

Behind Armour Blunt Trauma Injuries Sustained by Law Enforcement Officers

Cynthia A. Bir, Karin A. Rafaels, Kathryn L. Loftis

I. INTRODUCTION

Since 1987, over 3,000 law enforcement personnel have survived both ballistic and non-ballistic incidents because they were wearing body armour [1]. However, serious behind armour injuries have still occurred. Behind Armor Blunt Trauma (BABT) are injuries that occur after a non-penetrating ballistic impact to an individual wearing body armor. When the high velocity projectiles impact the front of the armour, there can be significant deformation at the back of the armor. This rapid deformation can result in minor to severe injuries due to the inability of the tissues to handle the high rate of loading. A review of BABT injuries sustained by law enforcement officers is presented.

II. METHODS

As part of this effort, medical records currently available from previous efforts were reviewed [1]. This dataset included cases that were part of the IACP/DuPont™ Kevlar® Survivors' Club® database, the Saves database within The Safariland Group and through word-of-mouth efforts. Once the individual was identified and consented to participate, they completed a survey to discern key information including the manufacturer, model and threat level of vest worn, a detailed account of the incident, and information about the injuries themselves. Medical records and police reports were then requested. If available, photographs of the injury and vest were obtained.

Medical Record Review

A total of 106 law enforcement cases with descriptions of BABT were reviewed. Medical records were obtained from 58 of these cases. For four (4) of the cases where medical records were not received, detailed photographs of the BABT injury were provided that assisted in classifying the level of injury. A total of nine (9) cases reported no BABT injury; eight (8) of the nine (9) did not have a medical record. For 29 more of the cases with no medical records, the injuries described by the survivor were considered minor, e.g., bruises, abrasions, and contusions; the remaining seven (7) self-reported internal or open skin injuries. For all cases with adequate information, injuries were coded using the Abbreviated Injury Scale (AIS) version 2005 Update 2008 [2].

III. INITIAL FINDINGS

Fifty-four (54) cases were classified as AIS 1, or minor injuries. Within this category, 3 officers suffered rib fractures, and 16 officers sustained skin injuries that required wound care. Six (6) cases were classified as AIS 2, or moderate injuries. These injuries included pulmonary contusions, liver contusions, injuries to the spleen, and a muscle tear. One case resulted in a more extensive pulmonary contusion that was classified as AIS 3. For nine (9) of the total cases, no injuries were reported. Two injury classifications were developed with Injury Classification A being clinically insignificant injuries and Injury Classification B being those that were clinically significant injuries. Of the 61 cases where adequate injury level/coding could be determined, 35 were considered Injury Classification A with the remaining 26 considered to be Injury Classification B. If self-reported minor injuries were also assumed to be AIS 1 injuries, then the total number of AIS 1 injuries from BABT would increase to 83 in this dataset (Figure 1).

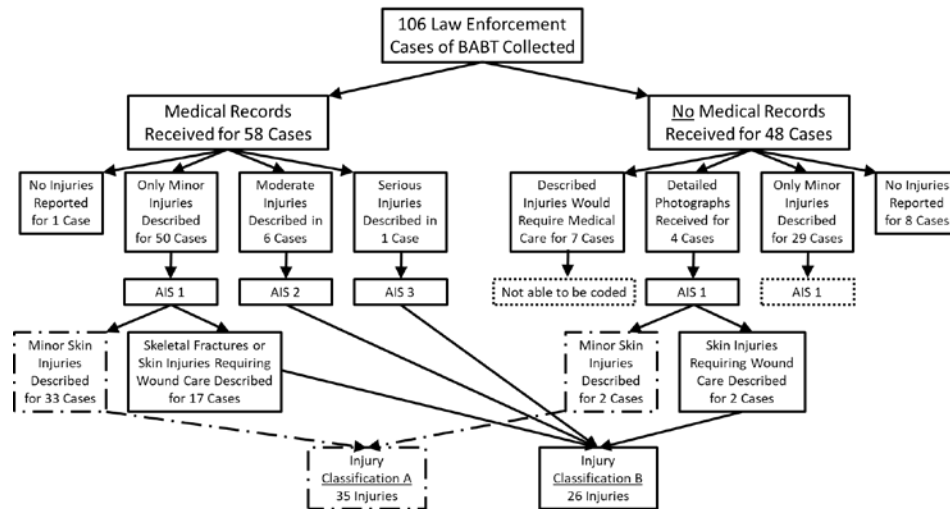


Fig. 1: The distribution of injuries within the collected law enforcement cases. Boxes that are outlined as dotted lines could not be accurately coded with AIS. Boxes and lines with the dash-dot indicate cases that would be categorised as an injury classification level A in the higher resolution codification scheme.

IV. DISCUSSION

In the United States, body armour is certified based on the threat level it is designed to protect against [3]. The cases included in this analysis involved armour protection from IIA to III. By taking into account the typical impact energy of the threat round and the impact energies used in the certification, an assessment was made to determine whether the impact condition was an over-match, i.e., outside of the armour design requirements, equivalent to the protection level or an under-match for the armour the officer was wearing. In theory, over-match scenarios may result in an increased risk of injury. Ten (10) cases were considered overmatches, thirty-three cases were considered equivalent impact conditions to the National Institute of Justice specifications, and forty-five were considered under-matches. There were eighteen (18) cases that could not be determined due to an unknown threat type. It is important to look at this parameter when evaluating the injuries in relation to the protective ability of the vest that was worn at the time of the incident.

Additional protection, such as a trauma pack, steel insert or hard plate, can also be added to the vest in the critical area, i.e., heart and lungs. For most of the cases reviewed, if additional protection was worn, the impact location did not involve the additional protection. Of the thirteen (13) cases known to involve impacts to the additional protection: steel inserts (n=7); trauma packs (n=7); polyethylene plate (n=1); and ceramic plates (n=2). The cases that included the additional protection resulted in minor to no injuries.

There were six (6) overmatch cases with medical records: one (1) of those injuries was an AIS 3 pulmonary contusion (serious and requiring medical care), two (2) more would be considered minor injuries that required medical care (AIS 1 and Injury Classification B), and the other three (3) were categorised as minor injury not requiring medical care (AIS 1 and Injury Classification A). For one of the Injury Classification A cases, the medical records indicated a possible pulmonary contusion, however the patient refused to stay in the hospital for further diagnostics. Twenty-one (21) of the equivalent protection cases had medical records or detailed pictures of the injuries. Eleven (11) of those cases were categorised as minor (AIS 1) but Injury Classification B (including a rib fracture) and two (2) cases were categorised as moderate injuries (AIS 2 pulmonary contusion and muscle tear) requiring medical care. Twenty-three (23) under-match cases had medical records or detailed pictures of the injuries. Two (2) of the under-match cases resulted in moderate (AIS 2) injuries (pulmonary contusion and spleen contusion with rib fracture) requiring medical care. Three (3) other under-match cases were classified as minor (AIS 1) injury but requiring medical care (Injury Classification B).

Future efforts will include further evaluation of the previously conducted recreations and the performance of a forensic analysis on the vest to determine the exact materials in each and the individual layer responses.

V. REFERENCES

[1] Bir CA et al, International Symposium on Ballistics, 2017.
 [2] Abbreviated Injury Scale: 2005, update 2008, AAAM, 2008.
 [3] National Institute of Justice. NIJ standard 0101.06, 2008.