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Coping in a calamity: Radiology during the cloudburst at Leh

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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.

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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 total of 549 casualties were received till 12 Aug, of which 108 required admission. Sixteen major and 138 minor surgeries were performed in this duration. To support this massive surgical effort, a total of 178 radiographs, 17 computed tomography (CT) scans, and

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%

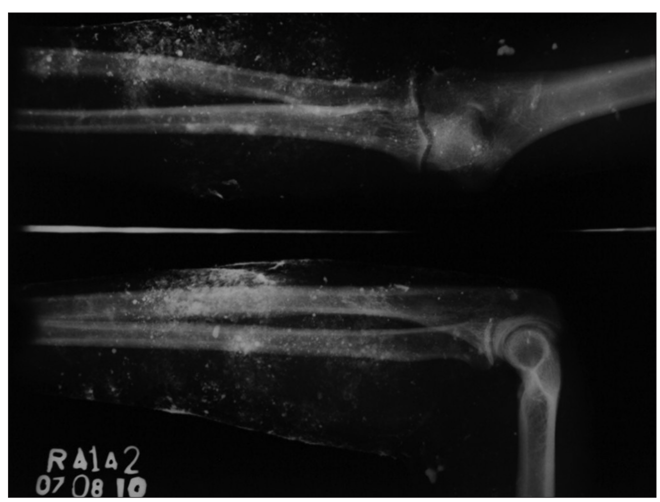

Figure 1: Radiograph of the elbow showing the bones obscured by mud and grit on the body surface

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 through-put. 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.[1] 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.

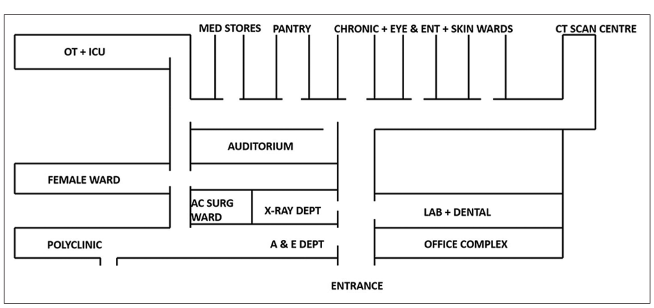

Figure 2: Line diagram showing the layout of the hospital. The CT scan center, radiography units, A and E Dept, and OT are at a considerable distance from each other

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,

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	

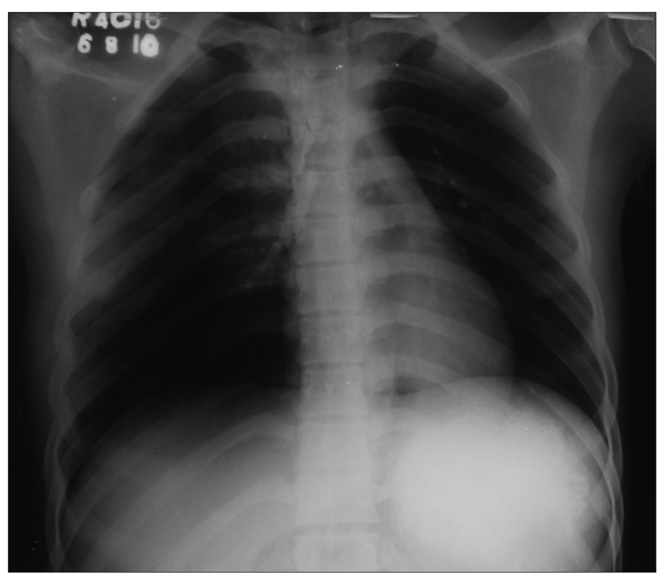

Figure 3: Radiograph Chest (PA view) showing aspirated mud outlining the trachea and bronchi (mud-bronchogram)

during Hurricane Katrina in Aug 2005. There were 3 staff radiologists, 3 residents, 16 technologists and support staff, 1 information services individual, and 1 service engineer retained in the hospital (rest of the departmental staff was evacuated) to deal with the casualties. A total of 130 examinations of all types were performed in the first 4 days.[2,3] During the 34 days of the Second Lebanon War (July-Aug 2006), the Technion-Israel Institute of Technology Medical School, Haifa, Israel, received 849 patients of whom 511 were physically injured and required medical imaging. More than 16 staff radiologists, 3 residents, 25 technologists, 5 nurses, and 10 clerks were present daily in the department.[4] It is apparent that in comparison, our experience was more impactful both in terms of number of radiological examinations conducted as well as the limited number of trained manpower available.

The lessons learnt during this calamity will help us in being better prepared in future and also provide valuable insights to others for dealing with similar situations. First and foremost, radiology needs to be incorporated into each and every disaster plan right from the time of infrastructure planning and execution. The average yield of the positive findings was much higher in our case partly due to the more efficient triage process due to the incorporation of the radiologist in the triage. If replicated during similar disasters, the strategy of the radiologist playing a pivotal role in the triage process, in addition to the anesthesiologist and other clinicians, will significantly augment the triage and make it more effective. Further, this incident also demonstrates the need of sensitizing Medical Officers and Clinicians tasked with the triage process to the requirement of triage for the radiological investigations which can become critical at such times. Inclusion of a radiologist in the triage team will help determine the appropriate investigative modality and its urgency and increase the yield of these tests.

It is important to have the Radiology Department with all its subsections like CT scan centre, Magnetic Resonance Imaging (MRI) centre, Digital Subtraction Angiography (DSA) lab as close to one another and to the Accident and Emergency Department and the Operation Theatres so that patients can be quickly triaged and sent for the appropriate medical imaging and subsequently for surgery if required. The department should have broad corridors to allow easy passage of trolleys and stretchers and large waiting areas to prevent crowding. Separate entrance and exits would allow unidirectional flow of patients and also prevent congestion and crowding.[5] Being an equipment-heavy department, which is prone to damage due to dust, moisture, and water, the department should preferably be located on the first floor of a building to avoid the danger of flooding. Adequate provision for electrical power points, piped oxygen, and suction and devices for hanging infusion sets should be present.[5] 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.

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