Opinion

Imaging considerations in suspected intraocular foreign bodies

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Abbreviations: OGIs, open-globe injuries; IOFBs, intraocular foreign bodies; CT, computed tomography; MRI, magnetic resonance imaging

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Ocular trauma is a leading cause of monocular blindness in the United States[1] with more than 2.4 million eye injuries occurring annually.[2] Over 200,000 of these patients each year are found to have open-globe injuries (OGIs);[3] with between 18 and 41% being due to intraocular foreign bodies (IOFBs);[4] Given the potentially devastating complications that can arise from IOFBs, including rates of endophthalmitis approaching 13%,[5] appropriate diagnosis and treatment are critical to obtain the best visual outcome. IOFBs pose several unique challenges, including but not limited to, the difficulty associated with visualizing the foreign body, which is frequently of unknown composition. Here we briefly discuss the common materials composing IOFBs and the challenges associated with their detection.

The mechanisms of trauma resulting in IOFBs vary greatly and play a critical role in establishing the material responsible for injury. The most common place of injury is the workplace[6] and IOFBs ultimately result in 3.3% of all occupational injuries causing lost workdays.[7] Injury most commonly results from hammering (60-80% of IOFBs), but use of power tools and firearms also constitute common mechanisms of injury.[4] Penetrating foreign bodies most commonly enter through the cornea[8] with a majority being ultimately found in the posterior segment.[9] Given the common mechanisms of injury, it is unsurprising that most IOFBs are metallic in origin; however, organic materials (e.g., wood, thorns, and hair) are also common culprits and pose unique challenges in detection.

While the history and physical examination are of significant utility in the evaluation of IOFBs, they are often limited by severity and complexity of the injury. Although some advocate plain film radiographs for screening, images can fail to visualize smaller[10] and radiolucent[11] objects. Computed tomography (CT) allows for the detection of smaller foreign bodies[12] and can also aid in detection of globe rupture and thus represents the most often initial imaging test in most centers. Magnetic resonance imaging (MRI) and ultrasound hold greatest utility as adjunctive tests following CT. If the presence of a metallic IOFB can be excluded, magnetic resonance imaging can provide insights although its use is often limited by practical considerations such as availability and scanning time in the trauma setting. Ultrasound is operator dependent and risk further globe trauma in inexperienced hands.

Metallic foreign bodies can usually be easily detected on CT scan, and efforts have been made to differentiate metal type based on imaging characteristics.[13] Organic material poses significant challenges in image detection. For instance, wood can present with varying density (depending upon its type and hydration status), which can result in an appearance similar to fat or even air. This, in part, results in an inability to detect these particles on plain film x-ray[14,13] and only limited success with CT and MRI.[15] Left untreated, these foreign bodies can result in significant morbidity including cellulitis, abscess formation, orbitocutaneous fistulas, and osteomyelitis among other sequelae. The ability to differentiate types of metal holds value as this can effect prognosis (with iron and copper holding greater pathogenicity) and surgical approach (e.g., the utility of using a magnet for IOFB removal intra-operatively). CT holds the greatest ability to divide metallic IOFBs into different categories based on density and artifact produced,[13] although exact determination is often challenging. Imaging characteristics of different IOFBs have been previously described[13,14,16,17] and the reader is referred to these sources for a more detailed discussion of specific findings.

The presence of an IOFB significantly changes the prognosis and management of patients with open globe injuries. Physicians should maintain a high index of suspicion for the presence of an IOFB when evaluated ocular trauma patients. Clinical exam is often limited in these settings[18] and as such imaging plays a central role in the detection and evaluation of IOFBs. Ophthalmologists should have a strong familiarity of imaging principles. Timely detection and subsequent treatment in IOFB based injuries can mitigate their significant complications and improve visual outcomes.

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Conflicts of interest

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