

SPECIAL COMMUNICATION

Spinal Cord Injury Management and Rehabilitation: Highlights and Shortcomings From the 2005 Earthquake in Pakistan

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Recent natural disasters have highlighted the lack of planning for rehabilitation and disability management in emergencies. A review of our experience with spinal cord injury (SCI) after the Pakistan earthquake of 2005, plus a review of other literature about SCI after natural disasters, shows that large numbers of people will incur SCIs in such disasters. The epidemiology of SCI after earthquakes has not been well studied and may vary with location, severity of the disaster, available resources, the expertise of the health care providers, and cultural issues. A lack of preparedness means that evacuation protocols, clinician training, dedicated acute management and rehabilitation facilities, specialist equipment, and supplies are not in place. The dearth of rehabilitation medicine specialists in developing regions further complicates the issue, as does the lack of national spinal cord registries. In our 3 makeshift SCI units, however, which are staffed by specialists and residents in rehabilitation medicine, there were no deaths, few complications, and a successful discharge for most patients. Technical concerns include air evacuation, early spinal fixation, aggressive management to optimize bowel and bladder care, and provision of appropriate skin care. Discharge planning requires substantial external support because SCI victims must often return to devastated communities and face changed vocational and social possibilities. Successful rehabilitation of victims of the Pakistan earthquake has important implications. The experience suggests that dedicated SCI centers are essential after a natural disaster. Furthermore, government and aid agency disaster planners are advised to consult with rehabilitation specialists experienced in SCI medicine in planning for the inevitable large number of people who will have disabilities after a natural disaster.

Key Words: Disasters; Earthquakes; Pakistan; Rehabilitation; Spinal cord injuries; Trauma.

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NATURAL DISASTERS FOLLOW no rules. All have the potential for devastating social, medical, and public health consequences. Earthquakes can cause mass casualties, widespread property destruction, and disruption of essential community services.¹ They often affect regions of the world that have limited resources with which to respond to mass casualties.

On October 8, 2005, at 8:52 AM PST, an earthquake measuring 7.6 on the Richter scale occurred in northern areas of Pakistan and India. It was the most devastating and debilitating natural disaster in Pakistan's history. More than 73,000 people were killed and 126,000 were injured.²

This article focuses on the lessons learned from, and the shortcomings in, the management and rehabilitation of large number of patients with spinal cord injury (SCI) in Pakistan after that earthquake.

SCI is among the most devastating conditions known to mankind. In Pakistan, the chronically disabled are generally disrespected and rarely function as useful members of society, a fact that presented an additional challenge in managing the hundreds of traumatic SCI patients after the earthquake. Because there is no SCI registry in Pakistan, an accurate assessment of the number of people who sustained an SCI cannot be made, but estimates are that it was between 650 and 750.³⁻⁵

In general, Pakistan—and its medical community in particular—coped very well with the challenges presented by the calamity, but mistakes were made and shortcomings exposed.⁵⁻⁸ It is therefore appropriate to appraise our management of the SCI victims to improve systems and processes and be better prepared for future disasters. Some of the authors had first hand experience in the rehabilitation of SCI patients in different hospitals in the twin cities of Islamabad and Rawalpindi in the months after the earthquake. We also had interaction with physicians and other health professionals who were involved in the evacuation and acute management of SCI patients.

EVACUATION EFFORTS

Lack of Spinal Trauma Evacuation Protocols

Spinal trauma is a surgical emergency that requires specialized care in the initial immobilization and transport of a patient. Movement of the spinal column must be restricted to avoid creating neurologic injuries additional to those produced by the inciting trauma.⁹ Unfortunately, after the earthquake, there was usually little such care taken in transporting patients with a suspected or diagnosed SCI.

In the Western world, the spinal board is an established means of extrication and efficient transport in the prehospital phase of trauma management.¹⁰ The boards, however, were rarely used in the aftermath of the Pakistan earthquake. In evacuating patients by road, all types of vehicles—from private

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cars to buses and trucks—were used; they are totally unsuitable for transporting SCI patients. These circumstances inadvertently resulted in worsening neurologic and vertebral damage and, in many instances, resulted in an incomplete SCI becoming a complete SCI. One patient gave the following description of his experience:

When the earthquake happened, I was struck on my back by the falling debris and had a severe backache when rescued from the rubble. I walked to the Neelum stadium and waited for my turn to be rescued. When the pain became unbearable I (laid) down. I still remember when people lifted me from my feet and arms to put me in the helicopter. I could hear my back snap and suddenly I was numb from the waist down and couldn't move my lower limbs. They told me, after 3 days in Rawalpindi, that I had a broken back.

Sadly, the majority of the health care providers involved in the search, rescue, and evacuation efforts were totally unaware of the concept of log rolling and the correct immobilization techniques for transporting the injured who had suspected or actual SCI.

Air Evacuation of Casualties

The choice of evacuation mode in SCI depends on the patient's condition and local settings.¹¹ After an earthquake, helicopter transport is the preferred method for evacuating casualties and supplying medical resources.^{12,13} The use of helicopters can significantly reduce transportation times, especially when ground ambulances are hindered by impassable roads.¹⁴

The earthquake struck remote communities that are nearly inaccessible even in the best of times. With the existing roads destroyed, only air transportation was possible. A helicopter rescue operation was launched immediately after the earthquake and served as both a supply lifeline and as a means to evacuate survivors. The airlift capabilities in Pakistan were vastly inadequate; therefore, international help was sought. The response was generous and immediate. Of the many Pakistani and international helicopters available, only 2 to 3 were air ambulances with medically trained aircrews. Once placed on the helicopters, patients often were crowded together, stretched out on the floor, to utilize every inch of space.

The overriding priority was to triage and evacuate as many casualties as possible during daylight because only a few aircraft were equipped to fly at night. In a time of chaos, with an overwhelming number of injured, the rescue operation successfully evacuated thousands of casualties from the disaster zone directly to tertiary care hospitals in the twin cities, where they had early access to specialty medical and surgical services. This may have contributed to the low mortality of SCI patients.

Unique Epidemiology of SCI

There is little in the literature about the epidemiology of SCI as a result of earthquakes; however, its epidemiology in this earthquake has been recently reported.¹⁵ Important highlights are: (1) the ratio of males to females injured was of 1:1.3; (2) the mean age of the injured was 28 years, with 16.5% of all injured being less than 18 years old; (3) paraplegia was the dominant level of SCI (89%), with no cases of complete tetraplegia reported; (4) air evacuation (83%) and spinal fixations (75%) in a large number of patients; and (5) there were no deaths among the SCI patients who were cared for by teams of rehabilitation specialists. These findings are in contrast to the typical epidemiology of traumatic SCI.¹⁵⁻¹⁹

INITIAL TREATMENT EFFORTS

Lack of an SCI Registry

Because Pakistan had no national SCI registry when the earthquake occurred, there is no accurate assessment of the exact number of people who sustained an SCI. In fact, very little is known about the epidemiology of SCI in Pakistan before the earthquake because only 3 studies have been published.^{16,20,21} The attempt by the National Data Registration Authority to document SCI in the initial post-earthquake period was a fair effort, but it had some major flaws. These included the following: (1) data collection was done by data entry operators rather than by health professionals; (2) instead of documenting injury level and degree of completeness, the only information entered was "spinal trauma, back trauma, SCI," thus making an accurate analysis difficult; (3) some patients who were bed bound and unable to move their lower limbs because of bilateral pelvic fractures or severe blunt muscular trauma to the back were also mistakenly included in the SCI database; and (4) the survey was carried out in the first few weeks after the earthquake within a specific time period. It is possible that patients with SCI who reported late were not included in this database. Also, SCI patients who died before the survey would not have been included.

Lack of Spinal Units and Rehabilitation Specialists

Spinal units were established in the West as early as World War II; these units were dedicated to the treatment and rehabilitation of SCI patients in order to manage their needs in a comprehensive manner.²² Unfortunately, this was never a priority for governments, health bureaucrats, or health professionals in Pakistan. The emphasis has been on surgical interventions after SCI and on giving advice about exercises at home after discharge from treatment. At the time of the earthquake, apart from the Armed Forces Institute of Rehabilitation Medicine (AFIRM), no other hospital in the twin cities had an SCI rehabilitation unit. Although neurosurgical departments were already established in nearly all the major teaching hospitals, dedicated spinal units using a multidisciplinary approach to rehabilitation were not. The paraplegia center at Hayatabad, Peshawar, is making commendable efforts to address this; however, the center's main focus is on physical therapy (PT), and has not had the involvement of rehabilitation medicine specialists.

The situation described above had important implications because SCI patients had to be cared for in makeshift paraplegia centers. At the Melody Rehabilitation Center and Paraplegic Center, District Headquarters Hospital (DHQ), many SCI patients were placed on charpoys (traditional beds of woven twine), which are totally unsuited for SCI patients (fig 1). Also, they were mobilized after spinal fixation without spinal braces. This resulted in many avoidable complications. The Agha Khan University trauma team from Karachi noted that paraplegic patients were the most neglected of all patients injured in the earthquake.⁸

At the time of the earthquake, there were few qualified neurosurgeons and spinal surgeons in Pakistan, but rehabilitation medicine specialists were even less common. In a country of 160 million people, the number of fellowships in physical medicine and rehabilitation was less than 20. The majority of patients with SCI were taken to hospitals in the twin cities, however, initially there was not 1 rehabilitation specialist in these hospitals who could facilitate SCI rehabilitation. Medical officers and house officers were in charge of paraplegia centers



Fig 1. SCI patients being managed on traditional charpoy in Melody Rehabilitation and Relief Center. Pressure ulcers are visible on both heels of the patient and were frequent complications in patients being managed in temporary spinal rehabilitation centers.

in many places, with the only SCI medical specialists being neurosurgeons who acted only as visiting consultants (table 1).

The clinical impressions of those of us who worked in the twin cities was that patients who received nonspecialized care were inadequately assessed, had longer lengths of stay, poorer functional outcomes, and an increased incidence of avoidable complications such as pressure ulcers and urinary tract infections, compared with patients treated by the rehabilitation specialists. Rehabilitation medicine specialists from AFIRM visited these centers to encourage the use of proper rehabilitation techniques so as to reduce the likelihood of SCI complications.

Inadequate and Inaccurate Assessment

The assessment of SCI has been standardized by the American Spinal Injury Association (ASIA) grading system, which is a widely accepted system that describes the level and extent of injury based on a systematic motor and sensory examination of neurologic function.²³ A thorough, accurate, and well-documented neurologic examination at the primary hospital is paramount. Ironically, many physicians involved in the care of

SCI patients were unaware of the ASIA system and its worksheet documentation. This resulted in errors in the diagnosis of complete and incomplete SCI. The difference between a complete and an incomplete SCI is the presence of sacral sparing as identified by anal sensation.²⁴ Many patients, however, were not examined for these symptoms.

This resulted in inaccurate assessments, with ASIA grade B or C being reported as a complete injury, or a patient being described as having C6 paraplegia. Rehabilitation physicians addressed this problem by teaching ASIA scoring and SCI assessment to doctors working in the makeshift paraplegia centers, and by distributing the Standard Neurological Classification of Spinal Cord Injury worksheets.

Functional assessment is important in monitoring the outcomes of rehabilitation interventions. Apart from AFIRM, where FIM instrument²⁵ scoring was done, no other center systematically recorded functional outcome.

Psychologic Support

Post-traumatic stress disorder, depression, insomnia, anxiety, substance abuse, and domestic violence have been reported after major disasters.²⁶⁻²⁸ Temporary symptoms are more common than severe long-term reactions,²⁷ however, the psychologic sequelae can persist for years.²⁹ This earthquake resulted in physical and psychologic trauma for those who sustained an SCI. Many survivors saw family members die, or trapped in rubble, calling for help. Many mothers sustained SCIs when they dashed into their houses trying to save their children¹⁵; they were the only survivors from families of 8 to 10 members. Despite this, the incidence of clinically detectable depression 3 months postearthquake in a group of 187 SCI patients was only 6%.¹⁵ This was probably the result of timely interventions by psychiatrists and psychologists, aided by a large number of volunteers and social support groups. They were successful in alleviating the survivors' fears and addressing their psychologic needs. Notable among these groups were the Organization for Rehabilitation of Disabled Persons, the Mental Health Centre at Military Hospital Rawalpindi, and teams of psychologists employed by the World Health Organization (WHO).

Religious and Spiritual Support

Religion plays a pivotal role in the lives of millions of people in Pakistan. Tragedies and calamities compel people to turn to God, seeking solace in their religion. The role of religious

Table 1: Main Spinal Units in the Wake of the Pakistan Earthquake

Name of Center	Location	Primary Responsibility
Neurosurgery department	PIMS, Islamabad	Neurosurgery team
Surgical department	NIHd, Islamabad	Neurosurgeon team and orthopedic team
Melody Rehabilitation and Relief Centre*	Renovated Melody cinema, Islamabad	Gynecologist assisted by visiting neurosurgeons
Neurosurgery department	Holy Family hospital, Rawalpindi	Neurosurgeons and medical officers
Paraplegia center	District Headquarters Hospital, Rawalpindi	Medical specialists, medical officers, and neurosurgeons
Spinal unit	Armed Forces Institute of Rehabilitation Medicine, Rawalpindi	Rehabilitation medicine specialists
Female surgical department*	Military Hospital, Rawalpindi	Spinal surgeon, rehabilitation medicine specialists
Surgical department	Combined Military Hospital, Rawalpindi	Spinal surgeon

Abbreviations: NIHd, National Institute for Handicapped; PIMS, Pakistan Institute of Medical Sciences.

*For female patients only.

organizations in the search and rescue operations just after the earthquake has been acknowledged both inside Pakistan and by the international community.³⁰⁻³³ Workers from religious organizations followed up on patients admitted to hospitals. Patients were comforted and counseled to cope by using their religious teachings for inspiration. This helped alleviate the sense of loss, especially for paraplegic mothers who were concerned about the future care of their children (in 1 case, a 38-year-old mother of 7 who had T12 ASIA grade A SCI). Al Huda, a religious organization that promotes Islamic knowledge among women of Pakistan and that has no political or sectarian agenda, did a commendable job of counseling women with SCI at the National Institute for Handicapped (NIHd) spinal unit and other paraplegic centers in the city.

SPINAL REHABILITATION ISSUES

SCI Rehabilitation Brought to Forefront

Some of the greatest clinical advances in the care of SCI patients in the last half century have been in rehabilitation.³⁴ SCI rehabilitation leads to better outcomes and should be started as early as possible.^{35,36} Rehabilitation medicine is still in its infancy in Pakistan and is often confused with PT. The earthquake resulted in its being recognized as an important component in the continuum of care of SCI patients after surgical intervention. There was a realization that optimal outcome after SCI depends on specialized rehabilitation interventions by rehabilitation medicine specialists.

Establishment of Spinal Units

Patients admitted to an SCI center early after injury are less likely to develop complications than are those who are admitted later.³⁷ An important positive outcome of the earthquake was the establishment of temporary and makeshift spinal units in Islamabad and Rawalpindi (see table 1). Some were upgraded to permanent spinal rehabilitation units, but many of these temporary centers were closed after 6 to 8 months. Only 2 (the spinal unit at NIHd and the Pakistan Institute of Medical Sciences satellite hospital at NIHd) are currently functioning under the auspices of WHO; they have approximately 150 inpatients. These are fairly basic units with an enormous need for improvements. Nevertheless, they are a great help to paraplegic subjects who still cannot return to their homes located in the hilly terrains of Kashmir and are inaccessible by roads.

There is a realization now among the surgical and the wider medical community that SCI management does not end with spinal fixation and that rehabilitation is necessary to ensure prevention of complications and successful integration of the patient into society.

International SCI Assistance

The earthquake was a unique learning experience for all who were involved in the rescue and management of casualties. In its wake, it brought to Pakistan SCI rehabilitation teams from around the world. These teams, which included physical therapists, occupational therapists, orthotists, and psychologists, worked with the local doctors, allied health staffs, and other health care professionals. They conducted courses and training in SCI rehabilitation. In many instances they provided useful patient education materials for future use. Especially notable were teams from Australia, Canada, Cuba, France, Switzerland, South Africa, and Turkey, as well as from Handicap International and the International Committee of the Red Cross.

ISSUES WITH FOLLOW-UP

Inadequate Patient Education and Counseling

Patient education is not a strong component of the Pakistani health care system. Patient educational materials about SCI written in the local language (Urdu) were nonexistent at the time of the earthquake. A commendable job was done in this regard by WHO when it prepared and distributed an SCI patient education manual in Urdu. A limitation in providing written information, however, is that it is not personalized to each patient's needs; also, in Pakistan, many survivors were either illiterate or minimally educated.

Many patients who sustained a complete SCI were young and were concerned about their future ability to walk, work, and marry. Health care professionals had difficulty explaining the poor prognosis for functional recovery, especially in cases of complete SCI. Unfortunately, in many instances, giving an appropriate prognosis to SCI patients was either neglected or tactfully avoided. In other cases, false reassurances were given. Future employment plans and sexual dysfunction were rarely discussed. Even after 1 year, many patients were unsure of their prognoses or the implications of SCI. This has led to local practices of resorting to local hakeems and faith healers.

Inadequate Monetary Support Distribution

In the wake of the earthquake, emotional spirits were very high. Monetary support poured in from within Pakistan and from around the world. Philanthropists and the general public visited the SCI centers and distributed money. Unfortunately, there were no criteria for distributing money to SCI patients. At some paraplegia shelters, patients were reluctant to be discharged because they feared the loss of financial support. This encouraged dependency rather than independence.

Many SCI patients were from poor socioeconomic backgrounds, having lived in remote and hilly rural areas in mud houses that lacked electricity, water, sewerage, or sanitation. Some had never seen electronic devices and they wasted donated money by buying expensive mobile phones or cassette or CD players.

In the later stages of the disaster relief, the government started a monthly assistance plan that gave 6000 rupees (US \$100) to every SCI patient. No differentiation was made, however, between those with paraplegia and quadriplegia or complete and incomplete SCI—even though someone who was bed-bound with tetraplegia would need more monetary assistance than a person who was mobile without assistance.

Lack of Social and Vocational Rehabilitation Services

The main emphasis of SCI rehabilitation postearthquake was on PT, occupational therapy, and counseling. Many patients who were employed before the earthquake and who sustained a complete SCI were unable to return to work. There was no coordinated approach to ensure a smooth transition into mainstream society. Only those people who had a neurologic recovery to at least ASIA grade D were able to return to the community and their previous employment. The overwhelming majority of victims still in hospitals are young people with paraplegia. This is in contrast to developed countries, where only a small number of patients—mostly elderly—are discharged to institutions.³⁸

ROLE OF AFIRM

After the earthquake, AFIRM played a prominent role in the management and rehabilitation of SCI patients. AFIRM is a 100-bed tertiary care rehabilitation institute, the only one of its

kind in Pakistan. Using a multidisciplinary approach, it provides comprehensive rehabilitation services to patients with SCI, amputations, stroke, pediatric disabilities, and musculoskeletal or orthopedic disorders. It has separate gymnasiums for men and women, and its own electrodiagnosis and urodynamics departments. The affiliated orthopedic technology workshop manufactures spinal and upper- and lower-limb orthoses and splints.

At the time of the earthquake, AFIRM had the largest number of spinal turning and tilting beds (20) in the country. One hundred forty patients were successfully managed at AFIRM in the months after the earthquake, without any deaths or major complications. It received its first earthquake SCI victim at 9:00 AM on October 9, 2005. Patients were either directly admitted after evacuation from the disaster zone or were transferred for SCI rehabilitation from Military Hospital, Combined Military Hospital, and the paraplegia center DHQ Hospital after surgical interventions. The spinal rehabilitation protocols and services provided included prevention of pressure ulcers, daily individual and group exercise programs, transfer training, gait training, wheelchair mobility skills, management of neurogenic bladder and bowel, psychologic support and counseling sessions, patient and family education and, in selected cases, follow-up.

Consultants and residents in rehabilitation medicine were called from combined military hospitals of Multan, Sialkot, Malir, and Quetta. They regularly visited a paraplegia center (DHQ Hospital), neurosurgical ward (Holy Family Hospital), Melody Rehabilitation Centre, and NIHd (Islamabad) to coordinate SCI rehabilitation with the care being provided by local physicians. At discharge, every patient who was still wheelchair dependent was provided with a wheelchair, commode chair, spinal orthoses and limb supports, walking frame, and a rollator (if indicated) for better ambulation and mobility. To provide relief for the overburdened spinal surgeons, 30 patients were transported to United Arab Emirates for spinal fixation and postoperative rehabilitation.

Three Pakistani rehabilitation medicine specialists living in the United Kingdom and the United States visited AFIRM at different times after the earthquake. The Swiss Pak Society (Switzerland) arranged for the distribution of 18 functional electric stimulation units to different paraplegia centers and spinal units.

AFIRM, in coordination with the Swiss Pak Society, twice invited spinal surgeon Max Aebi, MD, for 1-week visits to Pakistan, during which time he performed surgeries on SCI patients and delivered lectures. Two rehabilitation medicine specialists from AFIRM have completed a 4-month training program in SCI rehabilitation at the Stoke Mandeville Spinal Injuries Centre in the United Kingdom; more were expected to complete such training by the end of 2007. The Al Murshid Hospital in Karachi sponsors this program. Three rehabilitation medicine specialists completed a 4-month, hands-on training program at the Swiss Paraplegic Centre in Nottwill, Switzerland that was sponsored by the Swiss Pak Society.

A 2-day rehabilitation seminar, with emphasis on SCI rehabilitation, was held at the Armed Forces Post Graduate Medical Institute in Rawalpindi in the last week of November 2005. It was designed to increase awareness in the medical community about this important and neglected field. A 1-month refresher course for physiotherapists was held at AFIRM in January 2007 in collaboration with the Swiss Paraplegic Centre. Physical therapists hired by WHO to facilitate SCI rehabilitation in the civilian sector were trained in transfer, transport, handling, and exercise protocols for SCI patients at AFIRM.

Al Murshid Hospital, in collaboration with AFIRM, recently launched a community-based rehabilitation program for the earthquake's paraplegic victims in Balakot district and its surroundings. Patients have been identified and a center established. The program will be monitored by a rehabilitation consultant and a resident every 3 months.

LESSONS LEARNED

Within the methodologic limits of this report, and recognizing that circumstances in other disasters may differ from the Pakistani experience, we believe that people planning responses to disasters should consider the lessons learned from our experience:

- (1) A large number of SCIs should be anticipated in natural disasters such as earthquakes.
- (2) Many SCIs could have been prevented during this earthquake had there been an awareness of spinal trauma evacuation protocols and there been a disaster management plan in place.
- (3) Use of helicopters is a swift means for evacuating large numbers of casualties from hilly terrains when the roads are inaccessible or no longer exist after an earthquake.
- (4) Adequate and early psychologic support can minimize the mental trauma associated with such calamities. Depending on the local culture and traditions, religious teachings can be an immense source of comfort and solace.
- (5) SCI management does not mean spinal fixation or bracing alone. Only a multidisciplinary approach in a dedicated spinal unit can ensure accurate assessment of the problem, tailored management, and successful reintegration into the society.
- (6) Governments alone cannot deal with natural disasters. The results would be much worse in situations where there is no international assistance or participation of civilians in rescue efforts.
- (7) SCI rehabilitation is only complete when the patient re-enters society as a useful member, rather than being trapped indoors, and seeking only monetary support.

In Pakistan, there was inadequate community-based rehabilitation infrastructure for SCI patients before the earthquake. This seriously hampered the vocational and social rehabilitation of these patients.

Recommendations for the Future

We offer the following recommendations, based on lessons learned from the earthquake, which can hopefully be generalized to other earthquake-prone areas.

International responses. Many countries have disaster plans in place and many such plans have been extensively revised in light of Pakistan's experience. The expense involved in carrying out meaningful large disaster drills is a problem for poor countries such as Pakistan. Hurricane Katrina demonstrated how even the United States' emergency response floundered when faced with a disaster that was of a lesser magnitude than the Pakistan earthquake.

The following is suggested as an exemplary international effort. There must be a 1-window operation, so the United Nations (UN) is the obvious choice to coordinate the operation. We propose a UN standing rapid response disaster team, with countries pledging to provide and maintain the required equipment and manpower. There should be an international accreditation mechanism for team medical personnel. Five yearly international disaster drills should be conducted under UN auspices. The disaster team must have the capacity to mobilize

within 24 hours and to sustain its rescue operation for up to a maximum of 4 weeks. International help to poor countries of the world in the form of health care education and facilities is necessary to enable them to better cope with disasters in their own lands.

Disaster plans are very much akin to battle plans in that they bear little resemblance to what actually happens in the field. Still, they instill a sense of order and purpose in the proceedings and hence are indispensable.

Although people came from all around the world to help, substantial assistance from major rehabilitation societies in the West was conspicuously missing. Two years after the earthquake, Western rehabilitation societies have yet to play their role in helping their professional colleagues in Pakistan. Rehabilitation societies and SCI associations in the developed countries need to focus on developing countries such as Pakistan by offering exchange programs, training health care professionals, and providing educational audiovisual aids.

National responses. There is a need to increase disaster preparedness and have a tangible disaster management plan in place and periodic disaster drills. This may "reduce mortality after a serious earthquake."^{39(p443)}

Trauma management in disasters and the correct SCI evacuation, immobilization, and transport protocols should be taught during the training of emergency relief workers, ambulance officers, army medical staff, resident surgeons, and emergency physicians. Rescue units trained in methods to avoid and minimize spinal injuries should be established. They should be a part of the rapid response teams that can be deployed by air in such calamities.

Helicopters should be the preferred means for transporting SCI injured from remote areas after major disasters.

As previously highlighted by Ali Sheikh, the "medical community should undertake the task of teaching undergraduate medical students, postgraduate doctors, nursing, and all paramedical staff by holding workshops, symposia and as part of curriculum as how to act at the time of natural calamity and how to work with disaster management team."^{40(p747)}

A database of the SCI patients injured in Pakistan's 2005 earthquake should be maintained, preferably at AFIRM, in collaboration with the Earthquake Reconstruction and Rehabilitation Authority, WHO, and the Pakistani government. The outcomes of the SCI victims of the earthquake should be followed up and studied on a long-term basis.

Efforts should be directed toward establishing SCI units that would use a comprehensive multidisciplinary rehabilitation approach, including the sexual, psychologic, social, avocational, and vocational aspects, rather than focusing on spinal surgery or neurosurgical units.

Mental health support is needed after severe disasters, especially for people who have a major disabling injury such as SCI. It should be available for varying periods. Important components of this process should be to explain the prognosis of SCI and to provide patients and families with relevant SCI education.

There is a need to devise and implement a comprehensive community-based rehabilitation program tailored for these SCI patients, the majority of which live in hilly terrain with roads inaccessible even by 4-wheel drive vehicles.

Above all, there is a dire need to improve the number of people trained in rehabilitation medicine in Pakistan.

CONCLUSIONS

The 2005 Pakistan earthquake was a devastating tragedy that had long-lasting effects and left haunting memories. The medical community was successful to a large extent in managing

hundreds of SCI casualties because of its collective zeal to deliver its best efforts under the circumstances. This would not have been possible without the timely and generous support by civilians and the international community.

Rescue and medical teams arrived from within and outside the country. In a minor but significant proportion, their enthusiasm vastly surpassed their capabilities. There was no mechanism for accreditation or evaluation of medical personnel and/or their skill levels. One of the authors observed that some of our Western colleagues who were accustomed to working in sophisticated hospitals were unable to function in the aftermath chaos when removed from their familiar environment.

Given the overwhelming numbers of casualties, the remoteness and inhospitability of the terrain, and the loss of infrastructure, the evacuation effort was a marvel of international cooperation. There is, of course, room for improvement in triage and evacuation protocols. Nonetheless, if such a situation occurs elsewhere, rescue and medical personnel would do well to achieve what was achieved in Pakistan in October 2005.

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