Pattern of Fatal Injuries in Counter Terrorist Operations: An Innovative Analysis through Embalming Services

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Abstract

Background: Mortal remains of the soldiers killed in counter-terrorist operations in Kashmir valley are sent to their home after undergoing mandatory embalming.

Methods: Injuries on the mortal remains of the soldiers killed in counter terrorist operations between Jan 1999 to Dec 2006 were analysed with respect to the agent, mode of injury, age, rank structure, body parts involved, seasonal variations and changing trends. Fatalities consequent to enemy action across line of control and fatalities of Kargil war were also analysed for comparison. Statistical analysis was done using chi square test for difference in proportions.

Result: Over the study period, terrorist induced injuries accounted for 8.16 deaths per thousand troops deployed whereas enemy action from across the line of control accounted for 0.63 deaths per thousand. Terrorist induced fatalities peaked in 2001 and thereafter revealed a declining trend ($p < 0.001$). Fatalities due to enemy action across line of control declined to zero since 25 Nov 2003 consequent to effective ceasefire. Of the total fatalities, 89.5% were killed in action (KIA) while 10.5% died of their wounds after reaching the hospital. Fatality to total injured ratio peaked to 29% in 2001 and then stabilized to about 23%. Mean KIA to total casualty ratio was 21%. The rank structure of the fatalities was officers 8.6%, JCOs 7.3%, and Other Ranks 84.1%. Most of the soldiers died young, 51% being below 25 years of age. Out of the terrorist induced fatalities, 78.2% died of gunshot wounds and 21.5% by splinters and improvised explosive devices (IED). The ratio was reversed in enemy induced fatalities and in Kargil war. Fatalities peaked during June to November and declined in winters. Body region wise, 23.4% of all deaths were due to head injury, 8.4% due to neck and maxillofacial injury, 18.4% due to injury to lungs and 11% due to heart injury. Most frequent target of the fatal bullet was brain (25.4%), closely followed by lungs (22.5%) and heart (12.3%). When soldier died of splinters / IED, multiple body parts were injured in 57.5%, brain in 17.3%, face & neck in 3.5%, heart in 6.6%, lungs in 5.3%, abdomen in 3.5% and limbs in 5.8%. Fatality due to head and heart injury peaked in 2001, while multiple injuries peaked in 2000, declined in 2001 and peaked again in 2004 and 2005 ($p < 0.001$). In fatalities of Kargil war, chest injuries were less but multiple injuries were more.

Conclusion: Most of the fatalities were due to gunshot wounds selectively aimed at head, face, neck and thorax. Therefore, a lightweight flexible and effective bulletproof protection for this area will conserve manpower.

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Key Words : Fatal injuries; Counter terrorist operations; Combat medical statistics

Introduction

Peculiarities of terrain, training, equipment and environment makes it mandatory for each army to compile its own data for different operations. Indian Army is involved in one of the longest counter terrorist operations (CT Ops) in Jammu & Kashmir. Mortal remains of soldiers killed in these operations are sent to their home after embalming. In this study, we analysed the injuries on these mortal remains to generate combat specific medical statistics for primary prevention of fatalities in future.

Material and Methods

This study was done at the only centre for embalming in the valley at a Zonal Hospital of Indian Army. Study subjects were the Armed Forces personnel who lost their life

in CT-Ops between 1999 to 2006 and whose mortal remains were received for embalming prior to their transportation by air or road. Fatalities consequent to enemy action across line of control since 1999 were included as a separate group. Injuries on the mortal remains of fatalities of Kargil war 1999 received for embalming were analysed for comparison. Fatalities of paramilitary personnel were not included. Deaths due to illness, accidents and environmental factors, deaths of family members and civilians were also excluded.

Injuries sustained by the deceased were studied with respect to mode of injury, injuring agent, body parts involved, fatal injury, seasonal variations and changing trends over the years. Mortal remains were assessed without further mutilation. Injury was considered fatal, if it involved vital organs or major blood vessels. If more than one vital organ were involved, cause of death given by the medical officer on

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the death certificate was referred to. Multiple injuries were considered the cause of death if more than one non-adjacent vital organ were injured. Data for nonfatal casualties caused by terrorists and enemy across line of control received in this hospital during the same period was obtained for comparison. Nonfatal casualties of Kargil war were not included. Personal protective measures in use by the soldiers were reviewed. Data was analyzed using Microsoft excel software and chi square test for difference in proportions.

Results

Excluding Kargil war, 13.06 mortal remains per thousand troops deployed were received for embalming during these eight years. Out of these, accidental deaths (23.1%), environmental deaths (8.7%) and deaths caused by undefined source (0.9%) were excluded from the purview of this study. Terrorist induced injuries accounted for 62.5% deaths. Injury induced by enemy across the line of control, was responsible for 4.8% deaths. Terrorist induced fatalities peaked in 2001 and thereafter reveal a declining trend (Fig. 1). Fatalities due to enemy across line of control declined to zero since 25 Nov 2003 consequent to effective ceasefire on line of control. Changes in the proportions of modes of injury over the years were significant at a 'p' value < 0.001.

Out of 8.79 per thousand operational fatalities, 89.5% were killed in action (KIA) and 10.5% died of their wounds after reaching the hospital. Overall casualties and fatalities showing a decline. Fatality to total injured ratio, after peaking to 29% in 2001, has stabilized to about 23%. Mean KIA to total casualty ratio was 21% (Fig. 2).

The rank structure of the fatalities was officers 8.6%, JCOs 7.3% and Other Ranks 84.1%. Most of the soldiers died young; 51% were below 25 years of age, 23.3% between 25 and 30 years, 13% between 30 and 35 and rest 12.7% above 35 years.

Out of terrorist induced fatalities, 78.2% were by gun shot wounds and 21.5% by splinters and improvised explosive

devices (IED). The ratio reversed in enemy induced fatalities and in Kargil war (Table 1).

Seasonal trends (Fig. 3) reveal that fatalities peaked during June to November and declined in winters with the arrival of snow and uncongenial weather.

Body region wise distribution of fatal injuries (Table 2) reveals that 23.4% of all deaths were due to head injury, 8.4% due to neck and maxillofacial injury, 18.4% due to injury to lungs and 11% due to heart injury. When analyzed with respect to specific injuring agent most frequent target of the fatal bullet (6.7 per thousand troops) was brain (25.4%), closely followed by lungs (22.5%) and heart (12.3%) (Fig. 4). When soldier died of splinters and IED (2.05 per thousand troops), multiple body parts were injured in 57.5%, brain in 17.3%, face and neck in 3.5%, heart in 6.6%, lungs in 5.3%, abdomen in 3.5% and limbs in 5.8%. Fatality due to head and heart injury peaked in 2001, while multiple injuries peaked in 2000, declined in 2001 and peaked again in 2004 and 2005 (Fig. 5). Changes in proportions of the various organs involved over the years were statistically significant ('p' value < 0.001). In comparison, Kargil war fatalities had less of chest injuries and more of multiple injuries.

Discussion

Though this study pertains only to the bodies embalmed, given the fact that all recovered mortal remains undergo embalming at this centre prior to being dispatched to their next of kin by air or road, the data reasonably reflects the overall dead except occasional dead body that underwent local cremation or was not recovered at all. Out of 13.06 deaths per thousand troops, 8.79 deaths were directly ascribed to either terrorist or enemy across line of control.

In conventional wars for every casualty who dies in a medical treatment facility, as many as nine are reported to have died in the battlefield [1]. Despite differences in the mechanism of injury, we found similar proportion in counter terrorist operations in Kashmir. Out of 8.79 deaths per thousand troops over eight years, 89.5% died before reaching hospital. Same was the experience of Israeli defense forces in low intensity conflict [2]. Collation with data for nonfatal battle casualties from the same hospital (Fig. 2) reveals that 20.9% of the casualties were killed in action (brought-in-dead), 2.5% died of their wounds in hospital and rest 76.6% were non fatal. Predicted mortality in conventional land

Table 1

Mode of injury

Injuring agent	Terrorist induced	Enemy induced	Kargil war
GSW	78.2%	43.5%	36.7%
Splinters	4.6%	55.1%	62.1%
IED	16.9%		1.2%
Burns	0.1%	1.4%	
Drowning	0.1%		
Total	100	100	100

Table 2

Body region involved: Enemy / terrorist inflicted fatal injuries versus Kargil war

Mode	Head	Face/Neck	Lungs	Heart	Abdomen	Limbs	Whole body*	Multiple
Enemy	27.5%	2.9%	8.7%	11.6%	10.1%	4.3%	1.4%	33.3%
Terrorist	23.1%	8.8%	19.2%	10.9%	6.8%	5.9%	0.4%	24.9%
Total	23.4%	8.4%	18.4%	11%	7%	5.8%	0.5%	25.5%
Kargil war#	26.6%	6.8%	11.7%	2.7%	6.4%	5.3%		40.5%

* Burns and drowning involving whole body. # Fatalities whose mortal remains were embalmed at this hospital

'p' value: Enemy vs Kargil p < 0.05; Terrorist vs Kargil p < 0.001

Fig. 1 : Mode of sustaining fatal injury: 1999 to 2006 (Per thousand troops)

Fig. 2 : Total v/s Fatal Casualties: 1999 - 2006

Fig. 3 : Seasonal Trends 1999 - 2006 (Per thousand troops)

warfare in untreated combat casualties within first hour is estimated to be 19.5% and this was the case in Vietnam War where American casualties were airlifted within one to two hour [1]. Minor injuries were not evacuated to this zonal hospital, therefore brought-in-dead figure of 20.9% despite most of the fatalities having penetrating injuries suggests comparable speed of evacuation. Out of those who reached hospital alive, 3.2% died of their wounds. This compares favorably with the percentage of wounded dying of wounds in previous wars fought by US Army and Israel [3-5] (Table 3), but does not compare well with our own experience in Kargil 1999 (1%) [6] and Israeli experience in Lebanon in 1982 (1.1%) [7]. Fatalities in relation to total casualties were 23.5% that matches well with Vietnam War as well as Israeli experience in Palestine (Table 3) and is marginal improvement over past Indian experience (Table 4).

Proportion of officers and JCOs fatalities in this study is more than that in Kargil war (Table 5) [8]. In CT ops, troops move in small groups, each group led by an officer and/or JCO. Moreover, selective aiming at the leaders by terrorists may be responsible for this high ratio.

Our study highlights the difference in the predominant mechanism of fatal injury between conventional and

Fig 4 : Body region involved: Splinter / IED versus Bullet

Fig 5 : Body region wise distribution of injuries over the years

counter terrorist operations. Most of the combat casualties in conventional war are due to fragments/splinters [9]. In the Kargil war 62.1% of the mortal remains embalmed at this hospital, had died of splinters as compared to 36.7% due to gunshots (Table 1). While majority of deaths inflicted by enemy across line of control in this study were by artillery shell splinters, gunshots accounted for 78.2% of terrorist inflicted deaths. It was also the Israeli experience in Palestinian uprising where 16 of 23 fatalities were by gunshots [4].

In conventional war, direct aimed fire is infrequent and hits to the body region depend upon chance of exposure [3]. Burns et al [10] estimated the exposure in conventional wars to be 12% for head / neck, 16% for thorax, 11% for abdomen and 61% for extremities. Carey analysed the hits suffered on various body regions by US Army in World War II, Korean War and Vietnam War [3]. He concluded that nonfatal injuries match this pattern except for marginally higher number for head due to preferential exposure for monitoring the environment. However, due to high mortality, head and thorax injuries consistently accounted for greatest number of combat deaths amongst those killed in all three wars (Table 6). We found similar pattern but with an unusually high incidence of multiple organ injury. Nearly 57.5% of our splinter/IED mediated fatalities and more than one fourth of total fatalities had multiple potentially fatal injuries in different body regions. In 500

Table 3**Mortality comparisons in various Wars**

War & Army	Year	Killed in action/ Brought-in-dead	Number wounded	Died of wounds	% Fatal	% wounded dying of wound
WW I (US)*	1918	37,568	153,000	13,691	26.9	8
WW II (US)*	1942-45	210,343	599,724	26,706	29.3	4.5
Korea (US)*	1950-53	19,353	77,788	1957	21.9	2.5
Vietnam (US)*	1965-72	25342	96,811	3520	23.6	3.6
Palestinian	2000-01	16	80	7	24.0	8.7
(Israel) + Iraq (US)#	Till 16 Nov 2004	1004	5174	357	20.8	6.5
Present Study (India)	1999-2006	7.86 per thousand troops	29.68 per thousand troops	0.93 per thousand troops	23.5	3.2

*Carey ME [3], +Lakstein et al [4], # Gawande et al [5]

Table 4**Mortality comparisons in Indian military operations**

War	Year	Killed/Dead	Wounded alive	% Fatal
IndoPak#	1947-48	1103	3152	25.9
IndoPak#	1965	2902	8622	25.2
IndoPak#	1971	3630	9856	26.9
IPKF Srilanka#	1987-89	1157	2065	35.9
Siachin#	1984-99	650	10500	5.8
Kargil#	1999	481	1159	40.6
CI Ops (J& K)#	1989-99	867	2655	24.6
Present study	1999-2006	8.79 per thousand troops	28.75 per thousand troops	23.5

#Bammi YM. Kargil 1999: The Impregnable Conquered [8].

Table 5**Rank wise distribution of fatalities**

Rank	Present study 1999-2006 Fatalities (%)	Kargil war# 1999 Fatalities (%)
Officers	8.6	5.2
JCOs	7.3	3.5
ORs	84.1	91.2

#Bammi YM. Kargil 1999: The Impregnable Conquered [8].

p < 0.005

consecutive autopsies performed on Vietnam War fatalities, only 6% had more than one body region with a potentially fatal wound [1]. Trend analysis of body organs involved in our study (Fig. 5) reveals that the multiple injuries peaked in 1999-2000 and 2004-05. IED blast injuries revealed similar trend and were the major contributors to the peaks along with multiple gunshots. During cordon and search, troops enter into confined spaces in small groups. Restricted mobility in this situation makes them vulnerable to preferential targeting and multiple gunshots. Leibovici et al [11], have reported that explosions in confined spaces lead to multiple injuries and up to 49% mortality compared to 7.8% in open areas.

In this study head, neck or chest was the site of fatal injury in 70% of the deaths by bullets compared to only 33% of deaths by splinter/IED (Fig. 4) (Table 3). Significant difference in the body region involved

highlights the difference between aimed fire of bullet and randomness of splinter. The same was the experience of Israeli Army in low intensity conflict [2] and during second Palestinian uprising [4].

Nearly 53% of the total deaths (Table 2) and 60% of the deaths due to gunshots (Fig.4) were due to fatal injury over head and thorax, body regions conventionally protected by the armor (bullet proof jacket and headgear). Is it non performance or non-use of the armor? The armor that provides adequate protection against a randomly flying irregular-surfaced low energy splinter may not be adequate to protect against high velocity bullet fired from a rifled weapon from close proximity [12]. Army troops often did not wear their body armor in Vietnam War [13]. The risk of fatality for police officers assaulted with a firearm while not wearing body armor is estimated to be 14 times higher than for those wearing body armor. In USA, while most police officers recognized the dangers and 65 percent of those surveyed owned body armor, only 15 to 20 percent actually used it. The reasons given for not wearing ranged from legitimate concerns such as discomfort and weight, to misconceptions [14]. Some of these facts may apply to our soldiers as well.

The armor in use by the Indian army is inflexible and does not protect the maxillofacial and neck area. Injuries to this area accounted for 8.3% of total deaths in this study. In second Palestinian uprising six out of nine Israeli soldiers killed of head and neck injuries were wearing armor vest and Kevlar helmet but the bullets hit them in the space not covered [4]. An analysis of the Lebanon war fatal casualties suggested several possible modifications in the standard armor including an additional protective device over the front mid torso, a transparent and lightweight face-shield, a horizontal margin added to the standard helmet and a chin cover [15]. United States Army Research Lab is developing a liquid armor technology for vests, using a shear thickening fluid (STF) which contains poly ethylene glycol and nano-particles of silica. During normal handling, STF is deformable

Table 6**Body region wise distribution (%) of fatal injuries in various wars**

Body region	Area exposed *	World War II +	Korea +	Vietnam +	Present Study		
					Terrorist induced	Enemy induced	Kargil war #
Head Face Neck	12	49	48	42	31.9	30.4	33.4
Thorax	16	23	23	41	30.1	20.3	14.4
Abdomen	11	17	14	10	6.8	10.0	6.4
Limbs	61	12	11	7	5.9	4.3	5.9
Multiple					24.9	33.3	40.5

* Burns et al [10]; +Carey ME [3]; # Fatalities whose mortal remains were embalmed at this hospital

and flows like a liquid providing flexibility for use around cervical region and joints. Once a bullet hits the vest, the fluid transforms to a rigid material preventing the projectile from penetrating the soldiers' body [16].

To conclude, gunshot wounds account for most of the fatal injuries in CT Ops. Nearly 53% of deaths were due to injury to head and thorax conventionally protected by the armor suggesting that the use and the type of armor needs improvement. A lightweight flexible and effective bullet proof protection for head, face, neck and thorax that permits vision and hearing would be of help in primary prevention of combat deaths.

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Disclaimer

Data pertains to fatalities embalmed at this centre and may not match with official figures. Observations made and conclusions drawn are of the authors' and do not reflect official viewpoint of Indian Army.

Conflicts of Interest

None identified

Intellectual Contribution of Author

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