

Chapter 32

FOREIGN BODIES OF THE HEAD, NECK, AND SKULL BASE

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INTRODUCTION

The mechanism and extent of war injuries are significantly different from civilian trauma. Many of the wounds encountered are unique and not experienced even at Role 1 trauma centers throughout the United States. Deployed head and neck surgeons must be skilled at performing an array of evaluations and operations that in many cases they have not performed in a prior setting. During a 6-month tour in Afghanistan, all subspecialties of otolaryngology were encountered: head and neck (15%), facial plastic/reconstructive (32%), pediatric (10%), laryngology (8%), rhinology (8%), oral surgery (13%), otology (7%), and general ear, nose, and throat (7%). This is somewhat consistent with

other military conflicts. In a study done in Croatia with 117 patients who sustained penetrating neck injuries, about a quarter of the wounds were from gunshots while the rest were from shell or bomb shrapnel.¹ The injury patterns resulting from these mechanisms can vary widely, and treating each injury requires thoughtful planning to achieve a successful outcome.

This chapter will address penetrating neck injuries in general, followed specifically by foreign body injuries of the head, face, neck, and skull base. Multiple case studies will be presented to illustrate the types of foreign body injuries encountered in a war zone and their treatment.

PENETRATING NECK TRAUMA

The significant areas most commonly injured with penetrating neck trauma are the great vessels, followed by the spinal cord, the aerodigestive tract, and various nerves.²

Anatomy

The neck's anatomy is unique in that many vital structures are arranged in tight fascial compartments, making it particularly vulnerable to penetrating neck trauma. In many cases this trauma can be lethal. A good foundation in the anatomy of the neck is essential when managing a penetrating neck injury. Understanding the fascial planes and compartments of the neck in particular is vital in understanding the clinical presentation of various penetrating injuries.

The neck is generally divided into three anatomical zones for purposes of clinical evaluation and communication among physicians (Figure 32-1). Zone I is located between the body of the clavicle and the upper border of the cricoid cartilage. This area contains the great vessels, including the origin of the common carotid artery, the subclavian vessels, and the vertebral artery. The brachial plexus, trachea, esophagus, the upper aspect of the lung, and the thoracic duct can also be found in this region. The clavicle can make this zone difficult to expose surgically. Zone II lies in the area between the upper border of the cricoid cartilage and the angle of the mandible. The great vessels are also in this zone, but the subclavian vessels are not. The trachea and esophagus are vulnerable in this zone, as they are in zone I. Zone II is more readily accessible from an examination and surgical standpoint compared to the other two zones. Zone III extends from the angle of mandible to the base of skull and is difficult to access clinically and surgically. It includes

the distal carotid artery and jugular vein along with the vertebral arteries and pharynx.

In a study looking at the overall injury rates according to zone, zone II was most commonly injured (47%), followed by zone III (19%) and zone I (18%). About one in six cases involved injury to more than one zone.³ In patients with stab wounds, zone I was again most commonly injured (44%), followed by zone II (29%) and zone III (27%). Three out of every four stab wounds involved the left side of the neck, probably because the attackers were right-handed.³

Emergency Management

When dealing with a penetrating trauma of the head and neck, the initial evaluation should follow advanced trauma life support guidelines. Particular attention should be paid in the initial survey to airway obstruction (due to laryngotracheal trauma or external compression by a hematoma), tension pneumothorax,

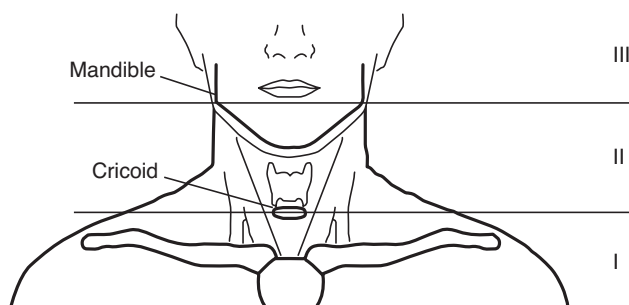


Figure 32-1. Surgical zones of the neck: zone I is between the clavicle and cricoid, zone II is between the cricoid and angle of mandible, and zone III is between the angle of mandible and the base of the skull.

significant active bleeding both externally and in the thorax, and spinal cord injury or brain ischemia from a carotid artery occlusion.

After finishing the primary survey, the secondary survey should be completed with particular attention paid to subtle vascular or laryngotracheal injuries, pharyngoesophageal injuries, cranial or peripheral nerve injuries, and occult pneumothoraces.

Clinical Examination

An extensive head and neck exam should be completed for any penetrating neck injury or foreign body presence. This is usually performed as part of the primary and secondary survey (specifics can be found in Chapter 11, Primary and Secondary Trauma Assessment). When dealing specifically with foreign body injury to the head and neck, physical exam is the most reliable diagnostic tool. If possible, a systematic, written protocol should be used. The protocol should be specifically directed to reveal injuries to the laryngotracheal/pharyngoesophageal region, the vessels pertinent to the zone involved, the lungs, and the spine. "Hard" signs are usually considered definitive indications of a specific injury, while "soft" signs are suspicious but not necessarily diagnostic.^{2,4} The way in which the injury occurred strongly influences signs and symptoms; for example, casualties with gunshot wounds (GSWs) usually present with a hematoma (20.6%), and those who sustained stab wounds with odynophagia (14.3%) and hemothorax or pneumothorax (13.5%).²

Investigations

While plain chest and neck films, ultrasound, color flow Doppler, angiography, and esophageal studies can all play a role in penetrating neck injury, computed tomography (CT) has become perhaps the most useful tool in evaluating GSWs and foreign bodies.

Computed Tomography

In Afghanistan, CT was used as a study of first choice in all stable patients who sustained GSWs and other foreign body wounds to the head and neck. When performing the CT, entry and exit wounds should be marked, and fine-cut (3 mm) CT slices should be performed between the two points. If there is no exit wound, then the slices should be performed between the entry wound and the remaining fragment. Trajectory can prove vital in determining the need for further studies or surgical intervention. Trajectories that are distant from the large vessels of the neck or the aerodi-

gestive tract can usually be watched conservatively unless the clinical condition changes.⁵ In one study, 68% of penetrating neck injuries trajectories on CT scan were noted to be distant from vital structures and no further intervention was performed.⁶ CT scanning can also provide insight into the status of the spinal cord, presence of bone or foreign body fragments in the spine, and hematomas near the spinal cord.⁵

Helical CT angiography has recently been used to evaluate large neck vessels after a penetrating neck injury. Results appear to be helpful in the evaluation process; in some cases, the method is used as the initial investigational tool when a vascular injury is suspected.⁷⁻⁹ Munera prospectively compared conventional angiography to helical CT angiography in a study of 60 patients. CT angiography showed a sensitivity of 90%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 98%.⁷ In a larger study with 175 patients, Munera found similar results, suggesting again that CT angiography can be very helpful in evaluating arterial injuries in the head and neck. He did mention, however, that CT angiography may have some limitations with metallic artifacts or large amounts of air in the soft tissues, in which case conventional angiography may be more helpful.⁸

Patients who have sustained penetrating neck injury with unexplained central neurological signs should undergo a brain CT scan. The brain CT is particularly useful in these scenarios for locating ischemic infarction secondary to a carotid injury or a direct injury from shrapnel.⁵ Also, a chest radiograph should be obtained in zone I injuries because 16% of GSWs to this region are associated with a hemothorax or pneumothorax.²

It can be difficult to detect some foreign bodies, even when there is high suspicion of their presence. This difficulty can be of significant consequence in the vicinity of critical structures such as major vessels, airway passages, gastrointestinal organs, and neurological structures. Foreign body localization is dependent on the composition of the object. Various factors can make a foreign object more or less detectable, such as the density of the object, the number of Hounsfield units it displays on CT, the proportion of the object that is air versus water, its ferromagnetic makeup, and its size. Some foreign objects, such as metal, bone, and windshield glass, can be readily detectable on radiograph. However, other types of glass and most plastics (including those used in most IEDs) may not be detectable on radiograph, CT, or MRI. Some foreign bodies can be hidden by bleeding and inflammation regardless of their composition. As stated earlier, CT is the best first choice for imaging, but in selective cases, and when available,

MRI may be helpful. Unfortunately, MRI cannot be used initially if there is any suspicion of a metallic foreign body.¹⁰⁻¹⁴

Imaging of foreign bodies can have some notable limitations. Plastic and vegetative material are very difficult to discern on CT or MRI. Dry wood can easily appear as air due to its lack of water content compared to green wood. Dry wood density, however, is not as dark as that seen in a paranasal sinus or in orbital emphysema, and is usually surrounded by inflammation. Air within the orbit is not known to cause inflammation, so a CT report with this description should raise suspicion. Any report stating there is a "linear density within the orbit" should also raise concern because there are no linear structures within the orbit save for the short segment of the optic nerve, which should be easily differentiated.¹⁵

A note should be made about modern digital CT displays that allow computer manipulation of the image's contrast levels on the desktop. This can lead to subtle foreign objects being erased or erroneously created. Conventional film processing may be more prudent in these cases. As mentioned previously, the low water content of dry wood can make it difficult to identify on CT. On MRI, however, dry wood can often be detected readily as a dark mass against the bright fat of T1-weighted images. This same principle can help delineate some plastics, but each has its own MRI characteristics. It can also be difficult to detect fresh blood

on MRI because its high proton content diminishes T1 contrast enhancement. CT and MRI are not as accurate in detecting fresh vegetable matter such as green wood because its high water content is similar to the water densities of fat and orbital hemorrhage. Dry wood can become more difficult to detect on MRI with time as it becomes hydrated in the body. Prolonged presence of a foreign body is usually associated with redness, pain, drainage, or fistula formation. Occasionally, chronic foreign bodies (especially those that are vegetable matter) will extrude spontaneously.^{11-14,16}

Studies for Laryngotracheal Evaluation

The laryngotracheal evaluation after a foreign body injury is of particular concern to the head and neck surgeon. A surgeon should be concerned about a laryngotracheal injury if there are soft signs such as small amounts of hemoptysis, voice changes, crepitus, or imaging showing a trajectory near the trachea or larynx. Flexible nasopharyngoscopy should be performed in the emergency room and most commonly will reveal blood or edema in the laryngotracheal tract.² Vocal cord abnormalities such as asymmetric movements are highly suspicious. Abnormal nasopharyngeal fiberoptic exams are more likely to result from GSWs than knife injuries (24.6% vs 8.5%). However, only about one in five patients with an abnormal finding require surgical intervention.^{2,17}

OPERATIVE VERSUS NONOPERATIVE MANAGEMENT

In years past it was thought that injuries violating the platysma should be routinely explored; physical exam was felt to be unreliable and a significant injury could be missed. It was thought that routine exploration would make expensive imaging studies and prolonged hospital stays unnecessary.¹⁸ However, this practice led to many unnecessary operations, ranging from 30% to 89% in some studies.^{18,19} Strong evidence has since shown that a good physical exam can be very reliable when determining the need for surgery: only about 17% of GSWs and 10% of stab wounds to the neck require a therapeutic surgical procedure, and subjecting the remaining 83% to 90% of patients to an unnecessary and sometimes morbid exploration is not an acceptable practice.^{2,3,20-26} The policy of mandatory exploration was therefore abandoned in Afghanistan during Operation Enduring Freedom and was replaced by a more selective process.

Since GSWs are usually associated with a higher incidence of significant injuries, it is sometimes argued that they should follow the previous protocol of immediate surgical exploration.²⁷ However, over

80% of GSWs to the head and neck do not require an operation, and evidence shows that many of these patients can be managed conservatively and spared the morbidity of an unnecessary operation.^{2,23,26,28-30}

Clinical examination and imaging are of paramount importance in making the correct choice. If the trajectory of the bullet has crossed the midline of the neck, the incidence of significant injury rises from 31% to 73%.²³ It is argued by some that this statistic mandates a surgical exploration for these patients.³¹ However, many of these patients, even if severely injured, do not benefit from surgical exploration, and a repair is not indicated in most cases of spinal cord injury or nerve laceration. In a study done in Los Angeles, 73% of patients had damage to a "vital" neck structure but only 21% required surgical intervention and repair.³² These patients were evaluated with thin-cut CT angiography as the imaging modality of choice, which allowed providers to determine which patients could be observed and which would benefit from further evaluation.^{4,9,33-35}

Factors in the Deployed Setting

Deciding whether an operation is clearly indicated for penetrating and foreign body injuries of the neck is even more important in the deployed setting, where a limited number of operating rooms, staff, and operative time are available. Surgeons may want to remove foreign bodies simply because they are “foreign” and do not belong in the head and neck region. This tendency must be resisted and replaced with thoughtful management decisions. If the foreign body is not causing, or potentially causing, an emergency by migration, it should be left in place and the patient evacuated or observed. As a general guideline, when soft signs such as a stable hematoma, reduced capillary refill and pulse, and nerve deficits are present after a foreign body has coursed within 1 cm of named vessels, a vascular injury is likely.³⁶ For coalition patients in Operation Enduring Freedom, unless the foreign object was causing a life-threatening injury, the objects were left in place and the patient air evacuated out of the theater of operations. In instances when the patient must have surgery for other injuries not involving the head and neck, and the object is accessible without increased morbidity, removal may be warranted, especially in coalition forces.

Operative Management

When the decision has been made to remove a foreign body, the correct approach is critical to limiting morbidity while also allowing for safe removal of the object. Objects lodged in the esophagus, for example, may be removed with rigid esophagoscopy. Some small esophageal tears may be allowed to heal secondarily. However, untreated esophageal tears can be life-threatening; therefore, if there is any question as to the extent of the tear, an open neck exploration and multi-layer repair is necessary. Objects lodged in the prevertebral or intervertebral disc space may be removed with endoscopy using image-intensified television to avoid a dangerous open-neck approach.³⁷ If the surgeon is not familiar with this technique or the instrumentation is not available, a safer route is an anterior neck approach. Magnets have been used, both externally and internally, to identify small metallic fragments that are difficult to find.³⁸ In some cases, magnets may obviate the need for more extensive imaging techniques. This technique was not utilized in Afghanistan but might have been of some value intraoperatively to locate small carotid sheath and pericardial fragments.

Occasionally, the surgeon will need to remove white phosphorus in order to limit burn injury and local trauma. This situation can be quite disturbing when

first encountered because irrigation will cause smoking when water is in contact with the phosphorus. If the presence of phosphorus is not realized, more irrigation will be used, causing further ignition of the phosphorus. Phosphorus should be removed expeditiously with minimal irrigation to prevent extending the damage. In a case in Afghanistan of phosphorus contamination after an improvised explosive device (IED) attack, the wounds of the head and neck were cleaned and closed without event, but concern was high for potential ignition and further injury to the patient.

Munitions lodged or embedded in the head and neck can add an extra level of difficulty. Any of these objects should be considered “live” and treated accordingly. In some instances, the explosive ordinance disposal (EOD) team will need to evaluate the object. The team should be notified immediately if there is any concern about the status of a foreign object located in any body part of the patient. The EOD team members may need to be in the operating room if the patient is unstable, and the operating surgeon should consider the safety of the operating team first and foremost. Only essential personnel should be involved in the case, and they should be protected with appropriate equipment. Extraction of the foreign body in these cases must be done meticulously, with minimal manipulation of the explosive foreign body. Proper disposal of the item should be left to the EOD team.

Postoperative Care

Intraoperative and postoperative antibiotics are usually administered to all patients with foreign objects in the head and neck, whether they are removed or not, because the vast majority of these injuries are contaminated. This practice of empirical perioperative antibiotic therapy is consistent with antibiotic use in other impalement case reports and series.³⁹ Generally, if the larynx or esophagus have not been violated, gram-positive skin coverage is adequate. In Afghanistan, cefazolin (Ancef, SmithKline Beecham, Philadelphia, PA) 1 g intravenous (IV) every 8 hours, or clindamycin 900 mg IV in penicillin-allergic patients, were routinely used. If the injury involved the larynx or esophagus, broader coverage for anaerobic and both gram-negative and gram-positive aerobes with ampicillin/sulbactam (Unasyn, Pfizer, New York, NY) 3 g IV every 6 hours was used. For penicillin-allergic patients, clindamycin 900 mg IV every 8 hours along with ciprofloxacin 400 mg every 12 hours is acceptable.

The literature supports outpatient observation for clinically stable patients with close regular follow-up and, in the case of children, thorough parent education

regarding signs of neurovascular injury. These procedures are based on the knowledge that some neurovascular sequelae after penetrating trauma can occur after 48 to 72 hours. However, reliability, language barriers, and distance from the hospital in the wartime setting

must be taken into consideration when deciding which patients may go home and which should be admitted for observation. The vast majority of patients heal uneventfully and without sequelae, but failure to identify a patient who will deteriorate can be devastating.

PEDIATRIC INJURIES

During the 6-month period in Afghanistan mentioned above, pediatric injuries comprised approximately 10% of all head and neck trauma cases. Many of the injuries were due to children encountering explosive devices when playing near their homes. Others were due to misfiring of IEDs planted by child soldiers. Children are at greater risk than adults for central nervous system, ocular, and major vascular injury from penetrating trauma to the craniofacial skeleton because of their increased craniofacial ratio, lower facial bone density and thickness, and underdeveloped paranasal

sinuses.⁴⁰ Despite this increased risk, significant morbidity and mortality are relatively infrequent when prompt diagnosis and treatment can be obtained. In a 1990 review of 21 cases of pediatric craniofacial trauma, Martin and Gussack proposed an algorithm for evaluation and management based on the anatomic area of injury.⁴¹ Three patients in that study succumbed to their injuries, but the survivors recovered with minimal sequelae. None of the children in the Afghanistan cases mentioned above had permanent sequelae from their penetrating head and neck injuries.

ORBITAL FOREIGN BODIES

Intraocular foreign body diagnosis and management is outside of the scope of this chapter and specialty, but mention should be made of foreign objects external to the globe but within the orbit. Small objects and missiles, while seemingly harmless to the rest of the body, are capable of creating devastating injury to the globe and orbital structures. Glass, plastic, metal, or vegetable matter from any source are all capable of inflicting serious orbital injury. These injuries were frequently encountered throughout the wars in Afghanistan and Iraq. Multiple glass fragments were removed from an Afghan National Police patient, including a solitary fragment that went through the pupil of the eye, causing blindness (Figure 32-2). Eye protection of any kind is critical because the great majority of ocular and orbital foreign body injuries could be prevented.⁴²

Most orbital foreign bodies are inert—with the notable exception of vegetable foreign bodies—and usually do not cause extensive damage just by their presence, but in the acute setting they can cause severe injury that can be quite difficult to diagnose and treat. When a history can be obtained from the patient, the likelihood of a foreign body can be quickly ascertained. However, a much higher index of suspicion must be

maintained when the history is unobtainable, such as with polytrauma patients who present to the trauma bay intubated and sedated. These cases are often complicated further by severe swelling and bruising, lacerations, or hemorrhage. Surgeons must also consider the possible presence of a broken or partial foreign body from a penetrating object such as a knife. Brisk bleeding from the orbit is a good indicator of a deep orbital injury. Medial penetrating eye injuries can cause significant hemorrhage due to the location of the anterior and posterior ethmoid arteries at the fronto-ethmoid junction. Hemorrhagic chemosis can signify globe rupture and also orbital hemorrhage secondary to one or more foreign bodies. A significant challenge arises when penetrating objects make their way deep into the orbit without any clear outward signs of injury. Some patients may not present until much later due to an initial lack of symptoms or focus on more obvious injuries. This can be a significant problem because vegetable foreign bodies, for example, may incite inflammatory reactions long after the entrance wound has healed, causing extensive damage. The astute ophthalmologist must maintain a high degree of suspicion for a retained foreign body at all times.¹⁵

SUMMARY

Penetrating foreign bodies of the head and neck present a unique and challenging situation for the head and neck surgeon in the wartime setting. Unfortunately, there is no way to plan for every injury

that will be encountered. As in any surgical procedure, a thorough understanding of the anatomy at risk is essential. Many of the usual landmarks and structures used in standard surgery will be distorted

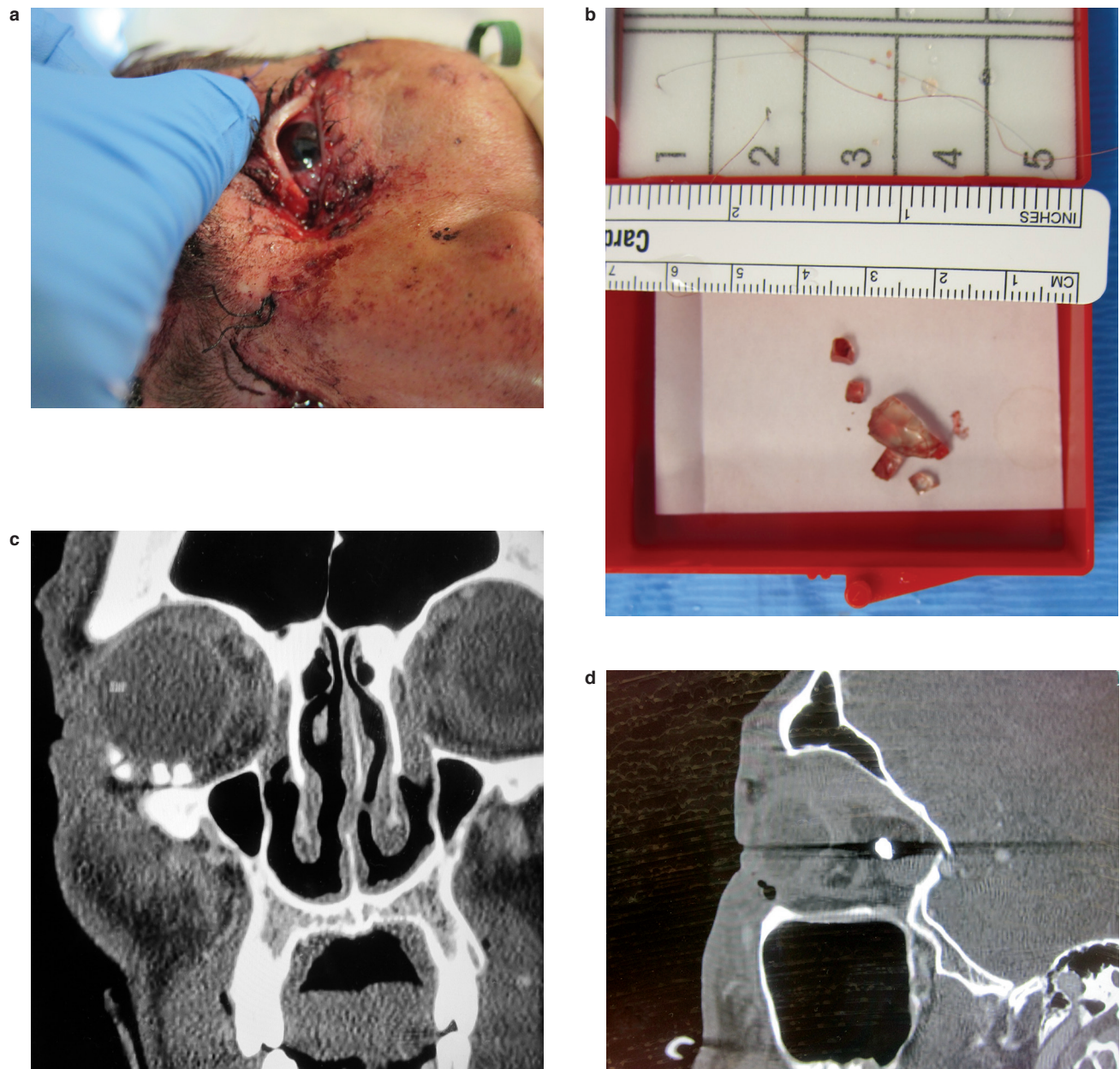


Figure 32-2. (a) Eye of an Afghan National Police member who was blinded by glass fragments that passed into the orbit and partially through the globe. (b) The glass fragments after removal. (c) Preoperative coronal and axial computed tomography scan slices showing glass fragments within the globe. (d) Preoperative axial computed tomography showing the glass fragment that passed through the pupil.

and replaced with unrecognizable tissue planes. A variety of surgical techniques must be employed (in many instances during the same procedure) and intraoperative decision-making can be crucial. An extensive background in facial reconstructive surgery is helpful in these situations, and a rotation at a Role 1 trauma center prior to deployment is ideal. In a demanding environment such as a war

zone operating room, it is imperative that the head and neck surgeon constantly evaluate the proper use of resources, the intraoperative goal, the safety of the hospital staff, and the dictum to “first, do no harm.” While basic, these principles are of utmost importance when faced with the uncertainty and variability of foreign object injuries of the face, head, and neck region.

CASE PRESENTATIONS

Case Study 32-1

Presentation

An adolescent child presented to the trauma bay at Bagram Air Base, Afghanistan, after sustaining a GSW to the face and oral cavity. The patient was intubated in the field and flown immediately to Bagram for definitive care.

Radiology/Preoperative Workup

An x-ray and CT scan were performed at the time of evaluation (Figure 32-3).

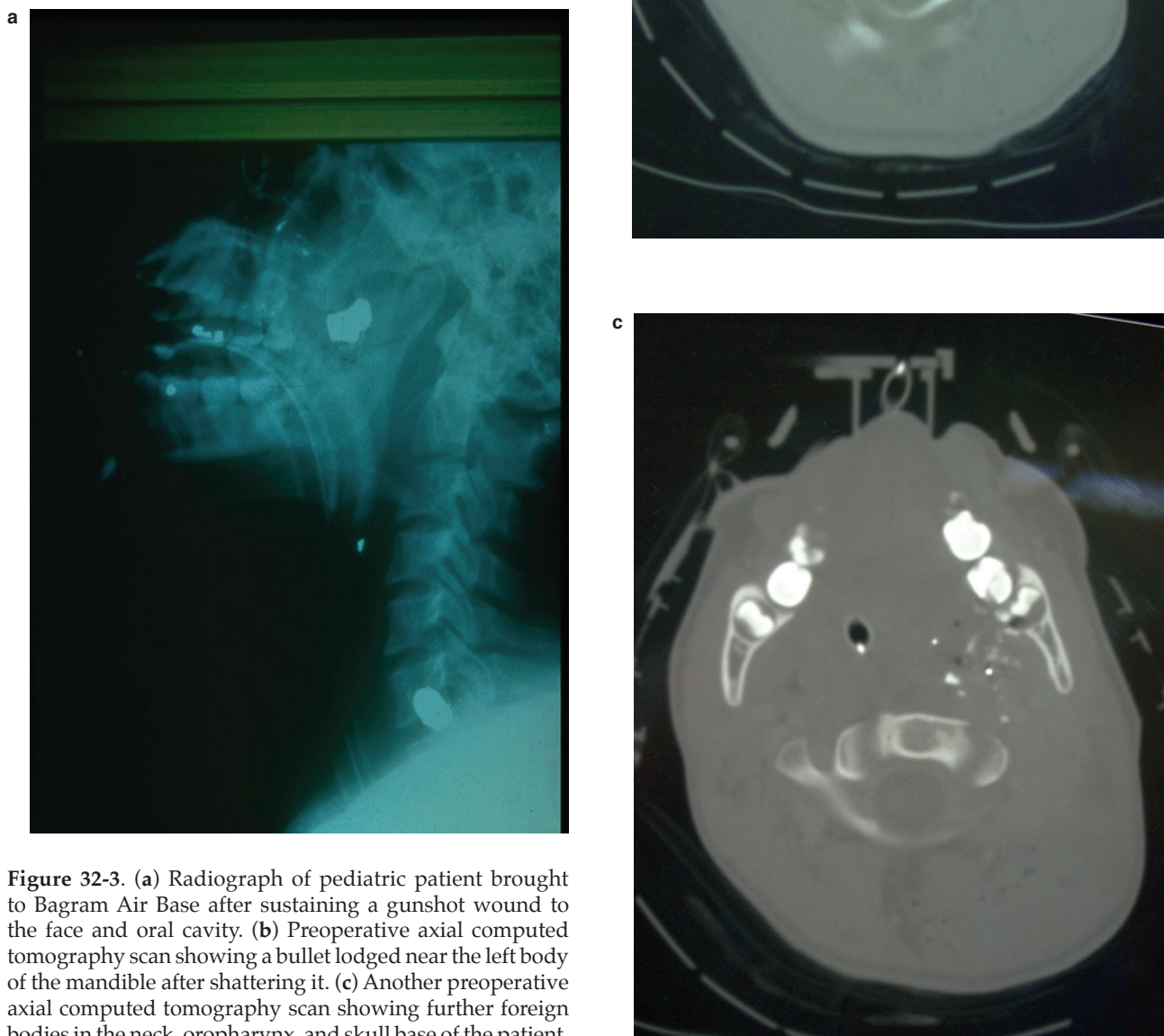


Figure 32-3. (a) Radiograph of pediatric patient brought to Bagram Air Base after sustaining a gunshot wound to the face and oral cavity. (b) Preoperative axial computed tomography scan showing a bullet lodged near the left body of the mandible after shattering it. (c) Another preoperative axial computed tomography scan showing further foreign bodies in the neck, oropharynx, and skull base of the patient.

Operative Plan/Timing of Surgery/Operation

Shortly after extubation, the patient began to develop signs of a pending cerebrovascular accident and was taken for an emergent neck exploration and transoral removal of the foreign bodies in the neck, oropharynx and skull base (Figure 32-4). The oral cavity wound was left to granulate and the neck was closed primarily (Figure 32-5).

Complications

At 1 month follow-up, the patient had no permanent sequelae of a cerebrovascular accident. He developed some trismus, which was treated with transoral scar band excision in the operating room and mouth-opening exercises. He eventually obtained normal mouth opening and was discharged from the ear, nose, and throat clinic.

Lessons Learned

It is essential to follow patients with head and neck penetrating injuries, and especially foreign bodies, for delayed sequelae. If this patient had not been observed closely by an astute intensive care team, a significant brain injury and even death may have ensued.

Case Study 32-2

Presentation

A local national Afghan male was brought to the trauma bay at Bagram Air Base after sustaining an IED injury to his right temple, eye, and arm.



Figure 32-4. Bullet seen in Figure 32-3b after removal. Note broken tooth fragment.



Figure 32-5. Postoperative photo of the oral cavity, granulating in well. The neck was closed primarily.

Preoperative Workup/Radiology

The patient had significant foreign bodies embedded in his facial wounds including rocks, shrapnel, and dirt (Figure 32-6).

Operative Plan/Timing of Surgery/Operation

The right temple area was debrided multiple times on consecutive days, and the eye was enucleated. A wound vacuum was eventually placed over the area and left in place for 5 days (Figure 32-7). A bed of granulation tissue was created and a subsequent cervicofacial rotation flap was used to supply adequate wound coverage (Figure 32-8). A well-matched ocular prosthesis was also placed upon follow-up, which was greatly appreciated by the patient and his family.

Complications

None.

Lessons Learned

While not used extensively in the head and neck region, wound vacuums can be of great benefit in certain scenarios. A seemingly very difficult wound became much more manageable after using this device.

Case Study 32-3

Presentation

A 5-year-old local Afghan male was evacuated from a British forward operating hospital to Bagram Air Base after aspirating a foreign body.

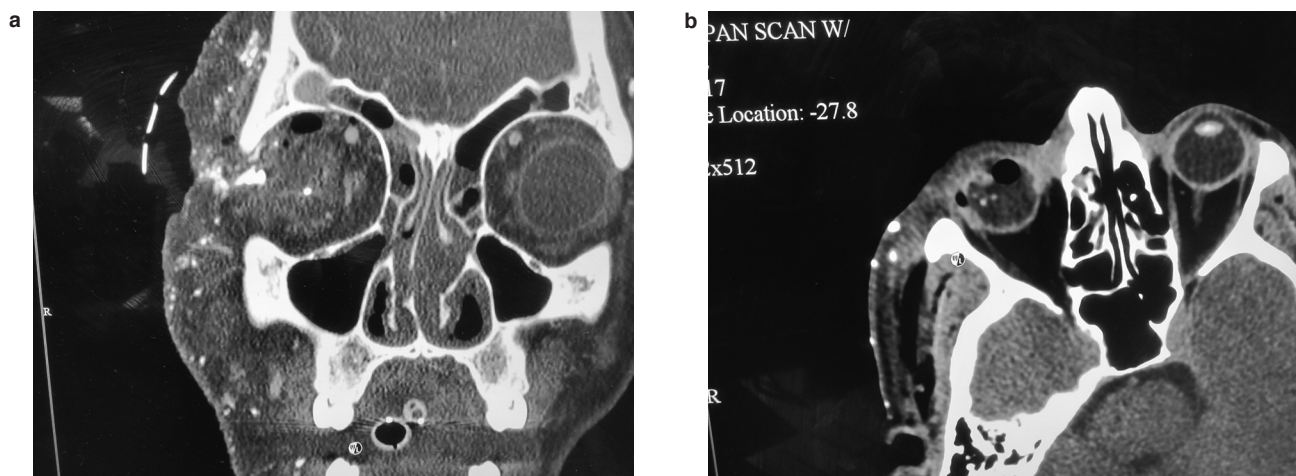


Figure 32-6. Coronal (a) and axial (b) computed tomography images of a facial wound from an improvised explosive device with a combination of rocks, dirt, and fragments embedded throughout.

Preoperative Workup/Radiology

The patient was noted to have a right mainstem obstruction by the transferring physician and was intubated.

Operative Plan/Timing of Surgery/Operation

Upon arrival, the patient was taken to the operating room, where rigid bronchoscopy was performed after extubation. Jet ventilation was unavailable so an apneic technique was utilized. The right mainstem bead was visualized to be completely occluding the

right mainstem bronchus at its entrance (Figure 32-9). It was extracted using pediatric forceps after some difficulty due to its round shape and size. The patient was immediately reintubated and weaned off of the ventilator that evening.

Complications

No sequelae were noted upon discharge.



Figure 32-7. Intraoperative photograph showing the facial wound vacuum in place.



Figure 32-8. After allowing for an adequate bed of granulation tissue to form, a cervicofacial rotation flap was rotated over the defect supplying coverage. Despite the foreign bodies and trauma to the flap, it healed completely without tissue loss.



Figure 32-9. Intraoperative photograph of an Afghan child's right mainstem showing an aspirated bead. The bead was safely removed using a rigid pediatric bronchoscopy forcep.

Lessons Learned

Pediatric airway foreign bodies can be some of the most challenging of cases, even in the best of circumstances. It is essential to have a discussion with the anesthesia team as well as a thorough review of instrumentation prior to accepting these cases at the hospital. In this particular case, only two optic forceps were available, and one of them was adequate to remove the object. Another possible option would have been to use a Fogarty catheter by passing it past the object, inflating it and pulling back. This technique is less controlled, however, and could result in lodging of the object within the tracheal lumen. If this occurs,



Figure 32-10. Facial radiograph of an Afghan National Police officer, several years after a blast injury, showing a round metallic foreign body within the left nasolacrimal duct.

the object should be pushed back into one of the mainstems for adequate ventilation. Another issue with this particular case is that jet ventilation was not available. The apneic technique was successful and saturations did not fall below 90% throughout the case. However, jet ventilation could have been useful had it taken longer to remove the object, and its absence should be taken into consideration on any airway foreign body case.

Case Study 32-4

Presentation

A middle-aged male Afghan National Police officer presented to the ophthalmology clinic with chronic left-sided epiphora. He had sustained a blast injury to the face a few years earlier.

Preoperative Workup/Radiology

An x-ray of the face was performed, showing a round metallic object within the left nasolacrimal duct (Figure 32-10).

Operative Plan/Timing of Surgery/Operation

The patient was taken to the operating room, where the nasolacrimal duct was incised through an external approach. The object was excised without difficulty, the nasolacrimal duct was repaired, and the epiphora resolved. It appeared that the object was ammunition from an old Afghan rifle, which had eroded into the nasolacrimal system (Figure 32-11).

Complications

None.

Lessons Learned

Injuries of all types can be encountered in a war zone. The surgeon must adapt and be flexible in the operative plan at all times. A positive note in this case is that a relatively straightforward operation can make a life-altering difference for the patient, who had not been able to see a head and neck surgeon in years.

Case Study 32-5

Presentation

A US Marine was struck by an IED while on patrol in southern Afghanistan. He sustained multiple foreign object wounds to the face.

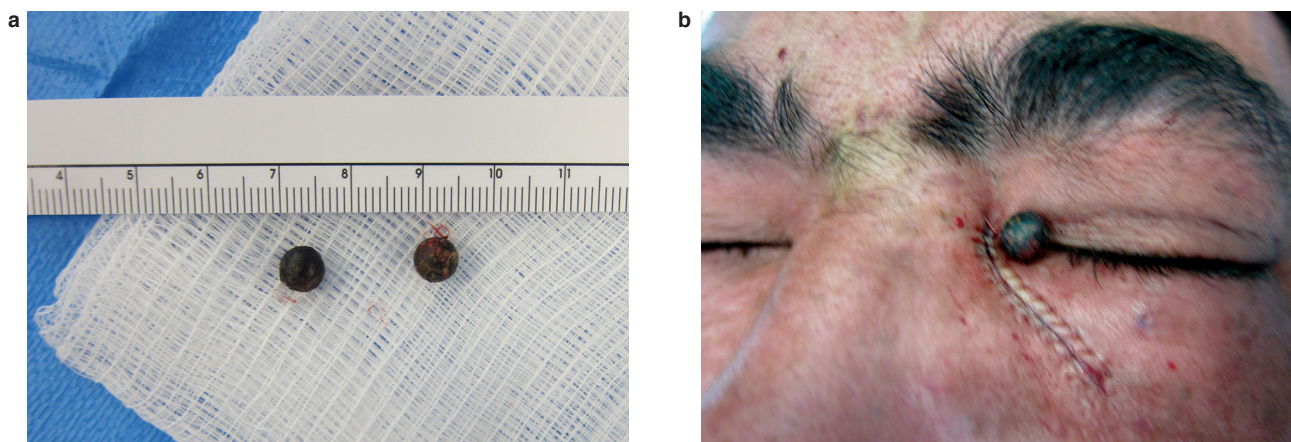


Figure 32-11 (a, b). Two views of the foreign body removed from the left nasolacrimal duct through an external approach. It appeared to be an older type of Afghan ammunition.

Operative Plan/Timing of Surgery/Operation

The patient was taken to the operating room and his face was debrided and cleaned under general anesthesia (Figure 32-12). Various-sized bone curettes were used to remove lodged debris from the depths of the wounds (Figure 32-13). This proved to be a very helpful technique to get objects that otherwise were inaccessible without significant trauma to the face.

Complications

None.

Lessons Learned

In this patient, large pieces of rock, glass, dirt, metal, and wood were removed that would have caused inflammation and scarring if left in place. These types of cases were quite frequent in Afghanistan, and follow-up when possible showed a significant improvement in appearance compared to patients who were not extensively debrided. In some cases, multiple trips to the operating room were required to complete the debridement as the wounds matured. Extensive benefits are gained in terms of improved outcome and recovery when these patients are debrided in the operating room.



Figure 32-12. Intraoperative photograph of a facial debridement of a US Marine struck by an improvised explosive device in southern Afghanistan.



Figure 32-13. Bone curettes proved invaluable in removing deeply embedded foreign bodies in the face, allowing for improved healing with significantly less scarring.



Figure 32-14. Intraoperative photograph of a large gunshot wound to the right temporal/parietal scalp of a US Army soldier.

Case Study 32-6

Presentation

A US Army soldier was struck with a bullet on the right temporal/parietal scalp while on patrol in Afghanistan (Figure 32-14).

Preoperative Workup/Radiology

CT scan revealed extensive injury to the skull and underlying brain, with shrapnel lodged within the



Figure 32-16. A temporalis muscle flap and a separate cervicofacial flap were used to cover the exposed brain matter prior to transport out of Afghanistan.

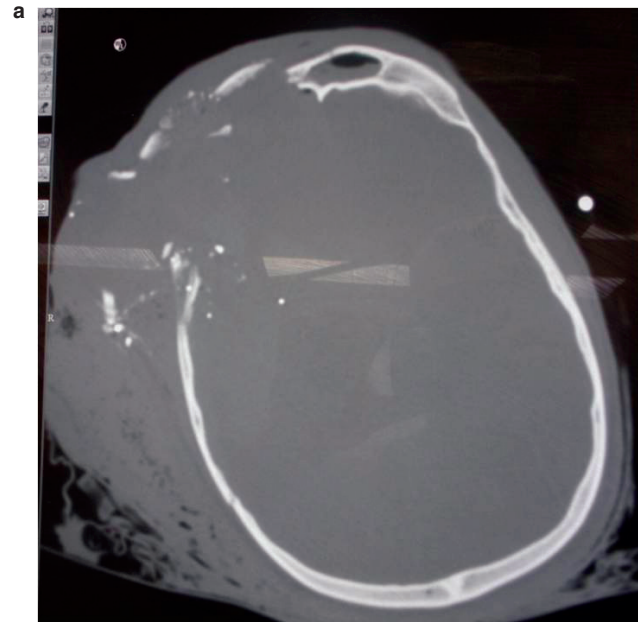


Figure 32-15 (a, b). Two preoperative computed tomography scans showing extensive bony and soft tissue injury of the skull and brain. Fragments can be seen lodged within the brain matter.

brain (Figure 32-15). The patient also sustained a left globe injury, rendering the eye nonfunctional.

Operative Plan/Timing of Surgery/Operation

The patient was taken to the operating room by the neurosurgery and otolaryngology teams for

control of bleeding and wound coverage prior to being evacuated out of theater. The foreign objects were left in place due to their depth. The exposed brain was covered using a two-flap technique: the temporalis muscle was mobilized through a modified cervicofacial rotation flap incision and placed over the defect, effectively covering any exposed brain, and a separate cervicofacial rotation flap was then used to cover the muscle. A back cut was made in the scalp so that an advancement flap could be used to close the wound (Figure 32-16). The patient was transported the following day out of theater in critical condition.

Complications

Unknown.

Lessons Learned

Brain coverage was necessary in this patient and a local flap was chosen for coverage. The temporalis muscle flap used separately from a cervicofacial rotation flap appeared to work quite nicely in this particular case. Like many cases in theater, however, follow-up was difficult, which can be frustrating for all involved when evaluating the efficacy of an operation.

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