiella were previously thought to preferentially infect patients who live in East Asia,¹⁰ there has been an emergence of Klebsiella across Western countries including the United States¹¹ as a causative organism of liver abscess. In 2007, Fang et al¹² conducted a retrospective cohort study of patients with a K. pneumoniae liver abscess and found that 13% of the patients developed a septic ocular or central nervous system infection.

Tucker et al¹³ published a case on the use of POCUS to visualize suspected exogenous endophthalmitis on a patient who had undergone recent cataract surgery. The patient presented to ED for eye pain 8 days after cataract surgery. Bedside ultrasonography visualized multiple mobile, hyperechoic densities within the globe.¹³ The findings of this report, in addition to our case, demonstrate the potential utility POCUS can have for patients presenting with either exogenous or endogenous endophthalmitis.

### 4 CONCLUSION

Point-of-care ultrasound is a vital tool in ophthalmic emergencies. In this case, the strongly demarcated hyperechoic debris in the globe visualized on ultrasound significantly raised clinical suspicion for endophthalmitis in addition to orbital cellulitis—a diagnosis that could not have been obtained by CT nor physical exam alone given the degree of periorbital swelling. The application of POCUS in this setting facilitated this patient’s management, as early recognition of intraocular involvement directly resulted in earlier transfer and definitive intravitreal treatment. Prior studies for the utilization of ultrasound in endophthalmitis have demonstrated promising potential diagnostic and prognostic findings related to endophthalmitis. However, more rigorous and systematic research should be conducted to elucidate the true benefits of ultrasound in endophthalmitis. As emergency physicians continue to incorporate POCUS in their daily practice, it is crucial to maintain an inquisitive mind and apply POCUS in innovative albeit unconventional ways to better serve our patients.

### REFERENCES

1. Durand ML. Bacterial and Fungal Endophthalmitis. Clin Microbiol Rev. 2017;30(3):597-613. https://doi.org/10.1128/CMR.00113-16
2. Birnbaum F, Gupta G, Fekrat S, Scott IU. Endogenous endophthalmitis: diagnosis and treatment. Eyenet Magazine. 2016;33-35.
3. Maresová K, Poláchová J, Bábková B, Rehák J. Ultrazvukové nálezy u endoftalmitidí [Ultrasound findings in endophthalmitis]. Cesk Slov Oftalmol. 2004;60(4):290-295. Czech. PMID: 15369266.
4. Manesch O, Csákány B, Németh J. Ultrasonographische Befunde bei Endophthalmitis nach Kataraktoperationen : rückblick auf 81 Fälle [Ultrasonographic findings in endophthalmitis following cataract surgery : a review of 81 cases. Ophthalmologe. 2009;106(11):1012-1015. https://doi.org/10.1007/s00347-008-1881-1. PMID: 19066906.
5. Kohanim S, Daniels AB, Huynh N, Elliott D, Chodosh J. Utility of ocular ultrasonography in diagnosing infectious endophthalmitis in patients with media opacities. Semin Ophthalmol. 2012;27(5-6):242-245. https://doi.org/10.1016/j.sopt.2012.07.002. PMID: 21363283.
6. Rachitskaya AV, Flynn HW Jr, Fisher YL, Ayres B. Correlation between baseline echographic features of endophthalmitis, microbiological isolates, and visual outcomes. Clin Ophthalmol. 2013;7:779-785. https://doi.org/10.2147/OPTH.S50433. Epub 2013 Apr 22. PMID: 23637520; PMCID: PMC365662.
7. Lahham S, Shniter I, Thompson M, et al. Point-of-care ultrasonography in the diagnosis of retinal detachment, vitreous hemorrhage, and vitreous detachment in the emergency department. JAMA Netw Open. 2019;2(4):e192162. https://doi.org/10.1001/jamanetworkopen. 2019.2162. PMID: 30977855; PMCID: PMC6481597.
8. Jackson TL, Eykyn SJ, Graham EM, Stanford MR. Endogenous bacterial endophthalmitis: a 17-year prospective series and review of 267 reported cases. Surv Ophthalmol. 2003;48(4):403-423. https://doi.org/10.1016/s0039-6257(03)00054-7. PMID: 12850229.
9. Jackson TL, Paraskewopoulos T, Georgalas I. Systematic review of 342 cases of endogenous bacterial endophthalmitis. Surv Ophthalmol. 2014;59(6):627-635. https://doi.org/10.1016/j.survophthal.2014.06.002. Epub 2014 Jun 18. PMID: 25113611.
10. Sheu SJ. Endophthalmitis. Korean J Ophthalmol. 2017;31(4):283-289. https://doi.org/10.3341/kjo.2017.0036
11. Kashani AH, Elliott D. The emergence of Klebsiella pneumoniae endogenous endophthalmitis in the USA: basic and clinical advances. J Ophthalmic Inflamm Infect. 2013;3(1):28. https://doi.org/10.1186/1869-5760-3-28 Published 2013 Feb 4
12. Fang CT, Lai SY, Yi WC, Hseueh PR, Liu KL, Chang SC. Klebsiella pneumoniae genotype K1: an emerging pathogen that causes septic ocular or central nervous system complications from pyogenic liver abscess. Clin Infect Dis. 2007;45(3):284-293. https://doi.org/10.1086/519262. Epub 2007 Jun 19. PMID: 17599305.
13. Tucker J, Patane J, Lahham S. Point-of-care ultrasound detection of endophthalmitis. J Educ Teach Emerg Med. 2018;3:1. https://doi.org/10.21980/JBGe3