

Sentinel Pathophysiologic Conditions: An Adjunct to Teaching Occupational and Environmental Disease Recognition and History Taking

HOWARD M. KIPEN^{*†} AND JAMES CRANER[†]

**Department of Environmental and Community Medicine and †Environmental and Occupational Health Sciences Institute, UMDNJ-Robert Wood Johnson Medical School, 675 Hoes Lane, Piscataway, New Jersey, 08854-5635*

Received May 15, 1992

Primary care physicians have an increasingly important role in identifying occupational and environmental (O/E) disease. However, the basic skills in O/E history taking, diagnosis, and management have not been adequately incorporated into traditional American medical education or practice. Reasons for these educational barriers are discussed. A new approach to O/E history taking, based on a modified list of occupational sentinel health events, is described. This list will give medical students and residents a practical, directed approach to recognizing O/E conditions and evaluating exposures in formulating a differential diagnosis. Through improved detection and assessment on the part of primary care physicians, appropriate referrals to occupational health specialists can be made for further investigation and public health surveillance. © 1992 Academic Press, Inc.

INTRODUCTION

The Institute of Medicine of the National Academy of Sciences published a report entitled "The Role of the Primary Care Physician in Occupational and Environmental Medicine" in 1988. It concluded that at a minimum, "all primary care physicians should be able to identify possible occupationally or environmentally (O/E) induced conditions and make the appropriate referrals for followup." Other expert groups such as the American College of Physicians have also proposed that primary practitioners be conversant with O/E medicine principles and practice (ACP, 1984, 1990), perhaps to an unrealistically ambitious level (Kipen, 1991). The American Academy of Family Practice requires resident training in occupational medicine.

Public and governmental perception and concerns about increasing occupational and environmental insults has magnified in the past decade, as reflected in the number of laws, regulations, citizen organizations, and technological advances that have proliferated in response to these problems. Yet, despite years of effort on the part of dedicated specialists, occupational and environmental (O/E) disease diagnosis, treatment, and prevention have yet to be incorporated into the mainstream of American medical education and practice (Levy, 1980, 1985; Abraham, 1980; Rosenstock, 1981; Rutstein *et al.*, 1983; Rosenstock and Hagopian, 1987). Paradoxically, the public views primary care physicians as one of the most important and reliable sources of information about O/E illness. This resource thus remains largely untapped.

The Institute of Medicine report proposed a list of explanations as to why

medicine has not responded to these emerging social issues (NAS, 1988). They include educational obstacles such as a long tradition of insufficient faculty awareness and teaching in medical schools of the toxic effects of workplace and environmental exposures; the often infrequent occurrence of occupational and environmental events compared to the incidence of many common chronic medical conditions; and the lack of informational support accessible to the primary practitioner. Obstacles at a societal/systematic level include the current limited relationships of practicing physicians to state, local, and federal health agencies and departments, in contrast with their close integration during the early part of this century in combating infectious diseases; entanglement with the worker's compensation system leading to concerns about payment delays, nonpayment, and paperwork; misunderstanding of, and aversion to, the legal and political issues associated with occupational and environmental health; and ethical dilemmas surrounding the doctor-patient-employer triangle. This latter group of societal obstacles is most often cited by physicians as an explanation for the lack of O/E involvement and performance because of their deleterious impact on the actual conduct of a viable medical practice. However, we believe the educational obstacles are more fundamental and must be rectified before the societal issues become really relevant.

Thus, the listed societal impediments to medical care for, and public health prevention of, O/E conditions are moot if physicians fail to *identify* these conditions in the first place. That is, if a physician is unable to properly entertain an O/E diagnosis in his mind because of unfamiliarity with the condition or how to properly make the diagnosis, then legal, ethical, or public health consultative impediments and deficiencies will not realistically have a chance to influence his thinking. It is these obstacles of history taking technique, knowledge base, and investigative capability that we address in this paper.

RATIONALE

The initial step in considering O/E diagnoses will always be to obtain appropriate historical information and, when appropriate, to initiate further investigation. We believe that a new approach to experientially teaching the O/E history in medical schools and residency training is necessary to improve the disappointing track record of physician preparation for undertaking the responsibilities outlined by the NAS and ACP.

O/E diseases are frequently pathologically, pathophysiologically, and symptomatically similar to non-O/E cases of the same illness except that they are derived from recognizable and preventable causes or exposures. Thus, physicians actually possess most of the tools necessary for *recognition of cases* of O/E diseases, because other than the exposure history they are the same as those for non-O/E diseases. We hypothesize that what is frequently lacking is competence, confidence, and motivation in the *historical evaluation of the exposure component* of the diagnosis. Thus, even if a physician wants to take an O/E history he likely has little "hands-on" experience or practice, and does not feel comfortable or confident in exploring these factors.

Our approach to the problems of ineffective history taking and physicians'

perceptions of a lack of efficacy, which is compounded by a lack of feedback on patient "successes" (cures), is to structure opportunities for practicing the O/E history into medical curriculum so that it will be initially practiced in contexts where it has maximum clinical yield. Practice opportunities will address the issues of competence and confidence, and it is hoped that motivation will derive from successes. We propose to develop the concept of Occupational/Environmental Sentinel Health Conditions (SHC) as a guide to the recognition of common, specific disease entities which have an occupational and/or environmental etiology and to recommend initial practicing of an O/E history specifically on those conditions.

METHODS

In 1976 Rutstein proposed the concept of the Sentinel Health Event (SHE) as an adjunct to measuring the quality of medical care (Rutstein *et al.*, 1983). A SHE is defined as a preventable disease, disability, or untimely death whose occurrence serves as a warning signal that the quality of care may need improvement. In 1983 this concept was applied to the field of occupational disease and 50 ICD-9 rubrics were identified as appropriate Occupational Sentinel Health Events (SHEO). This list of SHEOs, though developed for purposes of epidemiologic surveillance, has been used successfully for evaluation of inherently occupational diseases such as pneumoconioses and acute inhalation injuries (Kipen *et al.*, 1991; Valiante and Rosenman, 1989). One problem with this system as a purely epidemiologic tool is that physicians frequently err by classifying nonspecific conditions, such as pneumonias, into SHEO categories such as hypersensitivity pneumonitis without any attempt to identify or verify actual exposures (Kipen *et al.*, 1990). Somewhat more serious is the well-recognized and probably higher frequency with which physicians fail to recognize pathophysiologic conditions as having occupational or environmental causes (Abraham, 1980; Markowitz and Landrigan, 1989). From a public health standpoint, both false negatives and false positives make public health surveillance efforts for specific conditions inefficient; treatment strategies for individuals may be misguided and opportunities for prevention completely lost. Both may result from lack of competence or attention to the O/E history.

We propose to use the concept of Sentinel Events but have modified the list to contain Sentinel Pathophysiologic Conditions (SPC) or symptoms or lab findings rather than final diagnoses (Table 1). The list should not be based on diagnoses already recognized to be occupational (e.g., asbestosis, solvent-induced neuropathy), but rather on those less specific entities which have a reasonable likelihood of being O/E diagnoses (e.g., pulmonary fibrosis, peripheral neuropathy) once a connection to an exposure is established. The list should represent the initial impetus to explore O/E causes rather than the final diagnosis which is more applicable to epidemiologic purposes.

The list of sentinel O/E events and conditions which we propose, while certainly not a complete list of all conditions which may be associated with O/E causes, offers the advantage of being relatively concise and manageable. For some teaching settings it may even be shortened as a way of giving students a positive and meaningful guideline for history taking. It is limited to conditions

TABLE 1
SENTINEL PATHOPHYSIOLOGIC CONDITIONS FOR ENVIRONMENTAL/OCCUPATIONAL EVALUATION^a

Infectious
Tuberculosis
Silicosis
Hepatitis A, B, and C
Healthcare and childcare workers
Malignancies
Larynx
Asbestos, woodworkers
Lung
Asbestos, radon, chromates, coke ovens, Nickel, Arsenic
Mesothelioma
Asbestos
Bladder
Rubber and dye workers
Leukemias
Benzene, ionizing radiation
Hematologic
Hemolytic anemia
Arsine, electronics/plastics/dye/resin industries
Aplastic anemia
TNT, benzene, ionizing radiation
Agranulocytosis/neutropenia
Benzene, phosphorous, inorganic arsenic
Neurologic/EENT
Encephalitis/encephalopathy
Lead, solvents, mercury
Parkinson's disease
Manganese
Peripheral neuropathy including carpal tunnel syndrome
Hexane, lead, solvents, repetitive motion
Cataracts
Microwaves, infrared radiation, dinitrophenol
Hearing loss
Excessive noise
Headaches
Solvents, lead, carbon monoxide
Pulmonary
Pneumonia
Hypersensitivity pneumonitis agents (farmer's lung, woodworker's lung, etc.)
Asthma
Metal fumes, lab animals, irritants, chemical agents
Diffuse interstitial infiltrates
Asbestos, silica, coal
Acute or chronic bronchitis
Irritant dusts and fumes
Acute or chronic upper airway symptoms
Irritant dusts and fumes
Gastrointestinal
Noninfectious hepatitis including mild hepatic dysfunction—transaminitis
Chlorinated solvents, phosphorus
Renal

TABLE 1—*Continued*

Acute renal failure
Lead, solvents, arsine
Chronic renal failure
Lead, solvents
Miscellaneous
Dermatitis
Irritants, sensitizers
Infertility, male
Ethylene glycol, DBCP
Pregnancy
Lead, solvents, anesthetic gases
Raynaud's disease
Excessive vibration, vinyl chloride
Tendonitis, arthritis
Complaints associated with repetitive motion

^a Examples of exposure, agents, or occupations associated with the conditions are given. These are not inclusive and are for illustrative purposes only.

which we believe have reasonably frequent O/E causes. Moreover, these sentinel conditions have relevance for inpatient as well as outpatient care, as most students and residents still spend large amounts of time in an inpatient setting. We propose that when physicians have ready access to this list, as on a pocket card or as part of the medical history form, they will be more motivated to pursue the O/E history when it is potentially relevant, to ask more in-depth and appropriate questions (e.g., elicit a complete job description rather than just a job title), and to ascertain a specific chemical or physical etiology. Through such practice they can develop confidence in asking and exploring such questions as thoroughly as they explore the rest of the medical, family, and social history. Ideally this will lead them to pursue further studies to guide their consideration of an O/E diagnosis.

For example, we propose that one SPC will be pulmonary fibrosis (diffuse interstitial infiltrates). In all cases of pulmonary fibrosis (even when it does not appear to be the primary diagnosis) O/E factors should be completely explored by students and residents as part of their training, with particular emphasis on potential exposures which are prevalent in a patient's geographic location. For example, in our region of northern and central New Jersey, asbestos exposure, silica exposure, and exposure in coal miners who have migrated from nearby Pennsylvania would be paramount for consideration. In more rural southern New Jersey, farmer's lung might be appropriately added to the list, and coal given less emphasis. While different presentations of disease may indicate greater or lesser likelihood of an O/E cause, for instructional purposes, the broad differential diagnosis is a valuable end point itself. Once a suggestive history is obtained, discussion of diagnostic tools (or lack thereof), differential diagnosis, and treatment will ensue. The importance of recognizing relatively mild cases which nevertheless have both public health and personal risk significance should be emphasized.

Another proposed SPC is asthma. For all asthmatics a thorough past and present O/E history should become part of the medical record. Previous experience suggests that housestaff rarely obtain even a current occupational history from asthmatics admitted to the hospital or seen in the clinic. The desired history should detail the time of disease onset and note the presence, absence, or inability to determine the presence or absence of potential etiologic agents and exposures. Specific agents could be considered as they are suggested by various occupations or locales. Once possible O/E associations are identified, issues of workup including skin tests, early collection of portable peak flow data (Henneberger *et al.*, 1992), prognosis, and treatment during exposure will ensue.

IMPLEMENTATION

Discussion of details of incorporation of O/E teaching into the curriculum of medical school and residency is beyond the scope of this paper. In general terms, interest and thinking patterns should be emphasized early in the course of medical education, and should be given due allotment of time. For example, in second year Introduction to Clinical Medicine courses, students can be encouraged (required) to *practice* occupational history taking with each new patient. We believe that *practice* is the key element here, and that students who actually take a few occupational histories and try to write them up will have made significant progress toward an ultimate goal of clinical competence.

Third and fourth year medical student clerks may have O/E issues integrated into their inpatient and outpatient clinical experiences. For example, students may interview a live simulated patient who has been coached to give a particular occupational history, or an actual patient when available. The simulated or real physical findings can then be correlated with radiographic and laboratory findings so that the student can attempt to arrive at a diagnosis based on this interaction with the patient and the data provided by a preceptor. Finally, for housestaff, provision of the SHC list in pocket card format, combined with a modicum of interest and support from attending staff, will help to ingrain a habit and a skill of taking the O/E history in a meaningful way when it has an increased likelihood of diagnostic relevance. The O/E emphasis can be especially developed in the outpatient setting of Family Practice and Primary Care Internal Medicine residency programs, where outpatient care receives significantly more attention and time.

As cases are recognized or the differential of O/E disease is raised, referrals and consultation for whatever local expertise is available (occupational medicine group, pulmonary group, etc.) will be made, and the teaching loop can be closed because now some level of expertise can be brought to bear. The key is that the trainee has asked the question in a meaningful context, relevant to most specialists' differential diagnosis for the condition. Once this question is raised, O/E teaching and training are much more likely to follow than if the workup proceeded only along traditional lines of blood tests and biopsies while ignoring this aspect of the history.

DISCUSSION

The risk of providing this relatively narrow focus is justified by the lack of

success with previous broad-based attempts to increase O/E history taking on all patients in a given practice (Demers and Wall, 1983; Sokas and Cloeren, 1987). As with any other area of medicine, the more experience and confidence the physician gains in an area, the more likely he will be interested in learning more about it. We do not disparage broader approaches, i.e., the idea that all patients will have a complete O/E history on the chart, but simply suggest the limited focus as a *starting point* to encourage development of skills, knowledge, and attitude. We believe O/E disease experts can reasonably suggest to colleagues in Internal Medicine and Family Medicine that they implement use of these lists in routine medical student and residency training.

Our list of Sentinel Pathophysiologic Conditions will provide a signal to clinicians to make a more directed, thorough investigation of potential O/E risk factors for this limited number of conditions. This may come through direct text and literature reading, and/or through referral to appropriate agencies, occupational health clinics and consultants, and even site visits. When such risk factors are identified and confirmed (if possible) through appropriate laboratory, radiographic, or monitoring data, the condition will then be correctly assigned an occupational or environmental diagnosis. A specific diagnosis, obtained as a result of asking the right questions, may be crucial in the appropriate "treatment" of O/E disease, such as removing the patient from an ongoing exposure.

Learning how to take a medical history is already a formidable task for most medical students and housestaff since it requires learning new methods of organization and prioritization. The addition of "new" topic areas, as most housestaff and physicians currently view the O/E history, will often be viewed as overwhelming. Our approach is aimed at making students and housestaff aware of the concept of O/E exposures early in the process of learning to take a history, and to teach them that it is an important and manageable part of the medical history. We suggest an acronym to facilitate O/E history taking which can be printed below the SHC list: WATER (Work description; Associated symptoms; Toxic agents; Environment (other than work); and Resources (industrial hygiene or literature or other data or consultant needed to proceed with an evaluation).

Our ultimate aim through these teaching tools (SHC list, pocket cards, mnemonic) is for students and residents to become as comfortable in exploring the variables of a workplace or other exposure (duration, amount, personal protective equipment, other affected persons, specific agent vs process) as they do in characterizing the duration, intensity, position, and ameliorating factors for a chief complaint of chest pain or abdominal pain. As these skills become reinforced, we believe students and housestaff will be more likely to develop judgment as to when an entire O/E history is appropriate, as opposed to a more abbreviated list of suggested diagnoses. We hope these suggestions make the initial practice field more friendly.

ACKNOWLEDGMENTS

Dr. Kipen was supported in part by NIEHS Center Grant ES05022 and an NIEHS Academic Award in Environmental and Occupational Medicine K07ES00218. Dr. Craner was partially supported by NIOSH Training Grant T420H07125. We thank Jeff Carson, M.D. for his insightful comments on an earlier version of this manuscript. We thank Pat Hutty for valuable support in manuscript preparation.

REFERENCES

- Abraham, J. L. (1980). Underdiagnosis of pulmonary asbestosis (Letter). *N. Engl. J. Med.* 302, 464.
- American College of Physicians (ACP) (September 14, 1984). "The Role of the Internist in Occupational Medicine. A position paper," pp. 1-6.
- American College of Physicians (ACP) (1990). Occupational and environmental medicine: The internist's role. *Ann. Intern. Med.* 113, 974-982.
- Demers, R. Y., and Wall, S. J. (1983). Occupational history-taking in a family practice academic setting. *J. Med. Educ.* 58, 151-153.
- Henneberger, P. K., Stanbury, M. J., Trimboth, L. S., and Kipen, H. M. (1991). Use of portable peak flow meters in the surveillance of occupational asthma, *CHEST* 100, 1515-1521.
- Kipen, H. M. (1991). Occupational medicine: Too much expected (Letter)? *Ann. Intern. Med.* 114, 915.
- Kipen, H. M., Gelperin, K., Tepper, A., and Stanbury, M. (1991). Acute occupational respiratory diseases in hospital discharge data. *Am. J. Ind. Med.* 19(5), 637-642.
- Kipen, H. M., Tepper, A., Rosenman, K., and Weinrib, D. (1990). Limitations of hospital discharge diagnoses for surveillance of extrinsic allergic alveolitis. *Am. J. Ind. Med.* 17(6), 701-709.
- Levy, B. S. (1980). The teaching of occupational health in American medical schools. *J. Med. Educ.* 55, 18-22.
- Levy, B. S. (1985). The teaching of occupational health in United States medical schools: Five-year follow-up of an initial survey. *Am. J. Public Health* 75(1), 79-80.
- Markowitz, S., and Landrigan, P. (1989). "Occupational Disease in New Jersey." Report to the New Jersey Department of Health.
- National Academy of Science (NAS), Institute of Medicine, Division of Health Promotion and Disease Prevention (1988). "Role of the Primary Care Physician in Occupational and Environmental Medicine." Nat. Acad. Press, Washington, DC.
- Rosenstock, L. (1981). Occupational medicine: Too long neglected. *Ann. Intern. Med.* 95(6), 774-776.
- Rosenstock, L., and Hagopian, A. (1987). Ethical dilemmas in providing health care to workers. *Ann. Intern. Med.* 107, 575-580.
- Rutstein, D. D., Mullan, R. J., Frazier, T. M., Halpern, W. E., Melius, J. M., and Sestito, J. P. (1983). Sentinel health events (occupational): A basis for physician recognition and public health surveillance. *Am. J. Public Health* 73(9), 1054-1062.
- Sokas, R. K., and Cloeren, M. (1987). Occupational health and clinical training. *J. Occup. Med.* 29(5), 414-416.
- Valiante, D. J., and Rosenman, K. D. (1989). Does silicosis still occur? *J. Am. Med. Assoc.* 262(21), 3003-3007.