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# Competing interests of undergraduate medical education and industry: integration into longitudinal curricular themes.

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## Original Article

# Terrorist attacks in the largest metropolitan city of Pakistan: Profile of soft tissue and skeletal injuries from a single trauma center

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**BACKGROUND:** Pakistan has been hugely struck with massive bomb explosions (car and suicide bombs) resulting in multiple casualties in the past few years. The aim of this study is to present the patterns of skeletal and soft tissue injuries and to review the outcome of the victims who presented to our hospital.

**METHODS:** This is a retrospective chart review from January 2008 to December 2012. The medical record numbers of patients were obtained from the hospital Health Information and Management Sciences (HIMS) as per the ICD-9 coding.

**RESULTS:** During the study period, more than 100 suicide and implanted bomb blast attacks took place in the public proceedings, government offices, residential areas and other places of the city. Altogether 262 patients were enrolled in the study. The mean age of the patients was  $31 \pm 14$  years. The shrapnel inflicted wounds were present on the upper limb in 24 patients and the lower limb in 50.

**CONCLUSION:** Long bone fractures were the most common skeletal injuries. The fractures were complicated by penetrating fragments and nails which result in post operative infections and prolonged hospital stay.

**KEY WORDS:** Soft tissue injuries; Pakistan

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## INTRODUCTION

In the past few years there is an increasing threat of suicide and implanted bomb blast injuries that are posing on to the population creating a diverse injury profile.<sup>[1]</sup> Pakistan is a developing country that in the past few years has been hugely struck with massive bomb explosions (car and suicide bombs) resulting in multiple casualties. The majority of these events occur in the dense population centers in order to increase the morbidity and mortality. The injuries inflicted from these explosions are complicated because of the unique characteristics of the projectiles and the detonation devices, and the amalgamation of injuries both from an explosion effect as well as penetrating trauma. The shrapnel and ball

bearings are the most frequently used agents for inflicting injuries in these incidents.<sup>[2]</sup> Musculoskeletal trauma is the most frequently encountered injury in the military conflicts and civilian terrorist activity.<sup>[3,4]</sup> Despite of the major share of these injuries, our understanding of the extremity musculoskeletal injuries is limited by the paucity of blast injury research.<sup>[4]</sup> It is therefore incumbent upon the clinicians to have a better understanding of the underlying injury mechanisms of blast extremity trauma in order to drive the development of novel treatment and enhanced patient outcomes. The large number of studies reporting the injury profile from explosive events showed no attempts to study the effects of explosion on the pattern of skeletal and soft tissue injuries.<sup>[5–10]</sup> The aim

of our study is to present the patterns of skeletal and soft tissue limb injuries that occurred from these events in the densely populated areas and to review the outcome of the victims who presented to our hospital with such injuries.

## METHODS

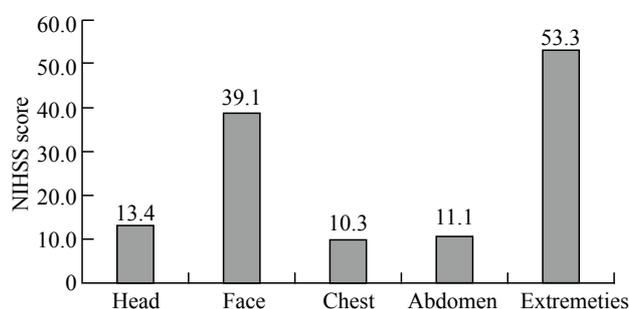
We conducted a retrospective chart review for blast victims admitted to Aga Khan University, a level I trauma center located in the heart of Karachi, the biggest metropolitan city of Pakistan, from January 2008 to December 2012. This time period was selected because the city faced injuries most frequently during these years. Patient medical record numbers were obtained from the Health Information and Management Services Department which codes the patient medical charts as per the International Classification of Diseases-9. The records coded as bomb blast injuries were obtained, which were then further refined to include suicidal, car and other forms of bomb blast injuries. The data collection was done on a predesigned questionnaire. Data from the victims in these incidents who presented to our hospital were collected by our data collectors who were trained for data recording on our questionnaire and for calculating the injury scores. In all these victims treatment was instituted as per our standard protocols of the Advanced Trauma Life Support. Fracture care was performed according to standard open fracture treatment protocol of operative debridement, irrigation and stabilization. Penetrating peripheral limb injuries are managed as per our hospital protocols for penetrating limb injuries. Basic demographic data collected included patient age, sex, mechanism of injury, date of injury, injury severity score (ISS) and length of stay. The data analysis was performed on SPSS version 19. We analyzed the pattern of injuries sustained on the limbs in such injuries and the post procedure infections.

## RESULTS

During the study period more than 100 suicide and implanted bomb blast attacks took place in the public proceedings, government offices, residential areas and other places of the city. A total of 262 patients were enrolled in our study. The mean age of our population was  $31 \pm 14$  years. Of the enrolled patients, 75 (34%) were in the age of 19–28 years. Males accounted for 220 (84%) in our data. Ten of our patients suffered from brain contusions and 14 had tympanic membrane perforation. Eleven of our patients had lung contusions

**Table 1.** Demographic and injury severity score details

Variables	Frequency (%)
Number of patients	262
Age	
<19 years	44 (17)
19–28 years	75 (29)
29–38 years	68 (26)
39–48 years	37 (14)
49–58 years	21 (8)
59 + years	17 (6)
Male/Female	220/42
Injury severity score	
<9	78 (31)
9–15	88 (35)
>15	83 (33)



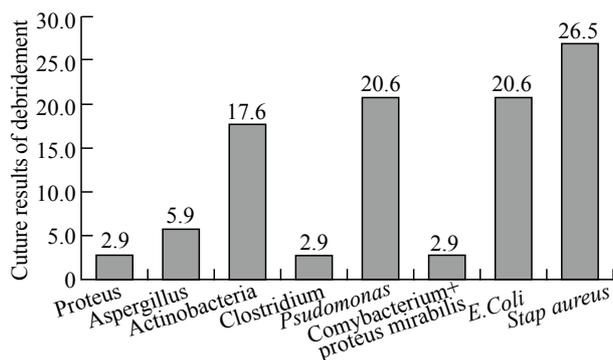
**Figure 1.** Body parts involved.

and 14 had pneumothorax. The mean length of hospital stay for our patients was  $10 \pm 22$  days. The demographic characteristics and injury severity scores are shown in Table 1. The patients whose ISS scores are not mentioned in the files are not included. The organ systems involved in these events are shown in Figure 1.

Sixty-five of our patients had long bone fractures and 48 suffered from soft tissue injuries. Abrasions were present in 12 victims. Mangled extremities and vascular injuries were inflicted in 2 victims each. Sharpnel inflicted wounds were present on the upper limbs in 24 patients and on the lower limbs in 50; the latter with the significant share of the injuries. Thirteen of our patients sustained face sharpnel injuries. Wound debridement was done in 94 patients. Primary fixation was done for the fractures in 51 individuals, upper limb amputation in 5, and lower limb amputation in 5, respectively. Of our patients, 49 were discharged after dressings and were stable and sustained no major injuries that needed hospitalization. Major surgical interventions done in the first 24 hours are shown in Table 2. All of our patients received tetanus and antibiotic prophylaxis. Culture results of the debridement showed significant proportion shared by *Staph aureus* followed by the *Pseudomonas* as shown in Figure 2.

**Table 2.** Major surgical interventions for limb injuries done in the first 24 hours

Variables	Frequency (%)
Debridement	94
Relook debridement	1
Primary fixation	51
Stage fixation	1
Fasciotomy	2
Bone grafting	1
Other	49

**Figure 2.** Culture results of debridement.

## DISCUSSION

Pakistan in the past few years has been inundated with terrorist threats. These incidents all have in common the tremendous challenge imposed on civilian medical services, which are unaccustomed to dealing with such disasters and the resulting injuries.<sup>[11-13]</sup> Among the variety of challenges posed by an array of potential threats, our study mainly focused on injuries from enhanced conventional explosives detonated by both suicide bombers and detonated devices, resulting in musculoskeletal injuries, creating a new injury profile. Our study indicated a clear vulnerability for males in these injuries that is in accordance with the study results published by Mirza et al.<sup>[13]</sup>

The limb injuries share a major contribution in such injuries, as these are the areas exposed during such events. The findings in our study are comparable to what was published by de Silva et al,<sup>[14]</sup> sharing the limb as the major organ involved in such incidents. The timely detonation and proximity of the events took place at areas close to some of the government hospitals of the country, which received the majority of the casualties. We are projecting only the tip of the iceberg with respect to cases that presented to our private hospital that could explain the differences of the injuries in the patient cohort. As the level 1 trauma care center, our hospital has also been receiving patients from the other parts of the

country as well. We have excluded such patients because of the incomplete data that were attributed to such patients.

Fragments, nails, and bolts contained in the bombs fly with great force, and their penetration in the human body results in penetrating wounds which can be hidden by clothes, hairs, etc. These patterns were different from those reported in the past.<sup>[11-14]</sup>

The present study represents a brief subset analysis of the limb injuries including both skeletal and soft tissue injuries in which the victims didn't sustained any spinal fractures. This finding is different from that from the Iraq combat. Although the ballistics used, there is more powerful magnitude but the detonation devices used in these blasts are comparable in terms of injuries.<sup>[15]</sup> Two of our patients suffered from ischemic vascular injuries were found to have non-viable limbs and were offered primary amputation that is up to six patients in other studies.<sup>[14]</sup> This lower rate of amputation is possibly due to early presentation of these patients in our hospital. Tissue samples were sent for culture, and the sensitivity and antibiotics were later modified according to culture report. The debridement culture results showed a dominance of *Staph aureus* and *Pseudomonas* (Figure 2) but post-operatively we had good results with no surgical site infections. The early wound debridement had actually been very effective in reducing such complications. Pre-operatively, culture results showed growth of the microorganism and no infection was observed according to the literature.<sup>[3-5]</sup> Generally, operative time was kept to minimum for the first debridement. In most of the cases, reconstruction of nerves and tendons was not attempted at the initial operation but performed at later stages once wound condition became satisfactory. In postoperative care, multidisciplinary approach was adopted including pain management, infection control, limb rehabilitation exercises, nutritional support and involvement of other specialties in visceral injuries.

Only two of our patients underwent fasciotomy. We have a low threshold of such procedures because of the early repair and early operative intervention for debridement giving less time for swelling and tenderness in distal muscle to develop.<sup>[14]</sup> The low threshold for early open fasciotomy contributed to good outcomes in our patients. Long bone fractures were the most common skeletal injuries, which are mostly related to the primary, and secondary blast wave generated from explosions. The fractures were complicated by the penetrating fragments and nail, which results in postoperative infections and prolonged hospital stay. The incidents occurred mostly

in an open air that also suggests why the injuries are mostly located in the limbs with a predominance of fractures and the limb soft tissue injuries as endorsed by other studies.<sup>[10–13]</sup> The addition of sharpnels and ball bearings in the recent civilian bombings is providing an insight regarding the management of such injuries by prompt wound debridement to prevent the post-operative complications. Also, skeletal fractures and soft tissue injuries from such incidents are pointing to prevention strategies for individuals in mass proceedings by providing preventive clothing for the limbs in addition to the torso, that are more vulnerable to get injured in such incidents.

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**Contributors:** Khan MS participated in data collection of this study and wrote the manuscript. Waheed S was involved in literature search and data analysis, and wrote the article. Ali A and Mumtaz N were involved in data collection. Nooruddin S was involved in the final review and supervision of the project.

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