



Health Issues Around the World Trade Center Disaster

Irritative and Respiratory Problems in Relation to Environmental Exposures from the World Trade Center Disaster: A Guide for Clinicians

Background

Since the September 11 terrorist attacks on the World Trade Center, there has been concern about the impact of environmental contaminants generated by the fires and building collapses on the health of workers at and near the site as well as of residents of the surrounding communities and workers returning to work at or near the site. Potential environmental exposures related to the WTC disaster exposures include: cement and glass dust, asbestos, fiberglass, PM_{2.5} and PM₁₀ (small particulate matter), larger particulate matter, lead and other heavy metals, PCBs, dibenzofurans, volatile organic compounds and other products of combustion. While concern has been primarily about inhalational exposures, there have been a number of reports of dermal irritation and rashes on exposed areas of the skin. In addition, those escaping the area on September 11th and those working without appropriate respiratory early after the disaster, experienced ingestional exposures. Primary short-term health effects of exposure to airborne contaminants may include asthma/reactive airways disease (RADS), chemical irritation of the eyes, nasal passages, throat, and upper airways, sinusitis, and persistent cough, and pneumonitis. Additionally, ingestional exposures may result in digestive symptoms such as irritation of the upper gastrointestinal tract with gastro-esophageal reflux (GERD).

In general, measured levels of exposure to individual airborne contaminants have been relatively low. However, there is a paucity of environmental and personal sampling data for the first days after September 11th. Furthermore, there have been intermittent elevations of levels of some contaminants in air or bulk dust samples. Additionally, conditions at the site are constantly changing, and exposures may vary widely depending on the ambient weather conditions, types of activities and whether or not fires are burning at the site on a particular day. Finally, workers at and near the site as well as residents report that outdoor air is highly irritating at certain days and times.

Conditions that have been seen in adults who have been at or near the site for as little as 24 to 36 hours, include reactive airways disease, new onset or exacerbation of pre-existing asthma, RADS, sinusitis, irritant rhinitis, persistent cough, and diffuse irritation of nasal mucosal surfaces. There has also been an increase in GERD symptoms, especially among first-responders or individuals who were hit by the cloud of dust and debris released from the collapse of the towers. The purpose of this report is to provide guidance on evaluation and management of the irritant and respiratory health effects being seen among adults that appear to be related to environmental and/or occupational exposures at or near the WTC site.

What Were the Exposures?

On September 11th, when the fire, explosion and collapse of the towers occurred, irritating materials such as concrete, silica, gypsum, plastics and fiberglass dusts, as well as soot were released. Asbestos, used in the World Trade Center buildings as an insulation and fireproofing material, has been found in the dust and debris. Other hazardous contaminants include polyaromatic hydrocarbons (PAHs), lead, polychlorinated biphenyls (PCBs), and other combustion products that could include dioxin-like components. Toxic and irritating gases, along with acid mists, were also released when plastics and other materials burned. More hazardous gases like carbon monoxide were also released from combustion at lower temperatures and in enclosed spaces. Given the extremely high temperatures of the fires generated in the combustion of jet fuel, combined with the tremendous range of contents of the towers, it is likely that we will never fully know the precise nature of exposures sustained immediately after the explosions, fires, and building collapses on September 11th.

Potentially hazardous exposures have continued since September 11th, because fires continue to burn at the site and dust and debris are disturbed during site activities, creating the potential for ongoing airborne exposures. Additionally, even in the absence of visible flames, the release of combustion products may continue. Other exposures result from the continuing torch cutting of numerous large beams by steelworkers. Clinicians can access information on results of personal air and environmental sampling at a number of web sites, which include: the EPA website, <http://www.epa.gov/epahome/wtc/> and the OSHA website, <http://www.osha.gov/>.

Who was exposed?

The population potentially affected by the disaster includes members of the following groups:

1. People who worked primarily at Ground Zero, either during or after the disaster, including New York Firefighters and firefighters from outside New York City, police officers from New York City and surrounding communities, emergency rescue workers from a variety of organizations (including emergency medical technicians and paramedics), building trades workers, members of the press/news media, health care workers, food service workers, structural and other engineers and a variety of other public and private sector workers;
2. People who worked in the immediate vicinity of Ground Zero restoring essential services such as telephone service, electricity, and transportation, or performing services vital to reopening buildings in the area, including cleaning and assessing the structural integrity of buildings;
3. People who had worked in the WTC vicinity prior to the disaster and who sustained exposures either on September 11 or upon their return to work in the area around the WTC. These include such disparate groups as financial sector workers, staff (and students) from surrounding schools and universities, retail workers, garment workers, municipal and state employees from a variety of agencies, health care workers and others; and,
4. Residents of the surrounding communities.

How to distinguish between WTC exposure-related conditions

and unrelated symptoms?

Individuals working at or near the WTC disaster area may present with various respiratory and irritative problems as described above. Clinical features which can help to distinguish WTC-related respiratory problems from other conditions such as seasonal allergies and viral illnesses include history of a clear temporal and geographical association between presence at or near the site AND onset of symptoms such as:

1. A history of irritation of the eyes, nose or throat while at or near the site.
2. Presence of burning of the nasal passages and/or throat for 10 or more days in the absence of seasonal allergies or an antecedent viral illness
3. Physical examination findings consistent with marked inflammation of nasal passages (cherry red mucosa with or without engorged blood vessels) and throat
4. Presence of a new or worsening cough, chest tightness, wheezing, decreased exercise tolerance and/or shortness of breath lasting 10 or more days in the absence of seasonal allergies or an antecedent viral illness.
5. Presence of new or worsening dyspnea especially with exertion. This may or may not be associated with wheezing and/or chest tightness.
6. Presence of new or worsening asthmatic complaints.
7. Presence of new or worsening dyspepsia (GERD related symptoms).
8. Presence of new or worsening chest tightness, pleuritic chest pain or chest burning.

Diagnostic and treatment guidelines for irritative and respiratory conditions among workers and residents related to the WTC disaster

Following is a description of recommendations for the diagnosis and treatment of WTC-related upper and lower respiratory problems. Health care professionals should report any respiratory diagnosis related to the World Trade Center disaster to the New York State Department of Health's Occupational Lung Disease Registry. This reporting is legally mandated.

1. Non-specific eye irritation

Symptoms: Acute onset of teary, red eyes, with no purulent secretion, that developed in direct relation to WTC exposure and started no later than two days after exposure. Patients may report a "crust-like" material in their eyes upon awakening.

Treatment: Non-prescription artificial tears frequently and use of eye protection while at the site. Ophthalmology consultation is recommended for any worker complaining of eye symptoms beyond those previously noted, or if these last for over a week after cessation of exposure.

2. Non-specific acute irritant rhinitis and/or irritant tracheo-laryngitis

Symptoms: Acute onset of itchy/runny nose; watery or mucous secretion; irritated, scratchy throat; the need to frequently clear the throat; usually paroxysms of coughing, that developed in direct relation to WTC exposure and started no later than two weeks after exposure, or in direct relation to returning to work to a site near the WTC area. No history of fever or chills. Nasal secretions may turn

yellowish or greenish. Irritated throat may exist with or without nasal congestion and/or cough, but certainly is made worse when either is present.

Treatment: Consider a combination of any of the following: saline spray or lavage, topical decongestants for not more than three days if a component of severe mucosal swelling is noted, and/or oral decongestants for 5 to 7 days (the new generation of "non-sedating" H-1 antagonist antihistamines is not adequate unless coupled with a decongestant). Serious consideration to the use of nasal steroids should be given on initial evaluation and should certainly be used if there is persistent or increasing nasal and throat symptoms after therapy with lavage and decongestants alone. It should be explained to patients that nasal steroid therapy must be continued for at least one-to-two weeks before any clinical improvement will be noted. If improvement does occur, then this type of therapy should be continued for two to three months. Cough-suppressant medication should be seriously considered if the cough is non-productive and if there are paroxysms of cough interfering with sleep or producing dyspnea, vomiting, headaches, near-syncope or syncope. The value of expectorants is unclear in this group. Caution should be exerted when prescribing antihistamines and cough suppressant medication to uniformed officers and personnel including equipment operators, in order to comply with specific regulations such as DOT and/or other job-specific regulations. Review and advise patient about adequate respiratory protection while at the site. If symptoms are severe and persistent despite treatment, consider recommending avoidance of exposure and ENT consultation.

3. Sinusitis

Symptoms: Acute onset of very similar to symptoms of non-specific rhinitis/laryngitis as described above, with more persistent yellowish to greenish nasal secretion and facial pain, presenting in direct relation to WTC exposure and starting not later than three weeks after exposure. The term sinusitis refers to inflammation of the paranasal sinuses, regardless of cause. Suspect bacterial super-infection if symptoms last over seven days, there is fever and/or chills; there is persistent purulent nasal discharge with maxillary tooth or unilateral facial pain, unilateral sinus tenderness or progressively worsening symptoms (1, 2), especially after improvement.

Treatment: Consider a combination of saline spray or lavage, topical nasal decongestants for 3-5 days, and/or oral nasal decongestants for five-to-seven days (as stated above). Nasal steroids should be instituted. If there is response, nasal steroids should be continued for two-to-three months. Antibiotics may be instituted if suspicion for clinical super-infection is present (1). Advise the patient to use adequate respiratory protection while at the site. If symptoms are severe and persistent despite treatment, consider recommending avoidance of exposure, sinus CT scan and ENT consultation.

4. RADS or asthma (3, 4, 5).

Symptoms: Acute-to-subacute onset of recurrent episodes of chest tightness, cough, wheezing and/or difficulty breathing; unusual responsiveness to exposure to environmental irritants such as second-hand smoke, car exhaust, temperature changes, strong odors, cleaning agents; nocturnal or early-morning symptoms.

- a. Consider RADS in patients with no previous history of asthma and no personal or family history of allergies.
- b. Consider new-onset asthma in patients with no previous symptoms of asthma who have a personal history of allergies or a strong positive family history of asthma or allergies, or in patients with a previous history of asthma that was inactive for two years or more years.
- c. Consider aggravated or exacerbated asthma in patients with a history of active asthma that was aggravated as a consequence of exposure.

Work up of respiratory complaints

1. If patient reports any type of respiratory complaints, consider spirometry.
2. If patient reports symptoms of the upper respiratory tract only, such as runny/itchy eyes or nose, scratchy throat, bouts of coughing, and spirometry is normal, treat for upper respiratory problems as noted above.
3. If patient reports lower respiratory tract complaints, such as shortness of breath, wheezing, chest tightness, cough: request spirometry.
4. If spirometry shows obstructive impairment, request post-bronchodilator spirometry. If significant response, i.e., an improvement of 12% or more in post FVC or post FEV1 WITH an increase of 200 ml or more in actual values of FEV1 or FVC: diagnose asthma or RADS, and treat.
5. If spirometry is normal but pre-exposure spirometry is available and there has been a decrease > 15% of either FVC or FEV1, obtain pre- and post-bronchodilator measurements, consider provocative challenge test (methacholine, histamine, cold air) when appropriate, and consider empiric treatment with inhaled bronchodilators and steroids.
6. If spirometry is normal and symptoms are strongly suggestive of asthma or RADS, consider empiric treatment with inhaled bronchodilators and steroids, and consider provocative challenge test (methacholine, histamine, cold air) when appropriate.
7. If spirometry is restrictive, obtain pre- and post-bronchodilator spirometry as we have found large number of patients with restrictive spirometry who in fact have obstructive airway disease on further testing. If restrictive impairment is still suspected, obtain chest radiograph, lung volumes and diffusion. Consider high-resolution chest CT scan without contrast. Consider provocative challenge testing when proof of obstructive airway disease is appropriate.
8. In individuals who complain of persistent dyspnea, and in whom obstructive airway impairment has been ruled out through clinical evaluation and pre- and post-spirometry, consider chest radiograph, total lung volumes and diffusion capacity and, when appropriate, provocative challenge test. Also consider empiric treatment with inhaled bronchodilators and steroids.

Request chest x-ray when spirometry is restrictive or when clinically indicated.

For all spirometry testing, please advise the patient not to use inhaled or oral bronchodilators for at least six hours previous to the time of the test. Oral or inhaled steroids do not need to be stopped for spirometry.

Provocative challenge test may be positive early on due to irritant induced hyperactivity or due to acute infectious bronchitis. If challenge testing is ordered, inhaled and systemic steroids should be discontinued for four to six weeks prior to testing.

Treatment of RADS/asthma: Treatment should include a combination of inhaled steroid AND inhaled bronchodilators, including rescue medication on a prn basis. Consider more aggressive management (i.e., systemic steroids, oral bronchodilators) if clinically indicated (3). Referral to pulmonologist recommended. Physicians should strongly advise the patient to use adequate respiratory protection while working at the site. If symptoms are severe and persistent despite treatment, insist on totally avoiding exposure at the work site.

5. **Bronchitis**

Symptoms: Bronchitis is a clinical diagnosis referring to cough (with or without phlegm). It would appear as cough related to the WTC collapse either: a) within the first two days after exposure or b) several weeks later, related to repeated exposure, persistent irritation/inflammation from sinusitis, RADS/asthma or GERD. Cough lasting over three weeks exceeds the case definition for "acute bronchitis" and should be considered as persistent or chronic cough illness (6).

Treatment: Randomized controlled trials have consistently demonstrated the benefit of therapy with bronchodilators (albuterol) as compared to placebo (even when the placebo was erythromycin (7)). The efficacy of bronchodilators in patients with uncomplicated acute bronchitis is well grounded in science as bronchial hyperresponsiveness is frequently found in these patients. Antitussive therapy is of questionable benefit during the first three weeks (unless debilitating symptoms are associated with cough), but may be of benefit in chronic cough (7). When cough is persistent (i.e., lasting for more than three weeks) and chest radiograph is normal, empiric treatment of sinusitis, asthma and GERD, perhaps in combination is recommended for prolonged time periods (6). Antibiotics should only be considered if super-infection is suspected.

6. **Dyspepsia and gastro-esophageal reflux**

Symptoms: highly specific for GERD are heartburn (pyrosis or substernal/epigastric burning pain), regurgitation (which often occurs after meals), or both (8, 9) presenting at least once a week or more frequently. These symptoms are often aggravated by recumbence or bending and are relieved by antacids. Acute onset or worsening of GERD symptoms temporally related to the WTC collapse may be the result of ingestion of airborne irritating materials and/or the stress associated with the event. It should be treated aggressively both for quality of life, its association with other gastrointestinal disease (dysphagia, peptic stricture, Barrett's esophagus and esophageal cancer) and its association with respiratory disease (hoarseness, laryngitis, sinusitis, asthma, and chronic cough).

Treatment: If the patient's history is typical for uncomplicated GERD, an initial trial of empiric therapy (including lifestyle modification) is appropriate (8, 9). Empiric therapy includes lifestyle modifications in diet and acid suppression. Proton pump inhibitors provide symptomatic relief and healing of esophagitis in the highest percentage of patients. Histamine-2 receptor blockers given in divided doses may also be used and are effective treatment in many patients with less severe GERD. Patients in whom empiric therapy is unsuccessful, or who have symptoms suggesting complicated or alternative disease, should have further diagnostic therapy.

7. Issues about Repeated Exposure in Workers at the Site

It is critical that workers be advised to use adequate respiratory protection while at the site. For rescue workers or individuals that have returned to work at or in the vicinity of the site, and present with significant symptoms, consideration should be given to limiting or eliminating exposures. This would be a prudent course of action given that rescue phase of operations has now ceased and experience has shown that repeated occupational exposure since September 11th has been a contributing factor in both the persistence and severity of symptoms. Workers hoping to return to work at or near the site who have asthma or established RADS (proven by spirometry, provocative challenge testing or with high clinical suspicion) should not continue to work at the site.

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