OTOLARYNGOLOGY/HEAD AND NECK SURGERY COMBAT CASUALTY CARE IN OPERATION IRAQI FREEDOM AND OPERATION ENDURING FREEDOM

Section V: Acute Head and Neck Surgery/Treatment in the Deployed Setting

Aerovac helicopter, Bagram Air Base, Afghanistan (2009).

Photograph: Courtesy of Colonel Joseph A. Brennan.

Chapter 16

PREOPERATIVE PLANNING FOR ACUTE HEAD AND NECK SURGERY

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INTRODUCTION

This chapter will outline the preoperative planning required for head and neck trauma patients in the acute deployed setting, building on the primary survey, secondary survey, and Advanced Trauma Life Support (ATLS) resuscitation protocols detailed in Chapters 11 through 15. Although small in surface area, the head and neck region is highly concentrated, containing the great vessels, larynx, trachea, pharynx, esophagus, and cranial nerves, structures that are vital to swallowing and airway protection. For this reason, a significant part of the chapter is dedicated to the work-up of penetrating neck trauma, with emphasis on the radiographic evaluation of the three zones of the neck. Key components of the preoperative evaluation will be highlighted using case studies. The actual management of the head and neck traumatic injuries is detailed in Chapters 17 through 32.

EVIDENCE-BASED REVIEW

Neck Anatomy and Zones of Injury

The neck is anatomically divided into three zones of injury to assist the surgeon in determining at-risk structures, the appropriate radiographic work-up, and the potential need for surgical exploration (Table 16-1). The zones of injury also provide a framework for the detailed review of symptoms described below.

By definition, zone I injuries extend from the thoracic inlet cephalad to the inferior border of the cricoid ring. The great vessels are the structures at highest risk within this zone, followed by the trachea, cervical esophagus, and cranial nerves IX, X, and XI. Patients with zone I injuries can initially appear asymptomatic. Given the high mortality rate (12%) associated these injuries, stable patients presenting with zone I trauma warrant vascular evaluation with formal four-vessel angiography or computed tomography angiography (CTA).[1] Injuries low in zone I are challenging to manage, often requiring a sternotomy or thoracotomy for access. For this reason, mandatory exploration of asymptomatic zone I injuries is not advocated.[2] If surgical intervention is required, the preoperative work-up should include timely consultation with the surgeon responsible for thoracic injuries.

Zone II injuries extend from the inferior border of the cricoid ring to the angle of the mandible. Penetrating zone II injuries are the most prevalent of cervical injuries, accounting for 60% to 75%.[2,3] The great vessels, larynx, pharynx, and cranial nerves IX, X, XI, and XII are at risk within this region.

The management of zone II injuries can be controversial, with debate over mandatory versus selective neck exploration. Historically, all zone II injuries with violation of the platysma muscle mandated surgical exploration.[4] The requirement for mandatory exploration emerged following World War II, when a high proportion of unrecognized neurovascular injuries were found in patients managed expectantly.[5–10] Mandatory exploration was further supported by a landmark study in 1956 by Fogelman and Stewart and continued through the Vietnam era.[11] Fogelman and Stewart's civilian trauma experience revealed a 6% mortality rate for patients undergoing immediate neck exploration, which was significantly lower than the 35% mortality reported in patients managed in a delayed or selective fashion. Advocates of mandatory zone II exploration contend that potentially life-threatening injuries can go unrecognized on preoperative imaging. They believe that in experienced hands mandatory exploration carries low morbidity and mortality. They also argue that the cost of mandatory exploration, even when negative, is offset by the cost for hospital observation in cases that are selectively managed, especially when the time and resources of the observing trauma staff are taken into consideration.[2,3]

However, because of recent advances in radiographic technology, many surgeons now advocate for selective management of penetrating zone II injuries. They contend that it is extremely rare for an asymptomatic patient under careful observation to suffer

TABLE 16-1

ZONES OF PENETRATING NECK INJURY

Zone	Boundaries	Vital At-Risk Structures
III	Skull base ⇧ Angle of mandible	Great vessels, pharynx, cranial nerves IX, X, XI, XII
II	Angle of mandible ⇧ Inferior border cricoid ring	Great vessels, larynx, pharynx, cranial nerves IX, X, XI, XII
I	Inferior border cricoid ring ⇧ Thoracic inlet	Great vessels, trachea, cervical esophagus, cranial nerves IX, X, XI

from complications of an undiagnosed hemorrhage.[2] Between 50% and 70% of patients routinely explored have negative findings. In the setting of selective neck exploration based on physical and radiographic evaluation, a significant number of head and neck trauma patients can be spared the morbidity and associated cost of mandatory exploration.[12,13] Venous injuries and small isolated pharyngeal injuries are the most common insults missed on preoperative physical examination. Since both types of injuries are self-limiting and therefore nonsurgical, proponents argue for selective management of the neck. To date, prospective studies have failed to demonstrate a significant increase in morbidity and mortality when patients are selectively explored.[2,14] For this reason, many trauma centers have transitioned to selective neck exploration protocols.

Selective management of zone II injuries becomes imperative during mass casualty and combat situations, when resources simply do not allow for the exploration of every stable patient. The decision to proceed directly to the operating room is based on both physical and radiographic findings. Patients who are hemodynamically unstable or have an exsanguinating hemorrhage, a rapidly expanding hematoma, massive crepitus or subcutaneous air, or airway compromise are taken directly to the operating room for immediate exploration. Preoperative work-up is not advocated in this emergent setting. Conversely, stable patients undergo a comprehensive radiographic evaluation as detailed below. If the radiographic work-up fails to identify vascular or upper aerodigestive tract trauma warranting surgical intervention, patients are closely observed for 24 to 48 hours. The selective management of penetrating neck trauma during Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) represents a major paradigm shift from the mandatory exploration practiced in previous wars.

Transverse cervical zone II penetrating injuries warrant special mention because they are often associated with injury to vital structures.[14] Demetriades et al[14] evaluated 97 patients who sustained gunshot wounds to the neck. Thirty-three patients (34%) presented with transcervical penetration, crossing the midline. This subset of patients had a significantly higher rate of injury to a vital structure (79%) compared to their unilateral counterparts (31%; $p = 0.02$).[14] For this reason, many proponents of selective exploration of penetrating zone II injuries advocate for mandatory exploration in cases of transcervical injuries.[15] Transcervical penetration should be considered a clinical predictor of visceral injury.

Zone III injuries extend from the angle of the mandible to the skull base. Involved structures include cranial nerves, the pharynx, and great vessels. Structures in this region are often shielded by the cranium. As a result, physical examination is often limited, and a patient can have a large expanding hematoma that is unrecognizable in the trauma bay (see Case 16-3 below). Patients with a suspected zone III injury should undergo repeat intraoral examination to rule out an expanding hematoma and progressive edema of the retropharyngeal or parapharyngeal region. As with zone I injuries, mandatory exploration of zone III is not advocated unless the patient is unstable.[2] Instead, radiographic evaluation with angiography or CTA is advised to rule out a high carotid injury. Abnormal neurological examination should prompt further preoperative imaging and a neurosurgical consultation if available.

History and Physical Examination

As with all preoperative evaluations, the ideal first step in surgical planning entails a thorough history and physical examination. This evaluation may be limited in the deployed setting due to challenges such as the patient arriving intubated or language barriers. When feasible, every effort should be made to obtain a history of the trauma. The surgeon should attempt to identify the mechanism of injury, including high versus low velocity or energy. This differentiation is of great importance because high energy injuries often appear innocuous at presentation, with underlying life-threatening injuries being far more extensive than initially appreciated on physical exam.[16] Patients may have required surgical stabilization at a forward operating base (FOB) prior to presentation. If time and resources permit, the original treating physician should be contacted to obtain information on intraoperative findings and intervention.

A thorough review of symptoms alerts the surgeon to the critical head and neck structures potentially injured. The history should always be followed with a comprehensive head and neck examination including neurological evaluation of the cranial nerves. Hoarseness, increased effort in breathing, and change in voice raises concern for laryngeal injury, especially if associated physical findings include neck crepitus, tachypnea, stertor, stridor, or diplophonia. Any concern for laryngeal trauma warrants bedside flexible nasopharyngoscopy if available and a keen recognition for the potential of airway loss (see Chapter 12, Airway Management).

Patients complaining of dysphagia, odynophagia, or difficulty handling secretions are at risk for pharyngeal injuries, which may not be easily appreciated during the bedside head and neck examination. Alter-

natively, injury to the hypoglossal, glossopharyngeal, or vagus nerve may contribute to these symptoms. Again, physicians must be vigilant about the potential for airway loss.

Physical findings suggestive of vascular injury include expanding hematoma, tracheal deviation, persistent bleeding, carotid bruit or thrill, loss of pulse, drop in hematocrit, and hypovolemic shock. Traumatic injury to the carotid artery carries significant mortality, reaching 50%.[17] Therefore, an extensive and time consuming preoperative evaluation should not delay the surgical intervention required for symptomatic patients.

Patients presenting with periocular bruising ("raccoon's eyes") or bruising over the mastoid region (Battle sign) are at risk for a basilar skull fracture, which is best appreciated on computed tomography (CT) scan. Similarly, patients presenting with a hemotympanum or clear drainage from the nose or ear suggestive of a cerebrospinal fluid leak may have sustained an anterior skull base fracture. Craniomaxillofacial and mandibular fractures can often be appreciated on physical palpation.

Exposure to improvised explosive device (IED) blasts necessitates a high suspicion for multiple head and neck injuries. Fox et al reported on their 26-month experience in treating head and neck injuries from OIF and OEF.[18] Blast injuries were often extensive, covering large surface areas: 23% of patients had injuries spanning more than one zone of the neck, 30% had concomitant traumatic brain or spinal cord injuries, and 20% required tracheostomy for airway management.

Laboratory Work-Up

Most trauma protocols include a comprehensive battery of blood tests during the initial evaluation in the trauma bay. If not already obtained, preoperative evaluation should include basic blood chemistries, blood counts to help determine the need for transfusion, and a coagulation panel. Patients requiring massive resuscitation with transfusion of ten or more units of packed red blood cells in a 24-hour period are at risk for life threatening coagulopathies and electrolyte imbalances.

Radiographic Work-Up

CT imaging remains the gold standard for evaluation of head and neck soft tissue and bony trauma.[19] A low threshold for performing a contrasted CT scan of the neck and face is required in the setting of presumed high energy injuries such as IED blasts.[16] A head CT is warranted for any patient thought to have sustained a loss of consciousness. However, many of the injuries encountered during OIF and OEF were secondary to IEDs, which pepper the casualty with metallic fragments,[16,18] and these retained foreign bodies can create significant scatter artifact, which limits the study. In addition, some materials such as wood will not appear radio-opaque on CT imaging. Plain film imaging, MRI, or color Doppler ultrasound may assist in the preoperative work up if the scatter is significant.

Vascular imaging is warranted for stable zone I and III patients, certain zone II patients, and anyone at risk for fracture of the carotid canal. Formal angiography remains the standard of care for evaluation of the carotid system, with approximately 98.5% accuracy.[18,20] If active, life-threatening contrast extravasation is found on angiography, patients should be taken immediately to the operating room for exploration. Vascular injuries account for up to 50% of head and neck trauma deaths, so further preoperative work-up should not delay surgery.[21] Contraindications for angiography include a rapidly expanding hematoma, shock, and uncontrollable bleeding; in these cases patients must proceed immediately to the operating room for control of the life threatening vascular injury.

Given the lack of interventional angiography in combat zones, CTA is a fast (taking 2–3 minutes), minimally invasive, and reliable alternative.[4,22–26] CTA provides more information about the integrity of the head and neck soft tissues and bony structures than traditional angiography. Prospective studies comparing helical CTA to traditional angiography have demonstrated 90% to 100% sensitivity and specificity in CTA diagnosis of cervical artery injuries.[23–26] Reviewing 5 year's experience using CTA for the evaluation of penetrating neck trauma, Osborn et al[4] reported that patients undergoing an initial CTA had a significantly lower rate of exploration (n = 6), compared to the 27 patients who underwent immediate exploration without an initial CTA. In all six CTA cases, exploration revealed a positive finding. Patients without a preoperative CTA were found to have a much higher negative exploration rate (48%). The authors concluded that CTA minimized the overall number of surgical explorations, missed no life-threatening injuries, and essentially eliminated negative neck explorations. For these reasons, their institution replaced angiography with CTA for the initial work-up of head and neck trauma patients. Many trauma centers have implemented similar changes, with CTA protocols replacing formal angiography.

Limited data is available on the prospective comparison of angiography versus CTA in the evaluation of penetrating neck trauma.[27] CTA has proven to be highly accurate when compared to angiography and surgical exploration. Studies demonstrate a sensitivity and specificity ranging between 90% and 100%, a 93% to 100% positive predictive value, and a 98% to 100% negative predictive value.[23,24,26,28,29] The additional information provided by CTA allows for the detection of concomitant injuries to the upper aerodigestive tract and bony skeleton. Currently, CTA is the radiographic modality with the greatest potential to rule out vascular injury while simultaneously assessing the upper aerodigestive tract.[30] From a practical standpoint, surgeons serving in a combat zone are more likely to have access to CTA protocols than to traditional angiography.

If an esophageal injury is strongly suspected, the preoperative work-up should go beyond CTA. Penetrating neck injuries involving the esophagus can be difficult to diagnose because patients often lack findings on physical examination.[30,31] Unfortunately, a delay in diagnosis can lead to significant morbidity and mortality.[32–34] Surgeons must maintain a high suspicion for esophageal injury based on mechanism and location of the trauma, especially if a patient presents with fever, tachycardia, or widening mediastinum on chest radiograph.

Numerous studies have demonstrated successful identification of traumatic esophageal injuries using contrasted esophagrams, with a sensitivity ranging from 90% to 100%.[35,36] Most radiologists recommend Gastrografin (Bracco Diagnostics Inc, Princeton, NJ) swallow as the first-order contrast study for esophageal evaluation because it is a hyperosmolar, water-soluble medium resulting in a low associated rate of mediastinitis in the setting of extravisation.[2] However, Gastrografin can be less sensitive in detecting an esophageal or pharyngeal leak. For this reason, a follow-up formal barium swallow should be considered for high risk patients with an initial negative Gastrografin study.[35]

Reports in the literature are conflicting. Armstrong et al identified only 62% of esophageal injuries on esophagogram[37]; for this reason, many surgeons advocate using rigid esophagoscopy in the evaluation.[38] Flexible esophagoscopy has been shown to be a reliable alternative to the rigid procedure.[39] However, flexible esophagoscopy can miss perforations at the level of the cricopharyngeus muscle and within hypopharyngeal subsites where the mucosa tends to be redundant.[2]

Given the somewhat confusing and conflicting findings in studies of the preoperative work-up for penetrating neck trauma involving the esophagus, the Eastern Association for the Surgery of Trauma has provided evidence-based clinical practice guidelines for penetrating zone II neck injuries.[30] Role 2 recommendations for diagnosing esophageal injury include either a contrast esophagography or esophagoscopy. Expeditious work-up within 24 hours of injury is imperative because morbidity has been shown to increase if repair is delayed beyond a day.[40] Ultimately, the modality utilized to evaluate traumatic injury to the cervical esophagus and pharynx will depend on the resources and surgeon's experience in the unique deployed setting.

All patients presenting with vocal cord paralysis, new onset hoarseness, neck tenderness, laryngeal crepitus, subcutaneous emphysema, or hemoptysis in the setting of neck trauma require a thorough airway evaluation. If the patient presents in respiratory distress, time does not allow for a comprehensive preoperative evaluation. Unstable patients require immediate airway stabilization as described in Chapter 12. Assessment of traumatic injuries to the trachea and larynx, presumably with direct laryngoscopy and bronchoscopy, should begin only after a stable airway is achieved.

Stable patients who present with penetrating trauma to zones I and II of the neck have time to undergo preoperative evaluation. Bedside flexible nasopharyngoscopy is helpful in evaluating the supraglottis, glottis, and even subglottic region if the patient is appropriately anesthetized using topical agents. This evaluation may identify edema, lacerations, exposed cartilage, or displaced or fractured cartilage that may require surgical intervention. CT scan can provide further information about cartilage injury and associated soft tissue swelling. If the patient is difficult to examine, is already intubated at the time of presentation, or requires further assessment, a more comprehensive evaluation can be obtained in the operating room using direct laryngoscopy and bronchoscopy.

In the preoperative evaluation, it is imperative to remember that up to 22% of head and neck trauma patients will have a concomitant cervical spine (C-spine) injury.[41] For this reason, all head and neck trauma patients should be presumed to have this injury until it is ruled out radiographically.[2] CT scanners are replacing plain film in the work-up of C-spine injuries.[42,43] If CT imaging is not available in theater, plain film imaging remains an acceptable alternative. By definition, a complete C-spine series should include anterior-posterior, lateral, and odontoid views. Many trauma protocols require an associated negative physical examination prior to removing C-spine precautions.

SUMMARY

The preoperative evaluation recommended in this chapter is meant to serve as a general guide. Evaluations for each trauma patient must be determined on an individual basis. The mechanism of injury, coupled with the presenting physical findings and symptoms, will dictate the need for further preoperative studies. The deployed setting provides additional challenges such as limited resources and overwhelming volume during mass casualty situations, both of which need to be considered during preoperative planning.

CASE PRESENTATIONS

Case Study 16-1: Transcervical Zone I Gunshot Wound Through the Larynx

A 15-year-old local national boy presented to the Craig Joint Theater Hospital (CJTH) in Afghanistan after sustaining a penetrating gunshot wound to the neck that traversed zone I just below the inferior border of the cricoid ring. He was intubated in the field, and both the entrance and exit wounds were covered with an occlusive dressing. He was hemodynamically stable on presentation and underwent complete work-up per ATLS protocol. He underwent a contrasted CT scan of the neck, which failed to demonstrate extravasation. Additional trauma to the larynx was not readily apparent on CT scan; however, a fine cut protocol was not feasible in the deployed setting.

Because of the potential for laryngeal trauma and the need to secure the airway, the patient was taken to the operating room for an open tracheostomy. A small, 3-cm horizontal incision was made superior to the sterna notch in the traditional tracheotomy fashion. After defining the midline raphe, the laryngeal framework was not immediately evident. Instead, the balloon of the endotracheal tube was visible, without associated overlying laryngeal cartilage. The traditional tracheostomy incision was widened for further exploration, and it then became apparent that the bullet entered the lateral neck, traversed through the larynx, likely severing both recurrent laryngeal nerves along the trajectory, and exited through the contralateral neck (Figure 16-1). There was no other damage to the great vessels or other cranial nerves. A high tracheastoma was matured through tracheal ring number 2, so that the patient could be awake with a stable airway and undergo assessment of vocal cord mobility. Flexible nasopharyngoscopy confirmed that both recurrent laryngeal nerves were paralyzed, with no associated movement of the vocal cords on phonation. The cords remained in the paramedian position, with minimal airway opening.

Local national patients discharged home in Afghanistan simply do not have a clean enough environment to allow for survival with a tracheostomy or percutaneous gastrostomy tube, and resources such as suction, tubing, and tube feeds are simply not available. For this reason, surgical management necessitated a reliable procedure affording the lowest complication rate, minimal hospitalization and follow-up, a long-term stable airway, and the ability to resume oral intake. While a cordectomy would establish an airway, the patient would be left with life-threatening aspiration and would not be able to survive in Afghanistan. For similar reasons, a cricotracheal resection was not feasible. His only option was a narrow field total laryngectomy (Figure 16-2). The procedure was uncomplicated. He resumed oral intake on postoperative day 5 and was discharged home after 1 week without a feeding tube. He was able to return for one postoperative outpatient visit, during which he demonstrated understandable esophageal speech (Figure 16-3).

This specific case highlights the fact that while CT imaging has higher sensitivity than bedside exam and is considered the standard of care,[2,22] some injuries will be missed. For this reason surgeons must maintain a high level of suspicion for life-threatening penetrating neck injuries, especially in the case of transcervical gunshot and blast injuries. This case also demonstrates how pre-

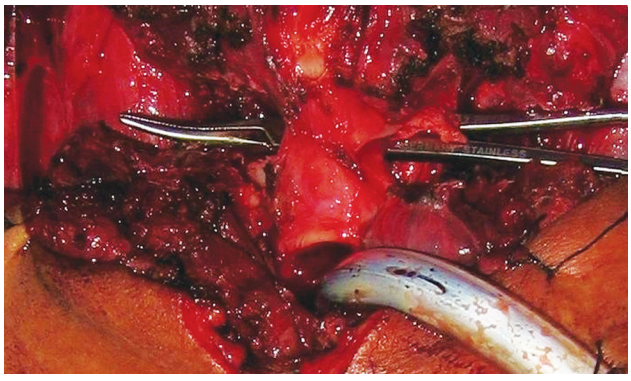

Figure 16-1. Surgical hemostat demonstrating the transverse trajectory of a gunshot wound through zone I of the neck, just below the inferior border of the cricoid ring. The airway was secured with an endotracheal tube placed through a tracheotomy site at tracheal ring number 2. The bullet severed both recurrent laryngeal nerves.

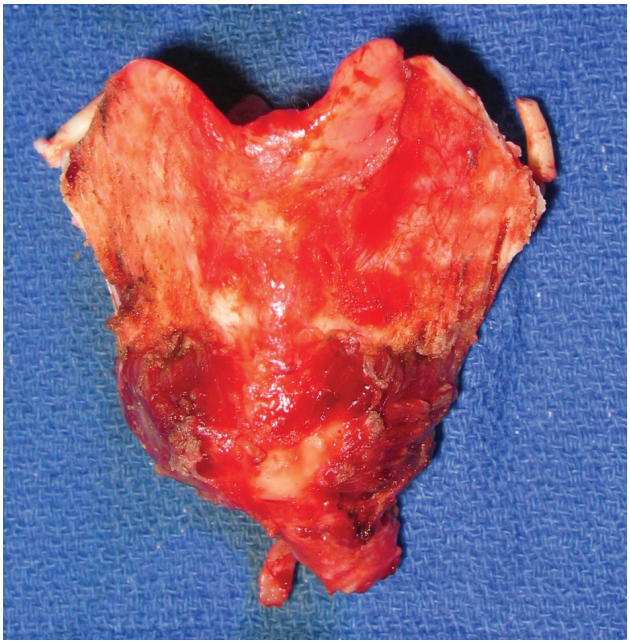

Figure 16-2. Narrow field laryngectomy specimen required for treatment of a local national patient who suffered a transverse gunshot wound through zone I of the neck that severed both recurrent laryngeal nerves.

operative planning and associated treatment depends on individual patients. Because he was a local national patient, the combat hospital provided definitive care. The ideal surgical intervention would meet standard of care in the United States, provide the highest success rate, the lowest morbidity, and the shortest hospital stay. However, surgical procedures that require extensive use of hospital beds and resources are not feasible in a combat setting. In addition, follow-up evaluation is limited and often inconsistent. The home environment must be considered in preoperative planning, one most consider the fact that an Afghani cannot survive long term with either a tracheostomy or percutaneous gastrostomy tube; the environment is extremely dirty.

Although this case highlights the importance of expeditious neck exploration in cases of penetrating zone I trauma, it is important to note that all cases do not require surgical exploration. Traditionally, any injury violating the platysma muscle was thought to require surgery. However, advances in CT radiography now allow for selective neck exploration. The surgeon must utilize radiographic imaging combined with history and clinical exam in deciding between surgical exploration and close observation. In this case, the transcervical gunshot trajectory mandated surgical exploration to both secure the airway and definitively assess for a tracheal injury, even after a negative CT scan.

Figure 16-3. The same patient following laryngectomy; he resumed all nutritional intake orally and developed intelligible esophageal speech.

Case Study 16-2: Zone II Injury

A 27-year-old soldier presented to the CJTH in Afghanistan after sustaining a gunshot wound that entered inferior to his right scapular tip, traveled cephalad to exit in the ipsilateral supraclavicular region, then reentered in zone II, and exited through the ipsilateral zygomaticomaxillary region (Figures 16-4 and 16-5). The patient was intubated and hemodynamically stable upon presentation. His facial wound had been packed with gauze and covered in an occlusive dressing. A contrasted CT scan of his face and neck was obtained, which demonstrated extravagation within the right neck and a severely comminuted right zygomaticomaxillary complex fracture. A noncontrasted chest CT was also obtained, which failed to demonstrate a pneumothorax. After scanning, the patient was immediately brought to the operating room, where his neck and facial wounds were explored. In anticipation of excessive bleeding, large-bore intravenous lines were placed, the patient's blood was cross matched for transfusion, and two separate suction systems were set up.

Figure 16-4. Gunshot wound in which the bullet reentered in zone II of the right neck and exited through the ipsilateral zygomaticomaxillary region.

Figure 16-6. Successful suture ligation of right transverse cervical artery.

Ultimately, he was found to have an injury to his transverse cervical artery, which was suture ligated (Figure 16-6). There was also diffuse bleeding from his pterygoid muscles, which was controlled with electric cautery. Ocular injuries were not sustained. After the bleeding was controlled, the patient was flown to Germany, and ultimately stateside for definitive care of his facial fractures and associated soft tissue loss.

This case illustrates the work-up of a zone II injury. The patient had been previously stabilized at an FOB, which afforded the team the opportunity to preoperatively image the patient. The imaging guided the exploration, which was especially helpful because of the unusual bullet trajectory. Had the soldier presented actively bleeding or with hemodynamic instability, he would have bypassed the CT scanner and proceeded immediately to the operating room.

This case also highlights the importance of patient demographics in preoperative planning. The role of the deployed surgeon in treating US military personnel is to stabilize and evacuate them as soon as safely possible so that definitive care can be rendered in the United States. Only small, isolated injuries that do not require long rehabilitation should be definitely treated in theater.[44] In this case, the vascular injury was treated immediately, but further preoperative evaluation and surgical planning for the extensive facial fractures was not conducted because this intervention would be rendered stateside.

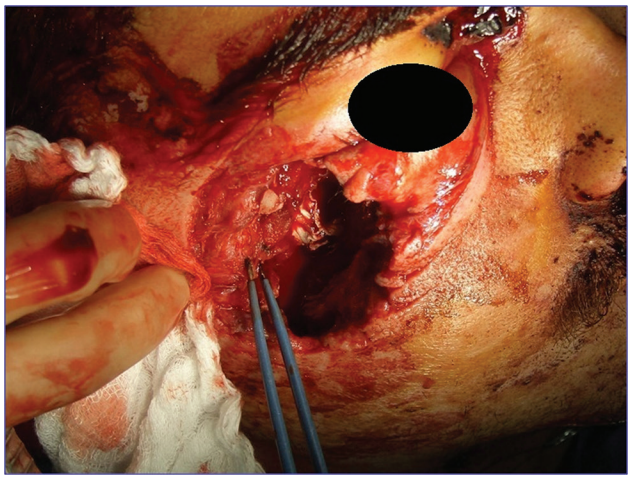

Figure 16-5. Exit site through the right zygomaticomaxillary region, resulting in severely comminuted fractures and loss of soft tissue.

Case Study 16-3: Zone III Injury

An American soldier presented to the CJTH en route from an FOB to Germany and ultimately home to the United States. The exact mechanism of injury was unknown but he was thought to have sustained a blast injury while in his Humvee that subsequently resulted in blunt cranial injury. He was reportedly wearing his helmet and body armor at the time of injury.

The patient initially presented to the FOB with mandibular and midface fractures, which were stabilized using maxillomandibular fixation. Approximately 12 hours following the initial injury, he was transported to the CJTH; he was alert and oriented upon presentation. He denied uncontrollable pain, hoarseness, change in voice, or breathing difficulties. His neurological examination, including the cranial nerve exam, was completely within normal limits. He did not require a tracheostomy tube.

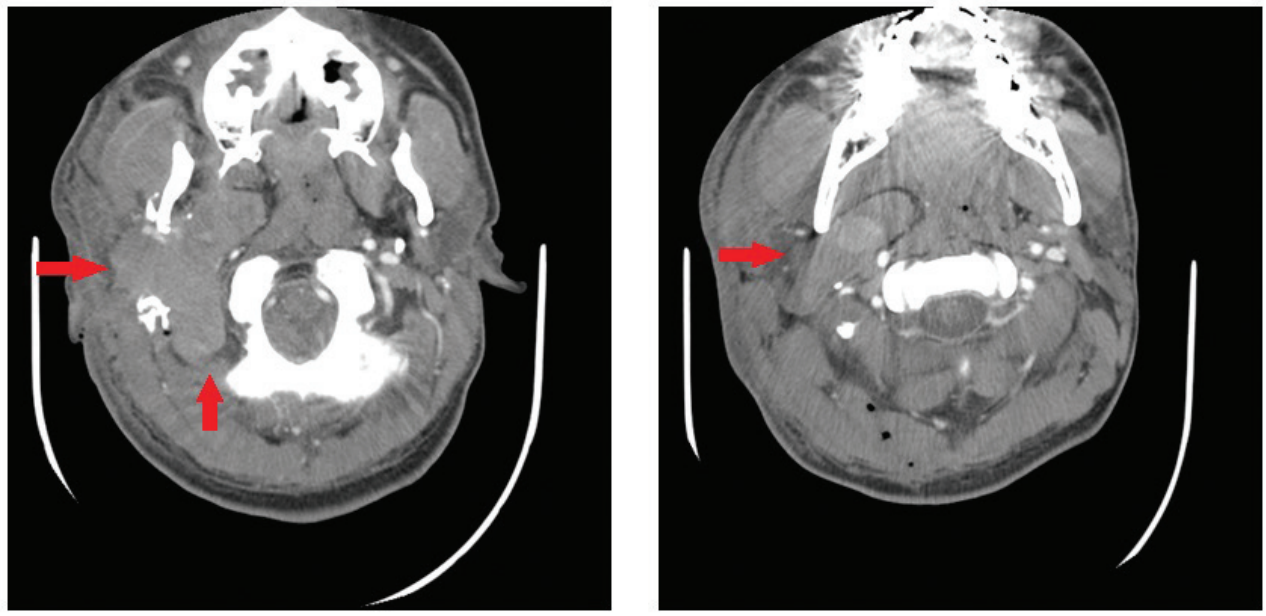

Figure 16-7. Two contrasted axial computed tomography images demonstrating extravagation at the level of the skull base in right zone III. Arrows point to the hematoma.

Per CJTH protocol, the patient underwent repeat CT imaging with contrast prior to evacuation. Extravagation was appreciated at the level of the skull base in right zone III (Figure 16-7). His hematocrit was stable and he remained alert, without any cognitive concerns. The original CT imaging was electronically obtained from the FOB, and upon comparison, there was no evidence of further hematoma expansion between the initial and repeat CT images. Given the stable physical and radiographic exams, the decision was made to manage the patient medically rather than surgically. His arch bars were kept in place, but prior to medevac he was cut out of maxillomandibular fixation as a precautionary measure in the unlikely event that he developed respiratory difficulties while en route.

This case highlights the diagnostic challenge of zone III injuries. Patients can have significant bleeding at the level of the skull base without associated signs and symptoms. For this reason, all zone III injuries require further vascular evaluation. Angiography with associated embolization is considered standard of care in the preoperative work-up and definitive treatment of these injuries. Unfortunately, interventional radiology is not readily available in a war zone. Surgical exploration is extremely challenging, often requiring mandibular dislocation, a craniotomy, or both. Cranial nerve injuries to the facial, glossopharyngeal, hypoglossal, vagus, and spinal accessory are extremely common in the setting of zone III exploration and can lead to significant swallowing and shoulder difficulties. In addition, the procedure can be extremely morbid, especially in the combat setting where there is no interventional radiology back-up if profuse bleeding is encountered in the operating room. For these reasons, surgical exploration of zone III injuries should be reserved for the unstable patient who will exsanguinate without intervention. In this case, the bleed was clearly stable and the patient was neurologically intact. This hematoma likely resulted from blunt vascular injury. The confined associated anatomic area was able to tamponade the bleeding. Exploring the area would have offered no benefit and could have resulted in death, because opening this area during surgery would have relieved the pressure that was successfully tamponading the bleeding.

Lastly, this case stresses the importance of communication. Obtaining the original imaging from the FOB allowed the radiologist to confidently determine that the hematoma was not expanding. This information played a vital part in the preoperative evaluation and decision to manage the patient medically. Repeat imaging in the setting of high energy trauma should be considered if the original information is not available, or if the capabilities of the FOB are unknown.

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