Chapter 3. Incidence and Epidemiology of Casualties treated at the Dutch role 2 Enhanced Medical Treatment Facility at Multi National Base Tarin Kowt, Afghanistan in the period 2006-2010

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ABSTRACT

Background: To improve care for the injured service member, we have analyzed battle casualty patterns and mechanisms. This study is the first documented report of wounding patterns and mechanisms of battle casualties treated at the Dutch role 2 Enhanced Medical Treatment Facility at Multi National Base Tarin Kowt, Uruzgan, Afghanistan.

Methods: Participants were selected from the trauma registry at the Dutch role 2 Enhanced Medical Treatment Facility, where they fitted the criteria battle casualty and disease non battle injury between August 2006 and August 2010.

Results: The trauma registry query resulted in 2,736 casualties, of which 60% (1,635/2,736) were classified as disease non-battle casualties and 40% (1,101/2,736) as battle casualties. The battle casualties sustained 1,617 combat wounds, resulting in 1.6 wounds per battle casualty, these injuries predominately were caused by explosions (55%) and gunshots (35%). The wounding pattern was as follows: head and neck (21%), thorax (13%), abdomen (14%), upper extremity (20%) and lower extremity (33%).

Conclusions: The wounding patterns seen at the Dutch role 2 Enhanced Medical Treatment Facility at Multi National Base Tarin Kowt resemble the patterns as recorded by other coalition partners. The wounding patterns differ with previous conflicts: a greater proportion of head and neck wounds, and a lower proportion of truncal wounds.

INTRODUCTION

In the aftermath of the terrorist attacks of September 11, 2001, the United States (US) initiated the so-called Global War on Terrorism and deployed military units to multiple theaters in the Middle East and Southwest Asia[1]. Since then, over 10,000 coalition service members have been killed and over 50,000 have been injured in Iraq and Afghanistan. Also, many thousands of contractors, host-nationals, foreign national security personnel, and insurgents were injured or killed. The Iraq and Afghanistan armed conflicts have produced comparable combat-related casualties with the Vietnam and the Korea War with injury patterns differing from previous theaters of war [2]. The International Security Assistance Force (ISAF) is a North Atlantic Treaty Organization (NATO) led security mission in Afghanistan that was authorized by the United Nations Security Council in December 2001.

The importance of describing the incidence and character of battle injuries, as well as their precipitating mechanisms, has been recognized since the 19th century. Since that time, many reports have been published concerning the types of battle injuries sustained by battle (combat) casualties (BCs)[3]. From August 2006 to August 2010 The Netherlands were Lead Nation in the Uruzgan province. The main component of the Dutch Task Force Uruzgan was located near Tarin Kowt at the Multi National Base Tarin Kowt. It was composed of approximately 1,200 Dutch service members and contained its own Medical Treatment Facility (MTF). The Dutch Role 2 Enhanced MTF (Role 2 MTF NL) was located at the Multi National Base Tarin Kowt and it was intentionally small with limited capabilities beyond resuscitative/ damage control surgery and limited ICU capacity. After stabilisation, patients could be transported to higher echelons of care.

To date, the number of treated casualties at Role 2 MTF NL has not been published and more current first-hand data has not been reported[4]. Therefore trends in battle injuries and battle casualties treated in Role 2 MTF NL at Multinational Base Tarin Kowt remain unreported. The goals of this study are to determine the total medical exposure at Role 2 MTF NL, the epidemiology of BCs and to contrast our findings with other MTF of coalition partners in Afghanistan and Iraq. Ultimately, our findings in epidemiologic trends of combat injuries may provide insight to the prevention and treatment of such injuries. The 4-year workload, volume and type of injuries treated may also be useful in future planning of the training and pre-deployment requirements of the Dutch military medical forces.

METHODS

This study was conducted under a protocol reviewed and approved by the Dutch Ministry of Defense and both the Institutional Review Board and Medical Ethical Committee of Leiden, The Netherlands.
A "casualty" in customary military usage means an active duty service member lost to the theatre of operations for medical reasons. The term, therefore, includes disease (illness) and noncombat injuries (NBI), as well as combat injuries. The definition of a battle (combat) casualty is as follows [5]. A battle casualty is identified as a service member being injured as direct result of hostile action, sustained in combat or sustained going to or coming from a combat mission. For the purpose of this study we included persons killed or wounded accidentally by friendly fire directed at a hostile force or what was thought to be a hostile force. We excluded (1) self-inflicted wounds (2) wounds or death inflicted by a friendly force when the serviceman is absent without leave, or is a voluntary absentee from his or her place of duty [5]. Participants eligible in this study were selected from a general digital admission database of the ministry of Defense, which fitted the criteria battle casualty and NBI between August 2006 and August 2010. For the Dutch battle casualties a follow up period of 30 days (complication and died of wounds) was used for discharge category. We performed an inventory of that were recorded in the database of the Trauma Registry at Role 2 MTF NL. We merged the casualty demographics with information from the medical records to identify the mechanism and type of injury. After segregating the NBI, the battle casualties were divided in seven groups, namely Coalition Forces (Australian, Czech, French, Great Britain, Dutch, US), Afghan National Security Force (composed of Afghan National Army, Afghan National Police, Afghan Security Guard, Kandak Amniante Uruzgan), Local Nationals, Other (Opposing Militant Forces, Interpreters, civilian contractors and unknown). In the calculation of the anatomical distribution of wounds, we excluded the unknown cases to correct for the missing data.
At the Multi National Base Tarin Kowt there was an adjacent forward US surgical team, which contributed to a low number of US battle casualties and missing information for these specific cases of classification of the mechanism of injury and anatomical distribution of wounds.
Due to missing information in the digital database, all information was manually collected, this contributed to the long delay in reporting this important statistics. A student investigator conducted data collection and verification. The first author performed a cross check of these data. All baseline information was registered in an electronic data file. All data were analyzed using SPSS 20.0. The categorical variables were analysed by their absolute and relative frequencies in percentages. The association between two categorical variables was calculated by applying the Pearson Chi square test. In all cases, $p < 0.05$ was considered statistically significant.

RESULTS

In the studied period between August 2006 and August 2010, a total of 2,736 patients (BC 40.2% [1,101/2,736] NBI 59.8% [1,635/2,736]) were treated to the Role 2 MTF NL. The combined study population was predominantly male 95.7% (1,054/1,101), with a mean age of 24 years. The patient discharge category of battle casualties and NBI was significantly different ($p<0.0001$) in respect to discharge to home/return to unit, referral to a local hospital or Role 1/2 MTF, referral to higher medical echelons and Killed in Action (KIA)/ Died of Wounds (DOW).

Battle casualty statistics

There were a total of 1,101 battle casualties treated to Role 2 MTF NL between August 2006 and August 2010. The distribution of the battle casualties was as follows: coalition forces comprised 24.3% (268/1,101) of the battle casualties (Australian 31.7% [85/268], Czech 0.4% [1/268], French 0.4% [1/268], Great Britain 2.6% [7/268], Dutch 58.6% [157/268], US 6.3% [17/268]). The Afghan National Security Forces 32.7% (360/1101), whereas Local Nationals 40.3% (444/1,101), Opposing Militant Forces 1.5% (16/1,101), interpreters 0.5% (5/1,101), civilian contractors 0.3% (3/1,101) and unknown 0.5% (5/1,101) comprised the remaining group of battle casualties. There was a significant difference ($p<0.0001$) in discharge category of battle casualties. There was significant difference between the coalition forces BCs, Afghan National Security Forces and Local Nationals in respect to discharge to home/return to unit, referral to a local hospital or Role 1/2 MTF and direct repatriation out of theatre (Table 1). The discharge category of the coalition forces BCs was of follows; 45.9% (123/268) returned to duty, 34.7% (93/268) were referred to a role 3 MTF or repatriated directly out of theatre, 13.1% (35/268) were killed in action or died of wounds (within 30 days) and 6,3% (17/268) unknown.

Mechanism of injury

There was a significant difference ($p<0.0001$) in the mechanism of injury when coalition forces were compared with Afghan National Security Forces and Local Nationals (Table 2). Coalition forces' 69.0% (185/268) casualties were injured more often by explosive devices compared with both Afghan National Security Forces 52.8% (190/360) and Local Nationals 47.9% (213/444). Similarly, Afghan National Security Forces 42.8% (154/360) and Local Nationals 40.1% (178/444) were more often victims of gunshot wounds compared with coalition forces 14.9 (40/268). The Local Nationals were more often injured by a stabbing incident when compared with coalition forces and Afghan National Security Forces.

Anatomical distribution of wounds

A total 1,037 battle casualties sustained 1,687 wounds, resulting in 1.6 wounds per battle casualty. The anatomical distribution of wounds was calculated without the unknown (74/1,101), which resulted in 1,037/1,101 unique battle casualties. Extremity injuries were most common among all groups (Table 3) and there was a significant difference ($p<0.0001$) in anatomical distribution of wounds. The Local Nationals 15.8% (112/710) more often sustained thorax injuries compared with coalition forces 7.7% (25/323) and the Local Nationals 18.5% (131/710) more abdominal injuries compared with coalition forces 9% (29/323) and Afghan National Security Forces 10.5% (57/543).

Discharge category	BC n=/ (%)	NBI n=/ (%)	Total n=/ (%)
Home/RTU	467 (42.4)	1,136 (69.5)	1,603 (58.6)
Role 1-2 MTF	290 (26.3)	290 (17.7)	580 (21.2)
Role 3 MTF	150 (13.6)	78 (4.8)	228 (8.3)
REPAT	52 (4.7)	28 (3.4)	80 (2.9)
KIA/DOW	99 (8.9)	45 (1.7)	144 (5.3)
UNK	43 (3.9)	58 (3.5)	101 (3.7)
Total	**1,101 (40.2)**	**1,635 (59.8)**	**2,736 (100)**

Table 1: *Battle casualty and disease non battle injury discharge category.*

RTU: Return to unit; Role 1-2: Local hospital or other NATO Forward Surgical Team; *MTF:* Medical Treatment Facility: *REPAT;* direct repatriation out of theatre; *KIA/DOW;* killed in action or died of wounds; UNK; Unknown; *NBI:* Disease Non Battle Injury; *BC:* battle casualty.

Patient category	Explosion n=/ (%)	GSW n=/ (%)	Other n=/ (%)	Unk n=/ (%)	Total n=/ (%)
CF	185 (69.0)	40 (15.9)	2 (0.7)	41 (15.3)	268 (24.3)
ANSF	190 (52.8)	154 (42.8)	9 (2.5)	7 (1.9)	360 (32.7)
LN	213 (47.9)	178 (40.1)	48 (10.8)	5 (1.2)	444 (40.3)
Other	16 (55.5)	9 (31.0)	1 (3.4)	3 (10.3)	29 (1.5)
Total	**604 (54.9)**	**381(34.6)**	**60(5.4)**	**56(5.1)**	**1,101 (100)**

Table 2: *Primary mechanism of injury from battle casualties (n=1,101).*

CF: Coalition Forces; *ANSF:* Afghan National Security Forces; *LN:* Local National; *Other (=OMF:* opposing military forces; *CIV:* Foreign civilian employee; *TERP:* interpreter); *UNK:* Unknown; *GSW:* Gunshot Wounds.

Patient category	Head/Neck n=/ (%)	Thorax n=/ (%)	Abdomen n=/ (%)	Lower Ex n=/ (%)	Upper Ex n=/ (%)	Total wounds n=/ (*)	Unk n=	Mean wounds per BC
CF	94 (29.1)	25 (7.7)	29 (9.0)	109 (33.7)	66 (20.4)	323 (220)	48	1.5
ANSF	120 (22.1)	59 (10.9)	57 (10.5)	203 (37.4)	104 (19.2)	543 (346)	14	1.6
LN	113 (15.9)	112 (15.8)	131 (18.5)	208 (29.3)	146 (20.6)	710 (436)	8	1.6
OTHER	6 (14.6)	9 (22.0)	3 (7.3)	11 (26.8)	12 (29.2)	41 (19)	4	2.2
Total	**333 (20.5)**	**205 (12.6)**	**220 (13.6)**	**531 (32.8)**	**328 (20.3)**	**1,617 (1037)***	**74**	**1.6**

Table 3: *Anatomical distribution of wounds (n= 1,037).*

CF: Coalition Forces; ANSF: Afghan National Security Forces; *LN:* Local National; *OTHER (=OMF:* opposing military forces; *CIV:* Foreign civilian employee: *TERP:* interpreter; UNK: Unknown); *Lower Ex:* Lower Extremity; *Upper Ex:* Upper Extremity; *AD:* anatomical distribution; *BC:* battle casualty.
*The anatomical distribution of wounds (excluded the unknown cases), mean is calculated without the unknown cases.

DISCUSSION

From August 2006 to August 2010, 2,736 (BC 40%, NBI 60%) patients were treated at Role 2 MTF NL. Coalition forces comprised 24% of the battle casualties, Afghan National Security Forces 33% and Local Nationals 40%. Almost 70% of the coalition forces BCs was injured by explosive devices, which is significantly higher compared with both Afghan National Security Forces (53%) and Local Nationals (48%). Battle injuries are mainly caused by explosions with many patients arriving in deplorable condition and these battle casualties are often wounded on multiple anatomical body regions. The use of protective body armor and explosions are a clear explanation for this change in anatomical distribution of wounds in the coalition fores[2]. Belmont et al.[3] and Owens et al.[6] reported similar data (Table 4 and 5) and these are comparable with findings of other NATO Role 2 facilities in Afghanistan[7-9]. There is a significant increase in wounds in the head and neck region and a significant decrease in thoracic wounds compared with previous wars[10-13], which could be attributed to improvement of protective body armour in recent wars.
Eastridge et al.[14] concludes that most battlefield casualties die of their injuries before ever reaching a surgeon. As most deaths are classified as nonsurvivable, mitigation strategies to impact outcomes need to be directed toward injury prevention. To impact the outcome of battle casualties with a potentially survivable injury, strategies must be developed to mitigate hemorrhage on the battlefield, optimize airway management, and decrease the time from point of injury to surgical intervention. Clarke et al.15 suggest that severely wounded BC victims should be retrieved by dedicated pre-hospital critical care teams and triaged to the highest and/or most appropriate level of medical care available within the region. The prehospital phase seems to be the most substantial opportunity to improve the outcome of a BC[16-17].

Campaign	GSW	Explosion
Civil war[10]	91	9
WWI[11]	65	35
WWII[11]	27	73
Korea[12]	31	69
Vietnam[13]	35	65
OEF/OIF Owens et al.[6]	19	81
OEF/OIF Belmont et al.[3]	23	77
Current study*	16	69

Table 4: *Mechanism of injury from Coalition Forces by campaign (%).*

GSW indicates gunshot wound; *WWI*. World War I; *WWII*. World War II; *OEF*: Operation Enduring Freedom; *OIF*: Operation Iraqi Freedom.
*Percentages do not add up to 100%, other/unknown cases 15%

Location	WWII[11]	Korea[12]	Vietnam[13]	OIF/OEF Owens et al.[10]	OEF/OIF Belmont et al.[3]	Current study
Head and Neck	21	21.4	16	30.0	36.2	29.1
Thorax	13.9	9.9	13.4	5.9	7.5	7.7
Abdomen	8	8.4	9.4	9.4	6.9	9
Extremities	58	60.2	61.1	54.5	49.4	54.1

Table 5: *Anatomical distribution of wounds from Coalition Forces by campaign (%).*

WWII: indicates World War II; *OEF:* Operation Enduring Freedom; *OIF:* Operation Iraqi Freedom.

Battle casualties produce a pattern of injury (mechanism of injury) that is not routinely seen in a civilian Dutch surgical practice. In an era of increasing surgical sub specialization, the deployed surgeons needs to acquire and maintain a wide range of skills from a variety of surgical specialties. Lack of knowledge and only basic civilian surgical skills on this broad spectrum of battle injuries can lead to higher morbidity and mortality of the battle casualties. This spectrum of injuries supports the recent discussion about the basic training and skills of the military surgeon[18-22]. Several Dutch military surgeons and military anaesthesiologist are employed in a level one trauma centre[23], therefore having the necessary exposure of severe polytrauma patients (ISS > 16). This civilian experience in comparable severity trauma patients may help when treating this type of patients on the Role 2 MTF NL. Recently the Definitive Surgical Trauma Care (DSTC®) course has been made mandatory before deployment for all Dutch military surgeons and the same for the Definitive Anaesthetic Trauma Course (DATC) for all Dutch military anaesthesiologists and intensivists. Both courses are in the Dutch Military Training curriculum, which not only focuses on (orthopaedic) trauma surgery, both also contains the necessary thoracic, vascular, urological, neurosurgical and paediatric surgical skills. Currently we are working on an Emergency or acute Surgery training in a high volume level one trauma centre with penetrating injuries, this being the next step in formation of a robust pre-deployment workup program for all Dutch military surgeons (depending on future deployments). Team training, not only including the surgeon and scrub nurses but also the anaesthesiologist and anaesthesia nurse, would be a further development. Further research is necessary to determine the contents of a mandatory training/ residency program for the Dutch military surgeons and anaesthesiologists[24] (unpublished data). Retrospective cohort studies are sensitive for bias and battle casualty definitions significantly affect casualty analysis results. Clearly defining the studied population is necessary to make valid comparisons and draw meaningful conclusions between wars, as most prior casualty reports lack this clear definition. The inclusion of KIA, Return to Unit, and NBI in any analyzed cohort will affect the distribution of wounds and mechanisms of injury [3]. In this study all stabbing incidents were defined as BI in the provided database, which could have led to overestimation of battle casualties in the Local Nationals group. The severity of the injuries in this study could not be scored in a consensus-derived global severity scoring system, such as the Abbreviated Injury Scale (AIS)[25] or the Injury Severity Score (ISS)[26]. Diaz et al[27]. described a cohort from August 2006 to August 2007, in which all ISS scores were calculated based on the available information of sustained injuries. The mean ISS for BCs was 9 (standard deviation ± 9) and NBI 7. These results give a good

indication of the severity of injuries in the investigated 4-year period. A civilian situation is hard to compare with the Role 2 MTF NL, although severity of injury and exposure are comparable with a level one trauma centre in The Netherlands[23]. The results of Spijkers et al.[23] show that level one trauma center University Medical Centre Utrecht had an admission of approximately 1,000 trauma patients over two periods of two years. The mean ISS over these two periods was 11. Sturm et al.[28] reported a mean ISS of 7.2 of trauma patients treated in Trauma Centre West Holland in the period 2004 to 2006. The mean ISS (9) of the trauma patients was lower than the published ISS of the level one trauma centers in The Netherlands, but higher than the level two and three hospitals. A cross check showed that the main ISS was an underestimation of the polytrauma patients (ISS > 16). Lastly, a major limitation was the limited possibility of data verification and missing data, due to the lack of a standardized, prospective trauma registry system. Coalition partners also reported poor population of data points and poor registration of pre-hospital data entered into a digital medical registration system, leading to missing data. Therefore, the US established in 2004 the Joint Theater Trauma Registry as a standardized system of data collection, designed to encompass all the roles echelons of Medical Support Organisation[29-30]. A NATO wide medical registry would be recommended.

In conclusion, the wounding patterns seen at the Dutch role 2 MTF at Multi National Base Tarin Kowt resemble the patterns as recorded by other coalition partners. The wounding patterns differ with previous conflicts: a greater proportion of head and neck wounds, and a lower proportion of truncal wounds. The use of improvised explosive devices have become more prevalent in current military operations, which lead to relatively more head and neck and extremity injuries. The deployed surgical teams were adequately prepared[24], were exposed to severely injured patients and functioned well under high physical and mental stress in a combat theatre, with limited resources and capabilities. The prehospital phase seems to be the most substantial opportunity to improve the outcome of battle casualties.

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