American Journal of Emergency Medicine (2005) **23**, 517–520

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The American Journal of Emergency Medicine

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Diagnosis of periorbital gas on ocular ultrasound after facial trauma

S. Timothy McIlrath MD, Michael Blaivas MD, RDMS*, Matthew Lyon MD, RDMS

Department of Emergency Medicine, Medical College of Georgia, Augusta, GA 30912-4007, USA

Received 14 October 2004; accepted 14 October 2004

Abstract Ocular trauma can occur from isolated facial trauma or in major blunt trauma such as motor vehicle accidents or falls. Despite the etiology of the injury, a thorough evaluation is important but may often be difficult if severe swelling is present. Recently, emergency ultrasound has seen the use of ocular ultrasound to evaluate visual changes and trauma. Literature suggests that unsuspected and difficult to diagnose pathology may be easily detected on ultrasound of the orbit. We present 3 cases of isolated facial trauma in which routine evaluation with ocular ultrasound led to the discovery of periorbital air with one patient having air insufflating the upper lid of the affected side.

1. Introduction

Facial trauma is seen as a result of multiple etiologies in the emergency department. Drivers involved in motor vehicle crashes who chose not to restrain themselves are more likely to suffer head and subsequent facial injury. However, a new safety restraint introduced into most cars over the last decade, the airbag, itself is responsible for facial injury in persons sitting too close to the dash. Although brain injury is frequently of greatest concern for the evaluating emergency physician, injury to the facial bones, orbits, or eyes requires immediate attention as well.

Typically, head and facial injury is now evaluated using computed tomography (CT). This has largely replaced both the wait-and-see approach to head injury of the past as well as plain films to evaluate for occult skull and facial bone fractures. However, when significant head injury is not suspected, CT may not be ordered and unsuspected facial injuries could be missed. The eye can be particularly difficult to examine as the patient may experience significant pain and swelling. Previous work has shown that emergency physicians are able to accurately diagnose ocular pathology with ultrasound with little or no physical evaluation of the eye being required initially [1].

We present 3 cases of periorbital air diagnosed on bedside ultrasound. In all cases, manipulation of the lids was difficult and the extent of injury found on ultrasound was not suspected clinically. Computed tomography, not initially planned for in these cases, was ordered and confirmed orbital fractures.

2. Case 1

MH is a 24-year-old woman who was dancing in a club and was punched in the left eye by an unseen attacker 8 hours before presentation. The patient suffered no loss of consciousness and continued to dance. When she returned

* Corresponding author. Tel.: +1 706 721 4467.
E-mail address: blaivas@pyro.net (M. Blaivas).

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doi:10.1016/j.ajem.2004.10.001

Fig. 1 Note the significant swelling of the left upper eyelid.

home and fell asleep, she noticed increasing swelling and ecchymosis of the left eye but had no complaints of visual deficits. Upon awakening 5 hours later, she noticed severe orbital swelling and thought she noticed increased swelling of the upper eyelid after sneezing. On presentation, the patient had normal and stable vital signs. The left lid was swollen and ecchymotic. Retraction of the upper lid was difficult without significant manipulation because of the swelling (Fig. 1). A bedside ultrasound examination was performed to evaluate for globe injury and traumatic retinal detachment. The globe could only be visualized through the inferior aspect of the lower lid because of soft tissue gas in the upper lid of the patient's eye (Fig. 2). The globe itself appeared intact and no evidence of retinal detachment was noted. A facial CT was ordered, which revealed fractures of the medial wall of the left orbit through the lamina papyracea. After ophthalmology consultation, the patient was started on prophylactic antibiotics and managed conservatively with clinic follow-up.

3. Case 2

WT is a 21-year-old man who was kicked in the left eye 2 hours before presentation. He denied loss of consciousness but did complain of generalized headache as well as left eye pain and blurry vision. He recalled having a bloody nose. Presenting vital signs were normal. Initial physical exam was remarkable for moderate orbital swelling and conjunctival injection in the affected eye. Visual acuity was 20/40 in the left vs 20/20 in the right. A moderate hyphema was present in the left eye. Pupils were equal and reactive and extraocular muscles were grossly intact. Fundoscopic exam was normal.

Bedside ultrasound examination demonstrated no evidence of retinal detachment; however, retroorbital gas was seen (Fig. 3). Head and orbital CT confirmed left lamina papyracea fracture with ethmoid air cell opacification and extensive left orbital emphysema and proptosis. The patient was seen by ophthalmology in the emergency department. He was instructed to avoid heavy lifting or nose blowing and to sleep with the head of the bed elevated. Eye drops were prescribed as well as prophylactic oral antibiotics. He was seen in follow-up in ophthalmology clinic for several weeks and was eventually discharged.

4. Case 3

CN is a 24-year-old man who was a restrained driver involved in a head on motor vehicle crash at moderate

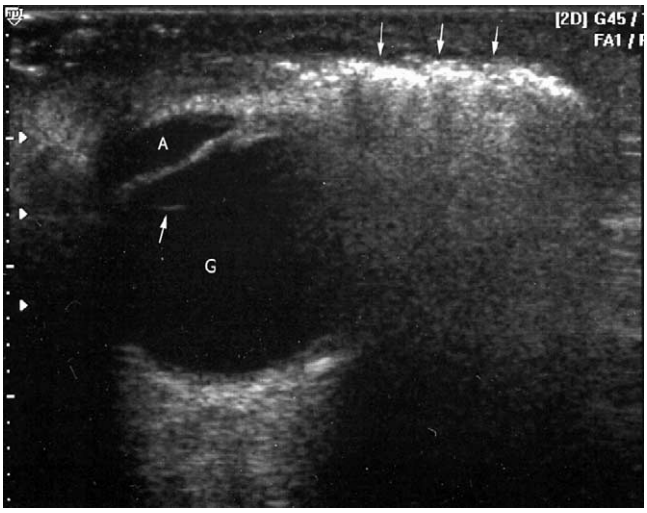

Fig. 2 The eye is seen through the lower lid. Air in the middle of the swollen upper lid is seen as bright reflectors (arrows) and casts a large dirty shadow blocking all useful information deep to it. A indicates anterior chamber; G, globe; arrow, lens.

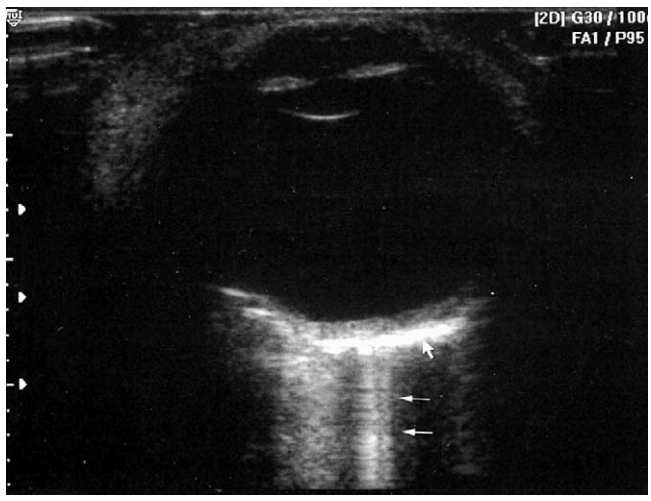

Fig. 3 The eye is seen with the lens anterior, at the top of the image. The singe arrow points to a bright area that represents the air. Dirty shadowing is seen behind the air (arrows) similar to that seen from bowel gas in abdominal ultrasound.

speed. His airbag deployed striking him in the chest and forehead. The patient complained of abrasions to the forehead and blurry vision in the left eye but suffered no loss of consciousness. Epistaxis, which occurred after impact, had stopped during transport to the emergency department. The patient's vital signs were normal and stable. Physical examination showed multiple abrasions to the forehead and swelling of the left upper lid as well as dried blood at both nares. Visual acuity in the left eye was 20/50 as compared to 20/20 in the right eye. Ultrasound was used at the patient's bedside to evaluate for possible traumatic retinal detachment.

Ultrasound examination revealed no evidence of retinal detachment, but posterior to the globe, distinct evidence of gas was seen. Although not clinically suspected, subsequent CT showed multiple facial fractures. Facial trauma service was consulted. He was prescribed prophylactic antibiotics and discharged to home with clinic follow-up on the following day. The patient went on to have several fractures surgically corrected approximately 2 weeks later but did not return for further follow-up.

5. Discussion

Ocular trauma is frequently evaluated in the emergency setting and is often the result of isolated facial trauma or blunt trauma such as from motor vehicle accidents or falls. Although early recognition and treatment of orbital injuries is important, they are often difficult to evaluate and occult fractures may still be missed despite a thorough physical examination. Clinical findings of orbital fractures such as decreased eye motility, diplopia, and palpable crepitus due to subcutaneous emphysema may not always be present or detectable. Furthermore, severe swelling of the eye or facial tissues may further complicate initial examination [2].

The role of CT scanning in the diagnosis and management of orbital injuries is well documented. Thin-section coronal CT is typically regarded as the "gold standard" imaging method of midface fractures and orbital trauma. But even CT is not perfect and has resulted in false negatives and false positives in studies investigating orbital trauma using perioperative findings as a reference method [3]. Coronal CT evaluation also requires adequate patient positioning that may not be possible given coexisting injuries such as an unstable cervical fracture [4]. Furthermore, in the less traumatic scenario, orbital injury may not be suspected and therefore CT scan may not be ordered at all. The reasonable clinician may opt to forgo the extra expense and radiation dose that a CT may present to the patient if the physical examination or mechanism of injury fails to raise adequate suspicion for orbital injury.

Ultrasonography has been used by ophthalmologists for decades in the diagnosis, evaluation, and treatment of various ocular diseases and injuries. However, in recent years, emergency physicians have used ultrasound as an effective tool in the evaluation of the smaller structures of the eye in the emergency setting, screening for such conditions as vitreous hemorrhage, retinal detachment, central retinal artery/vein occlusion, and globe rupture [1]. Ultrasound is also a useful modality in the evaluation of orbital trauma. The bony orbit is especially well suited to ultrasound imaging. The markedly different acoustic impedances of bone and soft tissue in the orbit make the orbital margins highly visible [4]. Described first in 1981, Ord et al [5] applied B-mode scanning ultrasound in the evaluation of orbital wall defects. Since then, the use of ultrasound as a reliable method in the diagnosis of orbital fractures is well described [3,6-9]. The findings of Forrest et al [6] suggest that high resolution ultrasound can diagnose orbital wall fractures and orbital emphysema with 94% correlation with axial and coronal CT images. In comparisons of ultrasound in the detection of orbital fractures vs CT as the standard, recent studies report sensitivity from 85% to 92% and specificity and positive predictive value of 100% [4,6]. Newer studies describe the use of curvilinear transducers, formally used for intraoral applications, for improved fitting and scanning of the anatomic structures of the orbital rims [10,11].

In the cases above, routine bedside ultrasound proved a useful adjunct in diagnosing facial fractures when clinical suspicion was low. In case 1, the presence of severe eyelid swelling made it difficult to satisfactorily examine the patient. The detection of orbital emphysema on bedside ultrasound led to further CT evaluation. The air was not immediately under the skin but rather toward the inner portion of the swollen lid. This caused us to miss the presence of air on mild palpation of the eyelid. The patient in case 2 had been kicked in the eye and had a relatively benign eye examination. Until the presence of retroorbital air was detected on ultrasound examination, CT examination had not been planned for. Likewise, the patient in case 3 had a fairly normal eye exam and the decision to obtain a CT was made only after the finding of retroorbital air on ultrasound. In the above cases, CT was not initially planned because of low clinical suspicion based upon physical examination and mechanisms of injury. Routine bedside ultrasound evaluation of the eye, however, demonstrated the presence of periorbital air that prompted further evaluation by CT imaging that revealed orbital wall fractures.

In the future, ultrasound may become more widely used in the screening, diagnosis, and treatment of various ocular diseases and injuries in the emergency department. It already holds some advantages to CT in that it is less expensive and may be conducted at the patient's bedside. Ultrasound is a widely available diagnostic modality without the associated radiation load of CT. Its use may be justified as an adjunct to physical examination when clinical suspicion of orbital wall fracture is low and CT may not otherwise be practical or clinically warranted.

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