

Mass Psychogenic Illness: Psychological Predisposition and Iatrogenic Pseudo-vocal Cord Dysfunction and Pseudo-reactive Airways Disease Syndrome

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Abstract A multidisciplinary team assessed five patients who alleged chronic medically unexplained multiorgan system symptoms described by idiopathic environmental intolerance allegedly triggered by exposure to solvents used in membrane roofing repair work on an office building. The event precipitated an incident of mass psychogenic illness (MPI). Treating physicians diagnosed irritant-associated vocal cord dysfunction (IVCD) and reactive airways disease syndrome (RADS) resulting from exposure. The authors conducted medical, psychological, and industrial hygiene evaluations. Air monitoring data for total volatile organic compounds obtained during the 2-day exposure period, measurements of emissions during membrane roofing repair at a similar site, mathematical modeling of air contaminant concentrations, and injection of tracer gas into the incident building revealed exposure levels well below those doses anticipated to cause clinical symptoms. There was no objective medical evidence validating symptoms. Review of the medical records indicated that the video laryngoscopy data, pulmonary function tests, and medical examinations relied upon by the treating physicians were inconsistent with published criteria for IVCD and RADS. Psychological evaluation identified defensiveness and self-serving misrepresentations of exaggerated health

concerns associated with somatization and malingering. Each case had personality traits associated with at least one personality disorder. Social histories identified premorbid life events and stressors associated with distress. This is the first study to assess psychological predisposition, social interaction among the plaintiffs, and iatrogenic reinforcement of beliefs by diagnoses of pseudo-disorders associated with patient misrepresentation of exaggerated health concerns in an incident of MPI.

Keywords Mass psychogenic illness (MPI) · Idiopathic environmental intolerance (IEI) · Irritant induced vocal cord dysfunction (IVCD) · Solvent · Toluene · Indoor air quality · Volatile organic compounds (VOC) · Reactive airways disease syndrome (RADS) · Somatoform disorder

Mass psychogenic illness (MPI) has manifested as medically unexplained symptoms modulated by cultural and social contexts since recorded history [1–3]. Today, MPI often involves odors, actual or perceived, believed to be toxic and originating from a specific site of exposure such as in “sick building syndrome” [4, 5]. Low-level exposure to volatile organic compounds (VOCs) may trigger sensory perception and higher levels may produce transient symptoms, such as headache or symptoms that arise from direct mucosal irritation. However, no data can explain how disability from chronic severe multiorgan system symptoms occurs in the absence of exposure to levels sufficient to cause documented injury [6]. The financial and social burdens associated with MPI are significant [7].

On 3–4 November 1999, several office employees working on the third floor in a four-storied office building with approximately 250 employees in Denver, Colorado, reported experiencing ill-health effects. Air contaminants reportedly entered the rooftop outside air intake of the building’s heating,

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ventilation, and air-conditioning (HVAC) system during installation of a new roofing membrane. Subsequently, five office workers reported chronic and debilitating ailments 3 years after this event. They had associated “diagnoses” of reactive airways dysfunction syndrome (RADS) [8], irritant-associated vocal cord dysfunction (IVCD) [9], and a wide spectrum of symptoms manifesting as intolerance to multiple low-dose chemicals characteristic of idiopathic environmental intolerance (IEI) [10].

This paper reports a detailed assessment of this episode addressing (1) establishing the exposure level in an incident of alleged hazardous chemical release; (2) validating patient symptoms by objective, standardized medical methodology; (3) assessing social and individual psychological factors that predispose certain individuals to initiate or to be affected by MPI epidemics; (4) identifying factors that maintain chronicity after removal from exposure; and (5) underscoring the role physicians play by asserting that the illness was a toxic response, thereby reinforcing false beliefs and adding an iatrogenic component to the individual’s dysfunction.

Methods

Medical evaluations consisted of a thorough review of all available records, a detailed history of prior medical problems, a thorough physical examination with emphasis on relevant organ systems of concern, complete pulmonary functions tests, and a methacholine challenge test. Blood tests were conducted by treating physicians, but since these were respiratory cases, there was no indication for basic laboratory work and that any positive findings would have been irrelevant.

Psychological evaluations were conducted 3 years after the incident with written informed consent. Interview assessed mental status, symptoms and belief about causation, history of the exposure incident, a brief medical history, and social history. Current symptoms of distress were assessed by the Derogatis Symptom Checklist (SCL-90R) [11]. In the analysis, the two categories with the highest T scores based on a normative sample were selected. The Minnesota Multiphasic Personality Inventory, 2nd edition (MMPI-2)

[12] and the Millon Clinical Multiaxial Inventory, 2nd edition (MCMI-II) [13] were administered to assess psychopathology and personality traits. Two performance-based tests of effort were used to objectively measure motivation rather than ability or neurocognitive impairment; the computerized assessment of response bias (CARB) [14], and the word memory test (WMT) [15].

A detailed industrial hygiene evaluation was done to: (1) determine the materials and methods used to install the membrane roofing of the incident building; (2) create a model of the exposure measuring the air contaminant emissions from a membrane roofing activity at another building under similar conditions; (3) model air contaminant concentrations that may have occurred on 3–4 November 1999; (4) calculate the theoretical worst-case air contaminant concentration by assuming a chemical spill within the building; and (5) inject a tracer gas into the building’s ventilation system to simulate potential roofing emissions intake with current measurements of indoor air concentrations.

Results

The demographics of the five cases are presented in Table 1. They were mostly female (four of five), middle-aged (mean=46.2 years), white-collar technicians with a high school education. They were life-long non-smokers. All were divorced at least once and remarried, and all had children.

Incident History for Individual Cases

Case no. 1 She was the index case, defined as the individual at the center of the reported incident. On 3 November 1999, she recalled experiencing symptoms of headache and dizziness in the morning. During the lunch period, she went outside and talked to others. Upon returning to the building, she also experienced cough (a symptom of one of the other patients with whom she met). At 2:15 p.m., the administrators announced that people could go home because of reported symptoms. The next morning, while working in the same area of the building, she recalled smelling fumes of glue and burning tar and had a metallic taste in her mouth. It should be noted

Table 1 Demographics

Case no.	Sex	Age (years)	Education (years)	Smoking history	Job description	Marital status	Number of children
1 Index	F	42	12	Never	Computer specialist	Divorced remarried	3
2	F	49	12	Never	Computer specialist	Divorced×2 remarried	1
3	F	39	13.5	Never	Administrative assistant	Divorced remarried	2
4	F	55	12	Never	Secretary	Divorced remarried	3
5	M	46	14.5	Never	Computer consultant	Divorced×2 remarried	4

that she did not report odors the previous day; also, no tar, hot or otherwise, was used in the roofing process. She left at 11:00 a.m. Upon arriving home, she spoke on the telephone to her sister, a nurse, who suggested that she had been poisoned. She called the local poison control center, which, based on her story, dispatched an ambulance to her house and alerted Denver Metro Rescue about the office building. She was transported to an emergency department, given oxygen, and told to follow up with an occupational medicine physician. The diagnosis was exposure to fumes.

Records from the poison control center documented that she complained of cough and respiratory irritation. She reported that hundreds of people had been exposed and that many were having symptoms. The poison control center record showed there was a prior visit by case no. 1 to an emergency room in 1993, where she had symptoms of headache, nausea, and general malaise for 24 h. On that occasion she had apparently developed symptoms at work where she reported exposure to sewer gas fumes that had entered her workplace. She was diagnosed as having a flu-like syndrome.

On subsequent evaluations, an occupational medicine physician diagnosed RADS and an allergist diagnosed IVCD caused by the building exposures. These physicians determined exposure only from patient recollections, and they did not obtain any empirical exposure level data. A lawsuit ensued and the plaintiff's attorney referred her to another occupational medicine physician who extrapolated her dosage based on her history and symptoms and told her she had been exposed to high levels of toxins. He informed her that she had suffered a brain injury from the building exposure and that she was left hypersensitive to multiple chemicals.

The first occupational medicine physician referred her to a national referral respiratory center. The evaluating physician at the center performed a number of tests including pulmonary function studies and video laryngoscopy and made the diagnosis of IVCD related to the building exposures. She was recruited to participate in a research study on IVCD and was later invited to present her testimonial at a fundraising event for the center.

Case no. 2 This individual did not go to work on 3 November 1999. On 4 November, she worked full day but did not have symptoms until after she left work. She saw the same occupational medicine physician as the other cases, but he did not diagnose her with a respiratory condition and found her to be at maximal-medical improvement (MMI) with no impairment and no work restrictions. Medical records for this time period show a diagnosis of breast cancer and subsequent bilateral mastectomy. Her attorney subsequently referred her to be evaluated by the same physician at a national referral respiratory center where she

underwent pulmonary function testing and video laryngoscopy and was diagnosed with IVCD related to building exposures on 4 November 1999.

Case no. 3 During the lunch period on 3 November 1999, she went outside the building with case no. 1, the index case, and another case no. 5, (below) during which they discussed how bad the odors were. She did not report detecting any odors or experiencing symptoms until after returning to the building. On 4 November, she detected odors upon entering the building. While at work, she received a phone call from the index case in which she was told that chemicals used in roofing are toxic and life threatening. She recalled detecting panic in the index case's voice. Fire fighters arrived in a fire truck and ambulance. They were on the phone with the rescue team at the index case's house. The firefighters ordered the building to be evacuated, and offered medical attention to anyone who could stop at the ambulance. She took the option and was administered oxygen, after which she felt better and went home.

She remained symptom free for approximately 6 weeks. On 12 December 1999, she was overwhelmed by uncontrollable cough while dancing at a holiday party. Subsequently, she saw the same occupational medicine physician as the other patients who discharged her at MMI without permanent impairment or need for work restrictions. She was also evaluated by the same allergist who diagnosed IVCD associated with the building exposures. Her attorney subsequently referred her to the same physician at the national referral respiratory center where she was diagnosed with IVCD related to building exposures on 3–4 November 1999. This evaluation notes a panic attack to explain her symptoms during the holiday party. Review of systems identified multisystem symptoms including anxiety, depression, mood swings, and irritability.

Case no. 4 On 3 November, she experienced symptoms in the morning. She heard others talking about feeling ill. She also had symptoms on November 4, but left work early to interview for a new position. She saw the same occupational medicine physician as other plaintiffs who took her off work permanently on the basis of RADS and IVCD. He did not conduct a video laryngoscopy, and the pulmonary function studies he ordered were normal. Nonetheless, this occupational medicine physician noted that she was "intermittently angry, particularly if she perceives any of the questions would suggest that there might be some underlying psychological component to her current symptoms." Additionally, he noted "her multiple neurological complaints and upper respiratory complaints appear to be out of proportion to the amount of exposure she had." And finally, "she reports job dissatisfaction and that she was

looking for a new job.” Her attorney referred her to the second occupational medicine physician, also seen by the index case, who told her the building exposure had left her hypersensitive to multiple chemicals. The medical records corroborated her account. She was also referred to the same physician at the national referral respiratory center but did not follow through on the recommended evaluation that included additional pulmonary function testing and video laryngoscopy.

Case # 5 He did not report symptoms on 3 November until after the lunch period meeting with two other cases when they discussed the odors. He did not report to work on 4 November. On 8 November, he went to an emergency department for evaluation and was referred to the same occupational medicine physician who saw the other patients. He was diagnosed with RADS and referred to the same physician at the national referral respiratory center who performed pulmonary function studies and video laryngoscopy and diagnosed him as having IVCD related to building exposures on 3–4 November 1999. The patient was recruited to participate in a research study on IVCD. He could not return to the building because of alleged reactions to multiple chemical exposures. He dated his belief that all his ailments were due to the exposures in the building to a phone call from the index case on 4 November, when he was out sick at home. She told him that the building had been evacuated and that several people had been sent to the hospital because of the toxic exposure to fumes.

Signs and Symptoms

Symptoms reported by the five cases during the initial event and 3 years later are presented in Table 2. The collective diverse, multisystem complaints during the alleged expo-

Table 2 Symptoms (frequency) for five cases

During alleged exposure, Nov. 3–4, 1999	3 years later
Headache (5)	Cognitive dysfunction (5)
Nausea (5)	Fatigue (5)
Vomiting (3)	Headache (4)
Dizziness (2)	Cough (3)
Cough (2)	Dizziness (2)
Short of breath (2)	Syncope (1)
Confusion, disorientation (2)	Paresthesia (1)
Difficulty concentrating (1)	Chest tightness (1)
Dysphonia (1)	Nausea (1)
Chest tightness (1)	Vomiting (1)
	Hoarseness (1)

sure and 3 years later are not specific for injury to the airway presenting as IVCD or RADS. The diverse symptoms were unsupported by objective findings. The symptoms at onset are consistent with anxiety and panic [16, 17].

Physical examinations of each of these plaintiffs by one of the authors (LR), specifically relevant to all of their building associated complaints, were entirely normal. Complete pulmonary function tests (spirometry, plethysmographic lung volumes, and diffusing capacity) were either uninterpretable due to poor effort and cooperation, or were entirely normal. Methacholine challenge tests, performed according to the methods of the American Thoracic Society Consensus Statement [18], were either uninterpretable due to poor effort and cooperation, or were entirely negative for airways hyperreactivity. Review of videotapes obtained on the four patients during laryngoscopic examination by one of the authors (KC) failed to support the diagnosis of VCD [19, 20].

Air Sampling and Exposure Modeling

Initial investigation of the roof repair by the responding fire department observed an open container of primer used to seal the roofing membrane in close proximity to the air intake on the roof. The material safety data sheet for the primer listed toluene as the primary solvent at a concentration of 90%. On 4 November 1999 at 3:00 p.m., members of the rescue services department took air sampling measurements inside the incident building indicative of total VOCs including toluene, with a hand-held, real-time VOC monitor and reported a measurement of zero to 1 ppm. For purposes of comparison, background air measurements taken 3 years later with another VOC monitor inside a nearby building and outside in a parking lot ranged from zero to 2.7 ppm. The building owner contracted an industrial hygiene firm and on 5 November, monitoring was conducted at 17 sites in the building, and on 8 November, a total of 27 sites were monitored. No “unique” odors were detected during the sampling and walk-through of the building on these dates. All measurements showed 0 ppm of VOCs, indicating only background concentrations.

Toluene was identified to be the primary constituent of the three most used chemical roofing solvents and glues, and was used as the contaminant of concern for modeling. Toluene odor threshold is 2.5 ppm [21], well below the OSHA Permissible Exposure limit of 200 ppm; the 20 ppm limit published by the American Conference of Governmental Industrial Hygienists (ACGIH Threshold Limit value (TLV)); and the 50 ppm EPRG-1 limit established by the American Industrial Hygiene Association (AIHA Emergency Planning Response Guideline). The AIHA defines the ERPG-1 as the

maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 h without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor. AIHA also has established an ERPG-2 of 300 ppm, which is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 h without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action. The reported exposure time of the plaintiffs on 3 November 1999 was estimated at 6.5 h; and on 4 November 1999, at 4.5 h, for a maximum possible total exposure time of 11 h. Each of the plaintiffs worked in the office/cubicle area in the central part of the third floor along with dozens of other workers who did not file complaints in regard to the subject incident.

Toluene has the lowest exposure limits among the VOCs identified as product constituents. Fixed area air samplers during a roofing membrane application at a similar site measured VOCs at 11 ppm. Among these VOCs, toluene was the most prevalent of the air contaminants detected, and was measured at 8.6 ppm. Air concentrations of acetone, heptane, isopropanol, and xylenes, other chemicals in the roofing glues and primers, were determined to be individually below 1 ppm. These air contaminant samples were collected with battery-powered, industrial hygiene personal air sampling pumps drawing air through activated charcoal tube media. Sample results were determined by a laboratory accredited in industrial hygiene analysis. For toluene, the lower limit of detection for this method is a nominal 0.01 ppm.

Measurements of VOCs emissions were recorded during short, discrete work tasks, e.g., applying primer to roofing membrane seams at the similar site. These measurements were collected with a VOC monitor, calibrated on the day of use, and were used to develop models of contaminated volumes of air entering the office building in 1999. These models estimated that the VOC concentrations ranged up to 15 ppm.

A theoretical, worst-case mathematical model, assuming a spill at Denver's altitude and complete evaporation inside the building of 1 gal of roofing membrane primer made up of 100% toluene, revealed an upper limit of 41 ppm. This modeling was performed to determine the absolute upper bound of solvent vapors that could have occurred inside the building during the November 1999 incident. One gallon is the approximate amount of primer to complete the daily sealing of overlapping membrane seams on the roof at the office building. This scenario would not likely occur since: (1) overly conservative assumptions were used in development of the model; (2) wind conditions typically found atop a building of this height would result in the majority of

toluene emissions from the process being diluted or blown away from the fresh air intake of the building; and (3) the primer was applied over an entire nominal 8-h work shift and not instantaneously as would occur in a spill of the contents of the entire primer container. While this is not a realistic depiction of the events of 3–4 November 1999, this worst-case model serves as a useful basis of assessment of possible dose and toxicity.

Tracer gas testing using sulfur hexafluoride was used to simulate the chemical exposure scenario that could have occurred during the roofing membrane application. Sulfur hexafluoride was injected into the fresh air intake of the building's HVAC system late at night when all building occupants were gone. Conservative assumptions were applied, as the injection rate for the tracer gas was based on the highest anticipated toluene emission rate calculated based on a day's usage of the primer of concern. During tracer gas testing in 2003, the building's HVAC system was configured to operate under conditions similar to those on 3–4 November 1999. A quantitative gas analyzer with a photo-acoustic infrared detector, capable of sub ppm measurements, was used to measure the tracer gas. Measurements recorded on the 3rd floor where the impacted employees worked revealed that toluene concentrations would not have exceeded 20 ppm.

The design forced ventilation of the building is 60,000 cubic feet per minute (cfm). On 3–4 November 1999, air handlers were operating at approximately 30% of maximum design flow, or 18,000 cfm. With a building volume of 820,000 cubic feet, the calculated complete air exchange time for the building is 14 min (by design) to 45 min (per subject incident estimated flow). However, air exchanges would occur more frequently than these calculated rates because of openings in doorways, stairwells, elevator shafts, utility chases, crack in walls, and other openings present in all buildings. Modeling based on toluene levels determined from the fixed monitors and the VOC monitor were based on 30% of design ventilation rates. The tracer gas measurements are real-time, and as such, incorporate building air exchanges from the actual forced ventilation and the natural ventilation occurring in the building at the time of the measurements. The spill "worst-case" scenario assumed static building conditions with no air exchanges.

Dose Estimate

A relative estimate of dose experienced by persons involved in the subject incident can be shown by computing ppm-hours for the incident versus an exposure limit. The ACGIH TLV for an 8-h work shift is 20 ppm. By ACGIH's definition, this time-weighted average TLV is the air concentration to which it is believed that nearly all workers may be repeatedly exposed, day after day, for a

working lifetime without adverse effect [22]. For a 40-h week, the imputed dose should not exceed 800 ppm-h (20 ppm × 40 h). The data collected during this study suggest that the incident's five cases had a dose up to 220 ppm-hours (20 ppm × 11 h), which is 28% of the imputed weekly occupational dose. This dose is the maximum possible, since some of the cases did not go to work for the full 2 days, as detailed in their case histories, above. At this dose, serious, long-lasting health effects are not expected.

Psychological Testing

The results of the psychological testing are presented in Table 3. Somatization and obsessive–compulsiveness were the most frequent SCL-90R categories of current distress. The MMPI-2 validity scales showed that three of the cases adopted a defensive approach. T scores >64 on the MMPI-2 validity scales L, K, and S reflect defensiveness characterized by denial of common human frailties, denial of psychological problems, and exaggerated virtue. None of the cases over-reported infrequent psychiatric symptoms, as would be indicated by an elevated F scale. On the MMPI-2 clinical scales 1 (Hs) and 3 (Hy), four cases showed elevations with T score >64 on both and one showed elevation on scale 3 only. Two cases demonstrated poor effort as measured by the CARB and WMT tests. In all cases, the MCMI-II identified traits associated with various personality disorders, which were confirmed by interview.

Medical and Stress History

The medical, mental health, and stress histories obtained during the psychological evaluation are presented in Table 4. The mental health histories are remarkable for multiple risk factors for emotional distress and lack of treatment.

Discussion

To our knowledge, this is the first study of MPI in which rigorous and comprehensive evaluation of cases' medical and psychological conditions were conducted in addition to industrial hygiene assessment. As previously noted, [1, 7, 23] social interactions among the patients contributed to the creation of a belief of harm and disability and initiated this incident of MPI. A purely sociological theoretical perspective of MPI suggests that interpersonal sociological phenomenon can affect anyone at random. This study demonstrated that the patients had psychological personality traits that predisposed them to create or be affected by the social aspects of MPI.

Table 3 Psychological testing results

Case number	SCL-90R, two highest categories (T scores)	MMPI-2, validity scales elevated T scores >64					MMPI-2, clinical scales elevated T scores >64					CARB, test of effort	WMT, test of effort	MCMI-II, axis-I disorder (base rate score)			MCMI-II, axis-II disorder (base rate score)			
		L	K	S	Hs	Hy	Ma	Sc	D	Pd	Pt			Anxiety	Somatiform	Dependent	Compulsive	Narcissistic	Histrionic	
1	65	81	70	74	61	73						Poor	Poor			93	70			
2	57	66			69	75	94	72				Good	Good			73	72			72
3	64				65	82						Poor	Poor			71	71			78
4	71	76	70	74	71	77						Good	Good			73	88			71
5		68			92	101	75	81	78	72	79	Good	Good	91	77					72

Table 4 Premorbid medical, mental health, and stress history

Case no.	Medical history	Mental health history	Stress history
1	Meningioma surgery, 1988; laminectomy, 1980	Grief counseling, 1987; denies psychotropic medications	Death of baby; second child with life threatening heart condition; and 1993 reports hydrogen sulfide exposure to poison control center
2	Irritable bowel syndrome, 1990; bilateral mastectomy, 2000; medically unsubstantiated “stroke”, 2002	Counseling during spousal abuse and denies psychotropic medications	Spousal abuse, sexual, physical, and psychological, 1993, with posttraumatic stress disorder sequelae; father dies, 1999; breast cancer, 1999; and “stroke” after argument with son, 2002
3	Motor vehicle accident resulting in lower back injury, 1999	Marriage counseling, first marriage and denies psychotropic medications	Father neglecting; mother mentally unstable; low self esteem; dislike of men, detested 1st husband; 2nd husband’s daughter disrupted family, left her feeling resentful and angry; and she blamed her son’s oppositional defiant disorder on her own anger during his pregnancy
4	Hypertension	Psychological evaluation, 2001; denies psychotherapy; and medications: Zoloft and Celexa for panic	1st husband unfaithful; divorced, 3 sons went with father; 2nd husband physically abusive; separation with 2nd husband while 1st wife; later she reconciled with 2nd husband
5	Hypertension and knee surgery	Denies psychotherapy; denies psychotropic medications and pre-incident psychological records showed a diagnosis of panic disorder with agoraphobia	2nd wife drug addict; child conceived out of wedlock, he paid alimony; 2nd child out of wedlock, married the mother 11 years later; large debt from lost legal case for failure to pay contractor; and delinquent IRS taxes with penalties

In the standard psychiatric nomenclature, MPI is subsumed under the general heading of somatoform disorder, subcategorized as conversion disorder [24]. This classification specifies that certain factors be observed in the index case(s) such as medically unexplained symptoms associated with somatization, medical seeking behavior to confirm a physical illness and maintain the sick role, denial of a psychological etiology, and alternative psychological factors to explain the ailments. These factors were identified not only in the index case, but in all cases. The initial symptoms (e.g., headaches, nausea and vomiting, shortness of breath) reflect symptoms of anxiety or panic induced by the perception of hazardous exposure [16]. The chronic multiorgan system complaints reflect beliefs molded by the prevailing fashionable somatic syndrome of IEI [25] presenting as “sick building syndrome.” Professional organizations have rejected IEI as a medical diagnosis [26, 27].

This is the first MPI study to demonstrate the potential iatrogenic role physicians play in reinforcing beliefs of a toxic induced illness by “diagnosing” unsubstantiated or pseudo-disorders that are semantic variations of IEI. In addition to the harm associated with false beliefs of a toxic illness, four cases in this series received medications to treat pseudo-disorders. Some medications, particularly systemic

oral corticosteroids, have associated risks to which patients were needlessly exposed.

There are several respiratory conditions that have been attributed to chemical intolerance that are without scientific foundation including IVCD. The single IVCD study published to date presented IVCD as a separate and distinct entity from VCD. It was designed as a retrospective chart review, which identified 11 patients who self-reported symptom onset temporally related to chemical exposure [9]. VCD is a well-described disorder with a characteristic clinical presentation that includes shortness of breath with audible wheeze and established laryngoscopic diagnostic criteria reliant upon proper laryngoscopic examination [19, 20]. The preponderance of the literature recognizes a psychologic etiology for these paroxysms of glottic obstruction due to paradoxical vocal cord adduction. Emotional distress, somatization, and poor ability to cope with stress are identified to be prevalent. Premorbid psychopathology including personality disorders play a significant role in the etiology of VCD [28], which is most often diagnosed as a somatoform disorder, specifically conversion disorder [29]. Evidence of organic disease, disorder or injury are absent and the psychologic nature can be demonstrated by a variety of methods including response to administration and withdrawal of helium,

response to placebo, resolution when the patient is distracted, respiratory maneuvers, and blinded provocation testing with self-reported triggers [19, 30].

Even though each of the cases in this report was diagnosed as having IVCD, none of the cases actually had VCD. Case no. 3 had laryngoscopic findings that have been previously noted when conscious efforts are made to produce laryngeal obstruction [19]. This individual was also one of two cases who met criteria for malingering by showing poor effort on cognitive performance tests of effort indicating exaggeration or misrepresentation of symptoms of neurocognitive dysfunction [31]. However, even if all five did have VCD, a psychological etiology for presenting respiratory symptoms predominates over an unsubstantiated theory of glottic injury with chronic respiratory impairment triggered by exposures to low-level multiple chemicals [30].

The MMPI-2 score elevations are typical in personal injury plaintiffs and represent the self-serving exaggeration of health difficulties [32, 33]. Over time, these misrepresentations interacted with social and iatrogenic factors to strengthen the conviction of toxic harm. By attributing medically unexplained symptoms to the environment, unresolved psychological conflicts stemming from premorbid distressing life events that the patient cannot cope with are projected external to the self.

In conclusion, we have presented a unique study in which rigorous industrial hygiene assessment demonstrated that no hazardous exposure had occurred, psychological assessment identified long-standing psychopathology that could explain the reporting of medically unsubstantiated symptoms, and medical evaluation exposed unwarranted “diagnoses” of pseudo-IVCD and pseudo-RADS. Psychological etiology should be considered in cases of building-related illness and “sick building syndrome,” especially when there is sudden onset of symptoms characteristic of MPI, which progress to chronic multiorgan system complaints attributed to an ever spreading array of environmental agents, a phenomenon without scientific basis for toxic causation [34].

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