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Basil Pruitt, MD
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Dear Dr. Pruitt:

We are pleased to submit our article "**Causes of Death of Canadian Forces Members in Afghanistan: Implications on Tactical Combat Casualty Care Provision**" to the Journal of Trauma for consideration for publication as an Original Article.

Also, we would like this article to be considered as part of the Canadian Forces Operational Medical Supplement.

Thank you for considering this manuscript,

Homer Tien, MD
Lieutenant Colonel
Canadian Forces

ABSTRACT

Background: As part of its contribution to the Global War on Terror and to NATO's International Security Assistance Force, the Canadian Forces deployed to Kandahar, Afghanistan in 2006. We have studied the causes of deaths sustained by the Canadian Forces during the first 28-months of this mission. The purpose of this study was to identify potential areas for improving battlefield trauma care.

Methods: We analyzed autopsy reports of Canadian soldiers killed in Afghanistan between January 2006 and April 2008. Demographic characteristics, injury data, location of death within the chain of evacuation and cause of death were determined. We also determined whether the death was potentially preventable using both explicit review and implicit review by a panel of trauma surgeons.

Results: During the study period, 73 Canadian Forces members died in Afghanistan. Their mean age was 29 (+/- 7) years. 98% were male. The predominant mechanism of injury was explosive blast, resulting in 81% of over-all deaths during the study period. Gunshot wounds and non-blast related MVCs were the second and third leading mechanisms of injury causing death. The mean ISS was 57 (+/- 24) for the 63 study patients analyzed. The most common cause of death was hemorrhage (38%), followed by neurological injury (33%), and blast injuries (16%). 3 deaths were deemed potentially preventable on explicit review, but implicit review only categorized two deaths as being potentially preventable.

Conclusions: The majority of combat-related deaths occurred in the field (92%). Very few deaths were potentially preventable with current Tactical Combat Casualty (TCCC) interventions. Our panel review identified several interventions that are not currently part of TCCC that may prevent future battlefield deaths.

Causes of Death in Canadian Forces Members Deployed to Afghanistan, And Implications on Tactical Combat Casualty Care Provision

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INTRODUCTION

In January 2006, the Canadian Forces (CF) deployed to Kandahar, Afghanistan as part of the US-led Global War on Terror, and later as part of the North Atlantic Treaty Organization's International Security Assistance Force (ISAF). As a part of its preparation for this mission, the CF trained a proportion of its soldiers and combat medical technicians in Tactical Combat Casualty Care (TCCC). TCCC was initially developed by the US Navy for special operations forces to treat preventable causes of death on the battlefield within the tactical constraints imposed by this environment [1,2]. A survey of causes of death during the Vietnam War identified exsanguinating extremity wounds, tension pneumothoraces and upper airway obstructions as common and potentially preventable causes of death during that conflict [3,4]. Therefore, classic TCCC interventions include tourniquet placement for exsanguinating extremity wounds, needle decompression for tension pneumothoraces and surgical cricothyrotomy for airway obstruction [5,6].

TCCC has since been adopted by many military and paramilitary organizations as the preferred method for providing trauma care on the battlefield [7-10]. As well, TCCC has continued to evolve as new research and lessons-learned from ongoing conflicts in Afghanistan and Iraq are processed and incorporated into newer versions [11,12]. For example, the recent development of hemostatic dressings such as Quik-Clot (Z-Medica Corp, Wallingford, CT) and the HemCon Bandage (HemCon Medical Technologies Inc, Portland, OR) have given combat medical technicians options for treating non-compressible, proximal femoral or axillary arterial bleeding [13-15].

In this study, we analyzed autopsy reports of all CF members killed in Afghanistan in a 28-month period. We identified the location of death within the chain of evacuation and cause of death. We determined whether the death was potentially preventable given standard TCCC interventions. The goal of this study was to improve battlefield trauma care. We aimed to identify fatal injuries where better provision of TCCC interventions might have improved outcome. Another focus was to identify fatal injuries that might be survivable with simple interventions not currently included in TCCC.

METHODS:

Using Canadian Forces press releases [16] and Canadian Forces Health Services data, we identified all CF personnel who died as a result of injuries sustained while deployed to Kandahar, Afghanistan. In general, CF members pronounced dead in the field are brought directly to the morgue at the Kandahar Airfield Base (KAF), and all therapeutic interventions are left in place for later forensic examination. Patients undergoing active resuscitation are brought to the Canadian-led Role 3 Multinational Medical Unit (R3MMU) at KAF. If still alive, Canadian casualties are then transported to the Landstuhl Regional Medical Center (LRMC), a US Army hospital in Germany and then to tertiary care civilian trauma centers in Canada. For this study, casualties were included if the CF member died as a result of injuries sustained in Kandahar from January 1, 2006 to April 30, 2008.

All CF personnel who died while serving in Afghanistan are repatriated to the Office of the Chief Coroner of Ontario in Toronto, Canada where a full autopsy is performed. A Canadian Forces medical officer also attends each autopsy, and submits his/her own independent report. Copies of the completed autopsy and medical officer reports are held by Canadian Forces Health Services in Ottawa, Canada. Using the name and date of death, we requested a copy of the autopsy and medical officer reports performed on all eligible study casualties.

We excluded all deaths that were the result of natural causes. We also excluded those cases where neither autopsy reports nor medical officer reports were found. Using the autopsy or medical officer report, we recorded demographic information and mechanism of injury. Injury Severity Scores (ISS) were calculated for each case, as many of these patients were pronounced dead in the field and were therefore not scored by the trauma registry nurse at the R3MMU. EISS-90 was used [17], and calculated by detailed inspection of each autopsy or medical officer report. Cases of decapitation or gross torso mutilation were assigned an ISS of 75. The authors (DP and HT) then identified the listed cause of death for each case. In cases where both autopsy and medical officer reports were found, we utilized information from the autopsy report as the primary source of data.

Location and Cause of Death

Cause of death was classified *a priori* into six categories. Deaths were deemed to be from catastrophic neurological injury (severe brain or cervical spine injuries), exsanguination, multiple organ failure, multiple causes (usually catastrophic neurological injury and exsanguination), mutilating blast, and other miscellaneous causes. In cases of exsanguination, we also attempted to localize the source of exsanguination as either being from the torso, junctional areas (not treatable with tourniquet placement, i.e axillary, groin and neck) and extremity areas (controllable with tourniquets).

We also determined the location of death. If a casualty died in the field from injuries sustained before reaching any surgical facility (R3MMU or any other forward surgical

team), the casualty was classified as being “Killed in Action” (KIA) [18]. Casualties who died after reaching a surgical facility were classified as having “Died of Wounds” (DOW) [18].

Potentially Preventable Deaths

In a previous study, Holcomb and colleagues studied causes of death in US special operations forces from 2001-2004 [19]. In this study, the authors classified deaths as either “potentially preventable” or “non-preventable”. They avoided the designation of “preventable death” which is often used in comparable civilian studies because they recognized that even though a wound may be treatable, the death may not have been preventable because of tactical battlefield considerations. We decided to use this same binary classification for the same reason.

When analyzing for potentially preventable deaths, we only examined those who were “Killed in Action”, as the focus of this study was to improve pre-hospital battlefield care. We determined preventability using explicit review and structured implicit review, and compared the results. Previous studies have used structured implicit review by panels of experts to assess preventability [19]. This method is sensitive to nuances of care, but can be reviewer dependent and can be biased by the reviewer’s experience, attention to detail and harshness of judgment [20]. As well, the composition of the panel can affect agreement within the panel [21]. In explicit review, a reviewer compares the processes of care to explicit criteria. Explicit review is insensitive to nuances of care, but shows very high inter-rater reliability. In explicit review, the burden of accuracy falls on the criteria, not the reviewer [22, 23].

For this study, we assessed preventability of death only in KIA cases. Explicit criteria for determining if a death was potentially preventable or not preventable were as follows:

- i) Deaths from either torso exsanguination, catastrophic brain injury or mutilating blast were automatically deemed non-preventable;
- ii) Deaths caused by airway obstruction, proximal to the cricoid cartilage, and not treated by surgical airway were deemed potentially preventable;
- iii) Deaths caused by tension pneumothorax, and not treated with a needle decompression of the affected side were deemed potentially preventable;
- iv) Deaths from extremity exsanguination not treated by tourniquet placement were deemed potentially preventable; and
- v) Deaths was from junctional area exsanguination (except for neck) that were not treated with a hemostatic dressing were deemed potentially preventable.

To assess the robustness of our preventability findings, we also reviewed all the KIA cases by implicit review. A summary of each case with listed injuries, lethal injuries and

pre-hospital interventions performed was sent to a panel of military trauma surgeons. A panel consensus rule format [20] was used to determine whether, based on current TCCC standards, the death should remain classified as either “potentially preventable” or should be re-classified as “non-preventable”. For each “non-preventable” death, the panel was then asked if they could identify any simple maneuvers that could be easily taught to combat medical technicians that might have potentially prevented death.

Autopsy and medical officer reports were copied onto password-protected discs, transported by courier only, and treated as a medical document with confidential health information. Data was stripped of personal identifiers, and coded using a unique identifier, with the coding key maintained in a separate, locked cabinet. Summary formats were prepared by stripping personal identifiers, sex, age, and date of injury so as to maintain anonymity. Data was stored on a secure server. This study was approved by the Surgeon General of the Canadian Forces, and by our institutional Research Ethics Review Board. Data was analyzed using SAS 9.2msoftware (SAS Institute, Cary, NC).

RESULTS

During the study period, 73 Canadian Forces members died as a result of service in Afghanistan. Their mean age was 29 (+/- 7) years. 98% were male. The predominant mechanism of injury causing death was blast injury, resulting in 81% of over-all deaths during the study period. Improvised explosive devices were the most common cause of blast-related deaths. Besides blast injury, gunshot wounds and non-IED related motor vehicle collisions were the second and third leading mechanisms of injury causing death. See Table 1.

Cause of death was determined using autopsy reports for 20 (27%) casualties, and medical officer reports for 43 (59%) of the 73 casualties. We therefore had data for 63 of the 73 study eligible study patients (86%). For these 63 casualties, their mean Injury Severity Score was 57 (+/- 24).

Cause of Death

For the 63 study casualties, the most common cause of death was exsanguinating hemorrhage (38%), followed closely by catastrophic neurological injury (32%), and then by mutilating blast injuries (16%). Three patients died from miscellaneous causes, and six died from multiple causes. None died from multiple organ failure. See Table 2.

1. Exsanguination

Of the 24 cases of exsanguination, 21 died from torso bleeding. One patient died from bilateral traumatic amputations of the legs. Two casualties died from exsanguination from junctional area bleeding (See Table 3).

2. Catastrophic Neurological Injury

A total of 20 casualties died from catastrophic neurological injury. A total 17 of these casualties suffered severe brain injuries. Ten of these were from penetrating injuries to the head with traumatic evacuation of the brain, bilateral brain injuries or extensive unilateral injury. There were also seven cases of severe closed head injury (CHI) causing death. Of these seven, three suffered midbrain avulsion due to acceleration/ deceleration forces, three died with large subarachnoid hemorrhages and one died with multiple intracerebral hemorrhages.

Cervical spinal cord injuries were the cause of death for three of the 20 patients with neurological injury. All of these patients suffered blunt force trauma as a result of IED incidents; all were in armored vehicles that were thrown by the blast. One patient suffered atlanto-axial ligamentous disruption. The second was found to have a fracture through C3, with associated atlanto-axial ligamentous disruption and associated cord hemorrhage. The third patient had a fracture through C1, atlanto/occipital ligamentous

injury and associated cord hemorrhage. None of these patients had cervical collars on at the time of their forensic examinations.

3. Miscellaneous Causes

Of the three casualties who died from miscellaneous causes, two died of isolated acute airway obstruction. Of these, one died from airway obstruction secondary to facial injuries, and another died from transection of the trachea at the level of the cricothyroid membrane. The third died from burn injuries, with evidence of inhalational injuries and whole body surface area burns.

4. Multiple Causes

Six casualties died from multiple causes; in each case, the casualty sustained more than one lethal injury. The six cases were as follows:

- i) One casualty had an airway obstruction from maxillofacial trauma, torso hemorrhage from an aortic laceration, and a severe penetrating head injury with a bihemispheric tract;
- ii) A second casualty died from a neck injury that lacerated both his common carotid artery and his trachea;
- iii) The third exsanguinated from his lacerated aorta but also had acute airway obstruction because of aspirated teeth at the level of the carina.
- iv) A fourth casualty suffered multiple gunshot wounds, causing unilateral penetrating head injury and a lacerated aorta;
- v) A fifth casualty suffered C2-C4 fractures with complete spinal cord disruption and a lacerated heart (right ventricle).
- vi) A sixth casualty had a fracture of the C1 vertebra and associated spinal cord transection as well as neck/facial trauma with airway transection.

Location of Death

In 58 cases (92%), the casualty was pronounced dead in the field and was therefore classified as “Killed in Action” (KIA). Five casualties died after reaching a definitive-care facility (“Died of Wounds”). Three of the DOW casualties died from exsanguination at the Role 3 MMU: one patient had liver and splenic injuries and died during damage control laparotomy; another died in the trauma room with left ventricular and pulmonary vein injuries; the last died in the operating room with a thoracic aortic laceration from a gunshot wound. Two patients died from penetrating injury to the head at the Role 3 MMU.

Potentially Preventable Deaths using Explicit Criteria

58 casualties were “KIA”. We analyzed the lethal injuries identified on autopsy for all 58 patients. A death was classified as being potentially preventable if a TCCC intervention was not performed that may have been able to treat the identified lethal

injury. Almost all deaths were non-preventable. 5% of KIA deaths (n=3) were classified on explicit review as being potentially preventable. In two cases, the identified cause of death was airway obstruction superior to the cricoid cartilage. Surgical airways were not performed in either case. Two cases were identified as have junctional area exsanguination, and in one case, local hemostatic dressings were not applied. Only one KIA casualty was identified as having exsanguinated from extremity hemorrhage, and in this case, tourniquets were applied. The feeling was that the casualty likely exsanguinated prior to tourniquet placement. In casualties with multiple causes of death, the death was deemed non preventable if at any one of the lethal injuries were deemed non-treatable by TCCC interventions. See Table 3.

Panel Review

On implicit review by the panel, one of the three cases of potentially preventable deaths were reclassified as being non-preventable. In one case of junctional area exsanguinations (femoral artery), the entrance wound was small; the panel felt that the wound geometry would make it nearly impossible to successfully apply a local hemostatic dressing. As well, there was some information in this case on the pre-hospital care, which suggested that the casualty was inaccessible to the combat medical technicians prior to exsanguination. Therefore, according to panel review, only 3% of KIA deaths (n=2) were potentially preventable, both of which were due to airway compromise.

Furthermore, panel review identified several simple interventions that are currently not part of TCCC that may potentially benefit a small proportion of battlefield casualties and affect outcome. Currently, TCCC does not explicitly recommend the use of cervical collars and log roll precautions as part of “Care Under Fire” or “Tactical Field Care”. In our study, we identified three cases where isolated cervical spine injuries may have been the underlying cause of death on the battlefield. In all cases, the underlying mechanism of injury was blunt trauma in an armored vehicle that had suffered an IED strike. Although the cervical cord injuries almost certainly occurred at the time of injury, the panel recommended that newer versions of TCCC highlight that cervical spine injuries may occur after IED-related incidents, particularly if casualties are in vehicles that hit IEDs. Therefore, combat medical technicians should consider spinal immobilization if tactically feasible and safe.

As well, the panel identified one case where the patient exsanguinated from femoral arterial bleeding, and where the wound geometry likely precluded the use of hemostatic dressings. The panel recommended that combat medical technicians be given a technique for dealing with difficult junctional area bleeding with small wound geometries. Suggestions included urinary catheters, which may be inserted into small wounds. Insufflation of the balloon may help achieve temporary hemostasis. Another proposal was that medical technicians pack such wounds with ribbon gauze.

Discussion:

In this study, we analyzed causes of death of Canadian Forces members who died of injury while serving in Afghanistan from 1 January 2006 to 30 April 2008. During this time 73 Canadian soldiers died, and we analyzed autopsy reports or medical officer summaries of autopsy findings for 63 casualties. The vast majority died as a result of blast injury (81%). The most common cause of death was exsanguination (38%), followed closely by severe neurological injury (32%). Mutilating blast caused 16% of overall deaths. There were two cases of deaths from acute upper airway obstruction, and six patients died from multiple causes. Most casualties died in the field (92%) and were classified as KIA; only 8% died of wounds. 5% of KIA deaths were classified as being potentially preventable on explicit review. On implicit review by a military trauma surgeon panel, however, only 3% of KIA deaths were considered potentially preventable.

Holcomb and colleagues did a similar study in 2007. They reported on causes of death in US special operations forces (SOF) from 2001 to 2004 [19]. However, our study differs from theirs in that we report on deaths in a conventional military force, whereas they reported only on special operations forces. As well, they report on deaths from both Iraq and Afghanistan, whereas all of our casualties occurred only in Afghanistan. The result is that our population suffered far more blast related-deaths, compared to their SOF population, which suffered a higher proportion of gunshot wounds. These differences may also account for differences observed in the proportion of observed “potentially preventable” deaths.

Cause-specific mortality data is often used to monitor quality of care [24]. One distinct measure of quality of care is the preventable death rate [25,26]. Policy makers can then use this data on cause of death and preventable death as the rationale for making decisions on priorities for health research, capital investment and medical training [26].

Using explicit review, we found that 5% (n=3) of KIA deaths were potentially preventable using current TCCC interventions. In two cases, autopsies reported that cause of death was from upper airway obstruction and no surgical cricothyrotomy had been performed in the field. Junctional-area bleeding caused death in another case. In this case, hemostatic dressings were not employed. However, explicit review is somewhat insensitive to nuances of care [22,23]. On panel review, 1 of these 3 deaths was reclassified as being non-preventable. For the patients with junctional exsanguination, the panel felt that the casualties inaccessibility to care precluded treatment by combat medical technicians. As well, the panel felt that the entrance wound over the groin area was possibly too small to employ hemostatic dressings effectively.

Surgical cricothyrotomy is currently being taught to Canadian Forces medical technicians prior to deployment to Afghanistan. Although this training has proven successful on previous occasions [27], surgical cricothyrotomy can be a daunting procedure for inexperienced, combat medical providers [28]. Previous studies have shown that certain TCCC interventions (particularly needle decompression) are under-used [10]. Although no literature has reported on the “under-use” of cricothyrotomy on

the battlefield, we wonder if these two casualties with upper airway obstruction represent cases of “under-use”. We recommend that combat medical technicians should continue to practice surgical airways in live-tissue labs. As well, didactic teaching should continue to review the indications for cricothyrotomy on the battlefield.

Based on this review, we also feel that future Canadian TCCC courses may be improved by giving battlefield providers a treatment option for dealing with exsanguination from small wounds at junctional areas (groin, axillary, neck). Currently, TCCC providers only have hemostatic dressings to deal with this difficult problem. However, unfavorable wound geometry can make utilization of these products unfeasible. As well, TCCC providers have no option for treating carotid artery hemorrhage in the neck. We suggest that combat medical technicians also carry urinary catheters; these can be inserted into wound tracts of small wounds. Insufflation of the balloon may provide temporary hemostasis of junctional bleeding, and buy enough time for evacuation to a definitive surgical facility. Another option would be to pack such wounds with ribbon gauze. These options may also be employed for posterior packing of life-threatening epistaxis associated with facial fractures.

On our review, we also noted that three casualties died from cervical spine injuries. All of these soldiers were occupants of armored vehicles that had suffered IED strikes. None of these casualties had cervical collars on at the time of forensic examination. These deaths were deemed non-preventable because current versions of TCCC do not stress the need for cervical spine immobilization. In the 2007 version of TCCC, medics are taught that during the “Care Under Fire” phase, “potential hazards of time and exposure do not warrant the application of a cervical collar for stabilization of the cervical spine prior to moving the CAX to cover, particularly if they have sustained only penetrating injuries” [29]. Although the report does acknowledge the risk of spinal cord injury with blunt trauma, no further mention of spinal immobilization is made during discussion on “Tactical Field Care”, when casualties are no longer under effective fire. As well, no discussion is made of spinal cord injuries associated with IED-related incidents.

We fully acknowledge that applying spinal immobilization is likely inappropriate during the “Care Under Fire” phase because of safety issues to the health care provider. We also realize that almost all cervical cord injuries likely occurred at the time of injury, rather than from movement of the neck post-injury. However, as armored vehicles continue to strike IEDs, we feel that combat medical technicians need to be sensitized to the possibility of spinal injuries occurring with this mechanism of injury. Therefore, we recommend that spinal immobilization be considered for all casualties suffering from blunt trauma or IED-related incidents during “Tactical Field Care”, IF the tactical situation permits, and IF the medical technician deems the situation to be safe enough to proceed with this procedure.

We also noted that the majority of KIA deaths were caused by torso exsanguination. With the current TCCC paradigm, these deaths remain non-preventable on the battlefield. Three pre-hospital solutions are possible to this problem. One solution is to improve

evacuation times to definitive surgical care. However, this solution is beyond the control of the health care provider on the ground [19]. Providing an injectable hemostatic agent such as recombinant activated factor VII (rFVIIa) for prehospital care providers is another solution. Unfortunately, randomized controlled trials have failed to show a survival benefit for using rFVIIa [30,31] on bleeding trauma patients. As well, a retrospective review of off-label rFVIIa use shows an increase in embolic complications [32]. A third solution is to provide combat medical technicians the means to maintain oxygen delivery to tissues before and during evacuation. Unfortunately, current hemoglobin-based oxygen carriers are not yet ready for clinical use, and may be harmful [33,34]. Prehospital providers can be taught to transfuse allogenic red blood cells in the field. However, the logistical challenges of having a transfusion capability in the pre-hospital setting are formidable. A simple temporary solution may be providing combat medical technicians with an autotransfusion capability from chest tube effluent during Tactical Field Care in select tactical situations [35].

Limitations

The goal of performance improvement in trauma care is to ensure that the right care is delivered at the right time [36]. Because our assessments were only based on autopsy reports, we have no sense of the events or circumstances that preceded the death of each casualty. For example, in cases deemed potentially preventable from upper airway obstruction, we do not know if tactical or other environmental circumstances made it impossible for the combat medical technicians to attend to the casualty prior to death. Performing a surgical airway on a patient after s/he has already died from hypoxia from airway obstruction would be wrong. Likewise, applying hemostatic dressings to casualties who have already exsanguinated from catastrophic junctional hemorrhage would be unnecessary. As well, we do not know if the medical technician was unavailable because of other casualties, or was a casualty himself.

Most importantly, the findings of this study are not meant to be criticism of the care provided by these health care providers. In fact, our experience is that combat medical technicians have provided exceptional care in extremely difficult circumstances [10, 27]. Combat medical technicians should justifiably be proud of their accomplishments. Instead, we are only trying to identify areas where we can better prepare them for their difficult tasks during their predeployment training phase. As well, we also wish to identify potential future tools to help them provide better care on the battlefield. In the end, our combined goal is to reduce preventable deaths of our fellow soldiers on the battlefield.

Conclusion

In this study, the predominant mechanism of injury causing death was blast, usually from IEDs. The major causes of death were torso exsanguination, neurological injury and gross mutilation. Relatively few deaths were deemed potentially preventable. Based on these data, we have recommended that combat medical technicians consider

spinal immobilization in IED-related incidents, and have suggested the use of either urinary catheters or ribbon gauze to tamponade junctional-area exsanguination with small entrance wounds. Furthermore, we strongly support the current TCCC recommendation for early consideration of surgical airway for airway obstruction. Future TCCC treatments and adjuncts will focus on relatively less frequent but potentially survivable injuries. It is hoped that this research may help to decrease the mortality of our soldiers in future operations.

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Table 1 – Mechanism of Injury

Mechanism		Number of Cases (%)	
	IED	42	
	RPG	12	
Blast	Landmine	3	59 (81)
	Cannon	1	
	Mortar	1	
	MVC		5 (7)
	GSW		6 (8)
	Helicopter		1 (2)
	Crash		
	Fall		1 (2)
TOTAL:			73

IED Improvised Explosive Device
RPG Rocket Propelled Grenade
MVC Motor Vehicle Collision
GSW Gunshot Wound

Table 2: Causes of Death

Cause of Death		Number of Occurrences
Neurological		
	Severe Brain	17
	Cervical Spine	3
Hemorrhage		
	Torso	21
	Junctional Areas	2
	Extremity	1
Gross Mutilation		10
Miscellaneous		
	Isolated Airway	2
	Burns/Asphyxia	1
Multiple Causes		6
Total		63

Table 3 – Potentially Preventable Deaths (n=58 KIA patients) on Explicit Review

Patient #	Description of Lethal Injury	Tourniquet Done	Local Hemostatic Agent	Needle Decomp	Surgical Airway	Potentially Preventable Deaths
1-18	Torso Hemorrhage					N
19-36	Catastrophic Neurological Injury					N
37	Junctional Hemorrhage (amputation at groin with massive soft tissue injury)		Y			N
38	Junctional Hemorrhage (small wound at femoral artery)		N			Y
39	Hemorrhage - Bilateral LE amputation	Y				N
40	Miscellaneous (Airway obstruction – facial trauma)				N	Y
41	Miscellaneous (Airway obstruction – cricothyroid)				N	Y
42	Miscellaneous - (Burns/Asphyxia)					N
43	Multiple Causes					N
	i) airway (max-facial injury)				N	
	ii) aortic laceration					
	iii) catastrophic neuro injury					
44	Multiple Causes					N
	i) airway – trachea				N	
	ii) common carotid					
45	Multiple Causes					N
	i) airway – FB at carina					
	ii) aortic laceration					
46	Multiple Causes					N
	i) cervical spine					
	ii) extremity amputation	N				
	iii) Cardiac laceration					
47	Multiple Causes					N
	i) catastrophic neuro injury					
	ii) thoracic aorta laceration					
48	Multiple Causes					N
	i) airway (pharyngeal transection)				N	
	ii) extremity amputation	N				
	iii) C-spine transection					
49-58	Mutilating Blast Injuries					N