Thorax and Lung Injuries Arising From the Two Earthquakes in Turkey in 1999*

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Study objective: To make a descriptive analysis of the frequency and the type of thorax and lung injuries among the casualties of the two devastating earthquakes that occurred in Turkey in 1999.

Design: Records of the hospitalized patients injured in the earthquakes were examined retrospectively.

Results: Among the total of 356 hospitalized patients, 21 (9.7%) in the Izmit earthquake and 6 (7.6%) in the Duzce earthquake had thorax and lung injuries. Pneumothorax and rib fractures were the two most frequent pathologies and accounted for 50% and 33.3% of the injuries, respectively.

Conclusion: Approximately 10% of the casualties of a great earthquake may be expected to have thorax and lung injuries, and traumatic chest diseases should be considered in planning the medical response strategies.

Key words: earthquake; injury; thorax

Turkey was hit by two devastating earthquakes on August 17 (Izmit region; magnitude, 7.4 on the Richter scale) and December 12 (Duzce region; magnitude, 7.2 on the Richter scale) in 1999.1 Officially, 15,000 people were killed and > 30,000 people were injured, but estimates were about twofold to threefold higher.2 A great number of the casualties were treated in Kartal Education and Research Hospital due to its nearby location.

Among the total of 356 hospitalized patients, 9.7% of the Izmit earthquake casualties and 7.6% of the Duzce earthquake casualties had thorax and lung injuries. A retrospective descriptive analysis of the frequency and type of thorax and lung injuries has been performed, and the results were compared with those from previous earthquake disasters that have been reported.

Materials and Methods

Two hundred sixty-one trauma patients were hospitalized between August 17 and 31, 1999, following the Izmit earthquake. Of those patients, 215 (82.38%) had records that could be accessed. Twenty-one of the 215 patients (9.77%) had thorax and/or lung injuries, and these records were examined in detail. Chest radiographs, physical examinations, and, in some cases, CT scans of the thorax were used in diagnosing the thorax and lung injuries.

Ninety-five trauma patients were hospitalized between December 12 and 20, 1999, due to the Duzce earthquake. Seventy-eight records for these 95 patients (82.11%) were available, and 6 patients (7.6%) were found to have thorax and lung injuries.

Results

There were 21 patients with thorax and lung injuries after the Izmit earthquake (9.77% of the total; women, 8 patients [38.1%]; men, 13 [61.9%]). The mean age was 35.6 years (age range, 6 months to 79 years). The distribution of the thorax injuries is summarized in Table 1.

Pneumothorax was the most frequent pathology (52.4%). One patient had a bilateral pneumothorax, and another one had a pneumohemothorax.

Four patients (19%) had hemothoraces, of which two were accompanied by rib fractures and one by a pneumothorax (Fig 1). Tube thoracostomy was performed on arrival at the hospital in 10 patients. Among the seven patients (33.3%) with rib fractures, five had multiple rib fractures (Fig 2).

Four patients (19%) with severe trauma developed crush syndrome and ARDS (Fig 3). The duration of the entrapment under the rubble was as long as 9 h for one patient. The time until rescue was not recorded in the other three patients, but we can infer from the date of hospitalization that it was < 24 h.
Three patients had pneumonia. Two of them had minor injuries and were admitted to the hospital because of the pneumonia that had developed within 3 days after the earthquake. The third patient was a child with head trauma who developed a case of hospital-acquired pneumonia on the sixth day of the hospitalization. One patient had a pulmonary embolism in the follow-up period.

Three patients (ARDS, two patients; pneumothorax and intra-abdominal bleeding, one patient) died. Other complications encountered were sepsis in two patients, acute renal insufficiency in four patients, GI bleeding in one patient, and pelvic infection in one patient.

The types of injuries that accompanied the thorax and lung injuries were as follows: extremity injury (bone fracture), eight patients; head trauma with subarachnoid hemorrhage, four patients; abdominal trauma, one patient; vertebral injury, one patient; and pelvis injury, one patient. Edema and contusion in several areas were seen in four patients.

There were six patients (7.6% of the total) with thorax and lung injuries after the Duzce earthquake. Of those patient, five were men (83.3%) and one was a woman (16.6%). The mean age was 51.3 years (age range, 35 to 70 years) The distribution of the thorax injuries is summarized in Table 2.

Pneumothorax was again the most common pathology (50%) after the Duzce earthquake. Two pneumothorax patients had also suffered rib fractures. The rib fractures in those patients were multiple, and one of them had a hemothorax while the other had subcutaneous emphysema. A tube thoracostomy was performed on arrival in four patients.

A pulmonary consultation was requested for two patients with dyspnea. Both had lower extremity bone fractures, and in one of them the chest radiograph revealed minor changes that were attributed to a pulmonary contusion. The second patient was consulted on in the emergency department on his arrival. He had moderate bronchospasm attributed

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**Table 1—Thorax Injury Details in Hospitalized Patients After the Izmit Earthquake**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax</td>
<td>11</td>
<td>52.4</td>
</tr>
<tr>
<td>Hemothorax</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Rib fracture</td>
<td>7</td>
<td>33.3</td>
</tr>
<tr>
<td>Subcutaneous emphysema</td>
<td>2</td>
<td>9.5</td>
</tr>
<tr>
<td>ARDS</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>1</td>
<td>4.8</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>3</td>
<td>14.3</td>
</tr>
</tbody>
</table>

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**Figure 1.** Chest radiograph of a 14-year-old girl with a left hemopneumothorax, who was rescued after 5 h of entrapment.

**Figure 2.** Chest radiograph of multiple rib fractures in an 11-year-old boy, who was rescued after 10 h of entrapment.

**Figure 3.** Chest radiograph of a 39-year-old man with crush syndrome and ARDS.
to the severe inhalation of dust (ie, bronchial hyper-reactivity), although he had no history of asthma. These patients were classified as the dyspnea group in Table 2.

The accompanying injuries of the patients in Duzce earthquake were lower extremity bone fractures in three patients and pelvis injury in one patient. None of the patients experienced crush syndrome or ARDS after the Duzce earthquake, and none of them died.

**Discussion**

Earthquakes are natural disasters in which a large number of people die in a very short period of time. Besides this, a great number of people are injured when medical facilities also are destroyed or are in great chaos. Problems pertaining to medical assistance during previous major earthquakes have been reported in the medical literature. An earthquake in Mexico in September 1985 with a magnitude of 9 on the Richter scale caused 14,000 deaths and $4.5 billion lost according to the official numbers. Thirteen hospitals in the region were severely damaged or totally destroyed, costing numerous medical staff and doctors their lives. Unfortunately, current community disaster plans in Turkey rely on hospitals for immediate medical care. The revision of such plans and the development of specialized medical and rescue teams that would be available immediately at the local level are essential because there may be considerable physical damage to the hospitals or to the roads that connect the hospitals to the disaster region, or the number of people requiring hospitalization may exceed the number of hospital beds that would be available. As part of an effective strategy, local health-care staff can be trained to have skills in emergency medicine and can perform essential life-saving procedures, including the insertion of chest tubes in the field, with adequate resources. However, these health-care staff will not be able to rescue victims who are trapped in collapsed structures. Training programs should be implemented for local residents. Local teams with specialists in search techniques, structural engineering, heavy rescue, and emergency medicine should be formed. All these programs can be formed only by a very structured organization that requires ample funding. Therefore, in developing or low-income countries small pilot projects in high-risk areas should be considered as an initial step. Since the likelihood of survival for entrapped victims rapidly declines after the first 24 to 48 h, the priority should be given to seismic safety in building design. A well-planned medical response is also important, but it constitutes just one component of the mortality-reducing strategy in the aftermath of earthquakes.

The earthquake in Turkey in 1999 resulted in a great number of deaths and injured people in a region where many medical facilities were put out of use by the earthquake. In our study, 9.2% of the casualties of both the Izmit and Duzce earthquakes had thorax and lung injuries. Pneumothorax was the most frequent pathology observed (50% of patients), and rib fracture was the second most frequent (33.3% of patients). Crush syndrome developed in four patients (19%) who had severe trauma. This condition is characterized by acute renal failure of rapid onset. A prolonged physical pressure on the muscles and partial or total loss of blood to the compressed parts lead to the release of harmful toxins that cause renal failure as well as damage to the lungs and heart.

In the Kobe, Japan, earthquake (magnitude, 7.2 on the Richter scale), 12.9% of the patients seen in Kobe University Hospital had thorax injuries. The most common types of injuries in these patients were superficial lacerations and contusions (46.0%) followed by the fracture of ribs or the clavicle (34.9%). The total number of thorax injuries in the Kobe earthquake is slightly higher than our total number of patients, but the patients hospitalized as well as the patients examined in the outpatient basis were included in the analysis of the Kobe University Hospital. Only the hospitalized patients are included in our study, because it is a retrospective analysis and the probability of unrecorded outpatients is high on the day of the disaster. The frequency of rib fractures was similar in both earthquakes (around 34%), but pneumothorax was a much more frequent finding in the earthquakes in Turkey (50%) than in the Kobe earthquake (3.2%).

### Table 2—Thorax Injury Details in Hospitalized Patients After the Duzce Earthquake

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax</td>
<td>3</td>
<td>50.0</td>
</tr>
<tr>
<td>Hemothorax</td>
<td>1</td>
<td>16.6</td>
</tr>
<tr>
<td>Rib fracture</td>
<td>2</td>
<td>33.3</td>
</tr>
<tr>
<td>Subcutaneous emphysema</td>
<td>1</td>
<td>16.6</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>2</td>
<td>33.3</td>
</tr>
</tbody>
</table>
were heavily entrapped survivors of totally collapsed buildings. In the Kobe earthquake, only 12.6% patients were hospitalized and only 9.5% were rescued from collapsed buildings. Most of the injuries were caused by pieces of flying glass or by falling objects.

CONCLUSION

Among the survivors of a great earthquake, approximately 10% may be expected to have thorax and/or lung injuries. The most frequent type of injury probably depends on the way one is exposed to the trauma, but, in general, pneumothoraces and rib fractures are the most frequent types of injuries among the heavily entrapped survivors of totally collapsed buildings.

ACKNOWLEDGMENTS: The authors thank Haluk Özsaraç MD, Hanife Yıldırım, Özlem Öncel, and Aysun Kanat for their help in collecting the data from the hospital records.

REFERENCES