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Earthquake and the Lung

Deprem ve Akciğer

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ABSTRACT

Natural disasters cause extensive damage to nature and impact on large numbers of people throughout the world. Recently, earthquakes have caused a large number of death, injured, missing, and displaced people. More than a million earthquakes occur worldwide every year, which equates to roughly two earthquakes per minute. Lung problems in earthquakes are one of the main causes of morbidity and mortality. Many pulmonary complications that occur after earthquakes are a direct result of the disaster itself. Pulmonary complications such as inhalation of dust and particulates from collapsed buildings in earthquakes, aspiration of water and pathogens due to tsunami after earthquakes, pulmonary thromboembolism, psychological effects caused by respiratory symptoms, infectious respiratory diseases and chest traumas such as pneumothorax, rib fracture, hemothorax, hemopneumothorax, diaphragmatic tear can develop after earthquakes. People in the earthquake area, search and rescue teams, and those involved in demolition and debris removal activities are at risk for asbestos exposure. The most effective solution against the lung effects of earthquakes is to take preventive and protective measures. It is very important for disaster preparedness and response teams to be aware of these problems. Respiratory problems that may arise in earthquakes were discussed in this review.
Keywords: Earthquake; lung; respiratory.

ÖZ

Doğal afetler, doğaya büyük zarar vermekte ve dünya çapında çok sayıda insanı etkilemektedir. Yakın zamanda, depremler çok sayıda can kaybına, yaralıya, kayıplara ve insanların yaşadıkları yerden ayrılmak zorunda kalmalarına neden olmuştur. Her yıl dünya çapında bir milyondan fazla deprem olmakta, bu da yaklaşık dakikada iki depreme denk gelmektedir. Depremlerdeki akciğer sorunları, morbidite ve mortalitenin ana nedenlerinden biridir. Depremlerden sonra meydana gelen pek çok pulmoner komplikasyon, felaketin kendisinin doğrudan bir sonucudur. Depremlerde yıkılan binalardan çıkan toz ve partiküllerin solunması, deprem sonrası oluşan tsunamiye bağlı su ve patojenlerin aspirasyonu, pulmoner tromboemboli, solunum semptomlarının neden olduğu psikolojik etkiler, depremlerden sonra ortaya çıkan bulaşıcı solunum yolu hastalıkları ve pnömotoraks, kaburga kırığı, hemotoraks, hemopnömotoraks, diyafragma yırtığı gibi göğüs travmaları gibi birçok pulmoner komplikasyon gelişebilmektedir. Deprem bölgesindeki insanlar, arama kurtarma ekipleri, yıkım ve enkaz kaldırma faaliyetlerinde bulunanlar asbeste maruz kalma riski altındadır. Depremlerin akciğerlere olan etkilerine karşı en etkili çözüm önleyici ve koruyucu tedbirlerin alınmasıdır. Afete hazırlık ve müdahale ekiplerinin bu sorunların farkında olması çok önemlidir. Bu derlemede depremlerde ortaya çıkabilecek solunumsal sorunlar ele alınmıştır.
Anahtar kelimeler: Deprem; akciğer; solunum.

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INTRODUCTION

Natural disasters cause extensive damage to nature and impact on large numbers of people throughout the world. The victims of disasters are not just those killed and injured but those displaced by the disaster and those whose access to health care is vastly compromised. Survivors of disasters are at risk of very serious lung diseases. Such risks may be directly related to the disaster or respiratory infections caused by overcrowding after the disaster (1,2). Earthquakes are some of the most catastrophic natural disasters to affect mankind. Recently, earthquakes have caused a large number of death. Also, earthquakes have caused a large number of injured, missing, and displaced people. More than a million earthquakes occur worldwide every year, which equates to roughly two earthquakes per minute (3,4). Many pulmonary complications that occur after earthquakes are a direct result of the disaster itself. Pulmonary complications are inhalation of dust and particulates, aspiration of water and water-borne pathogens, chest traumas, pulmonary thromboembolism, psychological effects caused by respiratory symptoms, and infectious respiratory diseases (1,5,6). Respiratory problems that may arise in earthquakes were discussed in this review.

Inhalation of Dust and Particulates

Although particles larger than 10 μm are usually filtered by the upper respiratory tract, particles larger than this size have been detected in the lungs of firefighters exposed to the dust cloud after the destruction of the World Trade Center in New York (7). It has been thought to be likely to occur as a result of exposure to high concentrations of particles as well as mouth breathing bypassing the nasal filtration system of the airways (8).

Studies conducted on rescue teams after the destruction of the World Trade Center have shown that short-term intense exposure can cause acute and chronic health effects. Acute bronchospasm, chronic rhinosinusitis, chronic cough, persistent bronchial hypersensitivity, and decreases in respiratory function test values were observed at high levels in rescue teams (8-10).

Asbestos is a known carcinogen that can cause mesothelioma or asbestosis. With the collapse of many buildings because of the earthquake, it is likely to have released asbestos fibers into the air putting disaster victims and rescue teams at risk of inhalation. Appropriate safety measures should be taken on how to control the risk of clean-up in earthquake-affected areas and how to safely dispose of asbestos waste (11,12).

Aspiration of Water and Water-Borne Pathogens

Earthquake-induced tsunamis cause mass casualties in a very short time, often due to temporary paralysis of local emergency response and health care services (13). Sudden increases in water levels that occur during a tsunami, hurricane, or flood are more likely to cause drowning, aspiration, and traumatic injuries than predictable increases (14). Water aspiration can lead to infection, loss of alveolar surfactant, pulmonary edema, and acute respiratory distress syndrome (ARDS) (15). Pulmonary edema is more common in salt water aspirations. Vomiting of swallowed water can also lead to aspiration of stomach contents due to unconsciousness and inhibition of airway protective reflexes. Significant aspiration findings are usually clinically detectable. Namely, if the physical examination, arterial blood gas, and chest X-ray are normal in patients at the admission stage and there are no signs of aspiration, treatment is required, and the probability of developing pulmonary edema or pneumonia is very low (16). After the tsunami in Sri Lanka in 2004, drowning and trauma accounted for the majority of post-disaster morbidity (17). Aspiration pneumonia developed in half of 37 patients who aspirated soil-contaminated salt water, reported by a medial group after the tsunami, and ARDS was observed in 8 patients. Different organisms may predominate in fresh water and salt water aspirations, but aerobic gram-negative bacteria, including pseudomonas and pseudomonas-like species, are the most commonly reported (15,18).

Antibiotic therapy should include those effective against pseudomonas and locally common organisms. Antibiotics should be started in patients with fever, pulmonary infiltrates, and/or signs of systemic toxicity (18). The fungal infection may be present in individuals with acute post-aspiration pneumonia, brain abscess, or meningitis who do not respond to antibacterial therapy. In this case, it has been reported that both *Pseudallescheria boydii* and aspergillus species were isolated as agents (18-20).

Pneumonia caused by aspirated sludge and bacteria and contaminated salt water due to tsunami is known as tsunami lung (21). A tsunami lung is thought to occur with the combination of bacterial and chemical pneumonia. Chest radiographs of two female patients, aged 88 and 37, who developed tsunami lung in the tsunami after the Great East Japan Earthquake, were shown in Figure 1 (22).

Chest Traumas

Trauma is an important cause of morbidity and mortality in earthquakes and is the most common cause of earthquake-related hospital admissions in the first 24 hours (23). The very young and the very old patients have a higher risk of earthquake-related mortality (24). Approximately 10% of those who applied to the hospital during the earthquake had chest traumas (25,26).

Chest injuries are often accompanied by injury to other organs, and multiple injuries are associated with increased mortality. In the 1999 Marmara earthquake, in 19 patients with chest trauma evaluated by Toker et al. (27), pneumothorax was 37%, rib fracture 26%, hemothorax and hemopneumothorax 11%, diaphragmatic tear 11%, subcutaneous emphysema 11%, and cervical tracheal damage 5%. Ozdoğan et al. (25) reported that in the Düzce and İzmit earthquakes in 1999, among the total of 356

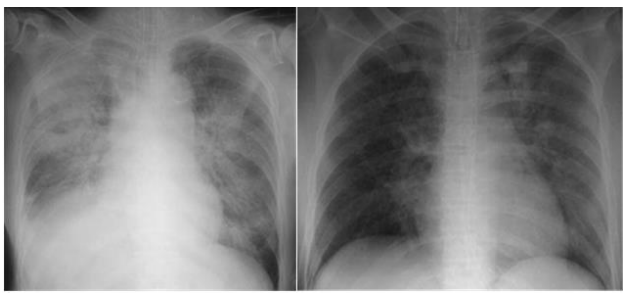

Figure 1. Tsunami lung of different two patients (22)

hospitalized patients, 21 (9.7%) in the İzmit earthquake, and 6 (7.6%) in the Düzce 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. They suggested that 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 (25). In the 2011 Van earthquakes, pneumothorax and rib fractures were reported as the most common thoracic injuries (26). In the 1999 Marmara earthquake, the most common surgical procedures performed by Bulut et al. (23) in patients with chest trauma were fasciotomy (38%) and tube thoracostomy (13%).

Pulmonary Thromboembolism

Cardiovascular events are often reported following disasters. Among these, venous thromboembolism is deemed serious and thus should be taken into consideration. Indeed, its risk has been demonstrated to increase following earthquakes, floods, burns, and intoxications. Proper venous risk assessment and guideline application have been determined to be essential in disaster management, which can increase the risk for venous thrombotic diseases (28). Dehydration, prolonged immobility, and earthquake-related injuries are thought to be the causes of the high prevalence of deep vein thrombosis in evacuees from earthquakes (29).

In a study evaluating risk factors for acute pulmonary embolism (APE) after the 2004 Mid-Niigata Prefecture earthquake in Japan, a rate of 5% and higher for settlements with a high post-earthquake evacuee rate, and <5% for an area with a low evacuee rate was found. The incidence of APE in the first month after the earthquake was high in the evacuated area and was also higher in women. All patients in the high evacuee area had stayed there in their automobiles for long periods of time, but none had done so in the low evacuee rate area (6). Also, Watanabe et al. (30), reported the possible role of automobile sheltering in the increased incidence of pulmonary embolism during the 2004 Niigata earthquake. Another study from Japan, it was confirmed that automobile sheltering and oral contraceptives are potential risk factors for pulmonary embolism (31).

Psychological Effects Caused by Respiratory Symptoms

Natural disasters create also great psychological stress. Post-disaster post-traumatic stress disorder and depression-like symptoms may occur. Respiratory complaints can cause anxiety syndromes. The psychological impact can also be seen in rescue and aid workers, victims, and survivors (32,33).

Infectious Respiratory Diseases

All infectious diseases, including those of the lung, usually occur in the aftermath of disasters. This is due to population displacement, unsafe water and sanitation facilities, non-functional health services in overcrowded and affected areas, and the poor and low immunization status of the state (34). Having to live in an overcrowded environment after a natural disaster is a common problem and can facilitate the transmission of infectious diseases, especially respiratory and gastrointestinal diseases. Due to the loss of housing, people are forced to live in emergency shelters and tents with limited daily life support. Respiratory tract infections are the main cause of morbidity and mortality in the first 3-5 days in populations who have to relocate after an emergency (1). The World Health Organization reported that the victims of the 2004 Aceh tsunami and the 2015 Pakistan earthquake had a large number of deaths due to acute respiratory infections (35,36).

Viral acute respiratory infections spread rapidly in crowded populations of victims. Overcrowding is a risk for lung infection for healthy survivors, especially children, and the injured. This risk of infection can be avoided by adequate ventilation to ensure good airflow and prevent increased concentrations of respiratory particles (1,37).

Rescuers and healthcare workers may also be at increased risk for acute respiratory infections. Kun et al. (38) reported acute upper respiratory tract infections (13.2%) were the most common disease in rescue teams living in shelters in the city of Beichuan after the 2008 China earthquake (38).

Pulmonary tuberculosis contagion also increases in populations displaced by natural disasters. Contagion is facilitated by the recirculation of external air, the length of contact with the tuberculosis patient, insufficient ultraviolet light, and malnutrition (39). Transmission rates increase as a result of staying away from tuberculosis treatment programs, especially due to population movements (40). Balbay et al. (41) published a study on whether 112 tuberculosis patients in Düzce were affected by the consequences of the earthquake after the Marmara earthquakes. According to this study, they reported that the treatment and follow-up of tuberculosis patients in the three periods before the earthquake, during the earthquake, and after the earthquake did not differ significantly. However, due to the small number of patients examined, it was specifically stated that it cannot be generalized to the entire Marmara region, which is a limitation of the study. Acquired drug resistance may occur due to non-compliance with treatment, inappropriate treatment regimens, irregular drug support and use, and poor drug quality in the periods after disasters. In these patients; precautions should be taken to provide medication for 2 weeks or 30 days, to issue a card containing the contact information of the personnel in charge of tuberculosis control, to send patient lists to national tuberculosis control units to be sent to other states, and finally to determine a reference center (1,42).

CONCLUSION

After an earthquake, lung diseases can be seen both directly and indirectly. Lung problems in earthquakes are one of the main causes of morbidity and mortality. The most effective solution against the lung effects of earthquakes is to take preventive and protective measures. It is very important for disaster preparedness and response teams to be aware of these problems. Strong disaster preparedness plans should be established and characterized by appropriate and adequate environmental planning and resilient health facilities. Early diagnosis, surveillance, and control of earthquake-related lung diseases are very important in reducing mortality.

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