Coping in a calamity: Radiology during the cloudburst at Leh

Debraj Sen
Department of Radiodiagnosis, Asst Prof. (Radiodiagnosis), Command Hospital (CC), Lucknow, Uttar Pradesh, India

Correspondence: Dr. Debraj Sen, Asst Prof. (Radiodiagnosis), Command Hospital (CC), Lucknow - 226 002, Uttar Pradesh, India.
E-mail: sendebraj@gmail.com

Abstract

The service hospital at Leh is a multispeciality hospital situated at an altitude of 11000 feet above mean sea level. On the nights of 4 and 5 Aug 2010, Leh was struck by a cloudburst leading to mudslides and consequently extensive damage to life and property. Being the only functional hospital, over a period of about 48 hours, 331 casualties were received. 549 casualties were received over the week with 108 admissions, 16 major surgeries and 138 minor surgeries. 178 radiographs, 17 CT scans and 09 ultrasound-colour Doppler examinations were performed on an urgent basis over 48 hours apart from the routine radiological investigations. Apart from chronicling the event, we hope that sharing the unique experience of the Radiology Department in dealing with the large influx of patients would provide an insight into the role of Radiology during the disaster and help in planning and developing management protocols during other calamities.

Key words: Calamity; emergency radiology; focused abdominal sonography for trauma; triage

Introduction

Leh, the capital of Ladakh region of the state of Jammu and Kashmir, is situated at an altitude of 11,000-11,500 feet above mean sea level. Ladakh is a cold desert and receives minimal precipitation. The topography is barren and devoid of trees or major vegetation on the mountain slopes. The loose soil is clay-like and hardens on loss of moisture. The local populace uses timber and sun-dried bricks made of this clay-like soil to construct their houses.

On the nights of 4 and 5 Aug 2010, there was a heavy downpour at Leh. Due to the barren topography, a large number of mudslides were triggered which inundated major parts of the town with mud, boulders, and rubble, and caused collapse of many houses, buildings, and bridges. The injured included locals, migrant labourers, and foreign tourists.

This was a disaster situation as the civil government hospital was rendered non-functional due to extensive sludge and waterlogging. In this scenario, all the casualties were diverted to the service hospital that faced a disaster management situation. It is a multispeciality hospital with a bed complement of 210 and a posted strength of 15 officers including 4 medical officers and a single surgeon, anesthesiologist, physician, radiologist, pathologist, dermatologist, ophthalmologist, and otorhinolaryngologist. Of these, 12 officers were present on the night of the cloudburst. Of the posted strength of 12 nursing officers, 10 were present. The Radiology Department had a single technician and radiologist.

In the immediate aftermath, over a period of 48 h, 331 casualties were received. The injuries were sustained due to collapse of buildings and due to the boulders and debris in the streams of mud in which many people got swept away. These injuries ranged from extensive abrasions, deep lacerations, and fractures to head injuries. A large number of people also suffered from post-traumatic stress due to loss of homes, family members, and livelihood. A large number of people also suffered from post-traumatic stress due to loss of homes, family members, and livelihood. A large number of people also suffered from post-traumatic stress due to loss of homes, family members, and livelihood. A large number of people also suffered from post-traumatic stress due to loss of homes, family members, and livelihood.
9 ultrasound-color Doppler examinations were performed on an urgent basis over the initial 48 h, apart from the routine radiological investigations. This radiological effort was equivalent to nearly 5 days of average radiography and CT workload and put a strain on the availability of the consumables. It required meticulous execution relying on a close coordination between the clinicians and the Radiology Department, an optimal utilization of the meagre radiological equipment available at the hospital, pragmatic administration, and a high level of motivation.

We hope that sharing the unique experience of the Radiology Department in dealing with the large influx of patients in the face of limited resources would provide an insight into the pivotal role of radiology during the disaster and help in planning and developing management protocols during other calamities in future.

Managing the Actual Event

The hospital disaster management plan was put into action. In this scenario, the problem was threefold: (a) Sudden influx of a large number of victims of the natural disaster overwhelming the available resources of the hospital; (b) transfer of all the existing in-patients of the civil hospital, some of whom were on critical care support, saturating the surge capacity of the hospital; and (c) managing the existing in-patients of the hospital.

Apart from the large number of patients, the mud-caked and wet clothing of the patients and mud on all the body surfaces, obscured wounds and anatomical landmarks, and made the investigation and diagnosis of the injuries difficult and time consuming.

Due to lack of space, triage and first-aid was conducted in the corridors adjacent to the entrance lobby of the hospital. The radiologist stationed himself at the triage area and was integrated into the triage process in identifying patients who required radiological investigations, the type of radiological investigation required like plain radiographs, Focused Abdominal Sonography in Trauma (FAST), CT scan, and its urgency. This facilitated the orderly inflow of patients toward the radiology services.

Patient identification and documentation was a problem due to a large number of patients being semi-conscious or being children. Further, placing appropriate identification marks on films was difficult. Hence, random numbers were placed on the patients’ forehead and wrist and tallied with films and the same marked on the case sheets. Radiographs were immediately processed and sent out with the patients’ documents to avoid interchange. The radiologist subsequently went to each ward to report on the films. The departmental documentation was also completed subsequently as and when the identity of the patients was confirmed.

The wet and mud-caked clothing presented a hindrance to imaging and their removal was a time-consuming process. The X-ray tables required frequent cleaning due to the mud and dirt shed from the clothing and bodies of the patients. Precious time was again lost cleaning the abdominal surface of all mud and grit before FAST. The presence of mud on the body surfaces and scalp hair made the radiographic interpretation difficult and often impossible [Figure 1]. CT scans presented a similar problem due to the omnipresent mud. The gantry and table had to be vacuum-cleaned after each scan. The problem was partially circumvented by seeking the assistance of attendants/volunteers in removing clothing and cleaning the body parts.

Interpreting all the radiographs, ultrasound, and CT scan images single-handedly within a reasonably short span of time and conveying the same to the surgeon or treating doctor was a Herculean task, especially in cases of unidentified patients.

Lack of space and trained manpower in the Radiology Department led to crowding in and outside the department. To save time, whenever possible, we performed radiographs on the stretchers itself with portable X-ray machines.

The distance between the Accident and Emergency (A and E) Department, operation theatres, surgical wards, and the radiology and CT wings was considerable (50 m) and valuable time was lost in transit [Figure 2] due to this design flaw. To avoid patient inconvenience and wastage of time, a portable ultrasound machine was stationed in the intensive care unit (ICU) to enable ultrasound examinations to be performed there itself.

A total of 178 radiographs, 17 CT scans, and 9 ultrasound-color Doppler scans were performed on an urgent basis [Tables 1 and 2]. Out of 178 radiographs, 124 had positive findings (~69% as compared to just about 35%
during non-emergency routines) in the form of fractures and aspiration of mud (mud-bronchogram) [Figure 3]. Intra-abdominal fluid was noted in four of the eight patients suspected to have abdominal trauma. Deep venous thrombosis of a lower limb was noted in one patient on color Doppler. Of the patients who underwent CT scans, 11 had skull fractures with signs of brain injury. Three patients had multiple vertebral and pelvic fractures. The presence of a radiologist during triage led to better decision making in terms of requirement of imaging for a particular patient, the modality that would best serve the purpose under the given circumstances, the urgency of imaging, and judicious and even usage of all available radiology resources. This contributed to a high yield of positive findings as is evident from Table 2. By helping reach a definite diagnosis and its severity, imaging was critical not only in deciding the appropriate course of action to be followed for a particular patient but also helped in the judicious and timely utilization of resources. Simple innovations like usage of serial numbers for all patients during initial documentation and imaging, pending confirmation of identity, helped obviate confusion and saved much valuable time. Other innovations like taking radiographs on the floor/stretchers obviated crowding within the department, excessive patient movement and reduced the requirement of manpower and increased patient throughput. Placing portable ultrasound machines and x-ray machines at critical areas apart from the radiology department also helped. Recruiting attendants and volunteers to help clean up the body parts and remove soiled clothing and also the radiography tables before imaging saved precious time and reduced distractions for the staff.

**Discussion**

A disaster is unanticipated low probability but high impact event that causes widespread devastation, disrupts routine life and causes a large number of people to become ill or injured. The International Federation of Red Cross and Red Crescent Societies defines a disaster as an event that causes more than 10 deaths, affects more than 100 people, or leads to an appeal for assistance by those affected. Planning and preparedness for a disaster is the only way of mitigating its effects. However, every new disaster presents new scenarios and provides new lessons and insights in terms of processes, practices, and resource utilization.

Radiology during disasters and calamities helps in arriving at the correct diagnosis, categorization of the severity of injuries, and hence appropriate management of patients.

Our experience can be contrasted with the experience of the Ochsner Medical Centre, New Orleans, USA, and other reported instances. A line diagram showing the layout of the hospital is provided to illustrate the location of various departments.

**Table 1: Demographics of patients**

|          | Males | Females | Total |
|----------|-------|---------|-------|
| Locals   | 50    | 17      | 67    |
| Migrants | 47    | 31      | 78    |
| **Total**| 97    | 48      | 145   |

**Table 2: Radiological investigations**

| Name of the investigation          | Number of investigations | Positive findings |
|------------------------------------|--------------------------|-------------------|
| Radiographs                        | 178                      | 124               |
| Chest                              | 43                       |                   |
| Bones and joints                   | 116                      |                   |
| Skull                              | 18                       |                   |
| Abdomen                            | 1                        |                   |
| Ultrasound-colour doppler          | 9                        | 4                 |
| Abdomen (FAST)                     | 8                        |                   |
| Colour-doppler lower limb (venous) | 1                        |                   |
| CT scans                           | 17                       | 14                |
| Head                               | 12                       |                   |
| Thorax                             | 1                        |                   |
| Spine                              | 2                        |                   |
| Others                             | 2                        |                   |
Radiology is a power-intensive department and there should be adequate power back-up in the form of generators and uninterruptible power supply (UPS) units for running the various equipments. The location of the generators should be such that they are safe from inundation in case of flooding. Multiple small portable generators may also be considered for individual machines at different locations in case of failure of the main generators. There should be adequate provision for storage of water, not only for drinking but also to service toilets, air-conditioners, and autoprocessors.

Frequently, in such situations, when the conventional communication modalities like telephones and mobile phones are overloaded, wireless radio sets would be a big advantage.

In disasters and calamities, when patient identification is a problem, each patient may be given a unique number tied to his/her wrist/ankle and all documents/investigations carry the same number till identity is established. Such tags should be made available at all times in the A and E dept.

Finally, adequate trained manpower is essential to deal with the sudden influx of a large number of casualties and the need to carry out routine departmental work and to ensure adequate rest and sleep for the staff. Toward this end, all paramedics should be made conversant with basic radiographic equipment and trained to take basic radiographs.

**Conclusion**

We can never be too prepared for calamities and disasters. Our disaster plans need to be pragmatic, flexible, and should be continuously reviewed, updated, and improved upon. It is hoped that the experience of the Department of Radiology at the service hospital during the cloudburst at Leh in Aug 2010 will help others in preparing for similar adversities.

**References**

1. Waltzman M, Fleeger E. Preparing for natural disasters. Clin Pediatr Emerg Med 2009;10:144-8.
2. Bluth EJ, Kay D, Smethinger D, DeVan D, Eick J, Mathews C, et al. Managing in a catastrophe: Radiology during Hurricane Katrina. AJR Am J Roentgenol 2007;188:630-2.
3. Heffernan TE, Alle S, Matthews CC. Weathering the Storm: Maintaining an operational radiology department at Ochsner Medical Center throughout Hurricane Katrina. Radiology 2007;242:334-7.
4. Engel A, Soudack M, Ofier A, Nitecki SS, Ghersin E, Fischer D, et al. Coping with war mass casualties in a hospital under fire: The Radiology experience. AJR Am J Roentgenol 2009;193:1212-21.
5. Eldar R, Inbar A. Diagnostic radiology in disaster medicine: Implications for design, planning and organization of X-ray departments. Injury 1987;18:247-9.