An Asthma Patient with Steroid-resistant Decrease in Peak Expiratory Flow after the Great East Japan Earthquake Showing Spontaneous Recovery after 1 Month

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Abstract

People living in Japan were affected in various ways after the Great East Japan earthquake of March 11, 2011. A 52-year-old female asthma patient not directly affected by the disaster experienced a decrease in peak expiratory flow (PEF) immediately after the earthquake. Despite increasing the inhaled and oral corticosteroid doses, her PEF did not recover. One month later, her PEF level abruptly returned to normal with minimal medications, which were previously ineffective, and the asthma-related symptoms vanished. The stabilization of her state of mind and actual social state seemed to be a part of the reason for the patient's recovery.

Key words: asthma, stress, disaster medical care, psychosomatic medicine, respiratory medicine

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Introduction

On March 11, 2011, the Great East Japan earthquake hit northeast Japan. A subsequent tsunami and a nuclear accident further devastated the region. Nearly 20,000 people died or are missing due to the disaster, which affected not only the immediate victims of the earthquake and tsunami, but also people living throughout Japan in many ways. Some of the most potent effects of the disaster may be due to psychological stress, which may have affected people's health statuses.

Natural disasters often cause massive societal devastation and destruction. For example, the 2004 Indian Ocean earthquake and subsequent tsunami devastated many countries around the Indian Ocean and left a major negative impact on the health of the survivors (1). Another example of such a catastrophic disaster is Hurricane Katrina; the storm hit the Gulf Coast of the USA in 2005 and was responsible for more than 1,800 deaths. Its negative impact on chronic diseases, including diabetes, has been reported (2). An increased incidence of acute myocardial infarction (AMI) over

the 3-year period following the storm was also reported (3). Chronic stress following the disaster may be an explanation for the increase in AMI incidence. An additional example of a devastating disaster in Japan's recent history is the Great Hanshin earthquake of January 1995, which killed more than 6,000 people in western Japan. An increase in hospital visits for pneumonia, asthma, peptic ulcers, and diabetes were reported following this incident (4). Additional examples of devastating disasters include the attacks of September 11, 2001 in New York, Virginia, and Pennsylvania. These attacks and subsequent rescue and recovery attempts also brought about various health problems and consequences to the USA, including the manifestation of mental health problems such as post-traumatic stress disorder or physical health problems such as respiratory diseases, gastro-esophageal symptoms, and cardiac complications (5, 6). American residents living far from the aforementioned sites also presented with numerous stress symptoms, including the development of sleep disorders, difficulties in concentrating, and disturbing thoughts and/or memories related to the event (7).

Although asthma is recognized as a somatic respiratory

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Figure 1. Peak expiratory flow monitoring. The peak expiratory flow (PEF) suddenly decreased on the day of the earthquake, and returned to normal 4 weeks later. The PEF did not respond to the treatment modification. Routine regimen: mometasone furoate, 100 μ g twice a day; budesonide 160 μ g plus formoterol 4.5 μ g, 1 puff twice a day; triamcinolone, 2 mg twice a week; pranlukast, 230 mg twice a day; theophylline, 200 mg twice a day. ICS: inhaled corticosteroid

disease, it also includes components and aspects of a psychosomatic disease (8, 9). The pathophysiology of asthma includes reversible airflow limitations induced by underlying allergic inflammation in the airways. Although the main cause of this inflammatory reaction may be an allergic response, it is often thought that psychological stress may contribute to asthma exacerbation (10-14). A predisposition to psychological stress is also positively correlated with the prevalence of asthma (15). Thus, a causal relationship between psychological stress and asthma is well recognized empirically.

In this report, we present a case of a female asthma patient who experienced a decrease in PEF after the Great East Japan earthquake. Although she was not a direct victim of this disaster, the emotional, psychological, and physical stress of the disaster was considered to be the cause of the disease worsening. The knowledge and further understanding of such a case with a detailed clinical course accompanied by PEF measurements obtained before, during, and after this devastating disaster is important for future patient care in the aftermath of disasters.

Case Report

The present report describes the case of a 52-year-old woman who regularly visited our clinic for asthma treatment. She was a non-smoker who did not have any other chronic diseases and was diagnosed with asthma when she was 30 years old. She experienced sporadic asthmatic exacerbations that sometimes required hospitalization, especially during the rainy season and early months of autumn, as well as during minor upper respiratory infections. Her asthma had been under good control after starting a treatment of inhaled and oral corticosteroids in combination with a long-acting inhaled beta-agonist, a leukotriene receptor antagonist, and theophylline from the age of 40 years. She was advised to modify treatments according to her action plan, that is, to increase her steroid dosage (both inhaled and oral) if

her PEF levels decreased below a certain range. Her average PEF was stable at approximately 320 L/min (body height: 151 cm; body weight: 44 kg). Triggers of asthmatic symptoms included exposure to house dust mite, aspirin use, cigarette smoke, exercise, tiredness, typhoons, use of air conditioners, as well as several other triggers. Her regular visit 4 days before the Great East Japan earthquake was uneventful and routine, and the usual medications were prescribed.

At 2:46 PM on March 11, 2011, the devastating earthquake struck. At this time, the patient was shopping on the 10th floor of a department store in Tokyo, more than 300 km away from the seismic center. Because of the sudden and violent movement, she had to cling onto a post for support until the shaking and seismic activity stopped. She then proceeded to evacuate the building and went to a nearby public park. She was not injured, but had a difficult time returning home due to transportation chaos following the earthquake.

That evening, her PEF decreased and remained constant at approximately 250 L/min, more than 20% less than her normal PEF levels (see Fig. 1). Although she had neither asthmatic attacks nor signs of infection such as fever, she reported some shortness of breath. She also experienced sleep disruptions due to anxiety; she slept in her living room for several nights wearing outdoor attire for fear of aftershocks. Although she did not suffer from any typical asthmatic symptoms, she modified her treatment because of the low PEF. Her combination therapy of inhaled budesonide/formoterol was doubled, and oral steroid equivalent to 12.5 mg prednisolone was added to her regular medicine together with a small dose of *d*-chlorpheniramine. Contrary to her expectations, her PEF did not respond to the newly adjusted dosage. She discontinued oral steroids after 3 days, but continued with her combination therapy at the newly increased dose without successful PEF recovery. Fortunately, during this period, she did not have any severe asthmatic symptoms.

One month after the earthquake, she came to our clinic for a regular visit and reported a decrease in PEF as well as an increase in anxiety levels due to the disaster and the aftermath. Physical examination revealed no remarkable findings. Anxiety and/or fatigue were considered to be possible causes for decrease in PEF. Further worsening of her asthma was thought to be unlikely at that point; however, to reassure the patient, she was provided a possible explanation for the decrease in PEF, and a transdermal beta-agonist, 2 mg of transdermal tulobuterol, was prescribed in addition to her usual prescriptions.

The patient's PEF abruptly returned to normal in the evening of day she visited our clinic. Although she still experienced shortness of breath for an additional 3 days, her PEF remained stable at normal levels. The transdermal beta-agonist was discontinued after 7 days without any subsequent decrease in PEF level.

In mid-May, the patient again exhibited a decrease in her

Figure 2. Number of earthquakes in Tokyo, Japan between February and May 2011. The Great East Japan earthquake occurred on March 11, 2011. The number of subsequent earthquakes or after-shocks gradually decreased. The strongest after-shock/earthquake was observed on April 11, 2011, and the number of earthquakes was transiently elevated on that day. The intensity of earthquakes is categorized according to the Japan Meteorological Agency (JMA) Seismic Intensity. Data were retrieved on December 22, 2011, from the JMA Seismic Intensity Database at http://www.seisvol.kishou.go.jp/eq/shindo_db/shindo_index.html. The database interface is in Japanese.

PEF levels in the evening and took a steroid burst according to her action plan. This time, her PEF levels returned to normal the following morning without further deterioration. At this point, the control of her asthma seemed to follow the expected treatment plan.

Discussion

The present report illustrates a case of a 52-year-old asthma patient who experienced a decrease in PEF after the Great East Japan earthquake. The change of seasons at this time of the year was not a likely cause of this decrease for her. The decreased PEF did not return to normal levels after a routine increase in medications indicated for such a condition. Her PEF returned to normal only after 1 month with the minimal prescription of a transdermal bronchodilator after a routine visit to the clinic. The existence of factors other than pharmacological effects was considered. If the recovery was due to the added bronchodilator, budesonide/formoterol that was doubled upon the PEF decrease should also have been effective to some extent. Further, because her PEF recovered simultaneously with the first application of the patch, the drug could not have been absorbed enough into the body at the time of recovery.

According to her asthma diary, she was able to sleep well after her clinic visit one month after the earthquake. This may be due to improvements in her psychological security, which may have, in turn, increased her strength reserve. Additionally, the alleviation of anxiety may have had a beneficial effect on PEF if the decrease in PEF had been due to psychological stress. In fact, worsening of asthma due to psychological distress has been reported to cause resistance to glucocorticoids (16), as was presumed for this patient. Part of this resistance may be explained by the central neu-

ral circuitry responsible for the interaction between emotion and exacerbation of asthma (17); this circuitry is thought to be different from the inflammatory immune system.

During or after catastrophic events, in patients influenced by disasters, the control of chronic diseases, such as hypertension or diabetes, worsens for a relatively long period (3, 5, 18). For instance, an increase in AMI incidence was reported after the Great Hanshin earthquake (19). Suzuki et al. attributed this increase to severe emotional stress due to a chaotic environment (20). There seems to be wide agreement that psychosomatic effects play an important role after such catastrophes.

After the Great East Japan earthquake, exacerbation of dementia was also reported in victims (21), and the necessity of psychological care for these patients has been previously discussed (22). Similarly, although they did not provide a clear explanation for their findings, Satoh et al. reported that the self-measured home blood pressure levels of victims were elevated immediately after the earthquake (23).

Interestingly, the home blood pressure elevation mentioned above also self-resolved after a month (23), similar to our patient's PEF recovery. Thus, the duration of changes in blood pressure coincides with the decrease in PEF in the present case. Although this similarity may be coincidental, we investigated further and surveyed social factors that may be involved in this "1 month effect" or phenomenon. Figure 2 shows the number of earthquakes that were monitored in Tokyo between February and May 2011. Subsequent earthquakes or aftershocks occurred frequently immediately after the main earthquake; however, the number decreased progressively with the exception of the largest after-quake, which struck on April 11. Since after-quakes were tragic reminders of the catastrophic disaster for the surviving victims as well as for non-affected residents, the decrease in after-quakes may have alleviated the fear and symptoms associated with this distress.

Figure 3 shows the average amount of television airtime that earthquake coverage received; this may explain the transition of social situations after a catastrophic earthquake from a different perspective. Immediately after the earthquake, virtually all television stations switched to special coverage of the disaster. However, after 1 month, the proportion of disaster coverage began to decline. A reduction in the disaster coverage may have diverted people's attention from the tragedy, thus reducing stress-related symptoms.

One or both of the aforementioned observations may explain, at least in part, the PEF changes that occurred during the stressful settings experienced by our asthma patient. These factors may have been responsible for the negative change in clinical parameters, including PEF. Interestingly, Takakura et al. (4) reported an immediate and temporal increase in patient visits for asthma after the Great Hanshin earthquake after 1 month, suggesting that changes in asthmatic status after a disastrous stress may often last for 1 month or more in the disaster-affected area, although no particular explanation was provided for this finding. Even if

Figure 3. Average broadcasting time (presented in minutes) per day of earthquake coverage on main TV networks and stations in Japan. Immediately after the main earthquake, most TV broadcasts switched to special news programs. The average broadcasting time of disaster coverage was very long, and began to decline 1 month after the earthquake. This figure is reproduced from a report (“The Great East Japan Earthquake,” a view from television coverage. [Rapid Communication]) (in Japanese) dated May 20, 2011 by the JCC Corporation, Tokyo, Japan. Data were available only for the period between March 11 and May 30, 2011; however, for ease of comparison with other figures, we present time intervals on the horizontal axis from February 11 to May 30.

we do not have a clear explanation for this “1 month” phenomenon, it is noteworthy to mention that the transient worsening of asthma symptoms due to the earthquake was observed even in a patient residing in an area that was distant from the disaster.

Thus, the mechanisms underlying the acute and chronic effects of psychological stress of disasters on chronic diseases, such as asthma, need to be further studied and understood. However, it seems to be clear that when patients in need of care are in catastrophic situations, attention should be given not only to those who are injured or directly affected by the disaster, but also to those with chronic diseases who require proper attention to avoid further deterioration of their illness. This is also true for patients who are not directly influenced by the disaster, as illustrated in this report.

The authors state that they have no Conflict of Interest (COI).

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