

# Study of the severity of musculoskeletal injuries and triage during the 2005 Pakistan earthquake

Syed Awais · Ayesha Saeed

Received: 11 June 2013 / Accepted: 24 June 2013 / Published online: 11 July 2013  
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## Abstract

**Purpose** On 8 October 2005 a massive earthquake hit the northern mountainous areas of Pakistan and Kashmir causing 73,338 deaths and leaving over 125,000 severely injured. In a region which was less prepared for such an enormous disaster, mobilising rescue, relief and rehabilitation posed great challenges. The first author (SMA) established two level 1 orthopaedic trauma and rehabilitation units in each of two severely hit major cities through private philanthropy. According to the severity of injuries, the patients were triaged and treated. The aim of this study is to improve the future strategies in similar scenarios.

**Methods** This is a retrospective review of medical records of patients suffering from musculoskeletal injuries in the aftermath of the 2005 earthquake who were managed in these centres in the order of triage priority. The patients were received, categorised, worked up and provided definitive surgical procedures. All patients were provided assistance for the fitting of a prosthesis and rehabilitation.

**Results** Of 128,304 (total of injured patients), 19,700 were managed in two centres established by SMA during the first months after the earthquake. Of these, 112 patients underwent amputations of upper and lower limbs.

**Conclusions** In a massive calamity over a wide geographical area away from big university hospitals, such as the 2005 Pakistan earthquake, the level 1 operating theatre facilities must be established within the area to meet the immediate

needs of the patients nearest to their homes and families, and run forever so that patients can have excellent follow-up and can use the same facilities regularly. In the aftermath of this earthquake the need to practise triage in the first 72 hours was thoroughly realised and effectively practised in our centres

## Introduction

The term *triage* comes from a French verb, *trier*, meaning to sort, sift or separate. Triage is a process of sorting people based on the need for immediate medical treatment as compared to their chance of benefiting from such care. Earthquakes have the potential to be one of the most catastrophic disasters that affect mankind. Despite all of the technological advances, the basic skill of a disaster team to triage the great numbers of injured so as to optimise the available resources remains a vital tool [1]. In an advanced triage process injured people are sorted into categories. Conventionally there are five classifications with corresponding colours and numbers although this may vary by region:

- **Black/expectant:** They are so severely injured that they will die of their injuries, possibly in hours or days (large-area burns, severe trauma, lethal radiation dose), or in a life-threatening medical crisis that they are unlikely to survive given the care available (cardiac arrest, septic shock, severe head or chest wounds); their treatment is usually palliative, such as being given painkillers, to reduce suffering.
- **Red/immediate:** They require immediate surgery or other life-saving intervention and have first priority for surgical teams or transport to advanced facilities; they “cannot wait” but are likely to survive with immediate treatment.
- **Yellow/observation:** Their condition is stable for the moment but requires watching by trained persons and frequent re-triage, and they will need hospital care (and

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S. Awais · A. Saeed (✉)  
Department of Orthopaedic Surgery and Traumatology,  
King Edward Medical University, Lahore, Pakistan  
e-mail: drayeshasaeed@yahoo.com

S. Awais  
e-mail: awais@kemu.edu.pk

S. Awais · A. Saeed  
King Edward Medical University/Mayo Hospital Lahore,  
Lahore, Pakistan

would receive immediate priority care under “normal” circumstances).

- Green/wait (walking wounded): They will require a doctor’s care in several hours or days but not immediately, may wait for a number of hours or be told to go home and come back the next day (broken bones without compound fractures, many soft tissue injuries).
- White/dismiss (walking wounded): They have minor injuries; first aid and home care are sufficient, and a doctor’s care is not required. Injuries are along the lines of cuts and scrapes or minor burns [2].

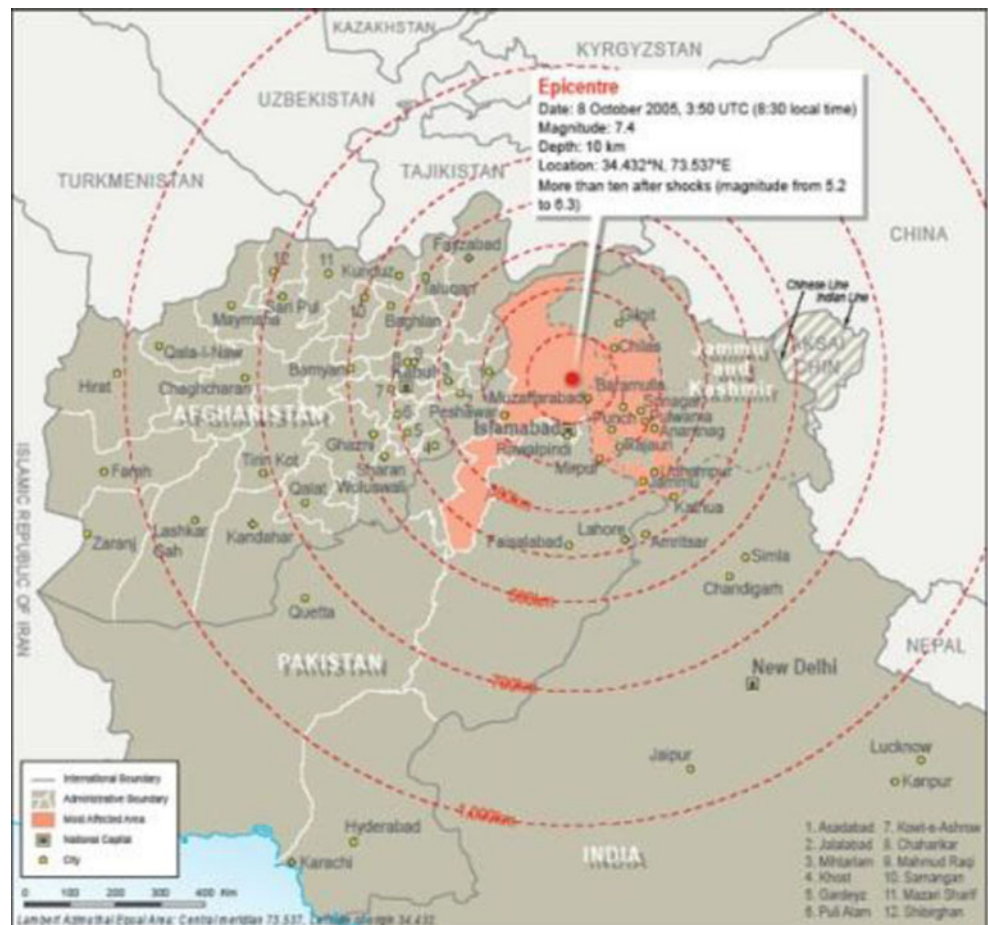
On 8 October 2005 at 08:50:38 Pakistan Standard Time (03:50:38 Coordinated Universal Time) a massive earthquake, 7.6 on the Richter scale, struck the northeast of Pakistan and western Kashmir [3, 4]. The epicentre was located near Muzaffarabad, the capital of Pakistan-administered Kashmir, 100 km northeast of Islamabad (Fig. 1). It was the world’s third deadliest natural disaster of the past 25 years, surpassed only by the 2004 Asian tsunami and the 1991 cyclone in Bangladesh [5–7]. During the earthquake approximately 3.5 million people were displaced, of which 73,338 died and 128,304 were severely

injured [8]. Those who were reported to have a limb loss totalled 713 accounting for 0.9 % of the major injuries (World Health Report 2006, WHO, Geneva). The earthquake in Pakistan also destroyed 594 small, medium and large health facilities in the area, thus complicating the health care delivery services [9].

## Materials and methods

The first author (SMA) established two new level 1 orthopaedic surgery and rehabilitation centres through private philanthropy in existing public hospitals [one at the Abbas Institute of Medical Science (AIMS) Muzaffarabad in Kashmir and the other in DHQ Hospital Mansehra in Khyber Pakhtun Khuwa (KPK) Province]. The aim was to immediately create a treatment facility for the injured within the earthquake-affected areas. The hospitals were taken over on 8 October 2005 and continued working under his direct supervision until September 2010 (five years). It was decided that the biggest needs would be: evacuation, treatment of injured patients, food, clothes and tents, and re-establishment of water and electricity units. As Immediate Past President

**Fig. 1** The epicentre of the 2005 Pakistan earthquake



**Table 1** Triage of initial 17,200 patients received on day 1 in Mansehra centre

	Triage category	Definition	Type of injuries	No of patients
1	Black	Expectant/deceased	Lethal	125
2	Red	Immediate	Blunt trauma abdomen Chest injuries Severe head injuries Polytrauma patients with multiple fractures, amputations	35 19 6 22
3	Yellow	Delayed/observation	Spine injuries Pelvic injuries Head scalp injuries Open fractures upper/lower limb	70 136 60 349
4	Green	Wait/minor injuries	Closed fractures upper limb Closed fractures lower limb Clavicle fractures Facial injuries Eye injuries Nose injuries	254 507 53 23 17 14
5	White	Walking wounded	Lacerations, abrasions & bruises, minor soft tissue injuries	210

and Chairman of the Earthquake Committee of the Pakistan Orthopaedic Association and member of the International Society of Orthopaedic Surgery and Traumatology (SICOT), SMA reported to his associations that they would establish good operating facilities in the district headquarters of Mansehra and Muzaffarabad. Fortunately in both public hospitals there were newly constructed small buildings that escaped the earthquake's effects.

The local administration of the hospitals and province provided the buildings, working staff and already available supplies. The first author was expected to furnish equipment and arrange resources. The philanthropic families and individuals known to SMA promised the required financial support to set up two operating theatres, five-bed intensive care units (ICUs), an X-ray facility and a diesel run electric

generator. So equipment was bought, including a big electric generator, large autoclaves, run both with gas and electricity, two operating tables, two operating lights, portable X-ray machine, image intensifier, anaesthesia machines and all essential instruments, linen and surgical items, implants etc. for orthopaedic surgery. We were able first to transfer all this material to Mansehra and we established our operating theatre the same night of the earthquake. Muzaffarabad was not accessible by road because of the mountain rock slides, but after two days the trucks entered the city and another operating theatre was established. There was a very positive response from the governments of Kashmir and the Frontier Province and the Federal Government of Pakistan, and also from volunteer workers, orthopaedic surgeons, anaesthetists, paramedical staff and nurses. Although the catastrophe was huge all operating theatres were working 24 hours a day. There were also organisations such as WHO, UNICEF, Doctors Without Borders, and the AO Foundation delivered material to both centres. We also received volunteers from Cuba, Holland, Turkey, the USA, Canada, Bangladesh, the UK, France, Singapore and Bosnia. In addition SICOT-International Research Society of Orthopaedic Surgery and Traumatology (SIROT) raised funds.

On the first day 1,900 patients were received, 2,500 on the second day and on the third day 2,800 patients were treated in Mansehra centre alone. The treatment of earthquake survivors with musculoskeletal trauma included medical treatment, debridement, fasciotomy, closed reduction, open reduction and amputation. The initial constraints

**Table 2** No. of patients with the pattern of injuries

Body part injured	No. of patients	Percentage
Lower limb	9,850	50
Upper limb	5,516	28
Pelvis	1,970	10
Spine	985	5
Head	591	3
Face	394	2
Abdomen	197	1
Chest	98	0.5
Eye	99	0.5
Total	19,700	100

**Table 3** Procedures performed on the patients received

Procedures performed	No. of patients
Patients received	19,700
Minor procedures (stitching, dressing, traction, splintage)	8,068
Major orthopaedic operations	1,145
General surgery procedures	33

were those of worn-out medical and surgical supplies, power breakdowns, overcrowding and limited medical personal which was further aggravated by the difficult geographical terrain.

All patients who were triaged with major and minor limb injuries or those received dead belonging to all age groups are included in this study retrospectively while analysing the trends in the overall mass casualties. Great care was taken to organise and computerise individual records of patients.

## Results

On the first day of the earthquake 1,900 patients were received in Mansehra centre alone. An open-air facility was chosen to receive the injured and they were tagged according to the major categories of triage, i.e. deceased, immediate, delayed and minor. As indicated in Table 1, 125 were received dead. There were 82 people requiring immediate treatment, including patients with abdominal, chest and head injuries and multiple fractures. The 868 patients with major orthopaedic injuries fell into the delayed category (spine and pelvic injuries, and open upper and lower limb fractures). The following few days after the earthquake were devoted to managing these patients, of which many including those with spine injuries were transported to specialised centres for better care. Emphasis was placed on applying the principles of damage control surgery.

The principle of reverse triage was also applied in order to offload the facility of the mostly minor wounded and give more attention to the seriously injured patients. The team ensured continuous integrated triage so that patients were evaluated again and again and categorised.

In the centres a total of 19,700 patients (with earthquake injuries) were received in the first seven months (emergency transfers and referrals from small centres in far-flung mountains), of which 12,000 were treated in Mansehra and 8,700 in Muzaffarabad. Table 2 shows the distribution of injuries in these patients. Of these injuries 58 % were of the lower limb, 28 % of the upper limb and 10 % of the pelvis. Of the 19,700 injured registered in our centres in the first seven months, 1,145 underwent implant reconstruction projects such as

**Table 4** Type or major orthopaedic procedure performed

Description	No. of patients
ORIF with implants (DHS, DCS, DCP)	375
Amputations	112
External fixators	295
Intramedullary nailing	113
Implant removal	250
Total	1,145

*ORIF* open reduction and internal fixation

external fixators, DCS, DHS, hemiarthroplasties, intramedullary nails etc. (Tables 3 and 4).

## Discussion

Earthquakes are known to cause mass deaths and injuries with devastating effects on infrastructure and civil structure [10, 11]. The October 2005 earthquake left a colossal economic loss of over US\$5 billion and a challenging task of 13,000 reconstruction projects [12]. The magnitude and impact of this disaster shook the whole nation [13]. In the earthquake, 40,000 were injured, of which 55 % had major injuries. Limb injuries accounted for 60 %, cavity injuries 20 %, spinal injuries 2 % and head injuries 1 % (World Health Report, WHO, Geneva). Though amputations accounted for just 0.9 % of the total injuries, they needed to be managed in the immediate and urgent phases of the triage [6, 7, 14–16]. Further, these patients needed extensive rehabilitation dealing with their physical, psychological and occupational liabilities [17].

A “Limb Fitting and Physiotherapy Centre” was established by the first author (SMA) in AIMS Muzaffarabad, with the financial support of private philanthropists and technical assistance by the Society for the Welfare of Orthopaedically Disabled Pakistan (SWOD). The goal was to rehabilitate the great numbers that were disabled. The Centre provided over 150 modern upper and lower limb prostheses (to amputees from other centres as well) and made physiotherapy services available to many.

The first-hand experience reported here is in line with the recommendations of the Earthquake Rehabilitation and Reconstruction Authority (ERRA) of Pakistan, which are:

- Restoration of health care infrastructure through a seismically safe and rationalised health care system
- Practising continuous integrated triage in the disaster fields and subsequently in the hospitals to treat the maximum with whatever resources are at hand [18, 19]
- Providing an integrated health care delivery system covering preventive, curative and rehabilitation services

- Strengthening the health services through revival of the management and organisational system

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