EARTHQUAKE RADIOLOGY

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ABSTRACT

Purpose: *To show the spectrum of patients a radiology department of an unaffected backup hospital may be faced with after a massive disaster like the earthquake of 17.8.1999 in the north western province of Turkey. Problems that had arisen during the increased work load at the emergency radiology department were also noted in order to make necessary improvements and modifications.* ***Methods:*** *Medical records of 284 patients who were transferred to our university hospital following the devastating Marmara earthquake have been reviewed. All types of radiological examinations were noted and classified. Demonstrative cases were selected.* ***Results:*** *Plain radiography was the most frequently used technique because most of the patients had multiple traumas (314 films in 174 cases). Different types of appendicular skeletal fractures and crush injuries were seen. Ultrasonography was mostly used for patients with blunt abdominal trauma. In seven cases, kidney changes secondary to acute tubular necrosis resulting from massive crush injury were noted. Cranial and vertebral column examinations were the two major computed tomographic examinations. Use of MRI or angiography was infrequent and did not increase the normal workload of these departments.* ***Conclusion:*** *Due to the acute increase in work load and change in the spectrum of patients in a catastrophic disaster even in a remote hospital, all radiology departments should have a well planned disaster response mechanism. Radiologists specialized in trauma and emergency radiology should be readily available.*

Key Words: *Disaster Medicine, Radiology.*

INTRODUCTION

The major earthquake that hit the northwestern area of Turkey at 3.02 a.m. on the 17th of August, 1999 caused a tremendous amount of damage in less than a minute. Seven cities, most of which are heavily industrialized, were located along the affected line of approximately 300 km. The total number of casualties were over 17,000 and the number of people injured were well above 45,000. Communication and transportation networks as well as other lifelines were severed in many places. The destruction of roads, highways, bridges, and railways made it difficult for people to move within this area. Thus, the modern healthy urban lives that people had taken for granted were lost in a moment. Medical facilities within the region were also greatly damaged. Emergency responses to the disaster were delayed. Although transportation of severely

injured patients away from the disaster area was not smooth because of the interruption of communication and traffic congestion, back-up hospitals in unaffected cities took over the responsibility of giving good medical service to the unfortunate victims. Radiology departments behaving as an emergency radiology section as a whole played one of the major roles.

In this study we tried to show the spectrum of patients with which a radiology department of an unaffected backup hospital may be faced after a massive disaster. The scope of the damage from the disaster, types of injuries, characteristics of the victims, problems with emergency radiology service encountered in such a massive disaster, and revisions of countermeasures executed after the disaster are reported.

MATERIALS AND METHODS

Our university hospital is a back-up hospital located nearly 200 km away from the disaster area. Medical records of 284 patients who were transferred to our university hospital within 10 days following the devastating Marmara earthquake have been reviewed retrospectively from the patients' charts. Types of injuries and applied radiological examinations were noted. Eight of the patients unfortunately were already dead at the time of arrival at the hospital. Among the remaining, 58 cases were excluded because of insufficient data in their records. Consequently 218 cases were included in this study.

RESULTS

Twentysix victims were found to be normal on physical examination and an additional 18 cases needed psychiatric consultation. No radiological examination was performed in those victims. One hundered and fifteen patients had direct physical injuries including skull, spine, extremities and blunt abdominal trauma. Thirty patients had either upper airway, pulmonary or gastrointestinal infections and the remaining 26 had other types of diseases such as cerebrovascular accident, deep venous thrombosis, angina and pregnancy-related problems. Seventyfive of the cases were hospitalized and others were treated on an out patient bases. Eight of these were sent to another center. Plain radiography was the most frequently used radiologic technique. The total number of radiographies was 341. Computed tomography was carried out 31 victims and ultrasonography was performed on 28 patients. The great majority of ultrasound examinations were performed to evaluate the abdominal cavity (21 out of 28). Angiography and MRI were used very seldom. Numbers of different types of examinations can be seen in table 1. A significant increase of workload was only seen in direct X-ray rooms and portable machines, which necessitates additional staff and supportive measures.

DISCUSSION

Disaster medicine is in its infancy all over the world but this area of medicine is rapidly developing into a sub-speciality within emergency medicine. Developed countries especially try to form detailed disaster response plans including designation of specially trained teams for different needs before the occurrence of a possible event (1). Medical care teams both at the affected site and in back-up hospitals will certainly play the major role in decreasing the immediate casualties and establishing a good working medical service for the survivors. A tremendous increase in the number of patients with multiple trauma in an unstable condition and even at significant risk of death within a short time period necessitates rapid diagnosis and application of the most appropriate treatment as soon as possible. In such cases radiology departments equipped with state of the art imaging facilities and well trained staff play the key role in increasing the patient turnover rate and quality of medical service (2).

Table - 1: Distribution of different type of radiologic examination.

	X-Ray	CT	US	MRI	Anjiography
Cranium	35	11	1	1	0
Spine	118	11	0	1	0
Chest	58	5	0	0	0
Abdomen	14	3	20	0	0
Pelvis	21	2	2	0	0
Extremities	95	0	5	0	2
Total	**341**	**32**	**28**	**2**	**2**

From the radiological perspective, results of this study revealed some important data that may be useful for future organization of radiology services in an unaffected back-up hospital. The numbers and figures emerging from this study will help to design new disaster response plans and allow us to delineate the roles and responsibilities of radiology departments within the medical team.

Although the majority of patients were trauma cases, a significant number of victims having medical problems not related to the disaster such as infectious or cerebrovascular diseases (34 %) were also transferred to our hospital. This ratio was reported as 41 % in the Kobe earthquake in 1995 (3) and it was stated that the number of patients with other types of illnesses continued to increase over the entire 15-day period after the earthquake (4). Preparation of the back-up hospitals not only for trauma cases but also for other types of medical problems is important. Hospitalization rate is quite high. Seventyfive of 218 victims were hospitalized (34 %). Increasing the inpatient capacity and discharging the patients with minimal risk should also be taken into account.

A major increase of workload was experienced only in the conventional radiography section of our radiology department within the 10 day period. Nye et al also reported that plain radiography, computed tomography and the hospital laboratory were the most significantly utilized services after the Oklahoma city terrorist bombing in 1995 (5). In addition to emergency radiology rooms, all out patient X-ray rooms served for the victims and no examination delay occurred. Increasing the number of technicians and other staff working in emergency radiology were the other measures for overcoming this problem. In our department two additional senior radiologists were scheduled on night call in case of an unexpected number of patient arrival. The majority of conventional radiographs was for extremity and vertebral column examinations (213 out of 341). (Fig. 1.) Those parts of the body were reported to be most frequently injured parts after the earthquakes (6, 7)

Computed tomography was used in 32 cases. The majority of examinations were used for cranial or spinal pathologies (22 of 32). Parenchymal organ laceration after blunt

Fig. 1: AP radiographs demonstrate fractures of femur shaft A. Before and B. After internal fixation.

abdominal trauma was another important indication for both abdominal CT (Fig. 2.) and ultrasonography (20 of 28). Evaluation of kidneys for oliguric or anuric patients with the possible diagnosis of crush syndrome was also requested. (Fig. 3.) No alteration in routine daily practice schedule was necessary in the ultrasonography and computed tomography sections. Use of other imaging modalities such as MRI and angiography was infrequent.

In conclusion, improvement of the quality and speed of the radiological service for large numbers of victims after an unexpected disaster

Fig. 2: Contrast enhanced computed tomography examination reveals laceration of right lobe of the liver.

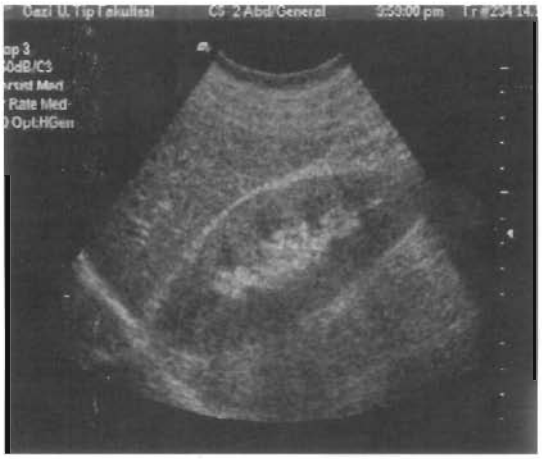

Fig. 3: Enlarged kidney due to rhabdomyolisis. Cortical echogenicity is increased and medullary pyramids are prominent.

is mandatory. In our opinion forming a team among the staff which can reach the hospital as soon as possible after such an event is one of the key points. Two senior, four junior radiologists and a sufficient number of radio-technologists should be included within this organization. The technical capacity of the emergency radiology department is the other important issue. Digital radiography, multiple conventional X-Ray tables Ultrasonography and spiral CT should be available within the emergency department or in the close vicinity. Fast daylight film processors facilitate the patient turnover.

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