

IS PRESENT BODY ARMOUR WORN BY PAKISTANI SOLDIERS SUFFICIENT IN PREVENTING THE TORSO INJURIES DURING COMBAT?

Riaz Anwar Bashir, Shahzad Ahmed Qasmi*, Mohammad Yasin, Faran Kiani, Ahmed Waqas

Combined Military Hospital Rawalpindi, *Combined Military Hospital Bahawalpur Cantt

ABSTRACT

Objective: To determine the frequency of penetrating torso injury from sides in soldiers equipped with torso body armour.

Study Design: Descriptive study

Place and Duration of Study: This study was carried out at Combined Military Hospital Peshawar, from 1st June 2008 to 30th May 2010.

Patients and Methods: All combat casualties with penetrating torso Injury received in 'Emergency Reception' of Combined Military Hospital, Peshawar were included in study. The parameters recorded were age, cause of the injury, direction of penetrating torso Injury (front/side), presence of other injuries e.g. PEI (Penetrating Extremity Injury) and PHNI (Penetrating Head and Neck Injury), haemo-dynamic status, conscious level, intensive care stay, ward admission duration, total hospital stay, morbidity and mortality.

Results: During the study period, 105 combat casualties with penetrating torso Injury, inspite of wearing body armour at time of injury, were received in 'Emergency Reception' of Combined Military Hospital, Peshawar. Seventy seven (73.3 %) cases had primary cause of injury being splinters from Improvised Explosive Devices (IED's) or bomb blast; while 28 (26.7%) cases had gunshot wounds. It was interesting to note that in 91 (86.67 %) cases PTI (Penetrating Torso Injury) occurred from sides, and in remaining cases it was from front, which was either at upper or lower areas of torso. Overall mortality was 17 (16.9 %) which was mainly due to uncontrolled haemorrhage, or due to accompanied injury of other body parts.

Conclusion: The use of torso body armour in Pakistan Armed Forces has decreased the mortality but it is still deficient in many aspects especially from sides, in preventing penetrating torso injury.

Keywords: Body armour, combat causality, injury patterns

INTRODUCTION

Armed forces internationally make use of some form of body armour as part of their personal protective system. Utilization of individual body armor has dramatically reduced thoracic and abdominal injuries in Iraq war from 33% to 4.6%¹. Body armor is not bulletproof. The best body armor in the world will not help people who are not wearing it. National Institute of Justice (NIJ) United States Standard-0101.04 establishes six formal armor classification types, as well as a seventh special type². The first step in selecting the appropriate protection level of body

users need based on the realistic weapon threat they face.

This brings in to focus the distinguished combat medical experience in the present anti-terrorist operations in FATA from that encountered in 1965 and 1971 wars. Foremost is that Pakistan armed forces are primarily engaged in anti-terrorist operations in a guerrilla warfare, in which enemy tactics are primarily based on terror campaign. The majority of battle casualties occur due to ambush, suicide bombing or increasingly from the use of improvised explosive devices. This has afforded the enemy a greater capability to take life and limb of soldiers. Belmont in his study of epidemiology of injuries sustained during Iraq war found that explosive mechanisms of injury, with IEDs being the most common, account for over 75% of all combat

Correspondence: Dr Shahzad Ahmed Qasmi, Surgical Specialist, CMH Bahawalpur Cantt.

Email: qasmi.shahzad@gmail.com

Received: 02 Nov 2012; Accepted: 04 Mar 2013

armor is to establish the level of protection that

casualties¹. As a result, there is no predictable pattern of injuries to our soldiers.

Utilization of individual body armor has dramatically reduced thoracic and abdominal injuries in Iraq war from 33% to 4.6%¹. The Advanced Composites Research Center at Air Weapons Complex (AWC) has carried out extensive research on bullet-proof materials. The bullet-proof jackets and helmets developed by AWC provide protection against ammunition according to NIG Standard 0101.03 which has been superseded by NIJ standard 0101.042. The jackets are level III and IIIA and are made of specific layers of biaxial woven kevlar fabric have been stitched in diamond pattern. The trauma pack is an integral part of the ballistic insert. The assembly is stitched in water/moisture-resistant black plastic to maintain its ballistic properties. This effectively stops the 9 mm bullet. The jacket can stop the 7.62 mm bullet after insertion of front and back laminated ceramic plate. However, there are no side plates and there is some evidence to show that there is increased number of penetrating torso injuries from sides, in spite of wearing Torso Body Armour (TBA) by Pakistan Armed Forces.

This study focus on various aspects where body armor can be improved. This analysis of combat casualties will help in identifying various weak aspects of torso body armor (TBA) worn by Pakistan Armed forces, so that these weaknesses should be corrected, to make TBA more protective.

PATIENTS AND METHODS

This is a descriptive study conducted for 24 months, of all male combat casualties, from 20 to 45 years of age, with PTI in spite of wearing body armour at time of injury, received in 'Emergency Reception' of Combined Military Hospital, Peshawar between 1st June 2008 and 30th May 2010. CMH Peshawar is a tertiary care hospital nearest to the tribal area where military operations are in progress. Following patients were excluded from study; those who were not

wearing torso protective gear; or were having injuries due to causative mechanisms other than GSW or explosions; or those who were having any co-morbid condition like HTN, asthma or IHD etc. Patients with direction of penetrating torso injury from back, PEI and PHNI were also excluded. Data was taken from the patient's medical charts and by personal evaluation. Data was recorded on proforma. The parameters recorded were age, cause of the injury, direction of penetrating torso injury (front/side), presence of other injuries e.g. haemo-dynamic status, conscious level, intensive care stay, ward admission duration, total hospital stay, morbidity and mortality. The term 'penetrating' implies that shrapnel or bullet has penetrated through skin, subcutaneous tissue and deep fascia. 'Unstable' haemo-dynamic status implies that combat casualty received has systolic B.P less than 100 mm Hg. Morbidity was defined as inability to return to active service. Data was entered and analyzed by using SPSS (version-15). Descriptive statistics were used to describe the data i.e. mean and standard deviation (SD) for quantitative variables while frequency and percentages for qualitative variables.

RESULTS

During the study period, 105 combat casualties, from 20 to 45 years age, with PTI despite of wearing body armour at time of injury, were received in 'emergency reception' of Combined Military Hospital, Peshawar. These were with injuries due to gunshot or explosive mechanism (including IED injuries). All patients were males with a mean age was 31.80 years (SD = 7.911±). Seventy seven (73.3 %) cases had primary cause of injury being splinters from Improvised Explosive Devices (IED's) or bomb blast; while 28 (26.7%) cases had gunshot wounds. The impact of causative agent on mortality is an important factor as demonstrated in Fig-1. Hemodynamically stable patients on arrival were 76.8% while 23.2% patients were unstable. Mean duration of stay in hospital was 10.33 days, with minimum 1 and maximum 38 days. All patients were evacuated to operation

theatre after necessary investigations, for respective operative treatment according to injuries. It was interesting to note that in 91 (86.67%) cases PTI occurred from sides, and in remaining case it was from front, which was also at upper or lower areas of torso (Fig-2). Overall mortality was 17 (16.9%) which was mainly due to uncontrolled haemorrhage (8%) at early stage and sepsis and multiple organ dysfunction (8.9%) in later days of treatment. Fourteen of these mortalities were those with PTI from sides and 3 with PTI from front ($p=0.64$, statistically insignificant). Both types of patient were similar with respect to the cause, hemodynamic stability, intensive care duration and hospital stays. Forty two survivors with lateral injuries and 7 with front injuries could not return to active service, as they were before surgery ($p=0.78$, statistically insignificant). They were either down-categorized or invalidated-out-of service.

DISCUSSION

A bullet-resistant vest is a part of individual armour that helps take up the impact from firearm-fired projectiles and shrapnel from explosions, and is worn on the trunk³. Soft vests are made from numerous layers of 'woven or laminated' fibers and can defend the wearer from small-caliber hand-gun and minute fragments from explosives such as hand-grenades. Additional protection from rifle rounds and metallic components can be provided by metal or ceramic plates. Current body armour may amalgamate a ballistic vest with other stuff of protective clothing, such as a combat helmet. Bullet-resistant vests use layers of very tough fiber to "catch" and deform a bullet, meshing it into a dish shape, and distributing its force over a larger section of the vest fiber. While a TBA can prevent bullet penetration, the TBA and wearer still take up the bullet's energy. Modern pistol bullets contain sufficient energy to cause blunt force trauma under the impact point, even without penetration, which is called as 'Behind Armor Blunt Trauma' (BABT). A numerous research work is being done in this direction^{4,5,6}. Law enforcement officers frequently wear vests

which are designed specially against bladed arms and pointed objects. These vests may add in coated and laminated textiles or metallic components⁷.

Use of body armour can be traced into antiquity. Romans, Greeks and other medieval and middle age armies wore Body armour of various types. It is astonishing that it was rarely heard of in both World Wars, Korean war, Vietnam war, Pak-India wars 1965 and 71 although work-up on it was going in background. The fact is that when muskets/ rifles were introduced, the existing body armour i.e. steel armour worn by knights was insufficient to stop a bullet. Till the invention of 'Kevlar' in 1975, there was no material 'light enough to be worn' by an infantry man and 'could stop a rifle bullet'. Modern history of TBA starts from 1538, when Francesco Maria della Rovere hired 'Filippo Negroli' to make a bullet-proof vest (BPV)⁸. In 1561, Maximilian II, Holy Roman Emperor tested his armour against gun-fire. Its real efficacy was contentious at the time. The etymology of "bullet" plus the adjective word of "proof" in the late 16th century would suggest that the term "bullet-proof" started shortly subsequently to recognize a dent on the armour which proved it would resist bullet breach. One of the initial recorded images of soft armour use was found in medieval Japan, with the armour having been made from silk⁹.

Near the beginning of World War II, the USA made TBA for infantry men, but most models were heavy and restricting to make them of any use in the field and mismatched with existing essential equipment. The military diverted its exploratory efforts in making jackets for aircraft crews. These jackets were prepared by nylon fabric and can stop shrapnel, but can't stop bullets. The Red Army wore several types of body armour, including the SN-42 ("Stalynoi Nagrudnik" in Russian means "steel breast-plate", and the number shows the design year). All were tested, but only the SN-42 was put in production¹⁰. During the Korean war several new TBA were produced for the United States

military, including the M-1951, which made use of reinforced plastic or aluminium segments woven into a nylon vest, but the armour was futile to stop bullets and fragments very effectively. T65-2 was the first vests designed to embrace hard ceramic plates, making them capable of stopping 7 mm rifle rounds. They were developed by Natick Laboratories in 1967. "Chicken Plates" were used by crew of low-flying aircraft, such as the UH-1 and UC-123, during the Vietnam War^{11,12}. These were prepared from boron carbide or silicon carbide or aluminium oxide. Richard A. Armellino, the founder of American Body Armour, marketed 'Kevlar vest' called the K-15 in 1975. It had 15 layers of Kevlar that also integrated with a 5" × 8" ballistic steel "Shock Plate" placed vertically over the heart¹³.

An area of unusual activity pertaining to TBA is the emerging use of small ceramic components. Big torso sized ceramic plates are difficult to manufacture and have few flaws. Monolithic plates also have limited multi-hit capability as a consequence of their large contact fracture zone. The new designs apply 2 or 3 directions of ceramic elements that can be inflexible, flexible or semi-flexible. 'Dragon Skin TBA' is one of these systems. It has lead to products that have multi-hit performance. At present, there are many methods by which nano-materials are being used in TBA production. These were first made at University of Delaware. It is based on nano-particles inside the suit that become inflexible sufficient enough to protect the wearer as almost immediately as a kinetic energy threshold is surpassed. These coatings have been described as 'shear thickening fluids'¹⁴.

Wounding patterns during operation Al-meezan and Rahe-Raast is different from 1965 and 1971 war. It is similar to injury pattern inflicted on US forces in OIF/OEF. These operations also witnessed a substantial increase in number of "casualties due to explosives" has increased relative to those caused by gunshot, which is consistent with generalized trend, over the course of the 20th century. In World War I, 65% of combat casualties resulted from gunshots¹⁵. This

decreased to 35% during Vietnam¹¹ and has been reported to around 20% in recent studies of OIF/OEF¹⁶. An analysis of the epidemiology of

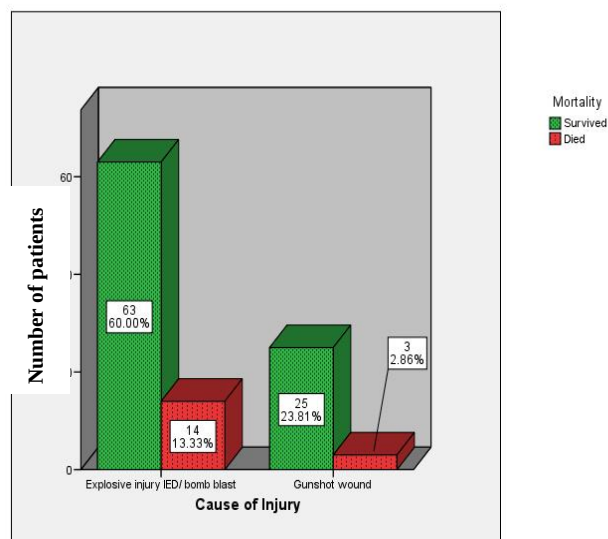


Figure-1: Distribution of cause and outcome of injuries (n=105) on the mortality of the patients.

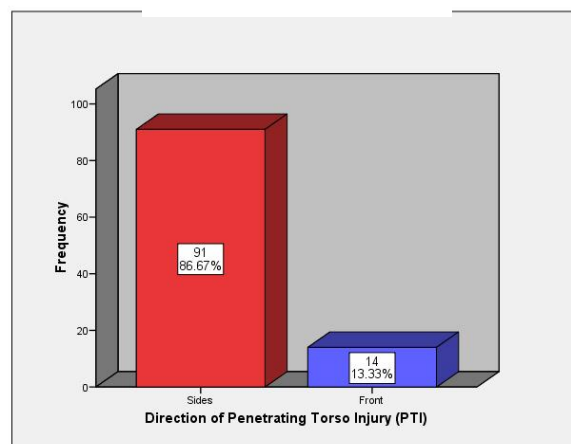


Figure-2: Distribution of penetrating torso injury of (PTI)(n=105).

injuries in OIF/OEF documented that 81% of all injuries were due to explosions¹³. In our study there occurred 73.3% injuries due to explosive mechanisms e.g IED, bomb blast etc. There occurred 16.9% mortality from these injuries. US forces have encountered almost 63% of the deaths due to IEDs in combat operations Operation Iraqi

Freedom/Operation Enduring Freedom 5 (OIF/OEF) and Afghanistan⁷. From June 2003 to June 2009, 1842 coalition soldiers were killed by IEDs in Iraq, and 487 died as a result of similar devices in Afghanistan¹⁷. The lethality of IEDs is demonstrated by the recently reported persons killed in action (KIA) rate of 26.5%¹⁸.

Our study shows that PTI from front when compared with those from lateral sides were similar and statistically insignificant in all aspects like morbidity, mortality and hospital stays except frequency (14 versus 91 respectively). Current design of body armours worn by Pakistani soldiers is also deficient in protection from sides.

Improved battlefield first-aid training, strategic placement of 'advanced paramedics' at forward combat areas and specialists at places where facilities are maximum to operate with 'damage control' aim, decreased time to medical evacuation, and sophisticated surgical care all contribute to an exceptionally low case fatality rate for soldiers with total personnel protective gear and injured on the battlefield. The exploration for most favorable fusion of multi-hit protection, environmentally friendly, operatively light and other characteristics of body armor is going on, and is a vast area of research.

CONCLUSION

The use of body armour has decreased the mortality but it is still deficient in many aspects especially protection from sides and needs improvement. Personal protective measures, such as individual body armor, mine-resistant ambush-protected vehicles, strategic placement

of 'advanced paramedics' and 'specialists' and above all 'rapid casualty evacuation' can help reduce the burden of injuries.

REFERENCES

1. Belmont PJ, Schoenfeld AJ, Goodman G. Epidemiology of Combat Wounds in Operation Iraqi Freedom and Operation Enduring Freedom: Orthopaedic Burden of Disease. JSOA 2010; 19(1):2-7.
2. Michael B. Ballistic Resistance of Body Armor NIJ Standard-0101.06 [Online]. July 2008; Available from: URL:<http://www.nij.gov/nij/pubs-sum/223054.htm>.
3. Ballistic vest [Online]. [cited July 4, 2012]; Available from: URL: http://en.wikipedia.org/wiki/Ballistic_vest.
4. Lidén E, Berlin R, Janzon B, Schantz B, Seeman T. Some observations relating to behind-body armour blunt trauma effects caused by ballistic impact. J Trauma. 1988; 28 (1):145-8.
5. Cannon L. Behind armour blunt trauma--an emerging problem. J R Army Med Corps. 2001; 147(1):87-96.
6. Roberts JC, Ward EE, Merkle AC, O'Connor JV. Assessing behind armor blunt trauma in accordance with the National Institute of Justice Standard for Personal Body Armor Protection using finite element modeling. J Trauma. 2007; 62(5):1127-33.
7. Ballistic-vest-review [Online]. [cited July 4, 2012]; Available from: URL:<http://www.tigerflare.com/component/content/article/1-latest-news/351-ballistic-vest-review>.
8. Allan W. The Knight and the Blast Furnace: A history of the metallurgy of armour in the middle ages and the early modern period. Boston, 2003; Brill Academic Publishers.
9. "Selection and Application guide to Personal Body Armor". National Criminal Justice Reference Service. Retrieved 2009-12-30.
10. Stephan, Restle (1997). Ballistische Schutzwesten und Stichschutzoptionen. Bischofszell: Kabinett Verlag, p.61.
11. Barron, Edward R, Park, Alice F, Alesi, Anthony L. Body Armor for Aircrewman. U.S. Army Natick Laboratories 2008; 11-2.
12. "Who are you calling Chicken?". Vietnam Gear.com. 2006-07-03. Retrieved 2008-11-12.
13. "US Patent 3971072 - Lightweight armor and method of fabrication". PatentStorm LLC. 1976-07-27. Retrieved 2008-11-12.
14. Lee, Young S; Wetzel, E D; Wagner, N J (July 2003). "The ballistic impact characteristics of Kevlar woven fabrics impregnated with a colloidal shear thickening fluid". Journal of Materials Science 38 (13): 2825-33.
15. Owens, BD, Kragh JF, Jr, Macaitis J, et al. Characterization of extremity wounds in Operation Iraqi Freedom and Operation Enduring Freedom. J. Orthop. Trauma 2007; 21:254-7.
16. Vanden Brook, T. Pentagon: New MRAPs saving troops' lives. USA Today, April 4, 2008. Available at: <http://www.usatoday.com/news/military/2008-04-03-MRAPsN.htm>. Accessed August 25, 2009.
17. Beebe GW, DeBakey ME. Death from wounding. In Battle Casualties, pp. 74-147, Charles C Thomas, Springfield, IL, 1952.
18. Hardaway RM. Vietnam wound analysis. J. Trauma .1978; 18:635-43.