

Chapter 15

MASS CASUALTIES AND TRIAGE

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INTRODUCTION

During the past 10 years in Iraq and Afghanistan, more than 7,200 head and neck trauma patients have been treated at American medical facilities in both war zones.¹ The high incidence of head and neck injuries (HNIs) is because of the limited head and neck protection provided by the body armor currently used by troops in the field.^{2,3-5} Neurosurgeons, otolaryngologists/head and neck surgeons, oral maxillofacial surgeons, and ophthalmologists comprise the multispecialty head and neck surgical teams treating the HNI patients in Iraq and Afghanistan.⁶ This head and neck multispecialty team witnessed the increased lethality of weapons used in both conflicts. Improvised explosive devices (IEDs) are now the most common mechanism of injury, accounting for as high as 76% of

combat injuries in Iraq and Afghanistan.² In previous conflicts, blast injuries accounted for less than 10% of wounded patients.⁷

IEDs cause multisystem trauma and typically wound many patients within a large area around the detonation site. For example, during the Mosul dining hall bombing on December 21, 2004, a human-borne IED killed 27 American service members and severely wounded more than 50 service members (Figure 15-1). Such a horrendous and unexpected trauma event resulted in a mass casualty scenario that overwhelmed available medical resources and required triage of the incoming wounded soldiers. The military's mass casualty response and triage methods will be discussed later in this chapter.



Figure 15-1. Human-borne improvised explosive device mass casualty in Mosul, Iraq, December 2004.

PATTERN OF HEAD AND NECK INJURIES DURING MASS CASUALTIES

Even though the head, face, and neck comprise only 12% of the total body surface area, the incidence of head, face, and neck injuries in Operation Iraqi

Freedom (OIF) and in Operation Enduring Freedom (OEF) ranges between 25% and 40% of American wounded.⁸⁻¹³ The most common mechanism of injury,

the IED, typically occurs at close range and results in multisystem, high-velocity injuries that can inflict heavy damage to the head and neck.^{14,15} In previous conflicts, during which IEDs were not utilized, the reported incidence of head, face, and neck injuries was significantly lower and ranged between 16% and 21% of wounded patients.^{8,9,11,12} The higher incidence of head, face, and neck injuries has also been reported in civilian casualties, including pediatric patients. Creamer et al¹⁶ examined the medical records of 2,060 pediatric patients admitted to American military facilities in OIF and OEF, and reported a head, face, and neck wound incidence of 23.5%. The significance of the increased rate of head and injuries in modern warfare from IEDs is that the head and neck surgeon should expect to treat a large number of wounded patients during all mass casualty events.

Body armor typically prevents torso, abdominal, and pelvic wounds. However, with the exception of

ballistic goggles and a helmet protecting the eyes and skull, the face and neck are unprotected.^{6,10} Body armor has a negligible impact on the incidence of head and neck wounds. Forward surgical team experience showed that US servicemen wearing body armor had a 19% incidence of head and neck wounds, whereas US servicemen without body armor had a 17% incidence of head and neck wounds.¹⁷ Head and neck surgical teams are able to treat more patients with isolated and potentially survivable head and neck wounds due to the success of body armor in preventing potentially lethal torso injuries. In previous conflicts, many soldiers with head and neck wounds would also present with potentially fatal chest and abdominal injuries, and be declared "expectant."⁶ The head and neck surgeon should be prepared to treat a large number of potentially survivable head and neck wounds in soldiers and marines wearing body armor that has shielded their torsos from IED fragment injury.

MASS CASUALTY EVACUATIONS

The levels of care within the combat zone have been discussed previously in this book, but will be briefly reviewed. *Role 1* treatment is immediate first aid delivered at the location of the mass casualty, generally by military medics.¹⁸ *Role 2* treatment provides increased medical capability and limited inpatient bed space, but requires evacuation to the *Role 2* facility from the mass casualty location.¹⁸ Typically, most *Role 2* facilities provide emergent and life-saving surgical capabilities.¹⁸ *Role 3* treatment provides the highest level of medical care in the war zone and contains the most inpatient beds.¹⁸ The Air Force Theater Hospitals (AFTHs) and the Army Combat Support Hospitals are fully equipped facilities that may be staffed with multispecialty head and neck

teams (otolaryngology, neurosurgery, ophthalmology, and oral maxillofacial surgery).⁶ In addition, these *Role 3* facilities provide intensive care units, inpatient wards, laboratories and blood banks, computerized tomography to include computerized tomographic angiography, and aeroevacuation capability to *Role 4* facilities.¹⁸ In Iraq, the *Role 3* hospitals were located within the primary combat zone (the Sunni Triangle) and were generally within a 45-minute helicopter ride from the sites of the mass casualties. In Afghanistan, the *Role 3* hospitals were generally located more than 1 to 2 hours via helicopter from the primary mass casualty sites. Finally, *Role 4* facilities provide definitive medical and surgical care outside of the combat zone.¹⁸

INCIDENCE OF MASS CASUALTY EVENTS

Over the past 20 years, more than 36,000 bombing or attempted bombing events have occurred in the United States, resulting in more than 5,900 injured and 700 dead victims.¹⁹ However, a 2008 US Congressional study showed that no hospitals surveyed in seven major cities (New York; Los Angeles; Chicago; Washington, DC; Houston; Denver; and Minneapolis) had sufficient emergency care capacity to treat the number of injured seen in the 2004 Madrid bombing (191 dead and more than 2,000 injured).^{19,20} Furthermore, bombing victims generally have a three-fold higher Injury Severity Score, a four-fold higher rate of multiple injuries, and a three-fold higher mortality rate.²¹

The incidence and magnitude of mass casualty events differed between Iraq and Afghanistan. One

author, who defined a mass casualty event as requiring the admission of more than 50 trauma patients within a 24-hour period, documented two mass casualty events in Iraq during his deployment to the *Role 3* AFTH.²² The two mass casualty events in Iraq included the Mosul dining hall bombing and the sustained mass casualty of the 10-day Second Battle of Fallujah (also known as Operation Phantom Fury). No mass casualties meeting the aforementioned criteria occurred in Afghanistan during his deployment to the *Role 3* AFTH.²² The author chose 50 trauma admissions within 24 hours as his criteria for a mass casualty event, since these two events overwhelmed the resources at the largest *Role 3* AFTH in Iraq. For example, during the Battle of Fallujah, the supply of banked blood was

exhausted by day 3 of the 10-day battle, and whole blood drives were used after this occurred.^{6,22} However, other authors used different criteria to define a mass casualty event. Salinas et al²³ reviewed their experience with three mass casualty events that occurred at the same Role 3 AFTH in Iraq. The AFTH treated a total

of 50 patients during these three mass casualty events with an average of 16.6 patients treated during each mass casualty. Salinas et al noted that about one third of these mass casualty patients suffered injuries to the head and neck, which was likewise shown in data from Israeli mass casualty events.^{23,24}

TRIAGE DURING MASS CASUALTIES

Triage is defined as the “dynamic process of sorting casualties to identify the priority of treatment and evacuation of the wounded given the limitations of ... available resources (time, equipment, supplies, personnel, and evacuation capabilities).”¹⁸ The ultimate goal of triage and combat medicine is to return the soldier to combat, and to preserve life, limb, and eyesight in those who are evacuated.¹⁸

The surgeon’s obligation during a mass casualty event is to care for patients in such a way as to provide the *most benefit* to the *most patients*.²⁵ The military triage categories previously outlined are need-/prognosis-based categories that prioritize care for those patients with the best chance for survival.²⁵ The principles of triage, as described in *Emergency War Surgery*,¹⁸ are as follows:

- injury priority/severity (airway > breathing > circulation > neurochanges),
- salvageability,
- available resources/personnel, and
- treatment time/distance/environment (aero-evacuation or capacity/availability).¹⁸

Triage categories include

- immediate,
- delayed,

- minimal, and
- expectant.¹⁸

Immediate patients require life-saving surgery, and the patient should have a high chance for survival, such as those patients with acute traumatic airway obstruction.¹⁸ *Delayed* patients are those wounded whose condition allows a delay in surgical treatment without endangering their life.¹⁸ Such operations, which often are time-consuming, include panfacial fracture repair in a patient with a secure airway. *Minimal* patients have minor injuries and can care for themselves, or can be helped by nonmedical personnel.¹⁸ Minimal patients could also include trauma patients on long-term ventilator support who require elective tracheotomy. Lastly, *expectant* patients have devastating injuries whose survival would be unlikely even with the benefit of massive medical resources.¹⁸ Expectant patients should be cared for in a private setting with comfort measures given.

Reverse triage occurs when a mass casualty victim is designated as expectant and treated only with comfort care in a respectful area.¹⁸ Expectant patients have devastating injuries with a low likelihood of survival, and their treatment needs exceed the available resources within the medical facility.¹⁸ Reverse triage is typically not seen in civilian centers, but may be seen in future civilian mass casualties when the number of injured exceeds the available resources of the medical facility.¹⁸

TIMING OF SURGERY DURING MASS CASUALTIES

American service members injured during mass casualties who are triaged to the immediate category will be taken to the operating rooms (ORs) as soon as possible. The immediate HNIs requiring immediate surgery include compromised airways (red or yellow airway), symptomatic penetrating neck trauma, and actively bleeding wounds. However, the timing of delayed American patients wounded during mass casualties requiring nonemergent surgery, such as repair of facial fractures, has been extremely controversial.

A head and neck lesson learned in Iraq was that open reduction and internal fixation (ORIF) of wounded American soldiers with facial fractures could be safely performed in the combat zone and

did not have to be deferred until arrival at hospitals in the United States.^{26,27} Due to fears of increased perioperative wound infections in the combat zone, the practice early in OIF was to defer the repair of most of these facial fractures until the patient arrived at a stateside hospital.^{6,26} Lopez and Arnholt²⁶ demonstrated that selected American servicemen could safely undergo ORIF in Iraq without an increased risk of wound infection and plate removal, thus changing current practice in OIF and OEF. Similarly, Salinas and Faulkner²⁷ demonstrated that immediate ORIF of American servicemen had a lower rate of complications than delayed ORIF of Americans performed at stateside hospitals. The United

Kingdom experience showed that of 153 facial fractures occurring in Afghanistan, 116 were treated in the Role 4 hospital in Birmingham with no significant effect on outcome.²⁸

The timing of surgery for American servicemen and service women with facial fractures after mass casualty events who are waiting for aeroevacuation to a Role 4 medical facility outside the combat zone remains controversial. Obviously, if the ORIF of an uncomplicated facial fracture will keep the soldier in theater, then repair should be performed.^{26,27} For patients needing aeroevacuation, the first question is: "Does the coalition soldier need to go to the operating room for urgent reasons such as a surgical airway, control of facial bleeding, neck exploration, or debridement and repair of soft-tissue trauma?" If surgery is indicated and the answer is yes, then consideration should be given to intermaxillary fixation (IMF) and possibly ORIF of facial fractures, since the decision has been made to go to the OR under general anesthesia. The extent of craniofacial bony repair should be individualized for each patient based on the extent of ORIF required and the possibility of delaying the patient's transfer to the Role 4 facility. If no surgery is warranted, then consideration should be given to delaying the ORIF of facial fractures so that aeroevacuation would not be delayed and the critically short bed space in the Role 3 facility can be opened for future casualties. The exception to this recommendation would be an unstable mandible fracture for which IMF would help control the bleeding, pain, and flail segments. If IMF is performed, then

a surgical airway should also be considered because accidental extubation during the two plane flights lasting 18 hours to the mainland, three bus trips to the planes, and the hospital transfers can be deadly. Likewise, dislodgement of a fresh tracheotomy in a patient with IMF could also be deadly. It is paramount for the surgeon to adequately safeguard the surgical airway with measures such as

- an inferiorly based Björk flap to block the pretracheal space,
- a safety suture around the cricoid or upper intact tracheal ring to act as a "cricoid hook" if needed,
- sutures securing the tracheotomy tube collar to the skin,
- a tracheotomy tape around the neck, and
- any other technique that better secures this surgical airway.

Lastly, in the frequently seen patient hit by an IED with a traumatic brain injury requiring IMF, strong consideration should also be given to tracheotomy. In Iraq, a patient presented to the emergency room after being sent immediately from an airplane that landed on our tarmac. He was hit by an IED and suffered traumatic brain injury, but was reportedly arousable, although somewhat somnolent postoperatively. The patient was seen in the emergency room, the IMF wires were removed, and he was intubated because he was now unresponsive with low oxygen saturation.

ROLE OF THE HEAD AND NECK SURGEON DURING MASS CASUALTIES

The bloodiest mass casualty in OIF and OEF occurred between November 8, 2004 and November 18, 2004 during the Second Battle of Fallujah (Operation Phantom Fury). During this battle, 381 American wounded were admitted to the AFTH in Balad, Iraq, including 52 wounded Americans admitted on November 9.⁶ In addition, hundreds of Iraqi soldiers, civilians, and enemy prisoners of war were also treated. The Battle of Fallujah in November 2004 was shown to cause the steepest rise in the graph of the cumulative number of American wounded in action over time that has been seen to date in either OIF or OEF.^{1,29}

The role of the head and neck surgeon during a mass casualty event is airway control and hemorrhage control. During the Battle of Fallujah, the head and neck surgeon would move from patient to patient in the emergency room and assess airway status by evaluating the presence of intelligible speech. If the patient did not respond with intelligible speech, then the airway was secured by the HNI surgeon, emergency room

staff, or anesthetist.³⁰ Hemorrhage control by the HNI surgeon was also performed both in the OR and in the emergency room.

Airway Management

Airway compromise is the third leading cause of potentially survivable death on the battlefield behind compressible hemorrhage and tension pneumothorax.^{6,31} Penetrating face and penetrating neck trauma account for more than 75% of the injuries necessitating traumatic airway control in OIF.³⁰ High-velocity trauma causes acute hemorrhage, tissue prolapse, and massive edema that may result in significant airway obstruction necessitating emergent airway control.^{6,32}

Traumatic airways can be classified into three groups: (1) red airways, (2) yellow airways, and (3) green airways.³⁰ Red airways are emergent airways requiring immediate airway control within 5 minutes.³⁰ Red airways occur in patients with acute airway

compromise or with exsanguinating hemorrhage necessitating immediate airway control.³⁰ Yellow or delayed airways require urgent airway control within 12 hours.³⁰ Yellow airways occur in patients with progressive or impending airway compromise, active head and neck bleeding, urgent repair of HNI, and symptomatic penetrating neck trauma (Figure 15-2).³⁰ Green airways are elective airways requiring control greater than 12 hours after consultation.³⁰ Green airways occur in those patients with respiratory failure on long-term ventilator support, closed-head trauma, and delayed HNI repair.³⁰

The best method to assess airway patency during the primary trauma survey is to ask the patient to talk.³⁰ If the patient can give an intelligible and appropriate reply, then he or she has a patent airway, adequate ventilation to vibrate the true vocal cords and generate voice, and a Glasgow Coma Scale score

of greater than 8 indicating brain perfusion.³⁰ Surgeons should also assess the direction of the missile track and the structures likely to be affected for clues on the likelihood of significant swelling. It is better to perform a definitive airway semielectively rather than in an emergency. The key to airway management is to prevent a yellow or green airway from becoming more unstable and transitioning to a red airway.³⁰ Trauma patients with a yellow airway and abnormal anatomy distorting airway landmarks will typically be managed with awake tracheotomy under local anesthesia. Awake tracheotomy may be a safer approach than attempting a difficult oral or nasal intubation, causing additional airway edema and bleeding, and necessitating an emergent cricothyroidotomy for an airway that is now red.

Ten percent of OIF patients with high-velocity HNI necessitating traumatic airway intervention



Figure 15-2. Soldier with symptomatic penetrating neck trauma who presented with an expanding neck hematoma and common carotid artery injury.

required immediate intubation or emergent cricothyroidotomy/tracheotomy by HNI surgeons after initial airway management failed.³⁰ This high rate of emergent airway control for high-velocity HNI is three times higher than that seen for civilian low-velocity HNI.³²⁻³⁴ Traumatic airway management in Iraq has yielded a survival rate of 94% in those wounded patients presenting with red or emergent airways requiring control of the airway generally within 5 minutes of presentation.³⁰ This high survival rate for wounded patients presenting with acute airway emergencies occurred because highly skilled surgical teams were stationed within the combat zone and could secure the airway immediately.³⁰ It is recommended that surgeons pre-position “emergency cricothyroidotomy kits” with the basic airway instruments in key locations of the combat hospital, like the emergency room and intensive care unit, for easy access should a red airway occur.

Hemorrhage Control + Vascular/Neural Control at the Skull Base

High-velocity HNI can result in devastating and massive soft-tissue injuries presenting with extensive bleeding from facial vessels and soft tissue. Massive facial soft-tissue trauma involving injury to three or more facial subunits has been associated with higher transfusion rates, higher Injury Severity Scores, increased eye injuries, and increased brain injuries.³⁵ Surgical control of the internal and external carotid arteries, the jugular vein, and the cranial nerves at the skull base will be discussed in the section on penetrating neck trauma.³⁶ Potentially lethal hemorrhage from the scalp, face, nasopharynx, oropharynx, and hypopharynx requiring resuscitation and emergent hemorrhage control is frequently seen in OIF and OEF. Figure 15-3 shows a US Marine who was hit with an rocket-propelled grenade that

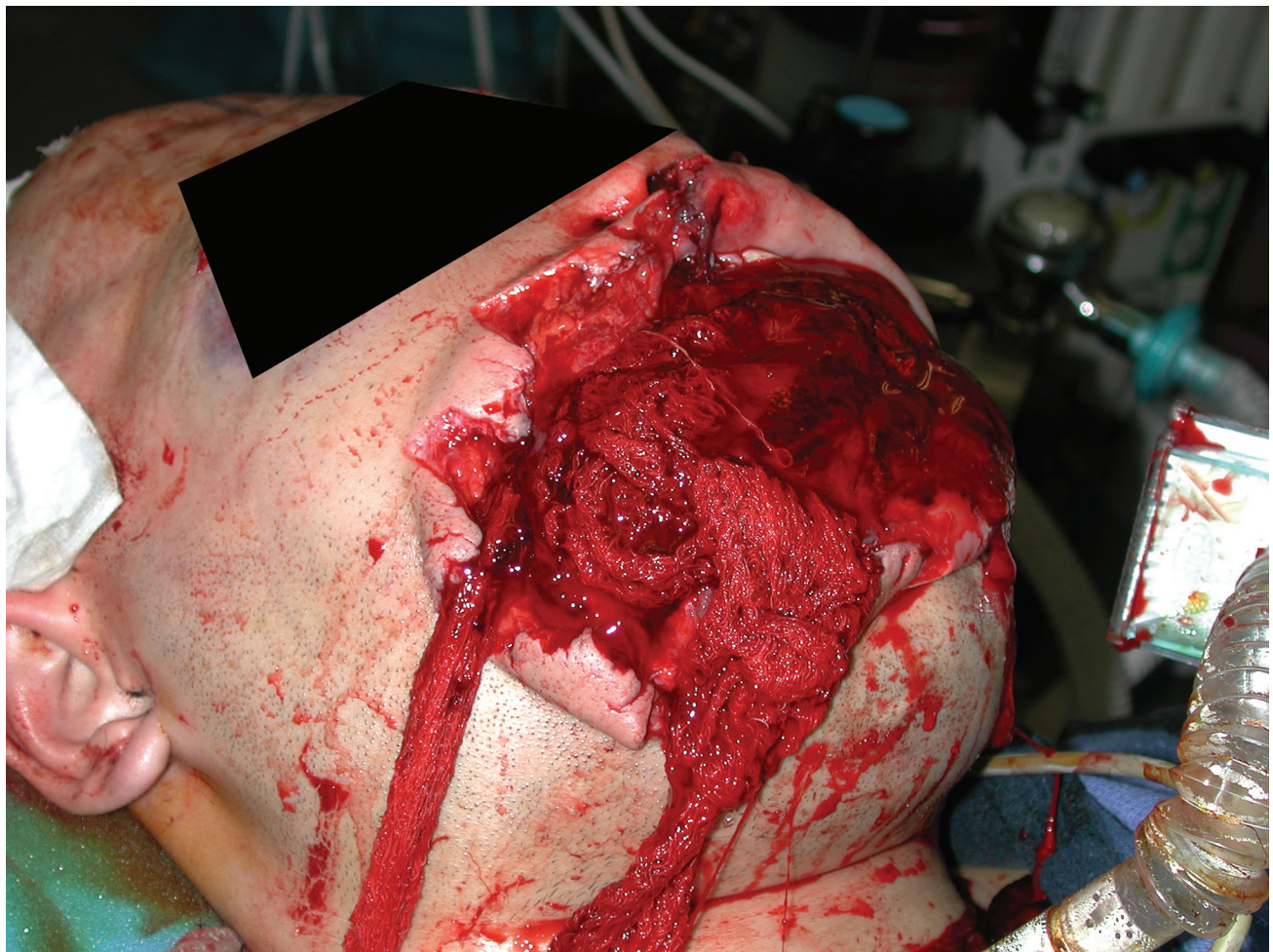


Figure 15-3. Marine with improvised explosive device injury necessitating emergent airway control (“red” airway).

obliterated his midface, tongue, and mandible, and required emergent airway control on presentation to our emergency room. After the airway was secured with a cricothyroidotomy, the brisk hemorrhage from his midface, tongue, and mandible was controlled using suture ligation, bipolar cautery, packing with SURGICEL (Ethicon, Inc, Somerville, NJ), and pressure. Bleeding was controlled, and the patient ultimately required more than 20 units of blood before being transferred to Landstuhl Re-

gional Medical Center (Landstuhl, Germany). If the previously described measures do not ultimately control bleeding, embolization of bleeding vessels should be considered if this option is available in the combat zone (this technique was not available during OEF and OIF deployments of the authors). In addition, ligation of the external carotid is strongly discouraged because this will eliminate the option of embolization of the terminal branches of the external carotid artery that are actively bleeding.

DIFFERENCE IN MASS CASUALTY TREATMENT BETWEEN IRAQ AND AFGHANISTAN

The most striking preoperative difference with respect to those wounded during mass casualties in both combat zones was the significantly lower percentage of wounded head and neck trauma patients in Iraq who were pretreated at Role 2 or Role 3 facilities with surgical capabilities.²² As previously noted, the AFTH in Balad, Iraq, was located directly in the middle of the restive Sunni Triangle where more than 90% of the war time trauma occurred. During the Battle of Fallujah in November 2004, the helicopter crews transported 381 wounded Americans and hundreds of Iraqi's directly to the AFTH after they received only Role 1 treatment.⁶ Consequently, these HNIs were "bleeding" wounds, and the head and neck surgeon was typically the first surgeon who would treat these patients. Ninety percent of head- and neck-wounded patients treated at the AFTH in Iraq received only Role 1 care before being treated by the head and neck surgeon.²² However, in Afghanistan, the most common sites of mass casualty events are generally located 1 to 3 hours away by helicopter, typically in the southern and eastern regions of the country. Role 2 and Role 3 medical facilities are spread across these areas so that lifesaving surgery can be performed, and the patient can be stabilized before being sent to the AFTH in Bagram, Afghanistan. Only 7% of head- and neck-wounded patients treated at the AFTH in Afghanistan received only Role 1 care, whereas 93% of patients have been pretreated by surgeons at Role 2 and Role 3 facilities before being seen by the head and neck surgeon.²² Consequently, "bleeding" wounds in the head and neck were infrequently seen in Afghanistan.

Due to the close proximity of the Role 3 theater hospitals to the sites of the mass casualties in Iraq, the head and neck practice primarily involved treatment of bleeding trauma that was lifesaving.²² In contrast, because of the long distances between the sites of mass casualties and the Role 3 theater hospitals in Afghanistan, the head and neck practice was a referral practice, typically for complex craniofacial reconstruction requiring multiple surgical procedures, after the patient was stabilized at forward-located Role 2 and Role 3

facilities.²² This difference in practice settings between Iraq and Afghanistan is evident when reviewing the incidence of the most common procedures performed in both combat zones. Neck explorations for penetrating neck trauma was far more common in Iraq, since those patients with symptomatic neck trauma would have lifesaving procedures performed at forward-located Role 2 and Role 3 facilities in Afghanistan before being aeroevacuated to Bagram.²² Furthermore, whereas the percentage of surgical airway cases was similar in both combat zones, a higher percentage of surgical airways were triaged as immediate in Iraq and were red or emergent airways requiring intervention within 5 minutes of patient contact.²² This difference is reflected by the increased incidence of head and neck trauma patients triaged to the immediate category in Iraq (11%), compared with those in Afghanistan (5%).²² Consequently, the perioperative mortality for head and neck trauma in Iraq (5.3%) was greater than the mortality in Afghanistan (1.3%).²² The higher incidence of emergent or red airways in Iraq and the higher incidence perioperative mortality occurred due to the increased frequency and magnitude of mass casualty events in Iraq and their proximity to the Role 3 theater hospital.²²

Head and neck surgeons must be well-trained and prepared to treat both acute bleeding trauma and complex craniofacial reconstructive trauma. The belief that "by the time I get there" the patient will be stabilized is false. Mass casualty events can and will occur both in civilian settings (eg, during Hurricane Katrina and the Oklahoma City bombing) and in the combat zone.^{6,25} Consequently, a rapid mass influx of trauma patients will challenge and perhaps overwhelm the medical resources in place. During these mass casualty events, as witnessed during the 10-day Battle of Fallujah, the head and neck surgeon will often be the primary surgeon managing airway emergencies and penetrating neck trauma.⁶ Also, the head and neck surgeon will manage devastating soft-tissue and bony facial trauma requiring complex repair. We have a duty and an obligation to maintain our surgical skill sets to deal with both scenarios.³⁷

OUTCOMES OF MASS CASUALTY EVENTS

Service members injured during mass casualty events are surviving at higher rates because of the significant advances in both medical treatment and protective equipment. For example, the survival rates for soldiers with penetrating neck trauma was

- 86% in World War I,
- 93% in World War II, and
- 93% to 96% in the Vietnam War.^{38–40}

In Iraq and Afghanistan, the survival rate for penetrating neck trauma was 97%, despite the fact that 70% of these wounds were caused by devastating IEDs, mortars, and rockets.^{36,41} The majority of these patients with penetrating neck wounds presented to the AFTH

during mass casualty events.³⁶ The increased survival in penetrating neck trauma occurred because surgical teams, specializing in head and neck and vascular surgery, were able to perform definitive repair of these injuries typically within the first golden hour of trauma after a mass casualty event.³⁶ In addition, traumatic airway management in Iraq and Afghanistan has yielded a survival rate of 94% in wounded patients presenting with red or emergent airways requiring control of the airway generally within 5 minutes of presentation.³⁰ This high survival rate for wounded patients presenting with acute airway emergencies occurred because highly skilled head and neck teams were stationed within the combat zone and could secure the airway immediately during mass casualties.³⁰

SUMMARY

Mass casualty events, especially those due to IEDs, will result in devastating HNIs that will test the skills of the finest head and neck surgeon. Head and neck surgeons need to maintain skill sets that can effectively

treat both acute bleeding trauma (eg, traumatic airway compromise and penetrating neck trauma) and more complex craniofacial bony and soft-tissue repair, which will occur during mass casualty events.

CASE PRESENTATIONS

Case Study 15-1

Presentation

A young Iraqi patient presented to the Balad Air Force Theater Hospital on day 9 of the Battle of Fallujah. The patient was intubated, with a systolic blood pressure of 75, and with blood pouring from a high-velocity wound between his eyebrows and no exit wound. Physical examination showed profuse bleeding from the entrance wound with obvious brain tissue extruding from the wound site; profuse bleeding from both nares; a Glasgow Coma Scale score of 3; and bilateral, fixed nonreactive pupils. Advanced Trauma Life Support was initiated, fluids/transfusions were begun, and the HNI surgeon could not stop the profuse bleeding with a head dressing and nasal packing.

Preoperative Workup

None.

Operative Planning/Timing of Surgery

All six operating beds were occupied with several American and Iraqi patients triaged as immediate who were waiting for the next available OR bed (Figure 15-4). In addition, the emergency room was notified

that a Boeing Ch-47 Chinook helicopter was en route with 10 wounded Americans, several of whom were deemed as critically injured.

Operation

None. The HNI surgeon designated the patient as expectant. The neurosurgeon was asked for a second opinion, and he also designated this patient as expectant. Both surgical subspecialists believed that this patient had suffered a devastating brain and cavernous sinus penetrating injury with very little chance for survival. In addition, this patient would have required a large amount of resources (eg, operating room services, blood, etc) that may have compromised the care for other immediate patients with more survivable injuries. Therefore, the patient was triaged as expectant, moved to a quiet area of the surgical intensive care unit where comfort measures were instituted, and expired shortly thereafter.

Complications

N/A.

Lessons Learned

The decision to declare a patient expectant has significant implications for both the patient and the surgeon. The patient will be moved to a respectful and

MASCAL BOARD										(Please Do Not Touch)									
OR										WARD 1 (13)		WARD 2 (15)		WARD 3 (4)					
1A										2B		ed 1 CALA		Bed 1 2180		Bed 1 78		Bed 1	
1B										3A		ed 2		Bed 2 2165		Bed 2 76		Bed 2	
2A 77										3B		ed 3		Bed 3 2127		Bed 3 73		Bed 3	
201 ICU 1 (6)										201 ICU 2 (4)		Bed 4 2143		Bed 4		Bed 4		Bed 4	
Bed 1										Bed 1 2179		Bed 5 2140		Bed 5		Bed 5		Bed 5	
Bed 2										Bed 2		Bed 6 55		Bed 6		Bed 6		Bed 6	
Bed 3										Bed 3 2056		Bed 7 74		Bed 7		Bed 7		Bed 7	
Bed 4										Bed 4		Bed 8 71 SE NOW		Bed 8 2181		Bed 8		Bed 8	
Bed 5 77										Bed 5		Bed 9 2136		Bed 9 2214		Bed 9		Bed 9	
Bed 6										Bed 6		Bed 10 10		Bed 10 2116		Bed 10		Bed 10	
Bed 7										Bed 7		Bed 11 1762		Bed 11 029		Bed 11		Bed 11	
Bed 8										Bed 8		Bed 12 69		Bed 12 2212		Bed 12		Bed 12	
Bed 9										Bed 9		Bed 13 72		Bed 13 005		Bed 13 75		Bed 13	
Bed 10 74										Bed 10		Bed 14		Bed 14 2219		Bed 14		Bed 14	
Bed 11										Bed 11		Bed 15		Bed 15 2176		Bed 15		Bed 15	
Bed 12										Bed 12		Bed 16		Bed 16 2222		Bed 16		Bed 16	
2 COAST										2 COAST		Bed 17		Bed 17		Bed 17		Bed 17	
Panding										Panding		Bed 18		Bed 18		Bed 18		Bed 18	
												Bed 19		Bed 19		Bed 19		Bed 19	

Figure 15-4. Mass casualty (MASCAL) board during the Battle of Fallujah, November 2004.

quiet area, be monitored and given comfort measures, and will expire. The surgeon who has made the decision to declare the patient expectant has to live with this decision. The decision not to operate is directly opposite to the surgeon's basic instinct and desire to immediately address the injury and to make every attempt to save the wounded patient's life. The surgeon will deal with self-doubt, guilt, and will never forget this decision and the death of this patient. Fortunately, very few patients during the mass casualty events in Iraq and Afghanistan were triaged as expectant.

Case Study 15-2

Presentation

A 23-year-old wounded American soldier presented with an AK-47 assault rifle wound to his right mid-forehead. When he presented to the

emergency room, the HNI surgeon was operating on a young Iraq girl and removing an orbital/mid-face mass through a midface degloving approach. After the midface tumor was removed and closure was begun, the ENT (ear, nose, and throat) technician told the HNI surgeon that he was needed urgently in the next OR. On his immediate arrival in the OR, the HNI surgeon witnessed the two neurosurgeons attempting to control massive arterial bleeding through a right craniotomy using packing. Despite these efforts, the arterial bleeding was so profuse that it resembled a grade-school science project of a volcano erupting, with profuse lava spouting from its opening. Systolic blood pressure was 60 and falling.

Preoperative Workup

None.

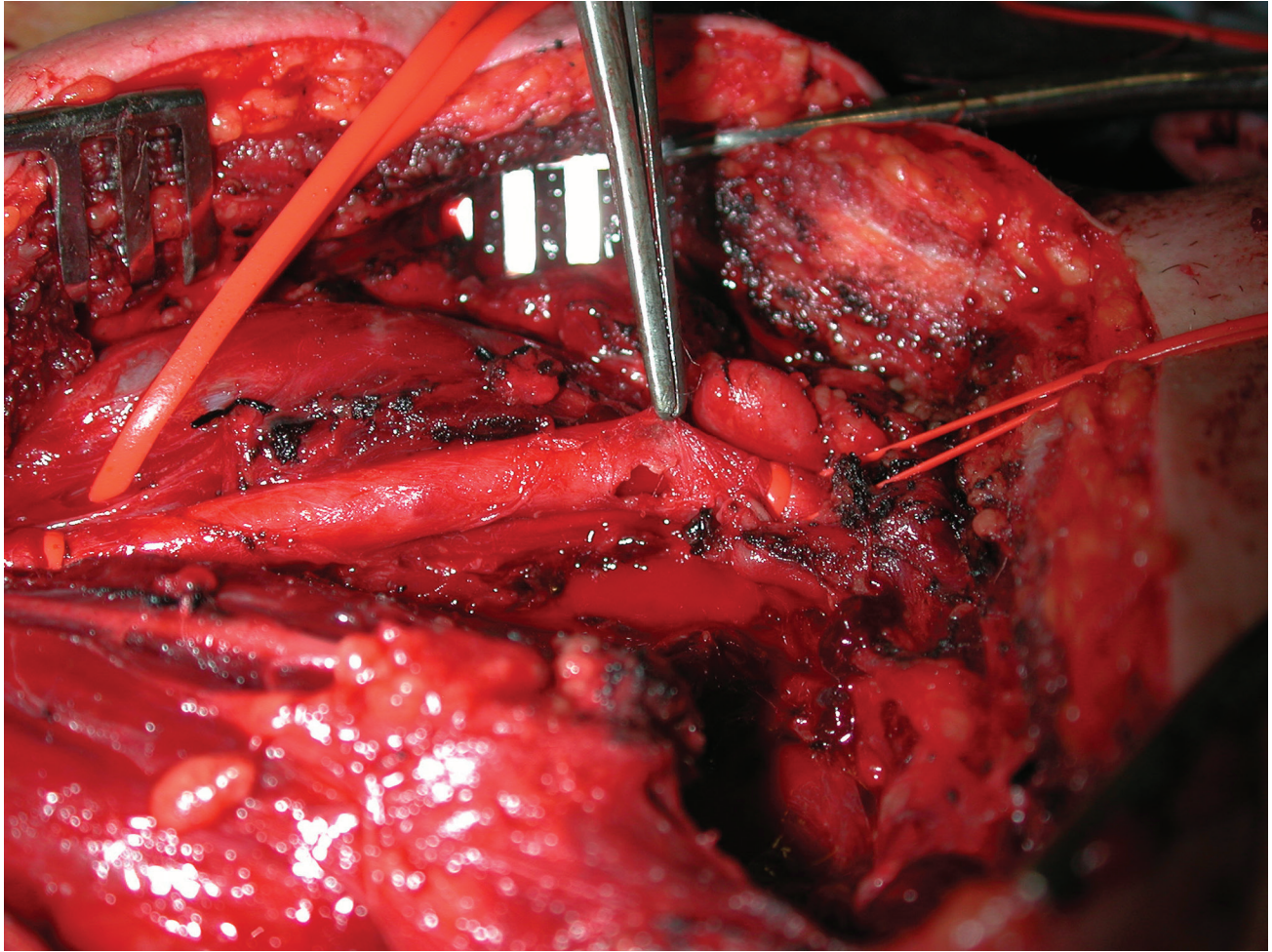


Figure 15-5. Double-loupe control of the carotid artery.

Operative Planning/Timing of Surgery

Immediate control of the internal carotid artery in the neck was necessary in this patient with profuse and continuous intracranial arterial bleeding and rapidly falling blood pressure despite massive transfusion efforts.

Operation

The ENT technician asked the HNI surgeon whether he should prep the neck. The HNI surgeon said that he immediately needed the knife, made a vertical incision along the anterior right sternocleidomastoid muscle (SCM), bluntly dissected the carotid sheath, and immediately occluded the common carotid artery with a Satinsky vascular clamp. Bleeding immediately slowed, and the neurosurgeons continued their attempts to control the intracranial bleeding. During this time, the HNI surgeon identified the internal carotid artery, the external carotid artery, and the common carotid artery.

These vessels were then controlled with vascular tapes, and the Satinsky vascular clamp was removed. The neurosurgeons requested that the carotid artery occlusion be released, and the profuse bleeding recurred. After attempts to stop intracranial bleeding failed, the internal carotid artery was ligated with cessation of bleeding.

Complications

The soldier suffered a moderate stroke postoperatively, but made an amazing recovery with minimal motor deficits. He is currently medically retired from the Army and living with his family.

Lessons Learned

First, the HNI surgeon needs to be trained on the techniques of vascular access and vascular control in the neck. As military trauma surgeons, we have a duty to train our residents on the technique of immediate

cervical vascular access. The HNI surgeon used to tease his vascular colleagues about the “ugly” vertical neck incision they use for carotid surgery. However, the HNI surgeon quickly learned that this vertical incision along the anterior SCM is the quickest and easiest pathway to access the carotid sheath with the least amount of dissection required. Needless to say, the HNI surgeon used this vertical SCM incision on all penetrating neck trauma explorations.³⁶

Second, the proper techniques of vascular control are critically important. The quickest way to gain vascular control is to directly clamp the vessel with a Satinsky vascular clamp. Such vascular clamps are noncrushing and will not damage the vessel wall or cause additional tearing of the fragile vein or artery. Crushing clamps (eg, hemostat or tonsil clamp) should never be used and may cause additional tearing of the injured vessel, especially the more fragile

veins such as the internal jugular vein. Furthermore, a basic tenet is to gain vascular control both proximal and distal to the site of the vessel injury before the injury site is manipulated (since this manipulation may increase bleeding if vascular control is not first obtained). Such control can be established using the technique of a “double loupe” of the vessel with a large vascular tape (Figure 15-5). The double-loupe technique involves passing a large vascular tape around the vessel two times. Then, a large 2-0 silk suture can be used to secure both free ends of the double loupe and the middle continuous portion within this single-tied suture. This suture will allow gentle retraction of the vessel without inadvertently pulling both loose ends, thus causing vessel occlusion (especially for the internal carotid artery if this vessel does not need to be occluded). However, if the vessel does need to be immediately occluded, then

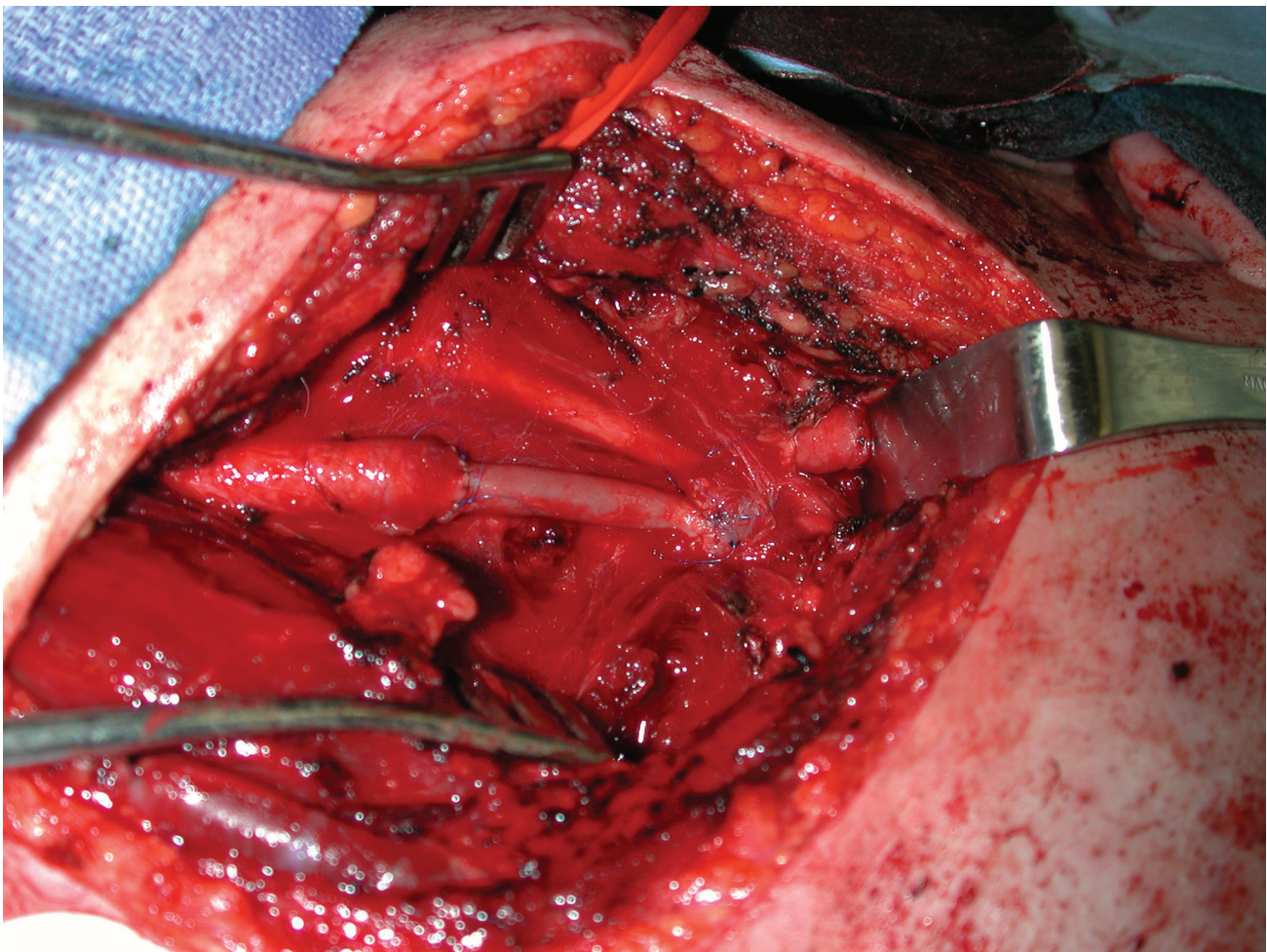


Figure 15-6. Interposition saphenous vein graft repair of the common carotid artery injury by the vascular/trauma surgeon.

simply cut the suture and pull both loose ends of the vessel tape that will occlude the vessel. Other techniques for vessel occlusion include using the end of a closed, right-angle clamp to gently occlude a bleeding vessel during exploration and slipping a red rubber catheter section around the loose ends of a vascular tape, then pressing the catheter into the vessel wall causing occlusion.

Third, it is paramount that the HNI surgeon works closely with his/her fellow vascular and trauma sur-

geons during these cases. The vascular and trauma surgeons have the expertise and training to repair the vessel injuries and place interposition grafts as indicated (Figure 15-6). Thus, the HNI surgeon needs to be trained to control these cervical vessels before the vascular/trauma surgeon arrives. During the aforementioned case, which occurred during a mass casualty event, the trauma and vascular surgeons were operating on other critically injured patients and were not immediately available.

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