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ORIGINAL RESEARCH

Environmentally Induced Dysfunction: The Camp Hill Medical Centre Experience

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In 1987, workers in the kitchen of one of the teaching hospitals in Halifax, Nova Scotia began to experience symptoms of pruritus, folliculitis, wheezing, conjunctival irritation, sore throat and headache, all suggestive of an indoor air quality (IAQ) problem. Approximately 127 of 160 kitchen workers were affected over a 2-year period and the complaints included cognitive difficulties and reactivity to environmental irritants. Workers in other parts of the hospital developed increasingly serious problems, including bronchial hyper-reactivity, nausea, diarrhoea, weight loss, hair loss, recurrent infections, myalgia and arthralgia as well as more sinister neurotoxic effects of memory loss, poor concentration, visual perceptual losses, peripheral paraesthesia, Raynaud's phenomenon, severe fatigue, dizziness and neuromuscular incoordination. Between 1991 and 1993, more than 700 workers, out of a total workforce of 1250, reported symptoms. Over 300 workers were off work for periods of from 3 months to 3 years and, at the time of writing, over 100 workers remain disabled and unable to work. During the course of this epidemic, it became clear that the clinical features did not readily fit into any widely accepted single disease category or syndrome. However, the ill health appeared to be related to IAQ problems in all buildings. It also became apparent that much of the symptomatology was similar to the condition known as multiple chemical sensitivity. The sick workers became intolerant of the hospital environment and their symptoms appeared to be precipitated by incitants such as chemicals, mould, dust, food, light or electromagnetic radiation. This state of ill health is described as environmentally induced dysfunction and the essential clinical features include chronic ill health for at least 3 months with evidence of dysfunction in multiple organ systems. The symptoms wax and wane, are provoked by exposure to certain environments (e.g. the workplace) and improve upon removal of triggers or irritants. Many of the workers improved when they stopped work and created a very clean environment at home. Most patients have cognitive impairment and evidence of autonomic nervous system dysfunction. Chemical sensitivity is an important part of this problem and recognition of the importance of this has to occur to allow research to take place and to assist in the treatment of those already afflicted and incapacitated by these problems. As a greater understanding is gained, it should be possible, in the future, to prevent problems of the same magnitude as reported here.

Keywords: chemical sensitivity, environmental illness, sick building syndrome, building-related illness, chronic fatigue syndrome, chronic toxic encephalopathy, fibromyalgia, epidemic myalgic encephalomyelitis.

INTRODUCTION

In the last 30 years the phenomenon of illness brought on by working in certain buildings has been identified. The term 'sick building syndrome' (SBS) has become widely recognized by many authorities including the World Health Organization [1] and has been defined as a set of varied symptoms experienced predominantly by people working in air-conditioned buildings [2]. The symptoms experienced with SBS occur in the general population but are more frequent in occupants of certain buildings and include the following:

- irritated, dry or watering eyes;
- irritated, runny or blocked nose;
- dry or sore throat;
- dryness, itching or irritation of the skin, occasionally with a rash;
- less specific symptoms such as headache, lethargy, irritability and poor concentration.

Such symptoms usually clear when the person is out of the 'sick building'. Some individuals become much more ill and develop additional symptoms, such as severe fatigue, which persist outside the building. A recent report describes patients from three different buildings who developed symptoms indistinguishable from chronic fatigue syndrome (CFS) which were superimposed upon the more conventional SBS symptoms [3]. This type of chronic fatigue is an example of a building-related illness (BRI). A variety of other problems have also been described under the designation 'BRI'.

SBS and BRI have been major problems in one of the teaching hospitals in Halifax during the last 5 years. Camp Hill Medical Centre (CHMC) is a metropolitan teaching hospital which consists of three buildings, Camp Hill Hospital (CHH), the Abbie J. Lane Building (AJL) and the Veterans' Memorial Building (VMB), at one location and the Halifax Infirmary at another site approximately 1 mile away. The VMB, the most recently constructed of the buildings, was opened in 1986.

The purpose of this paper is to describe the illnesses which occurred among the workers at CHMC and to suggest a definition.

ENVIRONMENTAL ILLNESS AT CHMC

In 1987, workers in the VMB kitchen began to experience symptoms of pruritus, folliculitis, wheezing, conjunctival irritation, sore throat and headache, all suggestive of an indoor air quality (IAQ) problem. Approximately 127 of 160 kitchen workers were affected over a 2-year period. Subsequently, it was shown that an air-borne irritant was the cause; this was identified as sodium hydroxide from the detergent used in the dishwasher which had been exhausted into a small outside courtyard close to the main fresh air intake to the kitchen [4]. This was corrected and the irritant effects on the workers began to resolve, but a proportion of the workers continued to develop a variety of complaints including cognitive difficulties and reactivity to environmental irritants. At this time, some workers in other parts of the building became sick, but the problems were not associated with the ill kitchen workers.

In late 1989 the first cases similar to the kitchen workers were recognized on the second floor of the VMB. The building occupants developed increasingly serious problems. There was a higher prevalence of bronchial hyper-reactivity compared with the kitchen workers, and the symptoms now included nausea, diarrhoea, weight loss, hair loss, recurrent infections, myalgia and arthralgia as well as the more sinister neurotoxic effects of memory loss, poor concentration, visual perceptual losses, peripheral paraesthesia, Raynaud's phenomenon, severe fatigue, dizziness and neuromuscular incoordination. The number of workers reporting symptoms throughout the three buildings increased rapidly between 1991 and 1993 when more than 700 workers reported symptoms out of a total workforce of 1250.

Almost all these cases were reported at the Camp Hill site but 17 cases were also identified in the workers from one ward of the Halifax infirmary, which had been recently renovated and in which significant IAQ problems had also been identified. Over 300 workers were off work for periods of from 3 months to 3 years and, at the time of writing, over 100 remain disabled and unable to work.

During the course of this epidemic, it became clear that the clinical features did not readily fit into any widely accepted, single disease category or syndrome. However, the ill health appeared to be related to IAQ problems in all the buildings. The term 'environmental irritant syndrome' was used to describe this condition and, as more patients have been seen, we have observed that an important part of the syndrome is reactivity to the presumed environmental irritants, such reactivity being manifest by impaired function in the various organ systems of the body. It also became apparent that much of the symptomatology was similar to the condition known as multiple chemical sensitivity (MCS). Randolph [5] originally described hypersensitivity to solvents and petroleum products and referred to this as chemical susceptibility. The condition has also been known by a variety of other names, such as twentieth-century disease or chemical sensitivity. One problem with defining MCS is the lack of pathognomonic features and easily obtained objective tests, although a number of definitions are available, for example that of the Thompson report [6] or that of Cullen [7]. With the ill health of the workers at CHMC, the sensitivity or hyper-responsiveness [4] to chemicals appeared to be an important part of the total clinical picture, but there were other clinical features which did not appear to be directly linked to the sensitivity to chemicals. For example, many of the affected patients reacted adversely to other substances and some had clearly defined allergies, presumably IgE mediated, to biological irritants such as mould and pollens.

With the experience at CHMC, we have had a unique opportunity to observe this major health problem closely. In view of the IAQ problems, the demonstration of irritants and the reactivity to these irritants, we conclude that the health problems of the workers are environmentally related. The pathophysiological changes leading to disordered function in the various systems are not well understood but, rather than claim that a new disease is described, or that the patient has multiple idiopathic conditions developing simultaneously, we propose an operational definition for this state of ill health which we refer to as 'environmentally induced dysfunction' (EID).

EID was postulated because of the exacerbation of symptoms or signs in various organ systems upon exposure to environmental irritants. EID patients show two major historical features:

- (1) the gradual but unremitting descent into ill health, usually over a period of more than 3 months by the time of presentation;
- (2) the development of distressing symptoms in more than one organ system aggravated or precipitated by exposure to environmental irritants.

These reactions occur on exposure to everyday concentrations of chemicals and other substances which do not normally produce symptoms or illness in others. The reactions abate when the patient is separated from the putative offending environment or trigger. The putative environmental irritants include biological materials such as mould, pollens (trees, grasses or weeds), animal dander, dust or dust mites. A majority of patients identify foods as exacerbating symptoms. For most of the patients, this does not appear to be a fixed allergy which is seen with certain foods such as peanuts or seafood. Our experience to date has revealed that many of the patients start to react to common foods which are usually eaten on a daily basis. After elimination of the food from the diet for a period of time, there is often an improvement with loss of the sensitivity. We concluded that this is food intolerance which has been recognized as occurring in patients with chemical sensitivity [8]. A third category of irritant is chemicals. Patients identify reactions to a wide variety of chemicals at ambient concentrations usually tolerated by other people. Some patients at

Camp Hill also identified an exacerbation of the symptoms by exposure to electromagnetic fields, being unable to use or be near computers, television sets or certain electrical appliances. A fifth category of environmental irritant appears to be physical and some patients became very easily perturbed by changes in temperature, by light, natural or artificial, or by noise. These environmental irritants rarely act alone and patients usually appear to have multiple types of reaction, some of which are synergistic and appear to precipitate or potentiate others.

The symptoms, resulting from impaired function, vary in their severity and can range from mildly disturbing to significantly disabling. The dysfunction was identifiable as a pathophysiological state or by diagnosis of a clinical syndrome. For example, bronchospasm, triggered by exposure to certain environments, was diagnosed as asthma or reactive airways disease. Patients with muscle aches, classical trigger points and difficulty in sleeping were diagnosed with fibromyalgia. Some patients had multiple diagnoses of pathophysiological states, clinical syndromes or 'diseases' of unknown aetiology such as asthma, irritable bowel syndrome (IBS), fibromyalgia, interstitial cystitis, migraine, anxiety attacks, arthritis, somatization disorder, dysfunctional uterine bleeding, etc., which alerted the occupational physician to the possibility of environmentally induced illness.

Fatigue was universally present in the patients at Camp Hill. Another important characteristic was fatigability, the development of severe fatigue and myalgia after exercise with a prolonged period required for recovery. This is a feature of the epidemic myalgic encephalomyelitis reported in hospital epidemics such as the Royal Free Disease [9].

Fluctuating symptoms were found to occur in almost any system. Skin problems were common and included pruritus, dryness, erythema, eczematoid reactions, folliculitis and acne necrotica. Most patients developed cognitive dysfunction with short-term memory impairment, an inability to concentrate or visual perceptual problems. Many complained of being dizzy and of having poor balance. Emotional lability with mood swings occurred, with some patients developing depression and anxiety. Patients frequently identified irritant symptoms of the eyes and upper respiratory tract. The lower respiratory tract was also affected with symptoms of shortness of breath, wheezing and bronchitis. Frequent gastrointestinal symptoms were nausea, loss of appetite, abdominal bloating, excessive flatus, constipation or diarrhoea. Many of these patients had the diagnostic label of IBS attached by the time the environmental aspect was recognized. Patients complained of increased frequency of micturition, incontinence, difficulty in initiating micturition, dribbling and nocturia. These appear to result from autonomic nervous system dysfunction. Additional symptoms of such dysfunction included disordered thermal regulation, cold sensitivity and cold extremities or frank Raynaud's phenomenon, as well as night sweats, flushing episodes or inappropriately bright red, hot extremities.

Examination revealed that patients often looked ill with a yellowish cast to their skin,—this has been identified as 'the chemical yellows'. Skin changes were seen, particularly adult-onset acne, together with oedema, petechiae, livedo reticularis, follicular hyperkeratosis and dark circles under the eyes. Examination of the nervous system revealed a positive Romberg's test in some patients and occasionally peripheral neuropathy. Detailed neuropsychological testing revealed various functional deficits in the majority.

DIAGNOSTIC PROCESS

When EID was suspected from such a presentation the link between environmental exposure and symptomatology was actively sought. Other syndromes such as CFS, fibromyalgia, IBS, peripheral neuropathy, migraine, asthma or eczema were identified and recorded in the problem list if the diagnostic criteria were fulfilled. It is recognized that with such diagnoses a problem solution is inadequate. Linkage with other problems and with the environment takes the solution to a higher level.

Abnormal laboratory tests confirmed dysfunction in some instances and supported the diagnosis of EID. For example, some had abnormal pulmonary function tests, a positive methacholine challenge test, abnormal neuropsychological tests or abnormal blood tests showing leucopenia, elevated liver enzymes and abnormal lymphocyte subsets. Similar abnormalities have been described in published series of MCS patients [10, 11]. In some patients, hypersensitivity or allergy has been confirmed by appropriate blood tests [12].

In order to link environmental exposure with symptomatology, suspected irritants need to be withdrawn. For adequate withdrawal the complex patient may need to be isolated for a time in a clean environment (free of most chemicals and biological irritants), including the elimination of foods that are suspected of causing symptoms and avoidance of other suspected triggers. In reports of patients with MCS, such measures will result in the improvement of symptoms or measurable signs [13, 14], which would be consistent with the hypothesis of the causative link with the environment. This has been our experience at Camp Hill and most of those afflicted improved with avoidance of the workplace and modifications of their home environments.

After improvement, the patient can be challenged in a variety of ways to determine if the symptomatology is related to environmental exposures. The most obvious method of challenge is to return the patient to the suspected offending environment, with careful observation and measurement of appropriate changes in function. While sometimes impractical, this is exactly what many patients have done repeatedly and it forms an important part of the history. Such information was available from many of the patients at CHMC. In the future, it will be important to verify EID objectively. This is being pursued with these patients using various published techniques. Some of the environmental irritants may be clearly linked to immune reactions and tests. It may be possible to link an identified mould, for example, with particular patients by the demonstration of specific antibodies and furthermore a rise in the antibody titer on return to the offending environment [15, 16]. Various types of challenge have been reported which include the administration of putative environmental irritants by intradermal injection [17, 18] or by placing sublingually [19, 20]. Intradermal testing, measuring the whealing response, can also be used to confirm hypersensitivity and can be quantified by serial dilution, a procedure endorsed by the Council on Scientific Affairs of the American Medical Association [21].

Chemical sensitivity, an important component of EID, is more difficult to confirm because the environmental irritants are ubiquitous and ambient concentrations do not produce symptoms in the majority of people. Until we have better characterization of the disease, some form of objective confirmation of chemical sensitivity is required. This has been claimed for an inhalational challenge and measuring changes in peak flow [22, 23]. If test conditions are rigorously controlled by a double-blind inhalational challenge, sensitivity to low levels of chemical [24, 25] can be confirmed. If these precautions are not followed, the test cannot be considered to be valid [26, 27]. Now that a cohort of patients has been identified with EID, accurate testing for chemical sensitivity needs to be developed.

Other tests were considered in these patients but were not available, for example, pupillography, a precise measurement of pupillary function, which is known to be significantly impaired in diabetic autonomic neuropathy [28]. Patients with chemical sensitivity and pesticide exposure demonstrate autonomic dysfunction [29].

Objective confirmation of reactivity to electromagnetic fields (EMF) or physical stimuli is not available. Our tentative conclusions are drawn from the clinical histories. However, EMF sensitivity has been demonstrated in one controlled study [30] but not in others [31, 32].

Aetiology and Treatment Considerations

With the Camp Hill experience, it has been obvious that the common aetiological factor in the illness of these patients has been the hospital buildings, and a variety of problems

related to air quality within these buildings have been identified. The pathophysiology continues to be studied, but as yet there is no clear understanding of the underlying mechanisms or identification of specific aetiological factors. We believe that the term chemical sensitivity, or as some prefer chemical hyper-responsiveness [4] should be reserved for use for clearly defined reactions to chemicals. The term can be safely used in this regard, but should not be used to encompass all the symptomatology since there are obviously a variety of environmental irritants apart from chemicals. Indeed, classical immediate hypersensitivity (IgE) to biological irritants appears to be an integral part of the problem. Confirmation of reactivity or hypersensitivity to different irritants is important in establishing a diagnosis and in directing treatment.

EID can have a devastating impact both in terms of human suffering as well as economically. It is important that it is recognized; if, as we believe, the patients are intolerant of low levels of chemicals and various biological materials, exhaustive evaluation of patients within hospitals and other potentially hostile environments is likely to make the patients worse and will not help in the diagnosis. Once the environmentally induced dysfunction is identified (Fig. 1), more appropriate investigation and treatment can be commenced.

CONCLUSIONS

If we are to understand this phenomenon and help our patients, we need to characterize and separate these patients clinically and study them carefully. The approach that we present here involves the recognition of impaired function which is induced by environmental incitants. This is termed 'environmentally induced dysfunction'. The criteria in Fig. 1 can be used as a working definition to help in the identification of patients. The definition is likely to be modified by further investigation, by careful monitoring of patient groups and by rigorous study of the various testing and treatment techniques. It is also important to recognize the patient's problems at this stage of potential reversibility before the likely end result of organ damage and permanent dysfunction.

Chemical sensitivity is an important part of this problem and more research is urgently needed to validate the claims for objective testing (Fig. 2). Recognition of the importance of these problems has to occur to allow the research to take place, and to assist in the

Pre-existent or associated conditions like asthma, irritable bowel syndrome, arthropathy, migraine, etc., are included.

- (1) Chronic ill health >3 months.
- (2) Evidence of dysfunction and absence of definite pathology.
- (3) Symptoms and/or signs.
 - (a) In multiple organ systems.
 - (b) Wax and wane.
 - (c) Provoked by exposure to certain environments (e.g. school or workplace).
 - (d) Ameliorated upon removal of triggers or irritants.
 - (e) Provoked by testing with identified irritants, such as biological allergens, foods or chemicals.
 - (f) Clear or significantly improve in a very clean environment.
- (4) Most patients have nervous system dysfunction or cognitive impairment such as poor memory, difficulty in concentrating, dizziness, irritability and mood swings.
- (5) Most patients have evidence of autonomic nervous system dysfunction, such as inability to keep warm, cold extremities, Raynaud's phenomenon or night sweats, inappropriately warm, vasodilated extremities and flushing episodes.

FIG. 1. Defining environmentally induced dysfunction.

- (1) Biological irritants—confirmation by standard tests such as scratch, contact sensitivity, intradermal testing or measurement of specific IgE (RAST).
- (2) Food intolerance—confirmation by improvement in symptoms after the removal of putative offending foods and after fasting or the use of a restricted diet, with return of symptoms upon reintroduction of single foods.
- (3) Chemicals—provocation of symptoms and objective change in physiological function (blood pressure, pulse, cognitive function, peak flow, etc.) by double-blind, placebo-controlled challenge testing to chemicals in low concentrations under environmentally controlled conditions.

FIG. 2. Objective confirmation of EID.

treatment of those already afflicted and incapacitated by these problems. We do not believe that EID is restricted to epidemics like that which has occurred at CHMC, and the case definition should be applied to other groups of patients where the aetiology is other than a sick building, for example exposure to occupational chemicals or pesticides. As a greater understanding is gained, it should be possible, in the future, to prevent problems of the same magnitude as reported here.

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REVIEW

Treating the Ectomorphic Constitution

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This paper looks at the concept of constitutional type and reviews a number of classification systems used by twentieth-century researchers and clinicians. In particular, it examines those very slim individuals characterized by W. H. Sheldon as ectomorphs. The paper contends that such individuals have, by virtue of their body build, the tendency to a catabolic-anabolic balance. This tendency is exacerbated by stress to which such individuals may be especially prone. Mutually reinforcing states of hyperarousal and hypermetabolism eventually result in states of fatigue, depression and the breakdown of immune and hormonal systems. This model has implications for treatment.

Keywords: constitution, ectomorph, catabolism, adrenal reserve.

INTRODUCTION

In my practice of psychiatry and nutrition over the years, I have come to notice that very slim individuals seem particularly prone to chronic states of fatigue, anxiety and environmental sensitivity. I have also come to realize that this observation has been made on many occasions, both in the recent and distant past, by physicians interested in the concept of constitution.

In attempting to make sense of this apparent correlation, I have come to believe that certain thin individuals, best characterized by W. H. Sheldon as ectomorphs (see later), have, by virtue of their body build, the tendency to a catabolic-anabolic imbalance. This tendency is usually exacerbated by stress to which such individuals may be especially prone. The end result, mutually reinforcing states of hyperarousal and hypermetabolism, eventually leads to chronic fatigue and the breakdown of immune and hormonal systems.

Our rapidly expanding knowledge of physiology and biochemistry provides new insights into the metabolic problems faced by ectomorphs as well as offering pointers for more effective prevention and treatment.

I will outline some of the relevant findings in the following, after considering the concept of constitution and its evolutionary strands in the twentieth century.

THE CONCEPT AND DEVELOPMENT OF CONSTITUTIONAL TYPING

The concept of constitution is a very old one and is embedded in the medical traditions of both East and West. The idea that there are a limited number of definable inherited physiques is by no means proven but the study of constitution is relevant for a number of reasons.

Current medical research seems to focus on micro-level functioning particularly in the realms of biochemistry and genetics. The study of constitution helps to refocus research and