

Patient Survives after a Gunshot Wound to the Head with Bilateral Fixed and Dilated Pupils

This article was published in the following Scient Open Access Journal:

Journal of General and Emergency Medicine

Received December 14, 2016; Accepted January 03, 2017; Published January 10, 2017

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Abstract

Bilateral fixed and dilated pupils in the setting of penetrating head trauma are commonly associated with severe brain injury and herniation. These findings are sometimes used in the consideration of death. Bilateral fixed and dilated pupils are consistently linked to a dismal patient outcome. We report a case of a patient who was brought to the emergency department following a self-inflicted gunshot wound (GSW) to the right temple with bilateral fixed and dilated pupils yet was awake on arrival. Bilateral lateral canthotomies with cantholysis were performed. The patient sustained complete loss of vision in both eyes but was otherwise neurologically intact.

Case Report

The initial EMS communication described finding a patient who was in a bedroom with bilateral fixed and dilated pupils and a gunshot wound to the head (Figure 1). However, shortly after arrival the patient was noted to be moaning. A 33 year old male was brought by paramedics for an apparent self-inflicted gunshot wound to the head. On arrival to the emergency department the patient was hemodynamically stable with mild tachycardia. The patient was having recurrent episodes of hematemesis but his airway and gag reflex were intact. He was breathing spontaneously and clear breath sounds were auscultated bilaterally. Pulses were equal in all extremities. The patient's Glasgow Coma Scale (GCS) was 8; he was moaning and his eyes were closed. He was able to intermittently follow commands, moving all extremities. An apparent entrance wound was located at his right temple and a presumed exit wound at his left temple just posterior to the orbital rim. Pupils were dilated and non-reactive to light bilaterally. Extraocular movements were absent. Both eyes were proptotic. Corneal reflex was not intact in either eye. The remaining secondary survey was negative for injuries and an extended focused assessment with sonography for trauma (EFAST) was negative for intraabdominal fluid or pneumothorax. With presumed intracranial injury and a diminished GCS the patient was intubated with rapid sequence intubation without any complication. A rapid CT scan of the head was then obtained.

The CT scan showed a bullet tract extending from temple to temple across both posterior orbits and through the posterior ethmoid labyrinth (Figures 2 and 3). There was extensive trauma through the right greater than left posterior orbits which included intraconal hemorrhage with mass effect and bone fragments. The left orbital floor demonstrated a comminuted blowout fracture with herniation of the left inferior

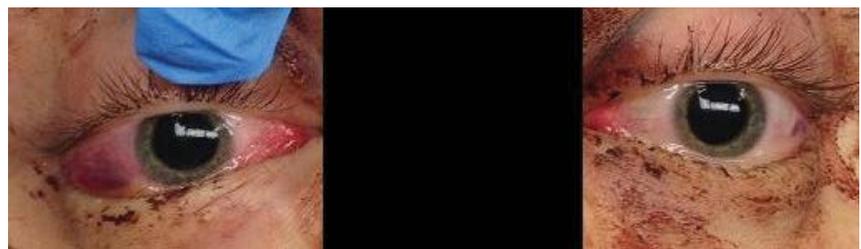
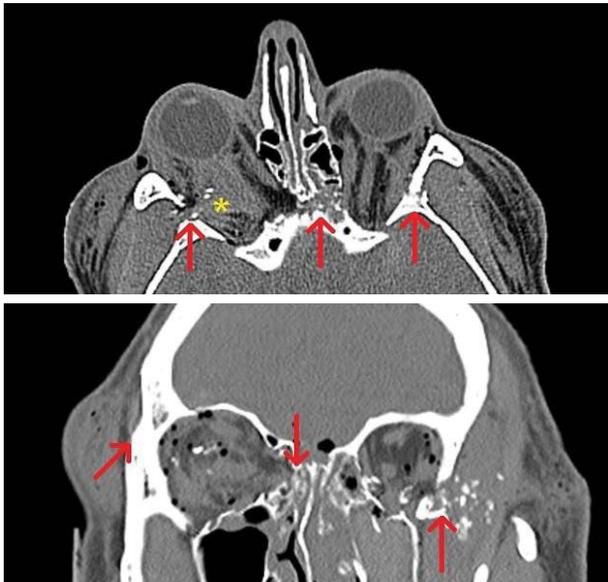


Figure 1: Fixed and dilated pupils.

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Figures 2 and 3: CT scan findings demonstrating a bullet tract extending from temple to temple across both posterior orbits and through the posterior ethmoid labyrinth (red arrows) and retrobulbar hematoma (yellow asterisk).

rectus muscle. There was no evidence of the bullet penetrating the calvarium. Subarachnoid hemorrhage was also noted and was predominantly distributed throughout the orbital frontal region.

The measured intraocular pressure of the left eye was 65 mmHg and 95 mmHg of right eye. Increased intraocular pressure and retrobulbar hematoma with evidence of mass effect indicated the need for lateral canthotomy. Bilateral lateral canthotomies with cantholysis were successfully performed within 40 minutes of patient arrival. Repeat intraocular pressures were markedly decreased to 20 and 24 mmHg for the left and right eyes respectively. Ophthalmology evaluation demonstrated bilateral pre-retinal hemorrhages and retinal edema. The patient was admitted to the surgical intensive care unit for continued management.

Unfortunately, despite the successful lateral canthotomies, the bullet had severely damaged both optic nerves. Two days after admission the patient was extubated. He was blind but otherwise neurologically intact.

Discussion

The classic teaching is that “bilateral fixed and dilated pupils suggest increased intracranial pressure with poor brain perfusion, bilateral uncal herniation, drug effect or severe hypoxia” [1]. Intracranial pressure with uncal herniation compresses parasympathetic fibers of the third cranial nerve producing pupil dilation as a result of unopposed sympathetic tone. Outside of

this classic mechanism other etiologies which result in dilated and non-reactive pupils are as follows: Direct trauma to the optic nerve. Indirect trauma to the optic nerve, usually as a result of ocular compartment syndrome. Extremes in body temperature including both hypothermia and heat stroke. Toxins such as cyanide, methanol, and ethylene glycol. Various drug categories to include barbiturates, anticholinergics and sympathomimetics. And even rare conditions such as tick paralysis can cause dilated and non-reactive pupils.

Bilateral fixed and dilated pupils are used as one of the neurologic criteria when determining brain death. Studies show that patients with bilateral fixed and dilated pupils and a Glasgow Coma Scale of 3 have a 100% mortality [2,3]. Medical personnel, often assume death or imminent death in patients with bilateral fixed and dilated pupils in the setting of a gunshot wound to the head. However, the patient’s full neurologic examination must be considered.

Our patient had a GCS of 8 and the cause of his bilateral pupillary defects was secondary to optic nerve injury and retrobulbar hematoma rather than traumatic brain injury. Optic nerve injury is also known as optic neuropathy from resulting damage directly to the axons of the optic nerve. Classically optic neuropathy results in an afferent pupillary defect and variable vision loss from partial field cuts to complete blindness.

Conclusion

Although studies show universal fatality when fixed and dilated pupils are paired with a GCS of 3 there is less data evaluating these findings with a GCS greater than 3 in the setting of penetrating head trauma. It is pertinent to obtain as much clinical information as possible when communicating with prehospital personnel. Penetrating head trauma with fixed and dilated pupils are common findings and the onus falls on the receiving physician to obtain further neurologic information. This case serves as a reminder that bilateral pupillary defects must be assessed within the context of a complete neurologic examination when determining a patient’s prognosis. Lastly, it is important to maintain a broad differential as there are multiple etiologies of fixed and dilated pupils other than brain death or increased intracranial pressure.

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