

Bedside Emergency Department Ultrasonography in the Evaluation of Ocular Pathology

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Abstract. The number of potential uses of emergency department (ED) ultrasound is growing. This brief report describes its use in two ED patients who presented with acute ocular pathology. The diagnoses were quickly made with ED ultrasound, and subsequently confirmed with more traditional methods of ocular evaluation. **Key words:** ED ultrasound; ocular pathology; ocular ultrasonography. *ACADEMIC EMERGENCY MEDICINE* 2000; 7:947–950

Emergency department (ED) ultrasonography is now rapidly growing with new applications emerging.¹ While traditional usage for trauma patients and evaluation of abdominal aortic aneurysms is still the only accepted application at some centers, many have branched into more advanced applications. Ultrasound examination of the gallbladder has become more common and has been shown to decrease length of stay for patients in the ED.² Other authors have used bedside ultrasound technology to facilitate joint arthrocentesis in ankles and hips.^{3,4} Still more advanced is the use of bedside ED ultrasonography in the evaluation of lower extremity deep venous thrombosis in a timely manner.^{5,6}

As emergency physicians seek to make their clinical practice more efficient, further leaps into nontraditional ED ultrasound applications are likely. To date no publications about ED ocular ultrasound are returned on a MEDLINE search. Ocular ultrasonography has become more common in the 1990s, but was initially advocated as early as the

1960s and early 1970s.⁷ Early attempts at application of ultrasonography to ocular diseases were hampered by a lack of high-resolution ultrasound technology and the concurrent development and high popularity of computed tomography (CT).⁸

New high-resolution ultrasound technology has enabled clinicians to evaluate the small structures of the eye. As a result, subtle processes such as retinal detachments, hemorrhages, and lens dislocation can be elicited. Our ophthalmology colleagues have also applied ultrasonography to ocular trauma patients. This paper describes two cases of differing etiologies in which ED bed-

side ultrasonography was instrumental in making rapid and accurate diagnoses of ocular pathology. A discussion of the technology and its potential novel application to emergency medicine is included.

CASE 1

A 42-year-old man was brought to our ED by emergency medical services (EMS) for an alleged stab wound to his left eye. The incident stemmed from a domestic dispute in which the patient's significant other stabbed him in or around the left eye with a kitchen knife. The knife was not recovered at the scene and the extent of the injury was unknown. On presentation the patient complained of excruciating left eye pain and decreased visual acuity. The patient denied any other injury and stated he was stabbed only once.

The patient denied any significant past medical history. He was taking no medications and had no allergies. His last tetanus shot was more than seven years ago. The patient's family history was non-contributory. Physical examination showed a blood pressure of 148/76 mm Hg. The patient's heart rate was 105 beats/min, his respiratory rate was 24 breaths/min, and he was afebrile. The patient's entire physical examination was unremarkable except for a 3- to 4-mm vertical laceration in the middle of the left upper eyelid. Initially the patient was re-



Figure 1. Comparison of normal right eye and injured left eye. Note the large scleral fold (*large arrow*) secondary to globe collapse. The scleral fold produces orbital shadowing (*small arrows*).

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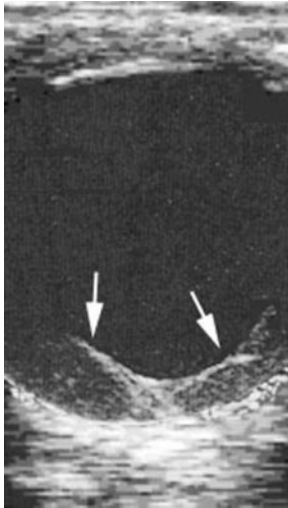


Figure 2. Incomplete posterior vitreous detachment is shown (arrows). The membrane is still anchored to the retina. Note the small amount of hemorrhage between the vitreous and retina.

luctant to have his eyelids manipulated due to extreme pain.

A large amount of ultrasound gel was applied to the patient's closed left lower eyelid and a 7.5-MHz linear array ultrasound transducer was gently applied to the eye. The patient did not complain of any increase in pain or sensation of pressure during the examination. Ultrasound examination revealed the globe to be decreased in size when compared with the right and buckling of the sclera was noted posteriorly, which was indicative of globe penetration and collapse (Fig. 1). No evidence of a retrobulbar hematoma was found. The ophthalmology service was contacted regarding the pa-

tient and informed of the diagnosis. A head CT with dedicated orbital views was obtained and confirmed the ultrasound diagnosis including the absence of any retrobulbar hematoma.

The patient was medicated to allow closer examination of the eye by ophthalmologic consultants. He noted being able to discern light only. A vertical laceration was seen through the iris. The patient was taken to the operating suite later in the morning for repair of the globe injury. On follow-up the patient has not regained more vision.

CASE 2

A 52-year-old woman with non-insulin-dependant diabetes mellitus and hypertension presented to the ED with complaints of seeing light flashes out of her left eye and some decreased vision out of the same eye. The patient stated that the symptoms began four hours prior to her arrival in the ED and lasted for two hours. Now her vision was completely back to her normal.

The patient denied any other significant past medical history. She was taking a sulfonylurea medication for her diabetes and took no other medications. The patient denied allergies to medications. Her family history was noncontributory. Physical examination showed a blood pressure of 156/86 mm Hg. The patient's heart rate was 83 beats/min, her respiratory rate was 14 breaths/min, and she was afebrile. The patient had 20/20 vision bilaterally with correction. No visual field cuts or defects were evident.

Fundal examination without dilatation revealed no abnormalities. Slit lamp examination and corneal staining were within normal limits. The rest of the patient's physical examination was unremarkable.

The patient presented late at night and normal ophthalmic consultation was not available. The patient's left eye was scanned with a 7.5-MHz linear array transducer through the closed lid in both axes. Figure 2 shows the thin membrane located in the vitreous signifying a partial posterior vitreous detachment. An ophthalmologist was consulted by phone and agreed that since there was no evidence of other pathology, the patient was safe to follow up in the ophthalmology clinic. Follow-up ophthalmologic evaluation confirmed a small vitreous detachment with no other pathology. The patient was managed conservatively for her eye and was placed on medical regimen for her hypertension. Her eyesight remained at baseline.

DISCUSSION

The patient in the first case was diagnosed as having globe rupture and had retrobulbar hematoma ruled out with no added discomfort. Furthermore, the diagnosis was made approximately 5 minutes after the patient's arrival. Due to a heavy trauma load, head CT results were not available for more than two hours after he arrived in the ED. Should a retrobulbar hematoma have been discovered, rapid intervention by ophthalmology might have been necessary. The second patient was accurately diagnosed as having vitreous detachment, which explained her complaints. Other pathology such as a large hemorrhage, tumor, or retinal detachment was ruled out. Although ocular ultrasound is a new application for emergency medicine (EM) ultrasonography, these cases represent examples of its potential use at the bedside.

One EM textbook notes that occult globe ruptures may be difficult to recognize and recommends minimal examination of the eye if such injury is suspected.⁹ Previously the recommended diagnostic modalities of CT, magnetic resonance imaging, and ultrasound were not readily available to the emergency physi-

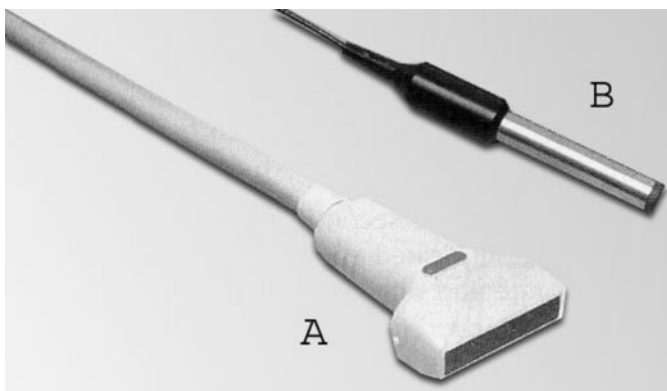


Figure 3. Linear array probe used in both cases, A. Typical specialized ocular probe is shown, B.



Figure 4. Longitudinal view of the eye showing a retrobulbar hematoma represented by the lucency deep to the retina (arrow).

cian (EP) at bedside. This may leave the EP without any options than to await a definitive study. Further complications can arise in institutions where head CT may not be readily available after hours. However, with the spread of ultrasound in EM, ocular pathology may be a reasonable next step for ED ultrasonography. Ultrasound utilization would allow the EP to evaluate for signs of globe and retrobulbar injury in the trauma patient as well as nontraumatic complaints.

Although ocular ultrasonography is usually performed with a specialized probe (Fig. 3), these probes are not available on most ultrasound systems. Ocular ultrasound machines usually cannot perform other functions and are of no use in the ED where machines must be versatile enough to be used in everything from trauma to gallbladder and testicular ultrasound examinations.

When a specialized probe is not available, substitution is possible. Some ophthalmologists recommend using an endovaginal probe. However, this proves awkward both to hold and to explain to the patient. A linear array transducer such as the one used in this case allows good visualization, and the frequency of 7.5 to 10 MHz will suffice for most ED applications (Fig. 3). Two typical scanning approaches exist. One is scanning through closed eyelids, and the other is placing the probe di-

rectly onto the naked eye. While the latter approach often provides increased resolution, it is not as practical in the trauma patient whose lids may be virtually unretractable due to swelling. A text notes the examination of the eye with swollen lids may be very difficult.⁹ The patient's comfort is also increased with ultrasound examination through closed eyelids. The globe is then scanned in both long and short axes.

Ocular ultrasonography has several applications that are especially enticing in the ED setting. Penetrating injuries to the eye can be examined through the closed lid with large amounts of gel and essentially no pressure applied to the eye. Globe rupture and collapse may produce posterior scleral folds as seen in Figure 1. Hemorrhage can be seen in the vitreous as a string-like echogenicity and is also suggestive of injury. In the first case presented, the knife did not penetrate through the globe posteriorly. If it had, posterior scleral rupture could have been found on ultrasound examination as an actual break in the scleral line. It is also usually associated with hemorrhage in vitreous and hematoma near the rupture site.

Retrobulbar hemorrhages are a frequent concern in patients with facial trauma. In many cases, if the question of a retrobulbar hemorrhage could be laid to rest quickly, the patient would be discharged home. This is currently not possible and patients await facial CT studies or are admitted for observation if CT availability is lacking during off hours. Ultrasound examination of the orbit can detect retrobulbar hematomas, which appear as a lucency just posterior to the globe and may distort the posterior aspect of the eye (Fig. 4).

Lens dislocation can occur with blunt trauma to the eye or can be idiopathic. Dislocation can be visualized on ultrasound examination (Fig. 5). The patient with lens dislocation commonly presents with decreased visual acuity. Iridodonesis, a trembling or shimmering of the iris after rapid eye movements, is a helpful sign of dislocation, but ultrasound imaging can define dislocation quickly and easily.¹⁰ This will not only reassure the EP of a correct diagnosis but can also save time and

obviate the need for emergent ophthalmologic consultation.

Intraocular foreign bodies may be detected by this high-resolution method and are seen as bright echogenic entities in the vitreous or walls of the globe. Metallic and other dense foreign bodies are seen best. A thorough scan of the entire globe is required. Retinal detachment from trauma is commonly seen in the ED.



Figure 5. Traumatic lens dislocation with the lens seen posteriorly against the retina (arrow).

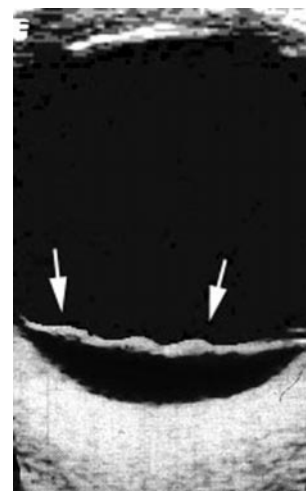


Figure 6. Retinal detachment. Note the thick irregular band (arrows) in comparison with that seen with vitreous detachment in Figure 2.

Symptoms such as floaters or flashing lights can be helpful clinically but the ability to visualize the retinal detachment with ultrasound in the ED may be exceedingly helpful, especially when ophthalmologic consultation is not readily available (Fig. 6).

CONCLUSIONS

Ocular ultrasound examination in both traumatic and nontraumatic complaints is an attractive application for bedside ED ultrasonography. More centers now have high-resolution linear array transducers on their ED ultrasound systems. These are used for the evaluation of skin foreign bodies, testicular pathology,

and lower extremity deep venous thrombosis. The probes may be readily used to evaluate the eye. Although all of the measurements of ocular ultrasound will not be attainable without the proper equipment, most conditions seen in the ED can be detected. Further research will help define the role of ocular ultrasonography in the ED.

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