Medical Care for Earthquake Victims

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A number of recent earthquakes such as the 1985 Mexico City earthquake, the 1986 El Salvador earthquake and the 1988 earthquake in Soviet Armenia demonstrate that the collapse of reinforced-concrete buildings is a significant and continuing problem. Traditionally, search and rescue (SAR) operations have been carried out, for the most part, by untrained persons such as relatives, neighbours, or local volunteer groups. It is clear that the increasing frequency of disasters in large urban areas, coupled with the collapse of reinforced concrete buildings, calls for a more professional approach, particularly for specialized medical and rescue skills.

Past research has shown that factors determining the number of people killed after a building collapses include entrapment, the severity of their injuries, how long they can survive without medical attention, and time to rescue and medical treatment. Rescue and medical personnel operate under a very constrained time element. Following a catastrophic earthquake, research has shown that 85-95% of the live recoveries are made within the first day, while, beyond that time, the rate of recovery of live victims drops off very sharply. Estimates of survivability for entrapped victims buried under collapsed earthen buildings in Turkey and China, indicate that within two to six hours, less than 50% of those buried are still alive. Although it is not always possible to determine whether a trapped person died immediately or survived for some time under the debris, it is undoubtedly true that more people might have been saved if they had been extricated sooner. In everyday trauma we talk about the "Golden Hour." For victims of building collapse,

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Earthquake victim carried from a destroyed building in Guatemala City.

we can talk about a "Golden Twenty-four Hours."

Successful search and rescue endeavours consist of rapid location, access, extrication, stabilization and transportation of victims. Since victims of building collapse may be trapped for hours, if not days, it is important that on-site medical personnel be trained to resuscitate and stabilize such patients while they are being actively extricated. In the case of Mexico City, more than 400 major buildings were seriously damaged, and there were more than 40 major collapses of reinforced-concrete buildings. It is estimated that more than 10,000 people were trapped in collapsed buildings as a result of the earthquake. In Armenia, more than 40,000 persons were trapped. When comparing the number of injuries to the number of available trained medical personnel, it becomes self-evident that what scarce resources are available must be used where they will do the most good. In other words, medical personnel must be able to rapidly determine approximate number of victims, probable locations of survivors, and potential for survival.

For those trapped survivors, there are serious problems with limb compression and dust inhalation. Some of these persons will require in-field amputation in order to extricate them. Therefore, search and rescue must be combined with effective immediate emergency medical care. Such medical care will of necessity be austere, and conditions usually will not allow for definitive care of minor or moderate injuries. Any field medical intervention should be oriented toward stabilization of immediate life threats (eg. maintenance of airway patency, management of external hemorrhage) and relief of severe pain.

Medical teams from many different countries have been used in past earthquake rescue operations. Unfortunately, with only a few exceptions, most of these teams had no previous earthquake or heavy urban rescue experience. This lack of experience points out the need for greater professionalization of disaster medicine in earthquakes, better equipment, techniques and training. The ultimate goal should be the development of well-trained, highly specialized rescue and medical personnel, preferably working together as a combined unit and located in areas of greatest seismic risk.

Members of building collapse rescue teams should be very familiar with the following topics:

- Causes of building collapse (e.g. earthquakes, wind, blast);
- Building types and construction (e.g. building typology by structural type, patterns of failure, characteristics of construction materials);
- Current state of the art in collapsed building search and rescue (e.g. new developments in location and extrication techniques and equipment);
- Injury patterns observed in building collapse (e.g. distribution of types of injury, morbidity/mortality time trends, crush injury/syndrome);
- Emergency medical treatment for victims of building collapse (e.g. first responder responsibilities, on-site treatment/triage, prevention and treatment of rhabdomyolysis (injury to muscle cells) communications and transportation);
- Health considerations for rescue and medical workers (e.g. physical hazards in the unstable collapse environment, precautions regarding food and water in less developed countries).

Necessary knowledge for effective rescue and medical care

For guiding future earthquake rescue and medical operations, it is necessary to have information about the actual location of the victims in the collapsed structure as well as specific details about the extrication process itself. Knowledge of collapse conditions helps set rescue and medical priorities. The construction of a building gives some indication of the way it may collapse as a result of a blast, earthquake, cyclone, or other disaster. Buildings of the same class and type of construction collapse in much the same way, and common factors are present. It is important that rescuers and disaster medicine specialists study these factors, since this knowledge will prove helpful when extricating and treating building-collapse casualties.

For example, almost all types of damaged buildings will contain voids or spaces in which trapped persons may remain alive for comparatively long periods of time. To know where these safe places may be, it is necessary to know the characteristics of various types of construction. Victims are best able to survive in V-shaped and lean-to voids, and by searching there first, rescue personnel have a better chance of reaching survivors in time.

It is not enough to know only where to find potential survivors. There should be no delay in instituting treatment for patients even when they are still entrapped. Rescue and medical personnel must know what to do once these persons are

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located. They must have some knowledge of what specific types of injuries to expect as well as how to estimate relative injury severity and prognosis. The latter is essential for effective triage. Severe dust inhalation with resultant pneumonitis is an important problem for victims of building collapse. Therefore on-site rescue and medical personnel should be well-versed in techniques of airway management and oxygen administration. Optimally, they should know how to stabilize the cervical spine and start intravenous lines and administer life-saving fluids and medications. They must also be able to recognize and treat problems of prolonged limb compression such as compartment syndrome and crush syndrome. These conditions require immediate attention and cannot wait until the victim has been completely extricated and transported to a treatment area.

In particular, they must be aware of the potential for acute renal failure associated with rhabdomyolysis and should carry the appropriate fluids and medications to treat this condition. Rescue personnel must be prepared for rapid deterioration of patients upon extrication due to decompression of limbs, shock, electrolyte abnormalities and metabolic acidosis.

Efforts to remove occupants from a collapsed building may expose rescuers and on-site medical personnel to dangers similar to those faced by the victims. Rescue and medical personnel must constantly observe all safety precautions to protect themselves from injury. For example, the destruction of buildings and industrial facilities by any catastrophe will invariably result in

El Salvador, earthquake 1986. ASC/Jean-Philippe Jutzi

ruptured electrical, water, gas, and sewer lines. Other hazards will be escaping gases and chemicals used in refrigeration units and in certain industrial operations. These utilities create serious problems for casualties and rescue personnel. Each person on the team must be knowledgeable regarding these potential hazards and trained to be alert to any change in conditions at the collapse site that could raise an additional threat to their safety. Rescue personnel should also be instructed in the proper method for shutting off water, gas, and electricity, and be informed of the probable locations of shutoff valves and master switches.

Research on rescue methods and medical treatments for victims of building collapse is currently underway at several centers. These include a systematic comparison of the many existing techniques of search and rescue, including a controlled evaluation of equipment and techniques (e.g., efficacy of dogteams; remote sensing equipment, portable seismographs, borehole cameras, infrared detectors, carbon dioxide sensors, etc.) Others are studying the functional requirements of search and extrication devices, including the development of performance specifications for devices which will penetrate a collapsed structure to detect or reach a victim.

Conclusions

It has become apparent from past building collapse events such as those in Mexico City and in Armenia that some principle for effective collaboration and compatible organization of rescue and disaster medicine teams is required. Training and education standards for rescue and disaster medicine personnel must be developed for effective response to earthquakes. The development of joint training for rescue and medical teams should lead to greater co-ordination and effectiveness in future earthquakes.

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