LUNG PROBLEMS IN ENVIRONMENTAL DISASTERS

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ABSTRACT

Natural disasters are associated with much mortality and morbidity. New research published in 2011 has thrown light on the significant number of lung diseases in natural disasters. Volcanoes and storms are known to increase harmful suspended particles like volcanic ash and toxic gas in air, not only at the time of the event but also for a long time there after. However, disasters like tsunami and floods are also instrumental in causing a large number of respiratory diseases, directly or indirectly. Disasters like earthquakes cause thoracic injury. People with pre existing diseases like COPD are more affected, but healthy subjects may also develop acute symptoms like bronchospasm and hemoptysis. Infectious diseases, both common ones like influenza and rare ones like Nocardia, occur with increasing frequency. Respiratory pathologies are often neglected in triage protocols. However, proper care for respiratory diseases can significantly decrease mortality.

Natural disasters like earthquake, hurricanes and volcanic eruption can cause damage to different systems of the body in various ways. A comprehensive new review published recently has shown that lung problems are major causes of morbidity and mortality following natural disasters.[1] Respiratory compromise was found to be the major cause of death in various natural disasters like forest fire and volcanic eruption that release large amount of suspended harmful particles in air. Even in other cases like floods and tsunami, lung pathology was significantly present in a large number of victims.

While people with chronic conditions like COPD and bronchiectasis were affected by the natural disasters, even respiratory systems of subjects with apparently no prior lung pathology were also found to be affected by these events. Adding to these is the large number of thoracic injury cases in situations like earthquake and avalanche.

However, while blood loss, head injury and water borne diseases like cholera are given importance during the rescue efforts, lung injury or respiratory compromise are often neglected in triage protocols. But inclusion of respiratory diseases in treatment algorithms can lead to significant decrease in mortality and morbidity.

VOLCANIC ERUPTIONS[2]

In volcanic eruptions, we get *smog*: sulfur dioxide and other gases released from the volcano and their

Table 1: Table showing the lung problems in different natural disasters

NATURAL DISASTER	LUNG PROBLEM
Wildfire	CO; SO_2; ash inhalation
Floods	Fungal spore inhalation; influenza; communicable disease in shelters
Tsunami	Tsunami lung
Storms/Desert storms	Pneumonitis, hypersensitivity
Earthquake	Injury, dust inhalation
Volcano	Ash inhalation; SO_2 inhalation
Collapse of Old houses and caves	fungal infection; allergy

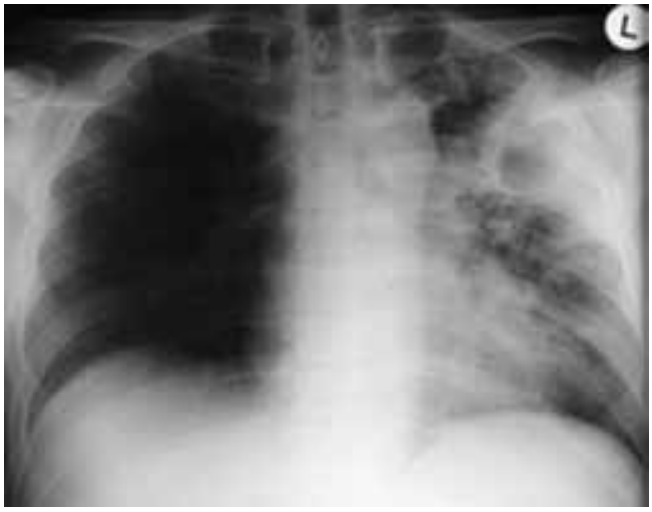

Fig. 1: A case of tsunami lung (necrotizing pneumonia)

reaction products with atmospheric elements. By far, the most harmful elements are the sulfur compounds. Also there is fine volcanic ash suspended in air for a long time. These suspend particles are small enough to enter lower airways. Also, most of these particles are acidic, that can directly irritate the mucosa. Thus existing chronic lung diseases like COPD and asthma are exacerbated and also, the sulfur compounds can impair the local immune system of the lung. People living near a volcano can present with acute respiratory emergencies like dyspnea and hemoptysis. Postmortem studies on victims killed by the 1982 St. Helens volcanic eruption demonstrated that over eighty percent died as a result of asphyxiation due to bronchial obstruction following ash inhalation. Potential respiratory symptoms from the inhalation of volcanic ash depend on a number of factors, including airborne concentration of total suspended particles, proportion of respirable particles in the ash (less than 10 microns in diameter), frequency and duration of exposure, presence of free crystalline silica and volcanic gases or aerosols mixed with the ash, meteorological conditions, and host factors (existing health conditions and the propensity of those exposed to incur respiratory problems), and the use of respiratory protective equipment.

Now, a new term called **Pneumonoultramicroscopic-silicovolcanoconiosis** has been coined to describe the lung problem in volcanic eruptions. This is shortened as P45. This is now the longest word in English Dictionary.

Special face masks should be worn by people near an active volcano. If no approved mask is available, a fabric mask improvised from handkerchiefs, cloth, or clothing will filter out the larger ash particles which may contribute to throat and eye irritation. Dampening the fabric with water will improve its effectiveness.[3]

TSUNAMI LUNG[4]

Tsunamis are notorious for water borne diseases like cholera and severe injuries. But, after the 2004 Tsunami in Asia, doctors found a new disease called Tsunami lung. Tsunami lung occurs when people being swept by tsunami waves inhale salt-water contaminated with mud and bacteria. The resulting pneumonia-like infections normally are treated with antibiotics. A combination of microbes likely contributes to tsunami lung. However, in a letter published in the 4 April 2005 issue of *The Medical Journal of Australia*, Anthony Allworth, director of infectious diseases at Royal Brisbane and Women's Hospital, describes culturing *Burkholderia pseudomallei* from two tsunami lung patients in a land-based hospital and *Nocardia* species from a third.

A diagnosis of tsunami lung is based on chest X-ray plus computed tomographic scanning of the brain to document abscesses. A case report published last June described successful antibiotic treatment of a 17-year-old girl who'd lost speech and was partially paralyzed because of brain abscesses;[5] figure 1.

DESERT STORM[6]

In 1992, in Saudi Arabia, the recognition of a new clinicopathological entity, Desert Storm pneumonitis or **Al Eskan disease** was reported. This was an acute desert-related disease when the mixture of the fine Saudi sand dust and pigeon droppings triggered a hyperergic lung condition. Sand particles less than 1 micron (0.1 microns to 0.25 microns) in diameter are present in substantial quantities in the Saudi sand and are pathogenic, causing hyperergia.

This is also a part of the infamous *Gulf War syndrome* in American troops. Also, extensive stay in deserts or places with draught can cause mycoplasma infections and its consequent systemic features.

FLOODS[7]

Floods are also noted for some lung problems. Standing water remaining from any flood is a breeding ground for microorganisms. Bacteria, viruses, and mold can become airborne and be inhaled, putting people at risk for lung disease. Also, inhalation of water into lungs by victims of near drowning can be a route of infection of alveoli. Even after the water recedes, the contaminants, bacteria, viruses and mold left behind pose a risk to those with preexisting lung disease. Exposure to these microorganisms and toxins may increase the risk of developing lung disease. In addition, the time spent in large group shelters may increase the risk of spread of infectious diseases, such as influenza, pneumonia, and tuberculosis.

After this emergency, contaminants and microorganisms may be inhaled during clean up efforts, which also add to lung disease complications. Clean up efforts will need to protect the

Figure 2: protective mask for volcanic ash

workers and occupants from exposure to airborne particles and gases. Long-term high levels of humidity can foster growth of dust mites, which can cause asthma and trigger allergic reactions and asthma attacks.

WILDFIRES[8]

Composition of Fire Smoke**:**

- The products of combustion vary with the burning material and are difficult to predict.
- Within a confined space, oxygen is quickly consumed leading to asphyxiation of any trapped person.
- Carbon monoxide is commonly produced and combines with hemoglobin, also leading to asphyxiation. Symptoms include occasional shortness of breath, confusion and chest heaviness.
- Sulfur dioxide (SO2) is a pungent gas which is very irritating to the lungs and can cause narrowing of the airways (bronchoconstriction) or sometimes chemical damage to the lungs.
- Nitrogen dioxide (NO2) is occasionally released in fire storms and can cause chemical damage to the lungs.
- Ozone (O3) can cause nasal and airway irritation.
- Cyanide can be produced by combustion, particularly of plastics (*left by tourists in forests*). It leads to asphyxiation and can be suspected by the presence of elevated lactate levels in patients brought to the hospital.
- Particulate matter (PM) may be released with some particles small enough (<10 microns) to penetrate deep into the lung and cause injury.

Depending on the distance from the fire, the air quality standards may be exceeded by smoke from wildfires. As the atmospheric removal mechanisms for fine particles work slowly, fine particles have long residence times (up to weeks), and transports distances. The elimination of fine particles out of the atmosphere is mainly by precipitation.

Thus in wildfires, people living nearby are at substantial risk. Outdoor exposure should be minimized and people with chronic lung disease should be preferably shifted to a new area for that period. In 1997 forest fires in Indonesia led to over 500 environmental haze related deaths in a three month period, with around 300,000 episodes of asthma, 50,000 cases of bronchitis, and 1.5 million respiratory infections reported during this time.

EARTHQUAKE[9]

Earthquakes are important mainly for the injuries they cause. The spectrum of injuries seen in those with chest trauma includes rib fractures (17-50%); lung collapse (6-52%), and serious bleeding into the chest cavity (11-19%)[1].But cement dust from broken buildings and fungal spores released in air by the rubbles, especially during efforts can cause various diseases. Coccidioidomycosis was the fungal infection with both pulmonary and extra pulmonary diseases in the 1994 Northridge **earthquake** in California.

HUT LUNG

This is a type of lung disease by particle inhalation. This occurs in people living in very old houses/caves and also by burning of biomass fuel. This leads to chronic bronchitis and can finally lead to lung fibrosis and cor pulmonale.

The psychological impact of these disasters can also lead to secondary respiratory compromise (E.g. Exacerbation of asthma by emotional episodes).

PREVENTION

- Inclusion of respiratory treatment equipments like nebulizer and face mask (fig. 2) in emergency response kits
- Early chest X Ray
- Examination of Buccal cavity and nose for mud, water etc.
- Relocation of susceptible persons like COPD patients

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