Casualty Wounding Patterns in Special Operations Forces in Operation Iraqi Freedom

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Abstract

This report describes compiled data on wound patterns for casualties sustained by Special Operations Forces (SOF) of the Combined Joint Special Operations Task Force-Arabian Peninsula during Operation Iraqi Freedom. The intent of this report is to provide information to the SOF Medic on the types of combat-related wounds that are most common in the ongoing Iraq war. During the period evaluated, the extremities and the head were the most common wound sites. Extremity wounds were commonly associated with fractures. Most of the fatally-injured had head and/or neck wounds. The information in this report may be used by SOF Medics to focus training to better address the types of injuries that are commonly seen on the current battlefield and to plan operational and logistical aspects of combat trauma medicine.

Objectives:

1. Describe common combat wound sites in SOF patients wounded in OIF.
2. Use wound pattern data to train and prepare for and execute emergency medical aspects of combat missions.
3. Provide guidelines for the compilation and analysis of SOF casualty data in future conflicts.

Introduction

Many studies have addressed combat casualty statistics for conventional U.S. military forces. Comparatively few published reports have described casualty data specifically for Special Operations Forces (SOF), and these have looked at data collected at higher level medical treatment facilities. The SOF Medic is unique among military Medics in that he must be capable of being the sole medical provider for a unit conducting unconventional warfare often in austere, isolated conditions for extended periods of time and with limited resources. Because of their advanced skills and isolated working conditions, SOF Medics often treat patients that would have been evacuated to a higher-level treatment facility for treatment in a conventional unit. Prolonged evacuation times for SOF wounded may also necessitate longer stabilization treatment by SOF Medics.[1] This report attempts to better characterize wound patterns typical of SOF operations by providing a snapshot of the array of wounds a SOF Medic is likely to encounter on the Iraq battlefield. It describes types of wounds, mechanisms of injury, and patient outcomes. It also addresses how to focus medical training and operational and logistical planning to best address these types of wounds.

Material and Methods

We collected data for the period from March 2003 to October 2007 for the Combined Joint Special Operations Task Force-Arabian Peninsula (CJSOTF-AP) and subordinate SOF elements throughout Iraq. We searched archived casualty reports, operational reports, and the casualty database maintained by CJSOTF-AP medical staff for information on SOF casualties from Operation Iraqi Freedom (OIF). The latter consisted of a compilation of descriptions of injuries reported during the course of OIF to CJSOTF-AP by SOF operators and further data collected by CJSOTF-AP medical staff from patient medical records. Morbidity and mortality data for battle wounds were compiled and analyzed to provide an overall picture of wounds received, causes of wounds, and short-term patient outcomes.

Inclusion criteria

The data set included all casualties wounded in action (WIA), killed in action (KIA), or died of wounds (DOW) due to combat operations.

Definitions:

Casualty: For the purposes of this study, any wounded personnel requiring treatment by medical providers, which includes SOF Medics (note: the term "casualty" generally denotes a servicemember (SM) that is removed from combat by illness, death, or injury that requires movement to a hospital for treatment. Because the purpose of this study is to collect data on battle wounds that SOF Medics will be treating in the field, we used an alternative definition). **WIA:** Any Soldier wounded as a direct result of engaging in combat missions. **KIA:** Any Soldier killed as a result of hostile action who died before arriving at a medical treatment facility. **DOW:** Any Soldier wounded as a result of hostile action who died after evacuation to a medical facility. **Fatalities:** The sum of the KIA and DOW. **Fatality rate:** Percentage of fatalities among a group of wounded. **IED:** Improvised explosive device (includes roadside IED, suicide IED, and vehicle-borne IED). **Head wound:** Any wound to the head or face (not including neck), to include penetrating wounds, superficial wounds, eardrum injuries, and concussions or traumatic brain injury where clinical signs of brain injury were recorded by medical personnel. **Neck wound:** Any injury to the neck or throat. **UE (upper extremity) wound:** Any injury to the hands, arms, or shoulders. **LE (lower extremity) wound:** Any injury to feet, legs, buttocks, or pelvic areas inferior to the abdominal cavity. **Thoracic wound:** Any injury, penetrating or superficial, to the thoracic area. **Abdominal wound:** Any injury, penetrating or superficial, to the abdominal area. **Spinal wound:** Any injury with clinical or radiological documentation of vertebral or spinal cord injury or where neurologic symptoms attributable to spinal injury were reported. **Multiple site:** Any individual injured in more than one of the above regions.

Results

Our search found records for 225 wounded service members from CJSOTF-AP and subordinate units from March 2003 to October 2007. Of these, 21 were classified as KIA and four as DOW, for a total fatality rate of 11.1%.

Sites of wounds

The following categories were used to classify wound sites: head, neck, UE, LE, thorax, abdomen, and spine. The most common wounds were as follows: 91 (40% of the wounded) had head wounds, followed by 76 (34%) with UE wounds and 71 (32%) with LE wounds. There were 37 casualties with wounds to the torso (7 abdominal, 18 thoracic, and 14 spinal). Table 1 gives a breakdown of the number of casualties with wounds in given locations and percent of total wounded. It also shows numbers wounded and killed as well as fatality rates for patients with each wound type and the percentage of fatalities that had wounds in given locations.

Approximately one third of the wounded had wounds in multiple sites (see Table 2). Of note, extremity wounds as a group (i.e., patients with upper and/or lower extremity wounds) were the most common injuries. There were 129 individuals with extremity wounds, 18 of which had wounds both to UE and LE.

As noted above, a large proportion of the casualties had injuries to the head. In fact, almost one fourth of the wounded presented with only a head wound. The reader should keep in mind that head injuries in this study include everything superior to the neck (soft tissue, bony, cerebral, facial, and ocular wounds). While available clinical descriptions did not always provide sufficient detail for exact wound site on the head, the following breakdown of numbers provides some detail on the nature of head wounds in this study: Of the 91 head injuries that were documented, approximately 39 cases (17% of all casualties) reported symptomatic post-concussive or tympanic membrane injuries, 18 of which had no visible soft tissue injuries to the head. It is unknown how many cases of traumatic brain injury went undiagnosed. Six cases of injuries to one or both eyes were reported, including destruction of the globe, foreign bodies, and unspecified eye injuries.

Table 1. Casualty wound patterns

	Head	Neck	UE	LE	Abdomen	Thorax	Spinal
Total casualties	91	19	76	71	7	18	14
% of total casualties with a given wound	40%	8%	34%	32%	3%	8%	6%
Number WIA	82	13	74	68	7	14	13
Number total fatalities	9	6	2	3	0	4	1
Fatality rate	10%	32%	3%	4%	0%	22%	7%
% of fatalities with a given wound	36%	24%	8%	12%	0%	16%	4%

Note: Because many casualties received wounds in multiple sites, the total numbers in this table are greater than the overall numbers of casualties, WIA, and total fatalities.

Fatalities by wound site

Neck wounds had the highest fatality rate, with 6 of 19 (32%) neck wounds associated with fatality, followed by 4 of 18 (22%) thoracic wounds, and 9 of 91 (10%) head wounds.

Head wounds were associated with the greatest overall number of fatalities. Of the 25 fatalities, 9 had head wounds (36%). Additionally, 24% of fatalities had neck wounds, 16% had thoracic wounds, and 20% had extremity wounds (UE and/or LE). If we consider head and neck injuries as a group, 12 (48%) of the fatalities had a wound to the head and/or neck, 3 (12%) of which had both head and neck wounds.

Many casualties presented with solitary wounds. Table 2 gives a breakdown of data for casualties with wounds in only one anatomical location. As previously indicated, 50 (23%) casualties presented with head wounds only, of which 5 (10%) were fatal. Three presented with neck wounds only, of which two (67%) were fatal. While many casualties presented with solitary wounds of the UE (36) or LE (37), only one such case was fatal (traumatic amputation of LE). Fewer casualties had wounds only to truncal regions (thorax, abdomen, or spinal), with only one fatality in this group (penetrating thoracic wound). Of the 74 casualties presenting with wounds in multiple sites, 16 (22%) were fatal. Thus multiply wounded individuals accounted for 64% of the fatalities, followed by solitary head injuries (20%), and solitary neck injuries (8%). (See Figure 1)

Mechanism of injury (MOI) by wound site

Not surprisingly, 5 of 13 (38%) explosively-formed penetrator (EFP) casualties and 32 of 84 (38%) IED casualties were multiply wounded. However, it should be noted that it was not always possible to determine if a blast was due to an EFP or an IED. This report simply relied on the reports given by Medics or other personnel and in some cases on operational reports for identification of the mechanism of injury. It is possible that in some cases EFPs were reported as IEDs and vice versa. Notably, 18 of 68 (26%) small-arms fire (SAF) casualties were multiply wounded. This generally resulted from either multiple bullets, fragmentation of bullets on or before impact, and tracking of bullets through different parts of the body.

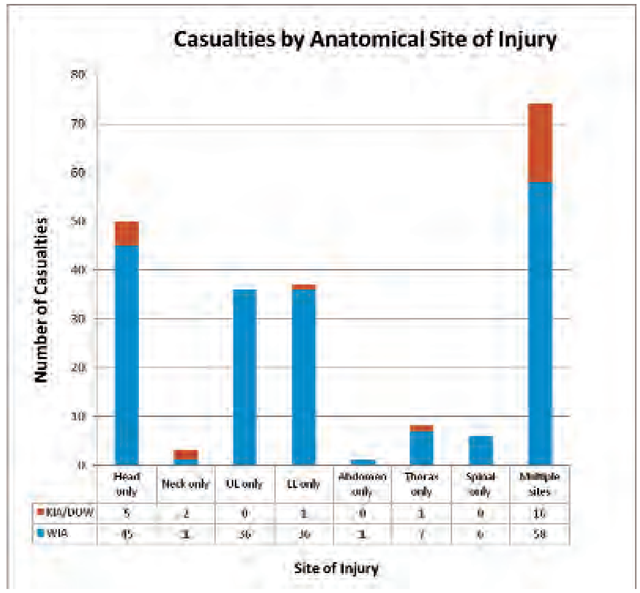

Figure 1 Number of casualties with solitary wounds and multiple wounds, with breakdown of number WIA and total fatalities (KIA/DOW)

Table 2. Casualty wound patterns for casualties with solitary wounds and multiple wound sites

	Head only	Neck only	UE only	LE only	Abdomen only	Thorax only	Spinal only	Multiple sites	total
Total casualties	50	3	36	37	1	8	6	74	215[a]
% of total casualties with given wound	23%	1%	17%	17%	0%	4%	3%	34%	100%
Number of WIA with given wound	45	1	36	36	1	7	6	58	190
Number KIA/DOW with given wound	5	2	0	1	0	1	0	16	25
CFR for given wound	10%	67%	0%	3%	0%	13%	0%	22%	
% of fatalities with the given wound	20%	8%	0%	4%	0%	4%	0%	64%	100%

Wound site data were not available in 10 cases, resulting in total of 215 of the total 225 casualties

Note: Because many casualties received wounds in multiple sites, the total numbers in this table are greater than the overall numbers of casualties, WIA, and total fatalities.

A comparison of wound sites for SAF and IEDs may shed light on the nature of aimed enemy fire and effectiveness of current body armor systems. Sixteen of 90 SAF wounds were to the head (18%). By comparison, 36 of 93 (39%) IED wounds affected the head (counting only visible external head wounds). (See Table 3) This proportion is more than double that of SAF ($p=0.002$). On the other hand, 10 of 90 (11%) SAF wounds were to the thorax compared to 1 of 93 (1.1%) IED wounds ($p=.005$). This data set takes into account all casualties, wounded or killed, for whom applicable MOI and wound site data were available. All p values were calculated using a two-tailed Fisher's exact test

Discussion

Mechanism of injury

The data in Table 3 may provide insight into the effectiveness of protective equipment against different types of weapons. Shrapnel from IEDs caused higher rates of head wounds compared to SAF, while SAF caused thoracic injuries much more commonly than did IEDs. We may conclude that SAF was more effective than IEDs at causing chest wounds. On the other hand, IEDs were more effective than SAF at causing head wounds. This specific analysis does not evaluate fatality rates of these particular types of wounds, a valuable piece of information that could be elucidated with a larger data set. Nonetheless, in this instance, it appears that currently used body armor provided effective protection of the thorax from IED type explosions. This may also reflect a tendency of the enemy to concentrate aimed fire more at the chest than at the head. In practical terms, these data imply the need to emphasize better protection of the head from explosive type injuries and protection of the chest from SAF. However, further investigation into these trends is warranted.

Wound sites

Several studies have looked at similar data patterns. While we must be cautious in comparing data from different types of studies, general trends in numbers may provide useful information. Montgomery et al. compiled data from OIF in 2003 on casualties who were evacuated to Walter Reed Army Medical Center and triaged to inpatient status.[2] Of 119 casualties, wound locations were as follows: 29 head and neck, 25 chest, 20 abdomen, 74 LE, and 36 UE. Our figures reveal higher rates of head and neck injury and lower rates of truncal and extremity injuries. This may be due to skewing of the results towards head injuries due to the inclusion of mild traumatic brain injuries (TBIs) in our data. In a 2006 Congressional Research Service report on Soldiers injured primarily in OIF and OEF, 229 (20%) out of the 1,124 injured had sustained multiple injuries.[3] While this rate is somewhat lower than the 74 (33%) of 225 casualties in our study, it shows a consistent trend of multiply injured patients. The difference may be attributed to higher rates of IED and EFP injuries in OIF compared to OEF, which may produce more multiply wounded patients.

Table 3: Number and % of total wounded with SAF wounds vs IED wounds in various locations of the body

	Head	Neck	UE	LE	Abdomen	Thorax	Spinal	Total
# casualties due to SAF with wounds at a given site	16	5	25	29	2	10	3	90
% of total SAF wounds	18%	6%	28%	32%	2%	11%	3%	
# casualties due to IEDs with wounds at a given site	36*	4	22	21	3	1	6	93
% of total IED wounds	39%	4%	24%	23%	3%	1%	6%	

*IED head wound figure does not include the 13 cases of concussion or TM injury due to IEDs with no mention of external wounds to head

Extremity injuries

The high rate of extremity injuries in this study is not surprising, since arms and legs present a relatively large profile and are usually not protected by body armor. Other studies have reported similar findings. Owens et al. reported that in previous conflicts extremities have accounted for 54 to 71% of combat wounds (WWII 58%, Korea 65%, Vietnam 61%, Desert Storm 71%, OIF/OEF 54%).[4] Another study on casualties evacuated to a level IV medical treatment facility early in OIF reported 68% with extremity wounds.[5] Zouris et al. reported that in one group of battle wounded in OIF, approximately 70% had extremity injuries.[6] Peoples et al. reported an extremity wound rate of 58% among 224 patients presented to a Forward Surgical Team in Afghanistan in 2001 and 2002.[7] Our study found 57% of casualties had extremity wounds. Thus there is some consistency in extremity wounding rates. In general terms, Medics should expect that a majority of their patients in combat will have extremity wounds, many severe enough to warrant evacuation from theater.

Owens et al. described 3,575 extremity wounds (to 1281 individuals) from OIF and OEF [not including those returned to duty (RTD) within 72 hours].[4] Of all extremity wounds, over half (53%) were penetrating soft tissue wounds and over one fourth (26%) had fractures. Half of the fractures were in the UE and half in the LE. Of all fractures, 82% were open. The article further reported that in previous conflicts, 23 to 39% of extremity wounds have involved fractures. By comparison, our data set included 129 casualties with extremity wounds, of which 76 had UE wounds and 71 LE wounds. Of all casualties with extremity wounds, 81 (63%) had soft tissue wounds only, and 25 (19%) had fractures. In 23 (18%) cases, our records did not specify if a fracture was present.

This data shows that extremity wounds are a consistent finding, and that fractures, most of which are open, generally occur in at about a fourth of extremity battle wounds, with a similar incidence in UE and LE. This suggests to Medics the importance of training on and preparing for initial management and stabilization of open UE and LE fractures. Such planning should include splinting, tourniquets, antimicrobial therapy, analgesia, wound management, etc. It is encouraging to note that there was only one death among those wounded only in the extremities. This may reflect effectiveness of current first aid techniques for extremity wounds.

Survivability

While our study did not evaluate survivability of fatal wounds, other studies have addressed this extremely important issue. A recent study by Holcomb et al. reported on 82 combat-related deaths in SOF from October 2001 to November 2004.[8] A panel of evaluating physicians classified 12 of the 82 (15%) as potentially survivable. These cases included truncal hemorrhage (8), compressible hemorrhage (2), hemorrhage amenable to tourniquet (1), tension pneumothorax (1), airway obstruction (1), and sepsis (1). Kelly et al. analyzed 982 autopsy reports from combat deaths in Iraq and Afghanistan from 2003 to 2006.[9] In this study, they found that noncompressible truncal hemorrhage was the leading cause of potentially survivable (PS) death, accounting for approximately half of all PS deaths. Hemorrhage amenable to a tourniquet and compressible hemorrhage not amenable to a tourniquet were the next leading causes, and these three categories accounted for approximately 85% of PS deaths. Such information should also be used by SOF medical personnel to focus their training and mission preparation. In our study, detailed descriptions of fatal wounds and causes of death were generally not available, though in most cases, the available descriptions suggest that the most common direct causes of death were head trauma or exsanguination. Future studies and data collection should address this important topic.

Limitations

This data set is bound by several limitations. The small sample size limits the reliability of comparisons between data sets. Our study used different inclusion criteria (e.g., including patients treated on site by SOF Medics) than many other studies have used, making comparisons of data difficult. Minor wounds were often not reported or were reported with little clinical information. There were some time gaps in the data, especially early in OIF, where records were either not kept or could not be located. It is unknown how many injuries were undiagnosed or unreported, but prior experience shows that traditionally about 50% of battlefield wounds are minor with RTD within 72 hours.[10] Such covert injuries can be especially difficult to document in the SOF community, where Operators are often reticent with injuries and illness, especially the less obvious injuries like TBI. This phenomenon could skew the results somewhat in favor of more serious injuries. In many cases, medical records from a medical treatment facility were not available for review. In these cases, the only available information was the description in the casualty database as recorded by previous CJSTOF-AP medical staff. As a result, some of these descriptions were vague or incomplete, and did not provide the level of detailed information that can obtained from a review of medical records. Furthermore, autopsy reports and definitive causes of death were not available in most cases. Therefore, for purposes of this study, we did not attempt to analyze the factors that affected survivability of wounds or a KIA versus DOW outcome. Finally, while this information provides applicable information to the current conflict, it may be less applicable in future conflicts in other scenarios. In spite of these limitations, we still believe these data proffer valuable and applicable information that can be used to develop tactics, techniques, procedures, training programs, and technology that can save lives.

Conclusions

Head and extremity wounds were very prevalent. Neck wounds, while present in lower numbers, were associated with high fatality rates. In spite of modern body armor, some thoracic wounds still occurred, most of which were SAF related. Medics should therefore be prepared to treat ballistic wounds to the torso. A large number of patients were wounded in multiple regions. Such patients present treatment and triage challenges for the first responder. Also of note was the significant number of SMs with concussive-type TBIs. This highlights the importance of recognition of these kinds of battle injuries. The prevalence of open fractures to upper and lower limbs suggests an obvious need to focus training and logistics to address such wounds. Treatment of such wounds is especially important because body armor modifications are unlikely to provide significant protection to the limbs.

High fatality rates of head, neck, thoracic, and multiply wounded casualties point to the importance of determining ways to prevent and treat such wounds. For example, future research may address alterations in helmet design to protect the head, and body armor modifications to protect the neck and axillary regions. Ideally, body armor should protect these vulnerable areas without becoming overly cumbersome and a hindrance to maneuverability.

Using this information, Medics may better prepare for upcoming conflicts by focusing training on certain types of injuries and adjusting their medical supply and operational planning for anticipated needs. For example, in a conflict like OIF, with an abundance of IED injuries, the Medic should be vigilant for blast wounds to the head, which may require airway management and rapid evacuation to a facility with computed tomography (CT) capabilities. A high probability of extremity fractures may guide medical logistics planning for analgesic medications, tourniquets, splints, and bandaging material. Furthermore, this information may be used to guide development of future products and technologies, such as body armor extensions, hemostasis products (tourniquets, hemostatic dressings, etc.), and treatments for hemorrhage (field transfusion, hemoglobin-based oxygen carriers, etc.).

A salient conclusion of this study is the need for SOF medical units to compile and maintain thorough, reliable data on all wounded. The following parameters should be tracked for all casualties: Patient ID; demographic information; date of injury; tactical situation; unit; MOI (specific); evacuated or RTD; when RTD; evacuation locations; types and locations of injuries (very specific and detailed); immediate outcome (WIA, KIA, DOW, RTD, etc.); long-term outcomes (disability, RTD, etc.); severity of wounds; and autopsy information for KIA/DOWs (direct cause of death, detailed wound descriptions, etc.) Other information that could be tracked includes effect on mission, protective equipment used, initial treatments received before evacuation, surgeries and other treatments required after evacuation, evacuation times, etc. Also for all fatalities, a medical evaluation should be performed to determine if the death was potentially preventable.

Thorough, accurate, reliable records of combat casualties provide extremely valuable information to SOF Medics and medical planners. This information will allow us to retrospectively evaluate the effects of changes in equipment, tactics, techniques, and procedures. By compiling and analyzing these data, we can monitor wounding trends and evaluate combat risks in order to determine how to best prevent, prepare for, and treat casualties in future combat operations.

References

1. Place RJ, Rush RM Jr, Arrington ED. (2003). Forward surgical team (FST) workload in a Special Operations environment: The 250th FST in Operation ENDURING FREEDOM. *Current Surgery*, 60(4), 418-22.
2. Montgomery SP, Swiecki CW, Shriver CD. (2005). The evaluation of casualties from Operation Iraqi Freedom on return to the continental United States from March to June 2003. *Journal of the American College of Surgeons*, 201(1), 7-12.
3. Fischer, Hannah. (2006). United States Military Casualty Statistics: Operation Iraqi Freedom and Operation Enduring Freedom. *CRS Report for Congress*. Accessed on 4 Decem ber 2007 at http://handle.dtic.mil/100.2/ADA458285.
4. Owens BD, Kragh JF Jr, Macaitis J, Svoboda SJ, Wenke JC. (2007). Characterization of extremity wounds in Operation Iraqi Freedom and Operation Enduring Freedom. *Journal of Orthopedic Trauma*, 21(4), 254-7.
5. Johnson BA, Carmack D, Neary M, Tenuta J, Chen J. (2005). Operation Iraqi Freedom: the Landstuhl Regional Medical Center Experience. *Journal of Foot and Ankle Surgery*, 44(3), 177-83.
6. Zouris JM, Walker GJ, Dye J, Galarneau M. (2006). Wounding patterns for U.S. Marines and sailors during Operation Iraqi Freedom, major combat phase. *Military Medicine*, 171(3), 246-52.
7. Peoples GE, Gerlinger T, Craig R, Burlingame B. (2005). Combat casualties in Afghanistan cared for by a single forward surgical team during the initial phases of Operation Enduring Freedom. *Military Medicine,* 170(6), 462-468.
8. Holcomb JB, McMullin NR, Pearse L, Caruso J, Wade CE, Oetjen-Gerdes L, Champion HR, Lawnick M, Farr W, Rodriguez S, Butler FK. (2007). Causes of death in U.S. Special Operations Forces in the global war on terrorism: 2001-2004. *Annals of Surgery,* 245(6), 986-91.
9. Kelly JF, Ritenour AE, McLaughlin DF, Bagg KA, Apodaca AN, Mallak CT, Pearse L, Lawnick MM, Champion HR, Wade CE, Holcomb JB. (2008) Injury severity and causes of death from Operation Iraqi Freedom and Operation Enduring Freedom: 2003-2004 versus 2006. *The Journal of Trauma, Injury, Infection, and Critical Care*, 64(2), S21-S27.
10. Holcomb JB, Stansbury LG, Champion HR, Wade C, Bellamy RF. (2006) Understanding Combat Casualty Care statistics. *The Journal of Trauma, Injury, Infection, and Critical Care,* 60(2), 397-401.

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