MANAGEMENT OF WAR INJURIES – EXPERIENCE AT CMH RAWALPINDI DURING 2008 – 2010

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ABSTRACT

Objective: To see the changing mode of injury from firearm to blast, pattern of injury with modern body armor and improved surgical options with results of different procedures done.

Study design: Descriptive study.

Place and Duration of Study: Department of Plastic Surgery Combined Military Hospital Rawalpindi between Jan 2008 and Dec 2010.

Material and Methods: All victims of low intensity conflict whether civilian or military personnel from all age groups without sex discrimination were included. Data was collected from history, transferring notes from the forward medical facility to this hospital, case record documents in this hospital and `patients follow up proforma. All these cases were managed in collaboration with other concerned specialties including orthopedic surgery, general surgery, otolaryngyology, maxillofacial surgery and vascular surgery.

Results: Plastic surgery department managed 212 patients over last three years i.e. 2008-2010. Age range was 14-58 years and male to female ratio was 71:1. Primary surgical wound management was done at field military hospitals in majority of cases and few were air evacuated directly to CMH Rawalpindi. Majority of injuries were caused by explosions followed by firearms. Simultaneous injuries were 68.9% and isolated injuries were 31.1%. Decision of wound closure was usually dependent on level of tissue damage, contamination and infection. Concept of reconstructive ladder was followed. Majority of wounds were closed in delayed primary setting. Infection was the most common complication followed by partial or complete graft or flap loss.

Minimum complication rate was encountered in the wounds which were closed in delayed primary setting.

Conclusion: All war wounds are primarily contaminated. If these wounds are closed in delayed primary setting after 2-3 debridements, best results can be achieved. Although infected wounds, wounds with severely damaged structures and injuries associated with tendon or nerve injuries or bone loss will require secondary reconstructive procedures.

Key words: War wounds, Management.

INTRODUCTION

Since the beginning of civilization, human beings have been engaged in conflict for preservation of self and personal possessions or in the pursuit of fame, power and politics. War is a man made calamity and innocent human beings are its unfortunate victims[1]. At no other time since the Second World War have more countries been involved in hostilities than now. Of the some 215 wars that have been fought on the globe since 1945, approximately 132 were domestic conflicts; the others involved 2 or more countries[2].

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Pakistan is facing an ongoing war scenario. Although civil population is facing and sharing but the main brunt is being born by the Armed Forces. This study was conducted at Combined Military Hospital Rawalpindi which is the main tertiary care hospital of Pakistan army. So a large number of war casualties were received and managed by this hospital.

War wounds are usually caused by explosions or firearm. Injuries due to shrepnells or due to blast wave are the two basic mechanisms in case of explosion while firearms usually cause damage due to projectile. Mine blast injury has caused a great damage to humanity. Globally, an estimated 800 persons die each month and 1200 persons sustain nonfatal injuries from landmine-related injuries[3,4].

The high kinetic energy delivered by modern munitions causes extensive soft-tissue zones of injury and results in wounds that are subject to more complications and may take longer to heal. These munitions focus destructive forces on the extremity, creating a particularly complex wound with fragments of the weapon and other debris driven into it. The blast wave peels away the clothing or boot and soft tissues. It also crushes bone and strips it away, leaving exposed bone, a flap of skin, and other soft tissue with debris forced between planes along the path of least resistance.

Burn is another special type of injury which may have different etiology like blast, road traffic accident or stove explosion. These injuries are mostly penetrating and primarily infected by shrapnel and bullets[5]. All war wounds caused by projectiles of armament need to be treated according to universal principles of war-surgery doctrine including the following:

All wounds are primarily contaminated. Surgical wound management is the most effective way to prevent wound infection.

A 6-8 hours period after injury is optimal for primary surgical wound management. Surgical management of war wounds is a two-step procedure: The first step is primary wound management and the second step is delayed wound closure. Primarily delayed wound closure is a rule for war wound management and could be performed 3 to 7 days after primary wound management. The main reason is that the extent of tissue damage is more than what is visible on first debridement[6].

The key to success in the management of war wounds in remote parts of the world lies in excellent primary surgery, with good wound excision[7] and that may have to be done repeatedly till wound is ready for closure / coverage.

The aim of this study was to see the changing mode of injury from firearm to blast, pattern of injury with modern body armor and improved surgical options with results of different procedures done.

PATIENTS AND METHODS

This was a descriptive study. Patients managed at CMH Rawalpindi from January 2008 to December 2010 were included in the study. These patients were received from forward operational areas after getting primary surgical treatment at field surgical units or blast victims from twin cities of Rawalpindi and Islamabad. All victims of low intensity conflict whether civilian or military personnel from all age groups without sex discrimination were included. Majority of patients were victims of explosions may it be bomb blast, artillery shell, hand, rocket propelled grenade or IEDs. Rest of the patients were victims of firearms. Majority of these patients received primary surgical management within 6 hours and then were evacuated to this hospital for definitive management.

Decision of timing and procedure like wound closure, coverage, reconstruction or amputation was dependent on general condition of the patient, degree of contamination, tissue damage and adequacy of primary surgical management received at forward medical facilities. Guidelines from mangled extremity severity score were used to help in decision making for amputations.

Data was collected from history, transferring notes from the forward medical facility to this hospital, case record documents in this hospital and patients follow up proforma. It included patients personal data, mode of injury whether blast, firearm, road traffic accident injury, primary surgical management, definitive surgical treatment including wound closure or coverage and reconstructive procedures including secondary reconstruction.

All these cases were managed in collaboration with other concerned specialties including orthopedic surgery, general surgery, otolaryngyology, maxillofacial surgery and vascular surgery.

Data analysis was done using SPSS 10. Descriptive statistics were used to describe the results.

RESULTS

Total 212 patients were managed. Being a military hospital majority (83%) of the patients were armed forces personnel and relatively less number of civilians (17%) injured in terrorist activities. Male (98.6%) to female (1.4%) ratio was 71:1. Age range of the patients was 14 to 58 years (mean 34 years). Blast victims were 75% while 25% had firearm injury. Isolated injuries were seen in 66 (31.1%) patients and 146(68.9%) had simultaneous injuries with the ratio 5:11. Majority of isolated injuries (n=66) involved lower limbs in 29(44%) followed by upper limbs 18(27%), chest 7(11%), abdomen 6(9%) and head and neck 6(9%).

Among the simultaneous injuries upper and lower extremity combination (49) was most commonly seen followed by face and extremity combination (37) (Table 1).

Primary surgical management was provided to 174 (82%) cases within 6 hours and 38(18%) cases received surgical management after 6 hours of injury.

Primary closure was done in 13 wounds, but majority of wounds were managed in delayed primary setting may it be delayed primary closure, coverage with skin graft or reconstruction with delayed primary flaps. Rest of the procedures like secondary closure, coverage with skin graft or reconstruction with flaps, nerve and tendon repairs and transfers were done in secondary setting (Table 2).

Among the flaps groin and sural were the common pedicled and latisimuss dorsi and anterolateral thigh flap were the common free flaps which were done in various reconstructive procedures(Table 3).

Vascularised fibular flaps were done for traumatic bone loss in 9 cases. Out of these three cases were of mandibular reconstruction, four for loss of humerus length, one for radius and one case for reconstruction of ulna. No complication was seen in these cases.

For secondary reconstructions toe to hand transfers were done in five cases.

Total 37 secondary reconstructive procedures were done other than flap reconstructions. Out of these, 20 patients were with nerve injuries, 2 case of thumb lengthening with distraction osteogenesis, 2 cases of web release and 13 had to undergo tendon procedures. Out of 10 cases of radial nerve injuries, four cases were treated with tendon transfers and nerve transfers were done in 6 cases. Anterior transfer of tibialis posterior was done in a case of common peroneal nerve injury and neurolysis was done for patient with sciatic nerve injury. Three cases of ulnar nerve injury in forearm were treated with nerve grafting and three cases were treated with nerve transfers. A case of median nerve injury in forearm was managed with nerve grafting and for the second one opponensplasty was done. Secondary repair of flexor pollicis longus was done in a case and release procedures were done for two cases of Volkman's ischemic contracture of forearm.

Patients with burns were treated initially with daily change of dressings. Three cases of superficial burns healed conservatively and skin grafting was done in 3 cases. Contractures developed in two cases, one axillary and other developed neck contracture which were released and covered with skin grafts. Nine unfortunate patients had amputations. Out of these 5 had lower limb amputations and 4 had upper limb amputations. Four out of five cases of lower limb amputations had below knee amputation and in one case above knee amputation had to be done. This patient had popliteal artery firearm injury and reached for primary surgical care after 20 hours of injury. All the four cases of below knee amputations were the victims of mine blast and improvised explosive devices laid by the terrorists. In upper limb one patient had through forearm, one through wrist and two patients had multiple finger amputations. Two cases sustained injuries due to mishandling of hand grenades and two cases faced explosions of unexploded ordinance.

Wound infection was the most common complication. Three (23%) out of 13 primary closures got infected. In comparison only 5 (2.5%) cases out of all the cases treated in delayed primary setting got infected.

Partial necrosis was seen in 4 (8.5%) pedicled and 2 (6%) free flaps while complete loss was seen in one case (3%).

Partial loss of skin grafts was seen in 6(10.7%) out of 56 cases of delayed primary and 4(19%) out of 21 cases of secondary setting. For these cases procedure had to be repeated.

We lost three patients with simultaneous injuries and one patient with almost 100% burns.

DISCUSSION

War injuries in Pakistan are response to ongoing war against terrorism for the last ten years. This hospital received cases majority from armed forces (83%) as compared to civilians casualties (17%) of terrorist attacks. During the aggression against Croatia out of the 220 casualties admitted to the Department of Maxillofacial Surgery in Zagreb between August 1991 and December 1992, almost one-fourth were civilians[8]. This is in contradiction to the recent international literature which says that civilian population is becoming the main target of present day conflicts taking main share (80%)of casualties[9]. Increasing trend of civilian casualties was also seen during Israel and Hizbullah war in 1996[10].

Male gender is the main sufferer as in this study the male to female ratio is 71:1. The reason being that female soldiers in Pakistan are on noncombatant appointments and terrorist organizations carrying relegious slogan with guerrilla mode of actions do not have their female members on active war front. In other studies although the male gender is still common but the female gender is having a little bigger share[11-14] .

Previously according to literature wounds of war generally stem from injuries inflicted by projectiles from firearms. These accounted for some 97% of wounds in the Second World War II. Blast is overwhelmingly the most common wounding etiology in the current conflicts[15,16]. This fact was also stressed in American Academy of Orthopedic surgeons 2006 annual meeting[17]. With present day armamentarium the number of blast victims is quite high as compared to firearm injuries[18]. A recent report cited that 88% of injuries were due to blast[19].

Simultaneous injuries are almost double in number as compared to isolated injuries. This is because of larger number of blast injuries (75%) as compared to firearm (25%) and other mechanisms. This change in pattern of etiology is because of change in mode of warfare. The dominating forces go for bombing before physical attack and others use mines, suicide bombing and improvised explosive devices as armament of modern conflicts. A study done in Quetta capital city of Balochistan (Pakistan) differs and they had (78.4%) cases with firearm

Table-1: Pattern of simultaneous injuries (n=146).

Regions involved	Number	Percentage
Upper and lower extremity	49	33.3%
Face and extremity	37	25.2%
Multiple injuries/ burns	18	12.1%
CNS and extremity	15	10%
Abdomen and extremity	10	7%
Chest and extremity	7	5%
Chest, abdomen and extremity	7	5%
Face, chest and extremity	3	2%

Table-2: Various procedures done. (n=212)

Procedure	Number (%)
Primary closure	13 (6.1)
Delayed primary closure	64 (30.2)
Secondary closure	23 (10.8)
Delayed primary skin grafts	56 (26.4)
Delayed primary reconstruction with flaps	80 (37.7)
Secondary skin grafts	21 (9.9)
Secondary reconstruction with flaps	10 (4.7)
Other secondary procedures for nerve and tendon injuries.	11 ()5.2
Amputations	9 (4.2)
Burn wound management	7 (3.3)

*multiple procedures were carried out

Table-3: Flaps used for wound coverage.

Flap	Pedicled (n=47)	Free (n=33)
Latissimus dorsi flap	8 (17%)	15 (45%)
Thoracodorsal artery perforator flap	1 (2.1%)	- (0%)
Radial forearm flap	7 (14.9%)	5 (15.2%)
Posterior interosseous artery flap	6 (12.8%)	- (0%)
Groin flap	10 (21.3%)	- (0%)
Anterolateral thigh flap	3 (6.4%)	7 (21.2%)
Sural flap	11 (23.4%)	- (0%)
Propeller flap	1 (2.1%)	- (0%)
Dorsalis pedis artery flap	- (0%)	1 (3%)
Rectus abdominus	- (0%)	5 (15.2%)

injuries[20]. Another study done in the same setting in Quetta reports 53(38%) firearm victims as compared to 88(62%) cases with splinter injuries due to blast[21]. These results are again similar to other international studies[6].

In various combinations of blast injuries the limbs are almost a constant entity[22]. A study done on Afghan war established that lower limb was most common body region to be injured[23]. Steel helmet and body armor are the two main reasons of head and trunk being relatively spared. In the current conflict, mortality has declined, and it is believed that this is because of the advances in body armor worn by the military personnel[24].

Progressing mechanization has improved the speed of evacuation of war casualties. So the injured soldiers are evacuated to primary surgical facility in shortest possible time. As in this study 174 patients received primary surgical treatment within 6 hours. Delay in evacuation may be due to various reasons including hostile ground situation and weather hazard. American military history also supports this fact as in Veitnam war a casualty used to take around 45 days to reach to the tertiary care hospital. In Iraq war an injured American soldier used to reach level 4 hospital in Germany within 12 hours and was evacuated to homeland within 3 days of injury[17]. Casualties may need to be rescued, picked up, classified, stabilized, registered and evacuated to the rear military hospitals under severe combat conditions, which will adversely affects their management[25].

Wound closure or coverage was done in primary, delayed primary and secondary settings. Most common being the delayed primary closure or coverage in accordance with the current recommendations. Moreover, these injuries often have much more soft-tissue damage than is initially apparent, and failure to investigate the planes or premature closure of the wounds can inevitably lead to sepsis. That is why battlefield wounds are initially left open because of the high risk of infection[26].

In this study 7 out of 212 patients had burns that make 3.3% which is similar to the study done at US Army Institute of Surgical Research Burn Centre. In their study burns casualties were 5% of total number[27].

In accordance with well-established indications, amputations are performed because of severe trauma to the limb; lower limb amputation is more common than upper limb amputation[28]. In this study also 5 out of 9 cases had lower limb amputations and one of these salvageable lower limb with popliteal artery injury had to undergo above knee amputation because of delay of more than 20 hours. Long delay in reaching medical care increases morbidity[13].

Groin and sural were the common pedicled and latissimus dorsi and ALTF were the common free flaps which were done. Groin flap was a good option for hand defects. Pedicled latissimus dorsi flap was used for coverage of arm and elbow defects as well as a functional flap. Sural flap was used for defects around ankle and proximal foot defects. Anterolateral thigh flap was a good option as free flap to cover defects of hand. Latissimus dorsi free flap was used in majority of the cases to cover distal leg and foot defects as muscle flap with split thickness skin graft. O'Brien was the first to use free groin flap for foot reconstruction in 1973[29]. After that the use or free flap for foot reconstruction greatly increased. Baudet et al. described free latissimus dorsi flap in 1976. After the initial use as myocutaneous flap[30,31], trend changed towards latissimus dorsi muscle flap with split thickness graft to avoid the excessive thickness of myocutaneous flap for foot defects[32]. Fasciocutaneous flaps came up with very strong recommendations in 1980s for foot reconstruction[33].

War wounds usually have massive soft tissue and bone injury and are potentially contaminated. So there is high risk of infection if treated improperly[34]. Infection was more common with the wounds closed in primary setting (23%) as compared to delayed primary wound closure(3%). Infection rate was 3.5% in delayed primary coverage with split thickness graft and 1.3% with flap coverage. So wound closure or coverage in delayed primary setting after 2-3 debridements was seen to carry

relatively less infection rate. Similar recommendations were made in a study done on Iraq war casualties[26].

Other complication of partial flap loss was seen in 4 cases of pedicled and 2 free flaps while complete loss was seen in one free flap. So free flap survival in this study was 96% which is same as described by

Soutar in his study and it was more than 90%[35].

Mortality was seen in three patients with simultaneous injuries who received primary surgical treatment after 6 hours of injury. The provision of primary surgical management within 6-8 hours decreases morbidity and mortality which was also seen in a study done in Yugoslavia during NATO war[6]. One patient was lost due to almost 100% burns. So overall mortality was 2.7% which is close to 4% mortality according to the study done at Quetta[21].

CONCLUSION

War injuries mainly afflict male gender. Usually productive and active age group is seen to be the main sufferer.

The concept of military personnel being the only victim has also changed altogether as civilian population is also having increasing share in war casualties.

Current trend of armament towards explosives is reflected in increasing number of blast injuries as compared to firearm injuries. That is why multiple simultaneous injuries are more common than isolated injuries. Limbs and specially lower limbs are the commonest to be injured in isolated as well as simultaneous injuries.

Improved means of casualty evacuation have greatly decreased morbidity and mortality by timely provision of primary surgical treatment. Optimal timing of primary surgical management is 6-8 hours after injury.

All war wounds are primarily contaminated. Delayed primary closure or coverage with skin graft or flap is considered the optimal strategy. Secondary wound closure or reconstruction is done where there is gross infection or tissue or functional loss.

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