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Klinik Çalışma

Experience with mass casualties in a subcontinent earthquake

Bir kıta parçası depremindeki kitlesel zayiat deneyimi

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BACKGROUND

A massive earthquake struck North Pakistan on 8 October 2005. The objective of this study was to evaluate the types of injuries and the procedures carried out on the admitted casualties, and to present recommendations based on these experiences for improvement in disaster preparedness and management. This is a descriptive study conducted at the Military Hospital, Rawalpindi.

METHODS

Inclusion criteria included all patients who required admission for treatment. Patients who had minor injuries not requiring indoor treatment and those who were dead on arrival were excluded from this study. The files of admitted patients were analyzed for type of injuries, procedures performed, complications, and causes of death.

RESULTS

The total number of patients received was 1698, of which 862 (50.8%) were admitted. A total of 2289 operations were performed including 1046 (45.7%) major interventions. Sixteen (1.5%) amputations were necessary. Seventeen deaths (1.9%) occurred in hospital, while 76 dead bodies were received.

CONCLUSION

After the initial days of life- and limb saving, it is important to quickly divide the manpower into teams with a major emphasis on plastic, orthopedics and spinal surgery, to start shifts and to utilize the volunteer manpower early and judiciously. Prevention of tetanus is essential.

Key Words: Debridement; earthquake; military hospital; surgery.

AMAÇ

8 Ekim 2005 tarihinde Kuzey Pakistan'ı büyük bir deprem vurdu. Bu çalışmada, hastaneye yatırılan yaralıların yaralanma tipleri ile uygulanan işlemler değerlendirildi ve bu deneyimlere dayanarak afetlere karşı hazırlıklı olma ve afet yöntemi ile ilgili olarak öneriler sunuldu. Bu çalışma, Rawalpindi'deki Asker Hastanesi'nde yürütülen tanımlayıcı bir çalışmadır.

GEREÇ VE YÖNTEM

Çalışmaya dahil edilme kriterleri, tedavi için hastaneye yatırılmayı gerektiren bütün hastaları kapsadı. Ayaktan tedavi görebilecek küçük yaralanmalılar ve hastaneye ulaştığında ölmüş olan kişiler çalışma dışında bırakıldı. Hastaneye yatırılan hastaların dosyaları, yaralanma tipi, uygulanan prosedürler, komplikasyonlar ve ölüm nedenleri analiz edildi.

BULGULAR

Başvuran toplam hasta sayısı 1698 idi ve bunların 862 tanesi (%50,8) hastaneye yatırıldı; 1046 tane (%45,7) majör girişimi içeren toplam 2289 ameliyat yapıldı. On altı adet (%1,5) amputasyon uygulanması gerekti. Hastanede 17 hasta yaşamını yitirdi (%1,9); dışarıdan 76 ceset getirildi.

SONUÇ

Hayat ve uzuv kurtarma ile ilgili ilk günlerden sonra, vardiyaları başlatmak, gönüllü insan gücünü erkenden ve mantıklı bir şekilde kullanmak ve plastik cerrahi, ortopedi ve spinal cerrahi konularına özellikle önem vermek kaydıyla insan gücünü hızlı bir şekilde ekiplere bölmek önemlidir. Tetanozun önlenmesi yaşamsal öneme sahiptir.

Anahtar Sözcükler: Debridman; deprem; asker hastanesi; cerrahi.

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A disaster is defined as a sudden massive disproportion between hostile elements of any kind and the survival resources that are available to counterbalance these in the shortest period of time. Disasters happen, and when major disasters strike, they put considerable strain on the system.[1]

The 8 October 2005 earthquake that struck northern Pakistan and India, measuring 7.6 on the Richter scale, 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. An estimated 74,650 to 80,000 people lost their lives, an equal number were injured, and 2.8 million left homeless – a higher death toll than the average annual loss to all natural and man-made disasters combined during the 1990s, excluding armed conflicts.[2,3] Most of the earthquake victims were evacuated to Rawalpindi, and the Military Hospital (MH) was one of the main frontline hospitals, which along with the Combined Military Hospital (CMH) received the major bulk of the initial casualties.

It was the objective of this study to evaluate the types of injuries and procedures carried out on the admitted casualties, and to present recommendations based on these experiences for improvement in disaster preparedness and management in such disasters.

MATERIALS AND METHODS

This descriptive study was based on the management of earthquake casualties in the surgical department of the MH, Rawalpindi. All casualties were initially received at the emergency department of the hospital. Due to the massive inflow and the grievous nature of these patients, the surgical unit was divided into three teams from the very beginning.

The first team (emergency team) worked in Emergency Reception (ER), led by a senior registrar in surgery, assisted by a junior registrar and medical officers, with duties around the clock. The second team was the 'general surgery team' led by the head of the surgical department and four consultant surgeons, and helped by senior and junior surgical postgraduate trainees posted in the MH. The third team (specialist team) included the specialists like plastic, orthopedic, pediatric, maxillofacial, and spinal surgeons. They managed the cases referred from the general surgery team (second team), as well as referrals from the disaster area emergency hospitals. After the first 24 hours of working around the clock, casualties were managed on 12-hour shifts, the working hours coinciding with the start and end of the fast, since it was the month of Ramadan.

Triage was done in the ER, and the patients were categorized into immediate, urgent and definitive groups by the first team. Initial assessment was done following the Advanced Trauma Life Support (ATLS) protocols.[4] Serious patients in the 'immediate category' were resuscitated in the emergency operation theater adjacent to ER by the first team. After resuscitation, patients were shifted to the 24-hour operational main operation theaters where consultant surgeons (second team) were available around the clock. Urgent category patients (those requiring surgical intervention but whose situation was not immediately life-threatening) were admitted after primary survey and then sent to the wards for further care and management. The definitive care group included the patients who had already received some treatment in the earthquake-hit area and were formally referred for specific tertiary care management. These were seen and managed by the second and third teams.

Inclusion criteria for the purpose of this report were all patients who required admission. Great emphasis was laid on the proper paperwork for each patient. Patients who could be discharged after treatment and those who were dead on arrival were not included in this study. Only a few had proper identification, and many seriously injured women and children were unaccompanied. Their file in the hospital included all the available data and a photograph of each patient with any document available with the person. A new department dedicated for this purpose was started, with a dedicated photographer and a senior officer from the Statistics Department of the hospital heading the team.

At the end of each day, a combined meeting of the surgical team and the administrators was held to discuss the day's problems together with possible solutions. Clinical cases were also discussed and a combined plan was outlined for these patients.

After receiving initial treatment, patients were shifted to rehabilitation and follow-up wards specially created in this mainly medical hospital, after discharging or shifting of non-urgent cases. In these wards, managed by doctors from non-surgical specialties, day to day care, documentation, locating of relatives, physiotherapy, dressings, and psychiatric support were provided. After full recovery and rehabilitation, patients were discharged, which in some cases took as long as six months.

Data was summarized on the basis of total number of casualties, injuries, procedures, complications, infection rate, rehabilitation, and mortality. This was then fed into a computer and printouts generated. These were used for identification and analyses, and were also made available to the higher headquarters and the civil government for data collection purposes.

Table 1. Account of casualties

Total no of casualties received	1698
No of casualties admitted	862
No of outdoor cases	836
Total no of casualties transferred to other hospitals	33
Total no of casualties discharged	651
Total no of operations performed	2289
	Major = 1046
	Minor = 1243
Total no of deaths	17
Total no of dead bodies received	76

Table 2. Details of procedures performed

Major wound debridement	238
Orthopedic operation	
a. Closed reduction	230
b. External fixation	47
c. Open reductions with fixation	14
- Interlocking / intramedullary nail	46
- Plating	28
- K-wire	6
- Austin Moore	9
- Dynamic hip screw	5
- Malleolar screw	21
d. Hip spica	
Amputations	16
Plastic surgery	
a. Flaps	127
- Local flaps	62
- Sural flaps	24
- Radial forearm flap	12
- Soleus flaps	11
- Gastroc flaps	4
- Abdominal flaps	3
- Medial leg flaps	4
- Supra malleolar flap	1
- Free flap	1
- Groin flaps	2
- Cross finger flaps	2
- Cross leg flap	1
b. Split skin grafts	196
Spinal surgery	21
Other procedures	
a. Laparotomies	17
b. Colostomies	4

RESULTS

The total number of patients received in the MH, Rawalpindi, from 8 October to 7 December was 1698. The maximum number of patients received in a single day was 78, on 10 October (Fig. 1). The maximum number of patients on hospital strength at one given time was 511 on 15 October (the normal number of beds on the surgical side is 120). During the initial days, most of the casualties received were unattended and directly referred from the earthquake-hit area. Later, more serious and attended casualties started to follow and the influx peaked between 10 October to 5 November 2005.

The total number of casualties admitted was 862 (50.8%), of which outdoor cases were 836 (49.2%). Thirty-three (3.8%) cases (mainly serving soldiers) were transferred to other MHs for follow-up care. Within the first three months, 651 (75.5%) cases were discharged after full treatment. As almost all the cases were of poly trauma, a total of 2289 operations were performed. Out of these, major and minor operations were 1046 (45.7%) and 1243 (54.3%), respectively (Table 1). The breakdown of the different procedures performed is given in Table 2.

The major injury encountered was compound fracture of bones and massive soft tissue losses. The fractures of various bones encountered are given in Table 3. Nine (1.04%) patients developed tetanus. They were all recovered from rubble several days after the earthquake with dirty, contaminated wounds (Fig. 2), and could not get prophylaxis at the disaster site. Five (0.05%) suffered from crush syndrome and 3 (0.03%) developed necrotizing fasciitis (Table 4). The causes of death in the 17 patients who died after admission are given in Table 5.

DISCUSSION

In mass casualty situations, demands always exceed the capacity of personnel and facilities. Mass casualties such as sailing ship disasters and war casualties have occupied the attention of surgeons since

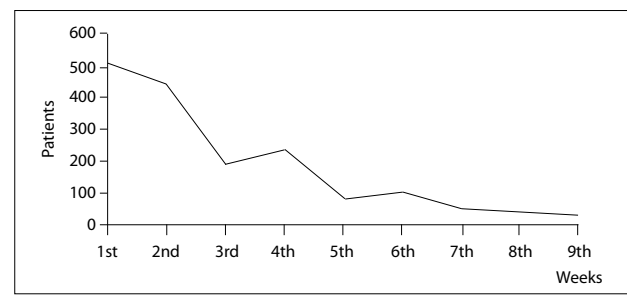

Fig. 1. Inflow of patients.

Table 3. Types of fractures

Upper limb fractures	
- Clavicle	8
- Humerus	17
- Radius ulna	24
- Hand injuries	54
Lower limb fractures	
- Hip dislocations	2
- Femur	47
- Tibia fibula	60
- Ankle	7
- Foot	26
Spinal injuries	48
Pelvis	76
Facial injuries with zygoma	14

Table 4. Complications seen in admitted cases

Crush syndrome	5
Colostomy for perineal wound care	4
Fasciotomies	5
Necrotizing fasciitis	2
Tetanus	9

Table 5. Causes of deaths in hospital

Tetanus	7
Polytrauma / sepsis	5
Spinal injury	2
Crush syndrome	2
Head injury	1
Total	17

the 17th century.[1,5] In the last few years, there has been an increased incidence of civil disasters; the spectrum of possible catastrophes has also increased dramatically as a result of an increasing technologically sophisticated society.[6,7]

The emphasis of medical management shifts from individualized treatment to standardized therapy for disaster victims, with the aim of providing maximum benefit to a maximum number of salvageable patients. A successful medical response to multi-injury civilian disasters, either natural or man-made, dictates formulation, dissemination and periodic assessment of a contingency plan to facilitate the triage and treatment of victims of the disaster.[8,9]

The earthquake that hit Northern Pakistan was one of the worst in human history. No individual or government is prepared for this kind of catastrophe

Fig. 2. Traumatic amputation with grossly contaminated wound.

beforehand. The response of the Pakistani Government and people was remarkable. In the initial days, the national and worldwide response to this catastrophe was spontaneous and ill-planned. Our own response was similar in view of the unprecedented and unanticipated shear workload. But after 48-72 hours, when the calamity was revealed in its totality, the surgical team was able to devise a well-planned strategy and arranged enough resources to deal with the huge number of casualties with relative ease and efficiency. This was similar to findings in the Turkish earthquake of 1999, where the response went through several phases from a period of ineptitude to effective management.[10]

During the first week, wound excisions, application of plaster casts and splints, amputations, and external fixator application accounted for the major work load. The emphasis was on strong immobilization and early skin cover. In the second week, in addition to all of the above, open reduction of fractures with fixation plus soft tissue covering was done. During the third and fourth weeks, plastic (grafting, flaps) and spinal surgeries were performed. Definitive orthopedic surgery, laparotomies and debridements continued throughout.

The fact that only 17 deaths (1.9% mortality) occurred out of 862 admitted cases is indeed a commendable feat. Nevertheless, some of these could also have been prevented. Seven deaths were due to tetanus. Early administration of globulin at the site of injury for major and dirty wounds may have prevented these. All patients admitted in the hospital received anti-tetanus globulin, according to the World

Health Organization (WHO) protocol, thus preventing any admitted patient from developing tetanus. Two patients died of crush syndrome and developed acute renal failure leading to complications. We expected many more patients with renal shutdown, as reported by several studies from Turkey (Marmara 1999 and Bingol 2003 earthquakes).[11,12] This could be because of early vigorous fluids given in the disaster area. Almost all patients who arrived had running intravenous infusions, a procedure which the first aid workers always do. Early isotonic saline followed by mannitol infusion is recommended for all such patients who are at risk.[12]

More than 90% patients were able to get curative treatment here while the rest needed prolonged rehabilitation at other facilities before discharge. These were mainly patients with severe spinal injuries. Only 16 (1.5%) amputations were required. In the Turkish study of the Marmara 1999 earthquake, 11.1% of extremity injuries needed amputations.[11] This could be because of aggressive wound management, fewer patients with renal failure,[12] availability of resources for active observation, and discussion among the surgeons before decision-making. Surgical site infection (SSI) occurred in two orthopedic implant surgeries. Both grew staphylococci, similar to the other studies.[13] We lost only three flaps and two grafts, which is remarkable considering the magnitude of surgeries performed, under less than ideal sterilization conditions. Redo surgeries were performed in six patients. When compared to the tsunami casualties in Indonesia,[14-16] the outcomes were much better. This may be due to the meticulous and systematic review of all the wounds by senior consultants, as well as the methodological care of wounds in a tertiary care hospital.

Most of the problems encountered were logistic in nature. However, a few definite problems were encountered and necessitate improvement for future catastrophes. A sufficient number of long limb splints and external fixators were not available in the initial days. Procurement of appropriate implants was a big problem, as the market soon ran out of its supplies. A sufficient number of these need to be always kept in stock, as part of disaster management emergency stocks.

Mobilization of medical students and other trained and untrained volunteers took a long time to fully take off. They eventually turned out to be a highly motivated and essential force, with benefits both for the patients and students themselves. Considering the number of split thickness grafts that were required, sufficient dermatomes and meshers were not readily available. On our feedback, the voluntary teams that came from other parts of the country brought these with them.

Patients were managed in 13 different wards with limited manpower. Many patients needed to be shifted into various wards for administrative and social needs, causing great hurdles in the continuity of care for these patients.

Patient waiting times outside theaters increased greatly once the load increased. As the teams were located in one theater area, all procedures including debridements and major dressings had to be performed there. A separate area, near their wards and away from the main operating theaters, where such procedures can be carried out, would reduce the congestion in waiting areas, as well as prevent mixing of contaminated and clean cases. Volunteer medical teams from home and abroad came in large numbers. All had traveled great distances and were truly dedicated. However, the limitation factor in the end was the theater space, equipment, supplies, and paramedical staff, not the surgeons. A better coordination is required for sending the teams where they are most needed, instead of deputizing them in an already staffed tertiary hospital.

Most of the procedures, even dressings, needed to be carried out under general anesthesia, in these already distressed patients. Intravenous ketamine was determined to be a safe and adequate anesthetic for most situations. This point has already been confirmed in other reports.[17,18]

In conclusion, reduction in mortality and morbidity in mass disaster can be achieved only by a well-organized and concise but flexible disaster plan. This avoids potential chaos in such situations. It is important to quickly organize teams that deal with patients in reception, wards and operation theaters. A shift system with recruitment and appropriate utilization of volunteer manpower is essential. The major bulk of the work involves soft tissue injuries, bones, spine and plastic surgical procedures. Preparedness and well-conceived plans prevent unnecessary morbidity and mortality.

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